

# DOUBLE PYRAMID 2016

TECH DOCUMENT



## Reading guide

*The importance of nutrition for people's health has been confirmed by a large number studies. In recent years, research has shown that the agri-food sector is one of those with the greatest responsibility for greenhouse gas emissions and water consumption.*

*The publication of the first "Double Pyramid" paper in June 2010 provided the first strong signal of the importance of careful and conscientious food choices, bringing evidences that what we eat does not only affect our health, but also the environment.*

*What the BCFN Double Pyramid communicates, is that foods which nutritionists recommend consuming more frequently are those which have a lower environmental impact. have a low environmental impact in terms of soil use, water consumption, and CO<sub>2</sub> emissions.*

*Over the years, the initial BCFN Double Pyramid model has been transformed into a real line of research. Some new versions of the model have been proposed, taking into account different nutritional needs- starting from*

*children. In seven years, the amount of data supporting the initial theory has been multiplied more than tenfold.*

*With this new edition of the Double Pyramid, the BCFN wants to remind everyone - especially in light of what emerged from the COP21 conference in Paris on the impact of agricultural systems on climate change and the increasing importance that food has in the political and socio-cultural debate - just how important is to go forward in the promotion of truly sustainable eating habits.*





	The Concept of the Double Pyramid	Good for you and for the environment: science based data & brief background	Page 5
	Diet and Health	Nutritional Guidelines, instructions for “living well” & data on food consumption	21
	Life Cycle Assessment and Environmental Indicators	Life Cycle Assessment, Food Environmental Footprints & other indicators	60
	The Food Chain and the Environment	The environmental impacts of different agricultural techniques, transports, cold chain and food cooking techniques	77
	Scientific Data Available	Presentation of the Double Pyramid database, data on statistical coverage and Water, Carbon & Ecological BCFN Pyramids	136
	Sustainable Diets and BCFN Double Pyramid	FAO Sustainable Diet definition, BCFN Double Pyramids and Menus, the Double Pyramid around the world	187





## The Cost of a Sustainable Diet

The cost of different eating choices in Italy, Europe and the US

Page  
**210**



## Contexts and Incentives for Promoting Sustainable Food Choices

Family eating habits, advertising, social communication, retailer and catering role

**233**



## Further Insights

Different issues connected with food sustainability: Food policies, Food & climate change, Dietary trends

**268**



## Dissemination of the Double Pyramid

Events & meetings in which the Double Pyramid was presented

**302**



## Bibliography

Want to learn more? Bibliographical and sitographical references

**314**



## Attachments

Technical details useful to understand the elaborations and data described in the document

**348**





# THE CONCEPT OF THE DOUBLE PYRAMID



THE MESSAGES OF THE DOUBLE PYRAMID

THE CONSTRUCTION OF THE ENVIRONMENTAL PYRAMID

HOW THE DOUBLE PYRAMID WAS BORN: BACKGROUND  
INFORMATION



## THE CONCEPT OF THE DOUBLE PYRAMID

*Proposed by the Barilla Center for Food & Nutrition in June 2009 and now in its seventh edition, the Double Pyramid proposes a model of sustainable food choices which protect both our health and the environment. The comparison between the classic Food Pyramid (constructed on the basis of nutritional properties of foods) and the new Environmental Pyramid (in which each food is positioned according to its environmental impact) shows clearly that the food recommended for more frequent consumption also benefits the “health” of the planet.*



### THE MESSAGES OF THE DOUBLE PYRAMID

The key message conveyed by the Double Pyramid is the relationship between the environmental impact of food production and consumption, and its nutritional aspects. In particular, a diet which follows the recommendations of nutritionists can be sustainable from a social (“Good for You”), environmental and economical viewpoint. It is equally clear, however, that these results must be included within a broader educational program involving various players, from the family to society as a whole. The main messages launched by the BCFN since the Double Pyramid paper was published for the first time are summarized below.

#### *Healthy Food, Healthy People*

The food section of the Double Pyramid was derived by pooling different international nutritional guidelines which can be traced back to the model known as the “Mediterranean Diet”. Recognized in 2010 as an Intangible Cultural Heritage of Humanity by UNESCO, the Mediterranean Diet stands out for its completeness and nutritional balance. Since 1992, the Mediterranean Diet has been represented in many papers and articles as a pyramid. This graphic form highlights how the

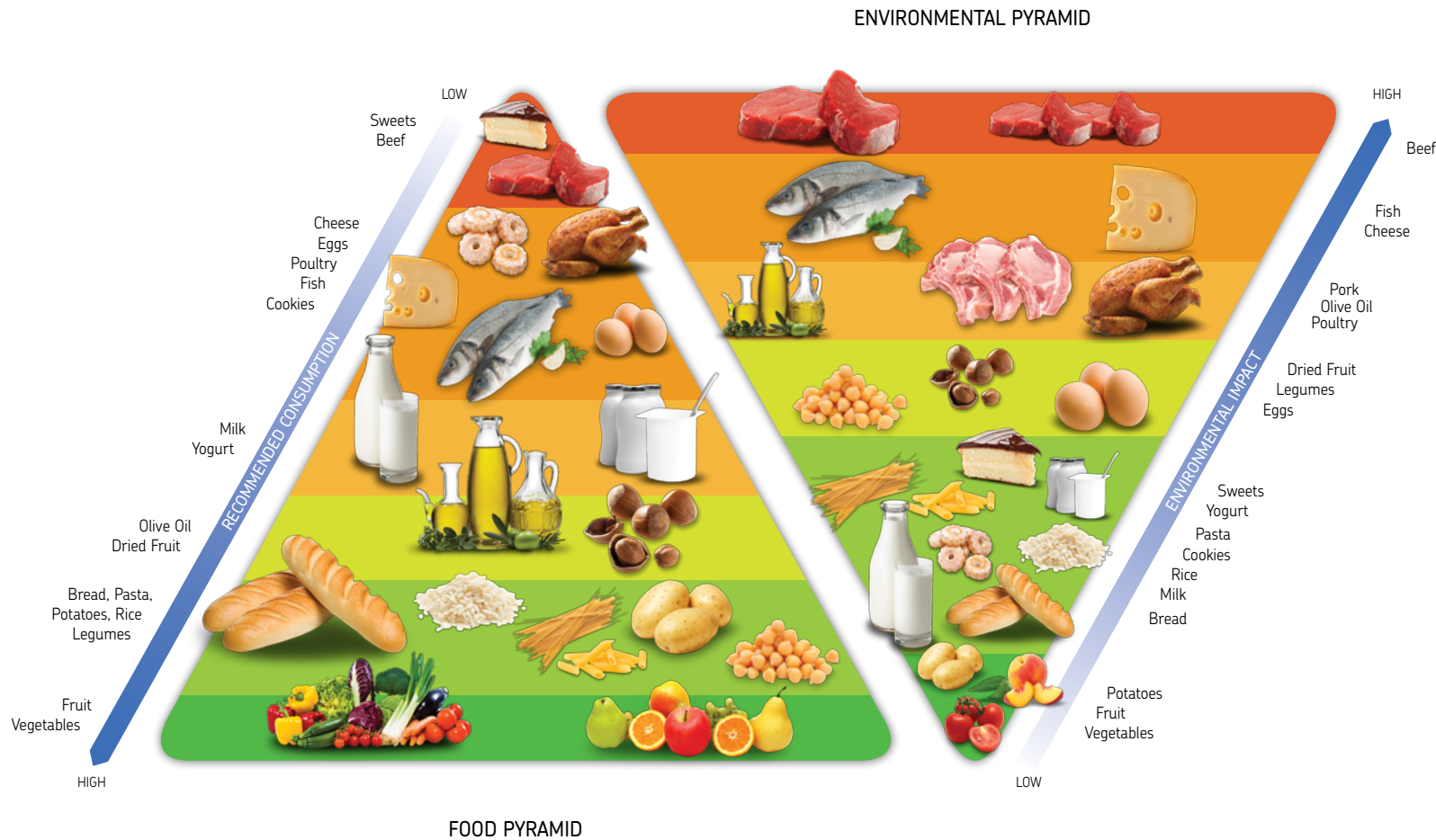
base of nutrition consists in foods of plant origin, typical of Mediterranean eating habits and rich in nutrients (vitamins, minerals, water) and protective compounds (fibre and bioactive compounds of vegetable origin). The pyramid narrows towards the top, recommending less frequent consumption of foods with increasing energy density, usually made from animal proteins, fats, and simple sugars. The value of the Food Pyramid is twofold: firstly, it is an excellent summary of the main knowledge in medicine and nutritional studies, essential for health-conscious people; furthermore, it is also a powerful tool for education and consumer markets, thanks to its simple and intuitive schematic diagram.

#### *Healthy Food, Healthy Planet*

The BFCN designed the environmental section of the Double Pyramid by reclassifying food not in accordance with its nutritional characteristics but in relation to its impact on the environment: using data on impact per kilo of product yields, an inverted pyramid was produced, with foods which have a greater environmental impact at the top and those with a reduced impact at the bottom. By combining the two pyramids, a single dietary pattern results which clearly matches two different but equally important objectives: health and environmental protection.







The Barilla Center for Food and Nutrition Double Pyramid  
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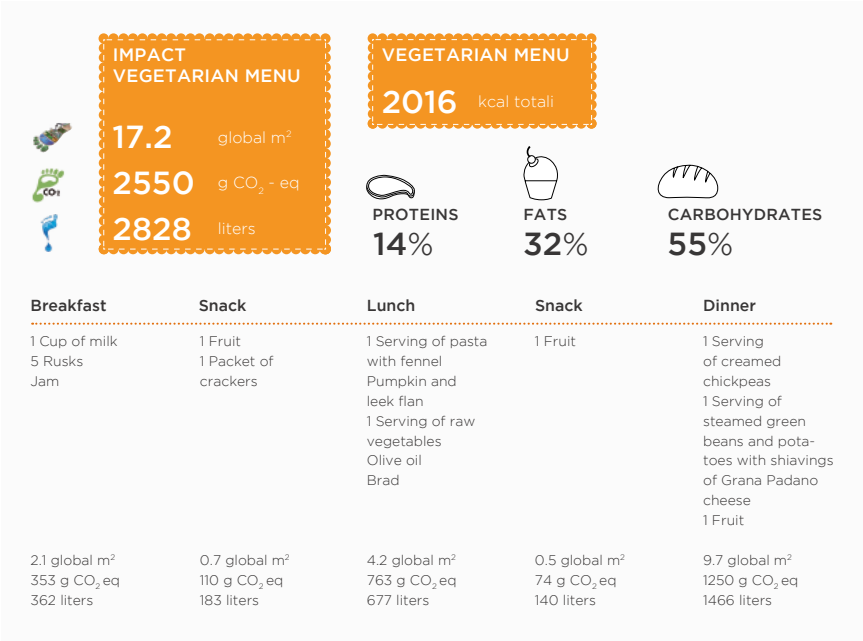
In order to estimate the extent to which individual food choices affect the environment over time, many recipes and menus were studied. Three of these, all nutritionally balanced, are analyzed below: The first (Vegan menu) relies exclusively on plant foods, whereas the second (Vegetarian) includes also animal products, but no meat. Finally, the third focuses on foods of animal origin, particularly meat. The menu based primarily on meat and animal proteins has an environmental impact that is two

times higher than those based on vegetable proteins (Vegetarian and Vegan menu). This draws attention to the influence of food choices on the overall environmental impact of people.

Affordable & sustainable diets

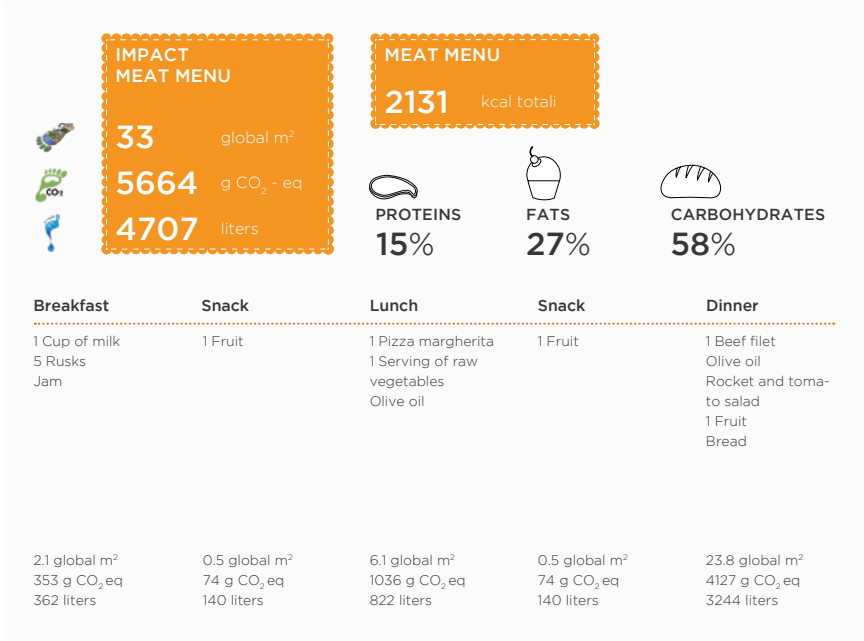
When assessing the sustainability of a diet, particular attention must be paid to evaluating its affordability.

In keeping with the analysis of environmental values, BCFN analyzed this aspect of sustainability by using available scientific information to calculate the economic impact of some “diet types” in Italy. The results show that, for the same nutritional value, the more protein-rich menus of animal origin (meat and especially fish) cost more (albeit only slightly). Comparing this result with that of similar studies conducted in other countries (United States, France, Great Britain, Sweden etc.), the situation is not



Composition of a Vegetarian menu and its environmental impact

Source: ©BCFN Foundation 2016



Composition of a Meat menu and its environmental impact

Source: ©BCFN Foundation 2016



uniform. A sustainable diet is more expensive for families in some countries, although the data might be influenced by the different calculation criteria adopted (price per protein, price per gram, etc.). Generally, it can be said that the Mediterranean Diet is affordable to everyone, provided that an informed selection of food is made, giving preference to low-cost foods with high nutritional value, such as pasta, legumes, certain types of vegetable oil, and dried fruit/nuts. In particular, low-fat dairy products and eggs are the least expensive source of protein. In summary, sustainable nutrition does not necessarily mean spending more, but it does require an extra effort by families in terms of time spent on selecting and preparing food.

#### *The role of education*

From the second edition of the Double Pyramid onward, the BCFN decided to go one step further and try to identify the best ways to spread the culture of “sustainable diets”. For this purpose, several studies on dietary habits were analyzed to understand to what extent the family can influence food choices, with some considerations on the roles of food advertising and social communication. With regard to the “outside-the-home” environment, a study commissioned by the BCFN also highlights the role of distributors in directing people towards sustainable food options; it concludes that it is worth focusing on this sector, along with catering businesses (including school and company

canteens), to develop a strategy for nutrition education.

The family alone is no longer enough: due to a lack of time, motivation, and, occasionally, the right knowledge and awareness, parents are no longer able to correctly orient their children or to limit or compensate the effect of advertising, which sends out messages that are inevitably unbalanced in terms of nutrition.

The conclusion reached is that people can adopt an eating style consistent with the Double Pyramid if they are informed and educated about the benefits the Mediterranean Diet provides in terms of health and the environment. Hence, a substantial collective effort which brings together institutions, producers, and distributors is necessary in order to effectively convey the correct messages.

#### *Further insights*

In addition to the above-mentioned aspects of sustainability, the seven editions of the Double Pyramid paper have analyzed several issues connected with food sustainability, ranging from food policy to the relationship between food and religion, from smart cities to international agreements on climate change. Starting from this seventh edition, these insights, which were previously addressed in the Double Pyramid report, have been included in the technical report.

## THE CONSTRUCTION OF THE ENVIRONMENTAL PYRAMID

The environmental impact associated with each food is assessed using data calculated by means of the Life Cycle Assessment (LCA) analysis. This takes the entire production chain into account and studies all its phases: production of the raw materials, manufacturing, packaging, transportation, distribution, and consumption of food.

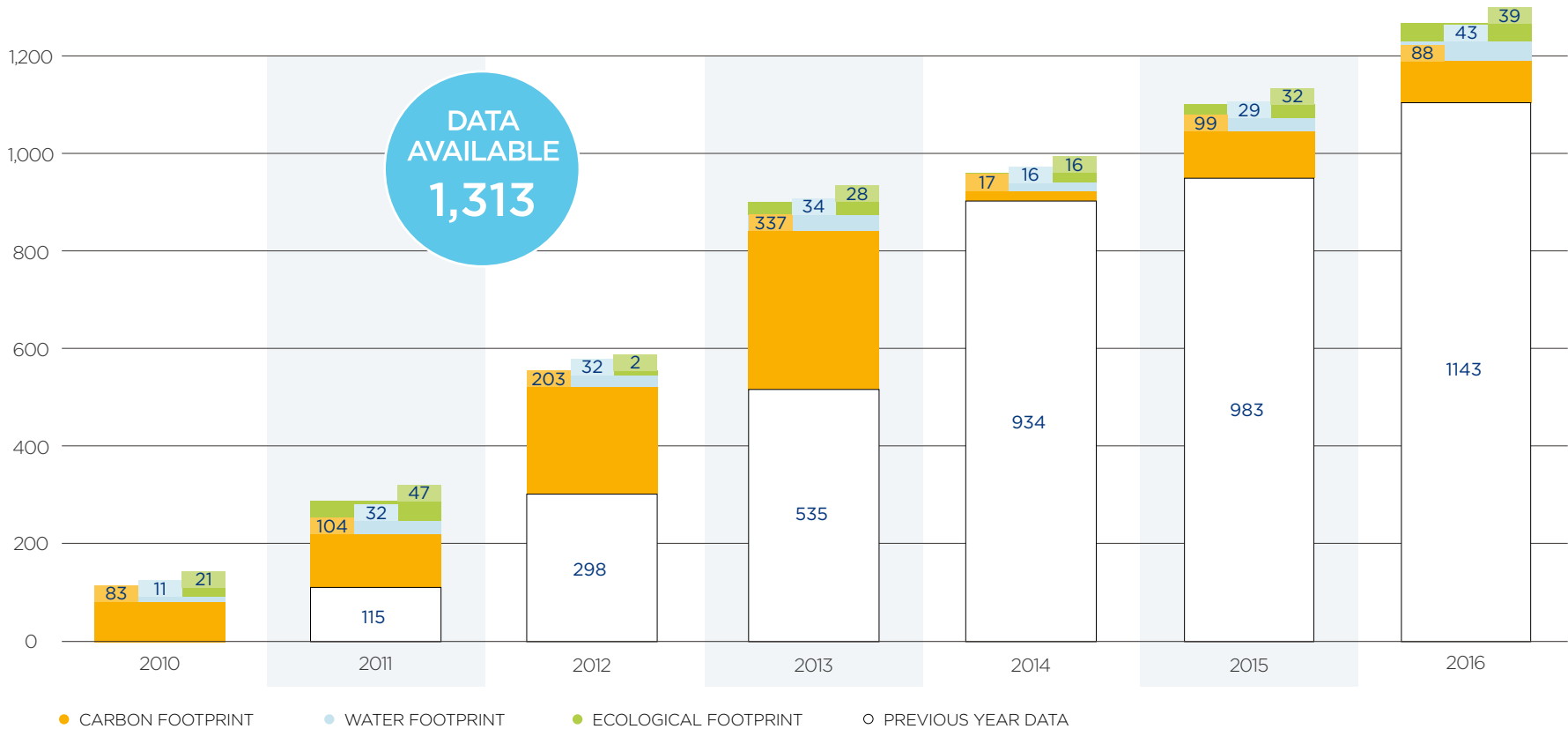
The Environmental Pyramid is based entirely on public data and information from scientific literature, producers’ publications, and databases typically consulted in life cycle analysis. After an initial consistency check with the transparency requirements imposed by the BCFN procedure, the data was subjected to a “logical reorganization” in order to construct the schematic diagram. From the inception of the Double Pyramid, the BCFN set itself the goal of eventually becoming a reference point for anyone seeking food environmental information; to this end, a database was built up, which is regularly updated and published. Over the years, the amount of available data has greatly increased, making the scientific basis much more reliable and resilient. This seventh edition features over 1,300 sources of data, as opposed to the 140 cited in the first edition.



Despite the increase in sources of information and its relative completeness, it is important to observe how updating the Environmental Pyramid results in few changes to the arrangement of foods; these changes

do not affect their position in the Pyramid and thus confirm the validity of the initial concept. Finally, a note on data presentation. To make the LCA study results easier to understand, summarizing

indicators are usually used and have been defined with the intent of keeping the analysis as scientifically-based as possible. In the case of the food products analyzed in this work, it was decided



Data used for the calculation of the averages of the environmental impacts of food in the five editions of the Double Pyramid





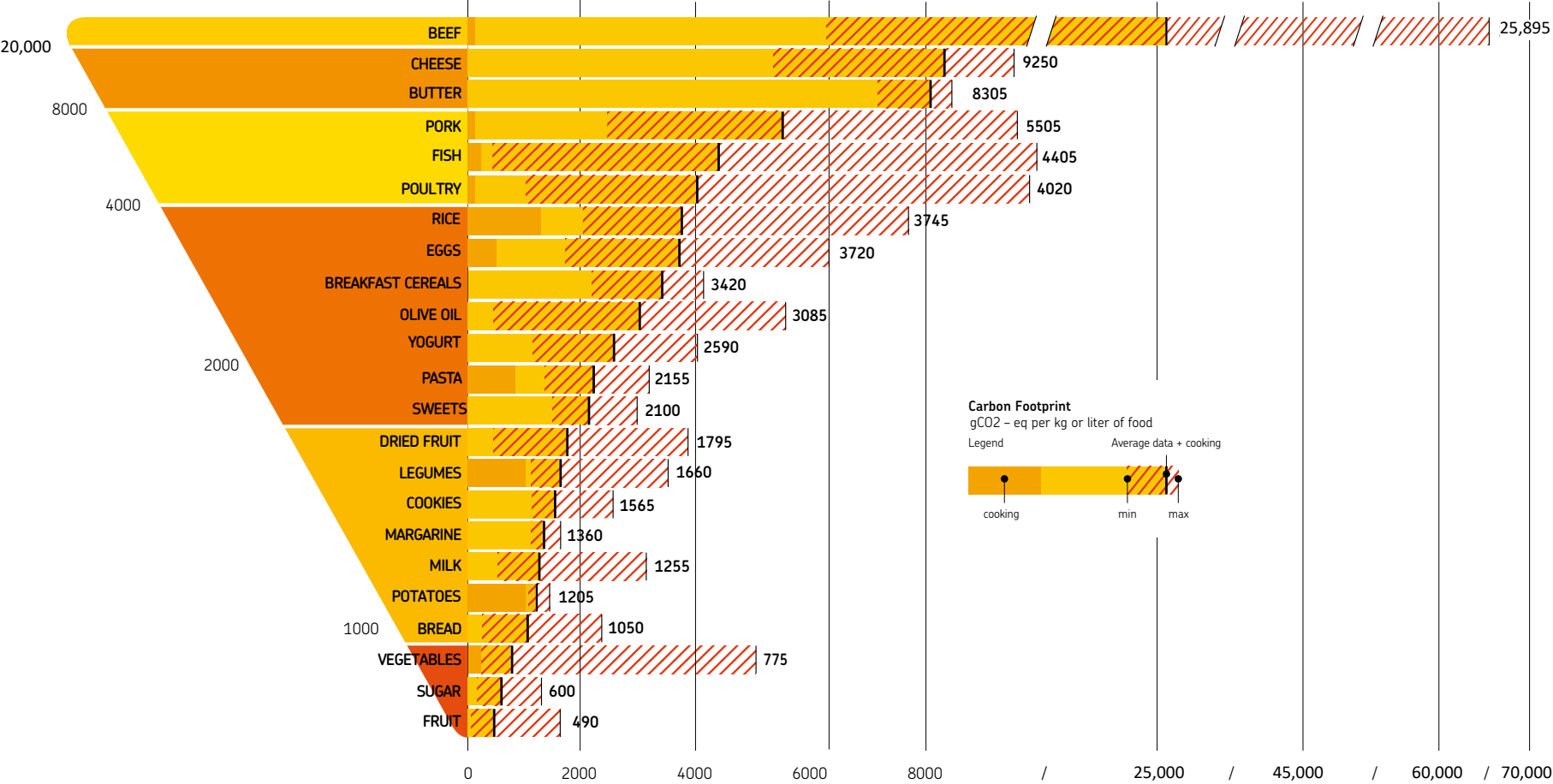
to focus on greenhouse gas emissions, water usage, and soil occupation. For this reason, impacts are shown with the following three footprint indicators:

- The **Carbon Footprint**, which identifies the greenhouse gas emissions responsible for climate change, and is measured as mass of carbon dioxide equivalent [CO<sub>2</sub>eq];
- The **Water Footprint**, which quantifies water consumption and how the resource is utilized, and is measured in volume, litres or cubic metres [m<sup>3</sup>], of water;
- The **Ecological Footprint**, which calculates the area of biologically productive land required to provide the resources and absorb the emissions associated with a production system, and is

measured in square metres [m<sup>2</sup>] or global hectares [global ha].

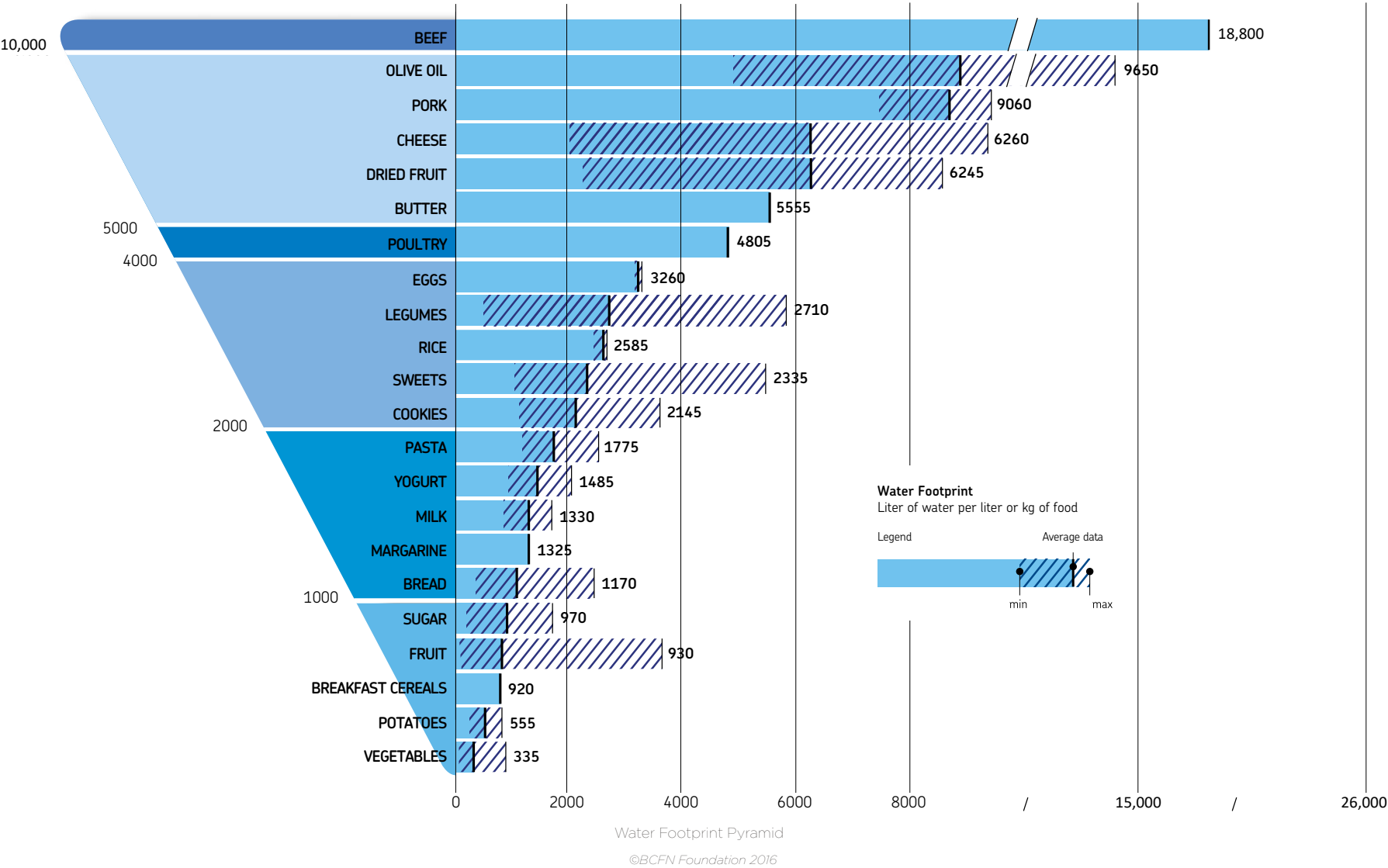
However, the Environmental Pyramid is constructed using the Ecological Footprint alone, selected for its ease of communication associated with the unit of measure used [m<sup>2</sup>].

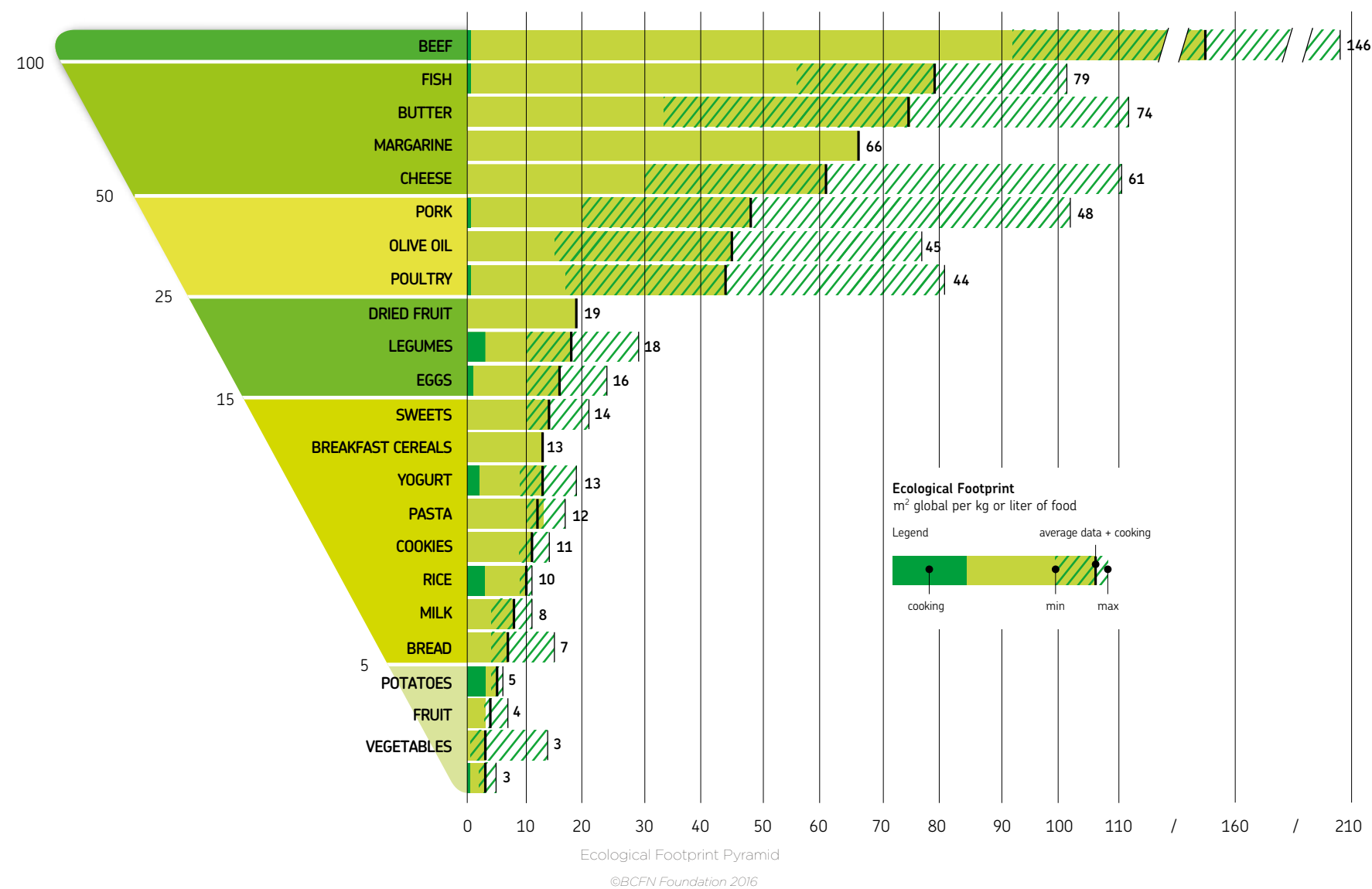




Carbon Footprint Pyramid  
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## HOW THE DOUBLE PYRAMID WAS BORN: BACKGROUND INFORMATION

In May 2009, Luca Ruini, BCFN Food for Sustainable Growth area responsible and Barilla Environment and Energy Director, invited Carlo Alberto Pratesi, Professor of Marketing and Corporate Communication at the University of Rome Tre, to collaborate in the analysis of the environmental impact associated with different categories of foods. This analysis was conducted with the assistance of Massimo Marino and a team of experts at Studio LCE in Turin, Italy.

Pratesi had already been asked by the Barilla Center for Food and Nutrition to collate the scientific content that the BCFN had collected from various sources in order to disseminate information on sustainability issues in the food sector to the public (education).

In particular, Luca Ruini asked Carlo Alberto Pratesi to study the easiest and most effective way to explain to people the differences in CO<sub>2</sub> impact among the different categories of food (taking into account the entire life cycle). In previous months, using the LCA methodology, Barilla had compared the production process of durum wheat pasta with those of other products (meat, fruit, etc.): one result which emerged was that some foods, such as meat, have a higher impact and are, therefore, much less environmentally sustainable than others.

	GRAMS PER SERVING	WEEKLY WELLNESS QUANTITIES	DAILY WELLNESS QUANTITIES	ECOLOGICAL FOOTPRINT gm <sup>2</sup>	CARBON FOOTPRINT (FOSSIL) g CO <sub>2</sub> eq	CARBON FOOTPRINT (BIO) g CO <sub>2</sub> eq
<b>Vegetables</b>	250	7	1	1.72	121	-
<b>Fresh salad</b>	50	7	1	0.34	24.2	-
<b>Fruit</b>	150	21	3	0.15	22.5	- 150
<b>Bread</b>	50	16	2.3	0.70	86	- 73.5
<b>Pasta and rice</b>	200	8	1.1	1.84	218.6	- 297
<b>Baked products</b>	20	7	1.0	0.42	40	- 30
<b>Potatoes</b>	200	2	0.3	2.80	344	- 294
<b>Meat</b>	100	5	0.7	3.20	1125.5	-
<b>Cured meats</b>	50	3	0.4	3.10	1035.5	-
<b>Fish</b>	150	2	0.3	0.32	103.8	-
<b>Egg</b>	60	2	0.3	0.43	90	- 204
<b>Legumes</b>	100	2	0.3	0.69	48.4	-
<b>Milk</b>	125	7	1	0.13	156.0	- 0.7
<b>Yogurt</b>	125	7	1	0.13	156.0	- 0.7
<b>Fresh cheese</b>	100	2	0.3	0.11	130	- 0.6
<b>Aged cheese</b>	50	2	0.3	0.06	65	- 0.3
<b>Butter</b>	10	5	0.7	-	-	-
<b>Sugar</b>	5	21	3	-	-	-
<b>Wine</b>	100	3	0.4	1.39	224	-
<b>Beer</b>	330	4	0.6	-	-	-
<b>Water</b>	1200	7	1	-	125.6	-

Ecological Footprint and CO<sub>2</sub> emissions of the foods that make up The Food Pyramid (May 2009)  
 Source: Reworking TEH - Ambrosetti Department of Medical Pathophysiology, Sapienza University of Rome and Studio LCE



An initial attempt to synthesize the concept took as a reference the traditional Food Pyramid diagram (the one developed by the U.S. Department of Agriculture, which Barilla had adopted and promoted in the '90s to explain to people that the Mediterranean Diet is universally recognized as the most balanced in terms of health care). This immediately revealed the strong (inverse) correlation between the consumption of individual foods recommended by nutritionists, and their impact.

Pratesi proposed making the concept more user-friendly by avoiding the two overlapping levels of information (nutrition and environmental impact), and by using two pyramids, one of which is inverted<sup>1</sup> (the figure shows the initial diagrams). Ruini immediately approved the diagram and promptly suggested that the BCFN use it in its first paper on this subject<sup>2</sup>. In the following months, the work group made up of Ruini, Pratesi, and Marino (with the collaboration of

TEHA<sup>3</sup>) collected data in order to verify the extent to which the two pyramids were actually symmetrical with respect to the positioning of foods. This hypothesis was confirmed and the Double Pyramid began to assume its final shape.

<sup>1</sup>This kind of pattern is usually adopted, for example in management, to represent a change in the hierarchy of values. Jan Carlzon, CEO of SAS, first used it in 1984.

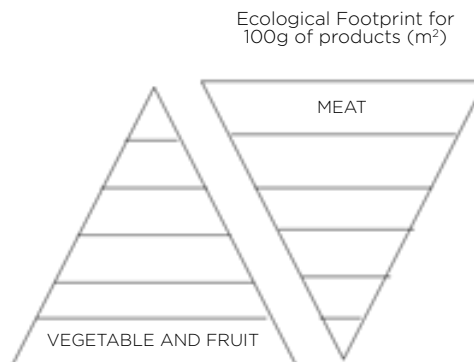
<sup>2</sup>BCFN. Climate Change, Agriculture and Food, Parma, 2009.

<sup>3</sup>The European House Ambrosetti.



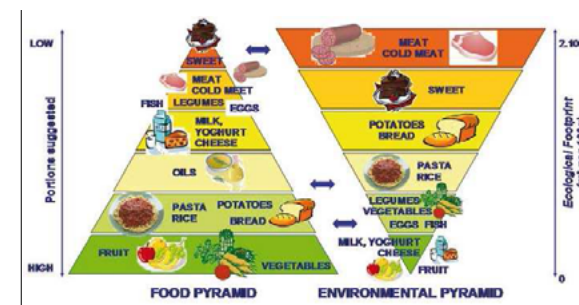
Ecological Footprint [global m²] for 100 grams of product (May 2009)

#### The inverse pyramid...



Recommended quantities for a balanced diet

Climate Change, Agriculture and Food



First graphic representation of the Double Pyramid, used in the BCFN Paper Climate Change, Agriculture and Food

The internal sharing process of the Double Pyramid was conducted with the involvement of Roberto Ciati, Barilla's Scientific Director and the coordinator of Food for Health BCFN, who contributed his expertise and references in the field of nutrition. Following the fruitful exchange with Ciati, the model was gradually refined and subsequent editions of the Double Pyramid were published.

Meanwhile, the same concept was also on the drawing board in other areas of the world. In particular, in November 2009, the Swedish government had promoted (in Lund) a conference entitled Climate Smart Food, to assess the environmental impact of food in terms of greenhouse gas emissions, relative to the entire food chain (i.e., from field to fork). This coincidence, of course, facilitated acceptance of the Barilla internal model, and allayed the qualms of the legal department which, mindful of events in the '90s, feared protests by several trade associations.

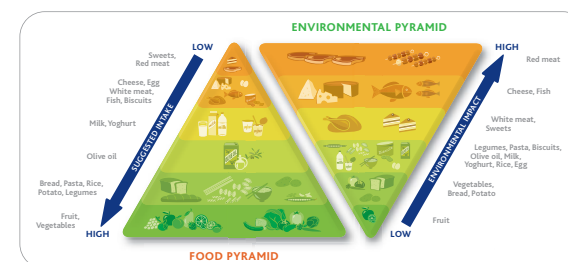
The Barilla brothers began to address these concepts on more than one public occasion: Paolo Barilla spoke at the World Pasta Day event in New York in October 2009, and stated "PASTA IS GOOD FOR PEOPLE, THE ENVIRONMENT, AND THE ECONOMY".

After the first public presentations to Italian institutions and stakeholders in 2009, Luca Virginio, the BCFN project manager and Chief Communication Officer for the Group, decided in January 2010 that the time had come to give dignity to the concept of the autonomous Double Pyramid, as an innovative contribution by the BCFN.

The decision was made to release that year the first BCFN paper dedicated exclusively to the Double Pyramid.

Visibility was first given to the concepts in a purely academic setting, with the BCFN presenting a paper at the 2010 Footprint Forum, organized by the University of Siena together with the Global Footprint Network. From then on, following the scientific community's approval, actions continued with specific conferences aimed at disseminating the Double Pyramid model to the general public also. The first appointment was on June 29, 2010, when a workshop was held at the Science Museum of Milan, "Alimentazione e Ambiente: sano per Te, sostenibile per il Pianeta" ("Food and Environment: Healthy for you, Sustainable for the planet", with the participation of Jeremy Rifkin and Mathis Wackernagel (Global Footprint Network President). The first BCFN Paper entirely dedicated to the Double Pyramid: healthy nutrition for people and sustainable for the planet was presented there.

But 2010 was also the year the concept took root abroad. In Brussels, on October 12, 2010, the European Parliament held a debate on nutrition, the environment, and health entitled "Healthy for you, sustainable for the planet". Along with Guido Barilla and Barbara Buchner, Mario Monti and Gabriele Riccardi, (all members of the Advisory Board of the Barilla Center for Food & Nutrition), several European institutional representatives, including Paolo De Castro (Member of the European Parliament and Chairman of the Agriculture and Rural Development



The first BCFN paper dedicated to the Double Pyramid containing the first version of the Double Pyramid



Commission), Paola Testori Coggi (Director General for Health and Consumer Protection of the European Commission), Karl Falkenberg (Director General for the Environment, European Commission) and Mark Driscoll (Head of the program One Planet Food for WWF, UK), also took part in the discussion.

Even wider involvement of the public came in November of that same year when the event “Buono per te, sostenibile per l'ambiente” (“Healthy for you, sustainable for the planet”) was held in Piazza San Giovanni in Rome, in collaboration with Legambiente: an interactive village dedicated to nutrition and sustainability.



**Barilla Center**  
FOR FOOD  
& NUTRITION

In 2011, the Double Pyramid was chosen as the icon of the BCFN.

An extension of the model, published in the July 2011 paper, 2011 Double Pyramid: healthy food for all, sustainable for the environment, takes into account the special nutritional needs of children.

The Double Pyramid was later presented by Guido Barilla, Jean-Paul Fitoussi and Claude Fischler



the Barilla strategic guidelines. In December 2012, a seminar was held at the Barilla Lab to define, together with the Marketing Directors, the model's effects on business lines and brands. That same year, the Mediterranean Diet became a staple for collective catering in company canteens through Barilla's Si.Mediterraneo project.



2012 saw a continuous succession of international events at which the model of the Double Pyramid and the research work by the Barilla Center for Food & Nutrition were presented and acknowledged.

in Paris, at an event organized at the Italian Embassy in France, and in Washington, D.C. at a Healthy Food | Healthy Planet group meeting.

In 2012, with the arrival of new CEO Claudio Colzani, the Double Pyramid fully entered

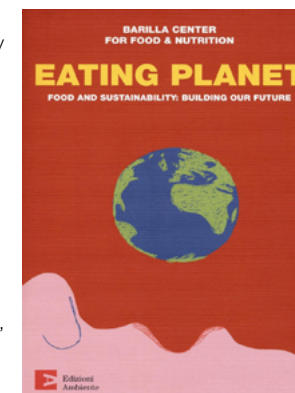
Meanwhile, the BCFN published its first book, Eating Planet 2012 - Nutrition today: a challenge for mankind and for the planet, presented in New York on June 28, 2012. The book explores the paradoxes of the global food system, the cultural value of food habits, of production and consumption, and the



effects of individual eating habits on health and the environment. It also highlights the promising efforts to increase agricultural sustainability. An entire chapter is devoted to the concept of the Double Pyramid.

In August of that same year, FAO presented the book Sustainable Diets and Biodiversity, with an entire chapter by Luca Ruini and Roberto Ciati on the Double Pyramid: Double Pyramid: healthy food for people and sustainable for the planet.

The third edition of the Barilla Center study, Double Pyramid 2012: promoting food choices, presented an initial reflection on the role





of food prices, showing that eating healthily is not necessarily more expensive. The paper was presented on October 10, 2012 through a Webinar in the presence of Barbara Burlingame, Adam Drewnowski, Alex Thomson, and Claude Fischler.

The United Nations named 2013 the International Year of Water Cooperation, and the BCFN presented and proposed the book *L'acqua che mangiamo* (The water we eat) on the occasion of World Water Day. The book takes a multidisciplinary approach to explain the water issue and its implications from economic, social, and political standpoints, and contains a contribution from the BCFN on the concept of the food and water Double Pyramid, along with data on the virtual water trade for pasta. Finally, in September, during the World Water Week, Luca Ruini spoke in Stockholm at the round table "Water Economy: Emergency water between availability and economic interests."

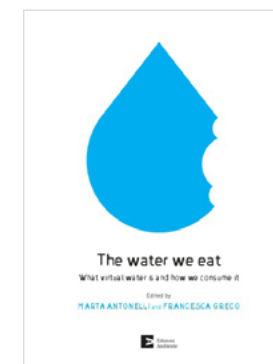
Publication of the BCFN Magazine *Alimentazione e ambiente: stili alimentare sani per le persone e per il pianeta* (Food and Environment: healthy and sustainable nutrition, for people and the planet), which was, in fact, the fourth update of the Double Pyramid paper, offered an additional opportunity to continue the discussion on how to improve and reduce the footprint of our food system. The Double Pyramid pictorial representation devised by the BCFN was proposed in Turkey, Greece, and Sweden in the Barilla company canteen SÌ.Mediterraneo Project.

The Double Pyramid was also presented at the 9th International Conference on Life Cycle Assessment



in the Agri-Food Sector in San Francisco, California in October 2014. This dynamic event, globally known as LCA Food 2014, brought together the scientific community, food industry professionals, researchers, academics, and policy makers. The conference's aim was to demonstrate that sustainability is measurable and therefore doable, thus providing consumers with choices and opportunities to enhance the sustainability of food systems.

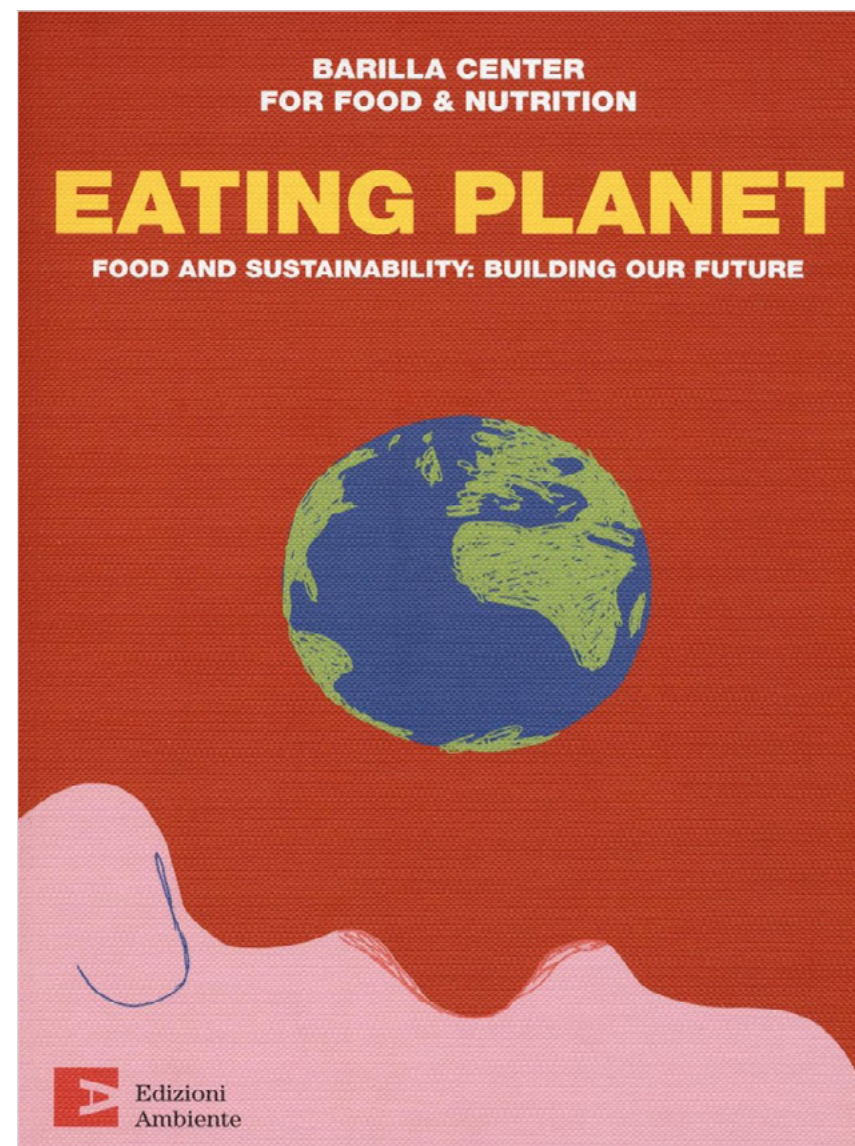
In January 2015, the Barilla Center for Food & Nutrition Foundation presented a policy paper on Sustainable Diets to the European Parliament: the paper was the latest in a series of stakeholder efforts calling on the EU institutions to build up a more sustainable food system across Europe and globally. The event "Good for You, Good for the Environment" was co-hosted by MEP Giovanni La Via, Chair of the Committee on Environment, Public Health and Food Safety (ENVI), and MEP Paolo De Castro, S&D Coordinator for the Committee on Agriculture and Rural Development (AGRI). In March 2015, BCFN experts took part in a session of the Italian Senate regarding a bill of law on the Mediterranean Diet.



In March 2015, a manuscript presenting the scientific underpinning of the Double Pyramid model was accepted for publication in a scientific journal for the first time. The peer-reviewed manuscript Working towards healthy and sustainable diets: the “Double Pyramid Model” developed by the Barilla Center for Food & Nutrition to raise awareness about the environmental and nutritional impact of foods, by Ruini et al., was accepted for publication in the journal *Frontiers in Nutrition and Environmental Sustainability*. In the second half of 2015, during EXPO, the Double Pyramid was presented at several national and international events. The sixth edition of the Double Pyramid paper “Double Pyramid 2015 - recommendations for a sustainable diet” was published on July 10th. The paper, consistent with the aims and goals of EXPO 2015, contained an insight on food policies, analyzing the measures adopted by national governments and international institutions to tackle the paradoxes of hunger and obesity.

In the first month of 2016, three years since the first edition, the BCFN Foundation updated the book *Eating Planet*. Published as “*Eating Planet. Food and sustainability: building our future*”, the new version puts forward an alternative development model that combines the wellness of humanity with the wellness of our planet. The book was presented in New York in April 2016.

The following table shows the main meetings (not only those organized by the BCFN), whose primary theme was food in relation to its environmental impact.







# DIET AND HEALTH



## THE FOOD PYRAMID

- 🍷 The Mediterranean Diet
- 🍷 The Food Pyramid as an educational tool
- 🍷 Adult nutrition
- 🍷 The nutritional requirements of children and adolescents
- 🍷 Diet and life expectancy
- 🍷 Nutritional models around the world
- 🍷 Guidelines for “living well”

## NUTRITIONAL RECOMMENDATIONS: INRAN GUIDELINES

## FOOD CONSUMPTION IN ITALY IN THE LAST 36 YEARS

- 🍷 Data collection method
- 🍷 Consumption of the 2000s
- 🍷 Trend Analysis
- 🍷 From mean to median

## FOOD CONSUMPTION IN THE WORLD

- 🍷 Dietary habits in Europe and in the United States
- 🍷 Dietary habits around the world: an overview from the FAOSTAT database
- 🍷 What households eat around the world



## DIET AND HEALTH

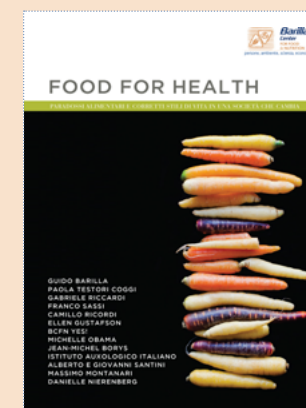
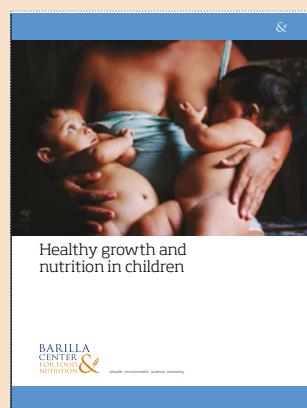
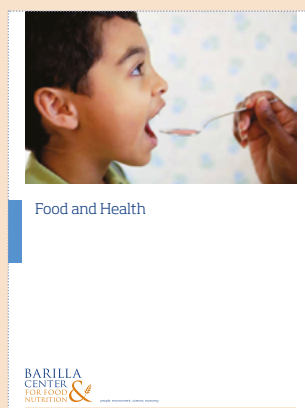
People have always been aware that correct nutrition is essential for their health. Nonetheless, for millennia, the driving need to find enough food to survive relegated this natural law to the back seat: until recently, very few had the luxury of choosing between different types of food in plentiful supply. Industrial development, the modernization of agriculture, and the introduction of free trade have increased the variety and quantity of food available to a growing number of people. Yet the problem of famine has certainly not been resolved - quite the contrary. We know that about one billion people throughout the world live in a state of undernourishment (or

malnutrition). This is despite the fact that the number of people who can choose what, and how much, to eat has risen. However, without a solid education about clear nutritional guidelines – scientifically-founded and widely facilitated – these individuals risk adopting imbalanced – or even incorrect – eating habits.

This chapter provides a brief overview of the nutritional studies that form the basis of the Nutritional Pyramid, which graphically represents the Mediterranean diet, a nutritional model whose positive effects on health are internationally recognized.

For more details on nutritional aspects, consult the following publications on [barillacfn.com](http://barillacfn.com):

- “Food and health” (2009)
- “Healthy growth and nutrition in children” (2010)
- “Nutrition & Well-Being for healthy living” (2012)
- “Obesity: the impacts on public health and society” (2012)
- “Food for Health: Paradoxes of food and healthy life styles in a changing society” (2013)



## THE FOOD PYRAMID

After more than 50 years of studies and research, the Mediterranean Diet has been recognized by UNESCO<sup>1</sup> as an example of intangible cultural heritage.

The dietary section of the Double Pyramid, the result of the combination of different international nutritional guidelines, is based on the Mediterranean Dietary model and represents a simple “compass” for a proper diet. Regardless of how the Mediterranean model is interpreted, the various indications are consistent with each other and converge on the fact that the base of the model lies on the consumption of fruit and vegetables; followed by cereals, milk, and dairy products; with the top of the pyramid made up of products of animal origin and sweets. In short, the foods at the bottom of the pyramid typically have a lower environmental impact, while those at the top (which should be consumed in moderation) tend to be those most harmful to the environment.

### The Mediterranean Diet

It was the American physiologist Ancel Keys, author of *Eat Well and Stay Well*<sup>2</sup> in the 1970s, who explained to the world why some Mediterranean regions – such as the Cilento (the area of Campania between the Gulf of Salerno and Policastro) – registered higher than average lifespans: the secret was that these populations had a balanced diet

consisting of natural foods. Their intake of fruit, vegetables, and cereal products was high, with fewer foods rich in saturated fats, less meat and limited sweets. In particular, Keys discovered that with this diet (which he named “Mediterranean”), the death rate due to heart diseases in Southern European and North African countries was lower than in English-speaking and Northern European nations, where diets are richer in saturated fats.

The nutritional value of the Mediterranean Diet was then scientifically demonstrated in the well-known Seven Country Study directed by Keys<sup>3</sup>. This study compared the diets of different populations to check their benefits and critical points. The researchers were able to identify the correlation between type of diet and the risk of chronic diseases (particularly cardiovascular diseases). The study found that a high level of saturated fatty acids (in the diet) and cholesterol (in the blood) could explain the differences in mortality rates as well as predict future rates of coronary diseases in the populations analyzed.

Since the first *Seven Country Study*, numerous research studies have been conducted analyzing the features and the correlation between diet and the onset of chronic diseases<sup>4</sup>. Furthermore, since the mid-1990s, a new trend of research has developed to investigate the association between diet and longevity. In general, what emerges is that the adoption of the Mediterranean Diet provides added protection against the most common chronic diseases thanks to a high consumption of vegetables, legumes, fruits and nuts, olive oil, and

cereals (50% of which are whole grain), the moderate consumption of fish and dairy products (especially cheese and yogurt), and low consumption of red meat, white meat, and sweets<sup>5</sup>. It has also been demonstrated that a high level of adherence to the Mediterranean Diet is associated with a lower risk of mortality<sup>6</sup>, metabolic conditions<sup>7</sup>, and certain types of cancer<sup>8</sup>. It is also linked to longevity and a lower risk of age-related diseases: researchers at Harvard University have recently found that greater adherence to the Mediterranean Diet is correlated with longer telomeres, ones of the biomarkers of ageing<sup>9</sup>. The dietary habits of the Mediterranean Diet are consistent with nutritional information in the guidelines produced by the most authoritative scientific associations and international institutions dealing with the greatest non-communicable diseases of our era (particularly regarding cardiovascular diseases, cancer, and diabetes).

<sup>1</sup> The United Nations Educational, Scientific and Cultural Organization [UNESCO] was founded in 1945 to encourage cooperation among nations within the fields of education, science, culture, and communication. One of UNESCO's missions is to identify a list of “heritage of humanity” locations, namely, places that are valuable from a natural or cultural point of view, and whose conservation is deemed important for the global community.

<sup>2</sup> Keys, A., M. Keys. 1975

<sup>3</sup> Keys, A. 1980

<sup>4</sup> Willet, W.C. 1998; WCRF. 2007.

<sup>5</sup> Willet, W.C., et al. 1995; Fung et al, 2009; Lopez-Garcia et al., 2014; Estruch et al, 2013

<sup>6</sup> Trichopoulou et al, 2003

<sup>7</sup> Babio et al, 2014

<sup>8</sup> Couto et al, 2014

<sup>9</sup> Cros-Bou et al, 2014







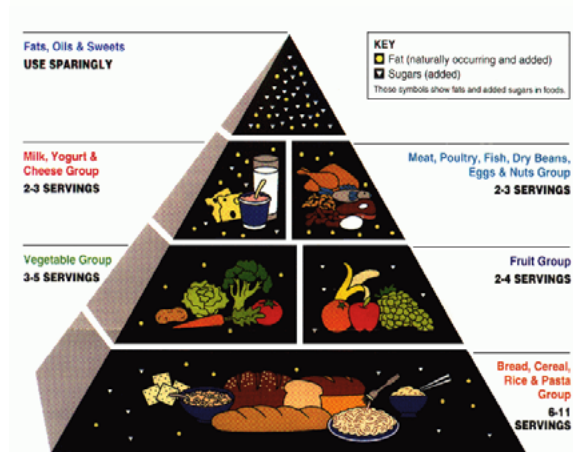
Since 2001, UNESCO has also begun to draw up a list of the intangible cultural heritages of humanity, namely, traditions which often do not have a “written” canon, but which are handed down orally across generations. The Mediterranean Diet is included in this list, and is described by UNESCO as follows:

*“The Mediterranean Diet constitutes a set of skills, knowledge, practices and traditions ranging from the landscape to the table, including the crops, harvesting, fishing, conservation, processing, preparation and, particularly, consumption of food. The Mediterranean Diet is characterized by a nutritional model that has remained constant over time and space, consisting mainly of olive oil, cereals, fresh or dried fruit and vegetables, a moderate amount of fish, dairy and meat, and many condiments and spices, all accompanied by wine or infusions, always respecting beliefs of each community. However, the Mediterranean Diet (from the Greek *diata* or “way of life”) encompasses more than just food. It promotes social interaction, since communal meals are the cornerstone of social customs and festive events. It has given rise to a considerable body of knowledge, songs, maxims, tales and legends. The system is rooted in respect for the territory and biodiversity, and ensures the conservation and development of traditional activities and crafts linked to fishing and farming in the Mediterranean communities of which Soria in Spain, Koroni in Greece, Cilento in Italy and Chefchaouen in Morocco are examples. Women play a particularly vital role in the transmission of expertise, as well as knowledge of rituals, traditional gestures and celebrations, and the safeguarding of techniques”*

### The Food Pyramid as an educational tool

In 1992, in order to undertake a nutritional education program based on the Mediterranean Diet, the U.S. Department of Agriculture [USDA] devised the first pyramid that concisely and effectively explained how to adopt a type of balanced nutrition.

In the following years, this pictorial representation was then adopted by international organizations and institutions including the Food and Agriculture Organization of the United Nations [FAO], the World Health Organization [WHO], and the Italian Ministry of Health. The FAO cited and adopted the U.S. Food Pyramid in a 1997 report, thus giving it credit and highlighting the importance of the message it transmitted.



Model for the Food Pyramid proposed by American Department of Agriculture [USDA]

Source: USDA / USDHHS

The Pyramid of the World Health Organization was proposed as part of the Countrywide Integrated Non-communicable Disease Intervention Programme [CINDI Programme] dedicated to the prevention of non-communicable diseases (such as cardiovascular disease, diabetes, etc.) which were deemed by the WHO to be the main health problem for the European region<sup>10</sup>. This program, launched in 1982 as part of the *Global strategy for Health for All by the Year 2000*, has since then promoted an integrated approach to initiatives aimed at reducing and controlling the risk factors associated with unhealthy nutrition, lack of physical exercise, alcohol abuse, and stress.

<sup>10</sup> WHO, 2000. CINDI Dietary guidelines. WHO, Geneva, 2000



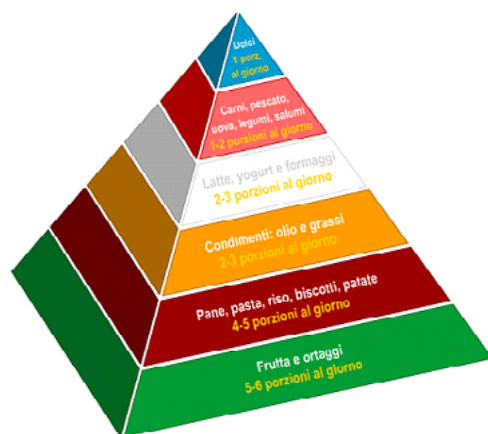
Model for the Food Pyramid proposed by the World Health Organization [WHO]

Source: WHO

After careful analysis and observation of current trends in Italy (BCFN base), in 2003<sup>11</sup>, the Ministry of Health asked a group of experts to develop a dietary reference model that was consistent with the country's lifestyle and food traditions.

The Institute of Food Science of the University of Rome developed the Italian Food Guide Pyramid, which indicates the portions of each food group that should be consumed to maintain a varied and balanced diet.

In November 2009, the International University Centre for Studies on Mediterranean Food Cultures [CIISCAM] presented a first version of the *Modern Mediterranean Diet Food Pyramid*. This new model of the pyramid, developed in collaboration with the Italian National Research

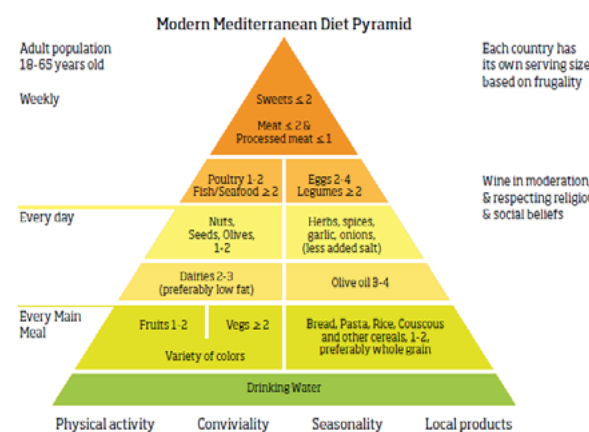


The Italian Food Guide Pyramid proposed by the Sapienza University of Rome

Source: Italian Ministry of Health

Institute for Food and Nutrition [INRAN, now CRA-NUT] and numerous other experts from international universities, highlights the importance of physical activity, conviviality at the table (eating together), the habit of drinking water, and recommends consumption of local seasonal produce<sup>12</sup>.

Though stemming from a common scientific base, each Pyramid adapts the original model to the specific characteristics of its target audience, differentiating between various age brackets (children, adults, the elderly), prevalent lifestyle (sedentary, active, etc.), specific times of life (pregnancy, nursing) or dietary practices (vegan, vegetarian, etc.). In addition, in almost all the recent versions of the Pyramid (such as, for example, the



The Food Pyramid proposed by the International University Centre for Studies on Mediterranean Food Cultures [CIISCAM]

Source: BCFN elaboration on image CIISCAM

Modern Mediterranean Diet Pyramid shown above), further recommendations for a correct lifestyle are appended to the diagram (for example, how much water should be drunk, how much time to dedicate to physical activity, etc.).

This intense and continuous communication activity has propagated knowledge about the Mediterranean Diet, establishing it in people's minds as a healthy dietary pattern.

Its adoption is especially pronounced in the more educated segments of the population (not only in Europe where, moreover, it is perceived as consistent with current socio-cultural trends, such as attention to well-being, the fight against obesity, the promotion of local products, the search for natural products, and attention to environmental protection). The value of the Food Guide Pyramid is twofold: firstly, it is an excellent summary of the entire body of knowledge gained from studies on medicine and nutrition, essential for everyone who pays attention to their health; moreover, it is a powerful tool for consumer education, thanks also to its effective graphic form and unquestionable simplicity. It plays an important promotional role for the benefit of all foods (fruits and vegetables, in particular) that are almost always "unbranded" and thus not advertised by manufacturers.

<sup>11</sup> Ministerial Decree of 09/01/2003

<sup>12</sup> CIISCAM, 2009

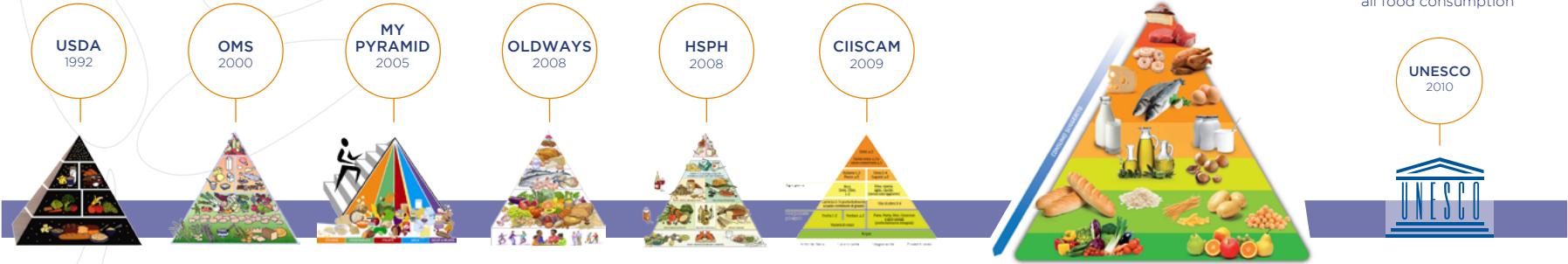


# THE FOOD PYRAMID EVOLUTION

BCFN  
2009

"The Mediterranean diet is a set of skills, practices, traditions and knowledge of food products from the field to the table, including crops, harvesting, fishing, conservation, processing, preparation, and above all food consumption"

UNESCO  
2010



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## Adult nutrition

In looking at the different diagrams, it is quick and easy to identify the common positions in which the various food groups are located: this simple evidence has led to the creation of the BCFN Food Pyramid. Taking a closer look, starting at the base, we find fruit and vegetables, which have reduced calorie content and provide the body with water, carbohydrates, vitamins, minerals, and fibre. Protein and fat contents are rather low. The carbohydrate intake of fruit and vegetables consists mainly of simple sugars, (easily converted into energy sources by the body), and little starch. Foods of plant origin are the main source of fibre - aside from regulating bowel function, fibre contributes to the sense of satiety and, thus helps reduce the consumption of foods characterized by high energy density.

Continuing the analysis, we find pasta, rice, potatoes, bread, and vegetables. Pasta is rich in starch, with a decent protein content and negligible amount of lipids. Rice, like all grains, has high starch content, is low in protein and fat, and also contains small amounts of B vitamins and minerals. Potatoes are poor in fats and proteins, while they are rich in starch and carbohydrates. They are one of the most important sources of potassium, phosphorus, and calcium. Bread is a staple food, as it provides the body with the carbohydrates needed to properly fuel the human body to produce energy.

Pulses are plant foods with the highest protein content and also have a great amount of fibre. They provide high-quality protein, since they are rich in

essential and easily digestible amino acids. They are a good source of B vitamins, especially B1 and B12, niacin, and minerals such as iron and zinc; and they also constitute an alternative to meat.

The pyramid next contains extra-virgin olive oil, which is composed of triglycerides (rich in monounsaturated fatty acids), essential fatty acids, vitamin E, and substances such as polyphenols and phytosterols, which have protective actions in the human body.

This group also contains nuts (a source of vitamins, minerals, antioxidants, and unsaturated fats), which help our body to function properly. Fat content is variable - between 50 and 70%, depending on the type - and consists mainly of monounsaturated and polyunsaturated fats.

Among the varieties of nuts are the most widely consumed almonds and hazelnuts, which are rich in omega 3 and omega 6 fatty acids and useful in preventing cardiovascular disease. Nuts also contain significant amounts of folic acid, which favors the reduction of cholesterol, as well as being rich in fibre, vitamins E, B1, B6, and numerous minerals such as copper, zinc, phosphorus, and magnesium. Almonds also have a high fibre-content, and are rich in various minerals such as calcium, magnesium, potassium, copper, phosphorus, and zinc; due to their high content of vitamin E (30g cover 50% of GDA), they also provide an extra dose of antioxidants. Finally, nuts also allow the intake of many minerals such as copper, magnesium, calcium, and potassium, and are a good natural source of vitamin E, as well as containing fibre and B vitamins (such as B6 and folic

acid).

Going further up the pyramid, there is a broad group of different products, such as milk, yogurt, cheese, meat, fish, eggs, and cookies. Milk is almost 90% water and contains traces of protein with a high biological value, short-chain saturated fat that is easily digestible (many milks are also rich in animal fats that promote increased levels of plasma cholesterol and must, therefore, be consumed in moderation) and sugars (mainly represented by lactose, composed of galactose and glucose). The vitamins present in milk in large quantities are A, B1, B2, B12, and pantothenic acid. Milk is also the main source of calcium for human nutrition. Yogurt, like milk, is a food with a high nutritional value, but may be more easily digestible for people who are lactose-intolerant, due to the presence of bacterial lactase. Cheese contains proteins and fats with almost no carbohydrates. Its calcium content is of particular interest - this is present in a highly bio-available form, which significantly contributes to meeting the needs of the human body. B vitamins are present in small quantities, while vitamin A is plentiful.

Looking at fish and eggs, we see that fish contains protein of high biological value and varying amounts of fat, which can reach 10% in weight. Fatty fish contain polyunsaturated fatty acids, which belong to the category of essential fatty acids. The family of omega-3 fatty acids, in particular, is considered beneficial in preventing cardiovascular disease. Eggs contain protein with such a high biological value that for years the composition of the egg was the benchmark for assessing the protein quality of other



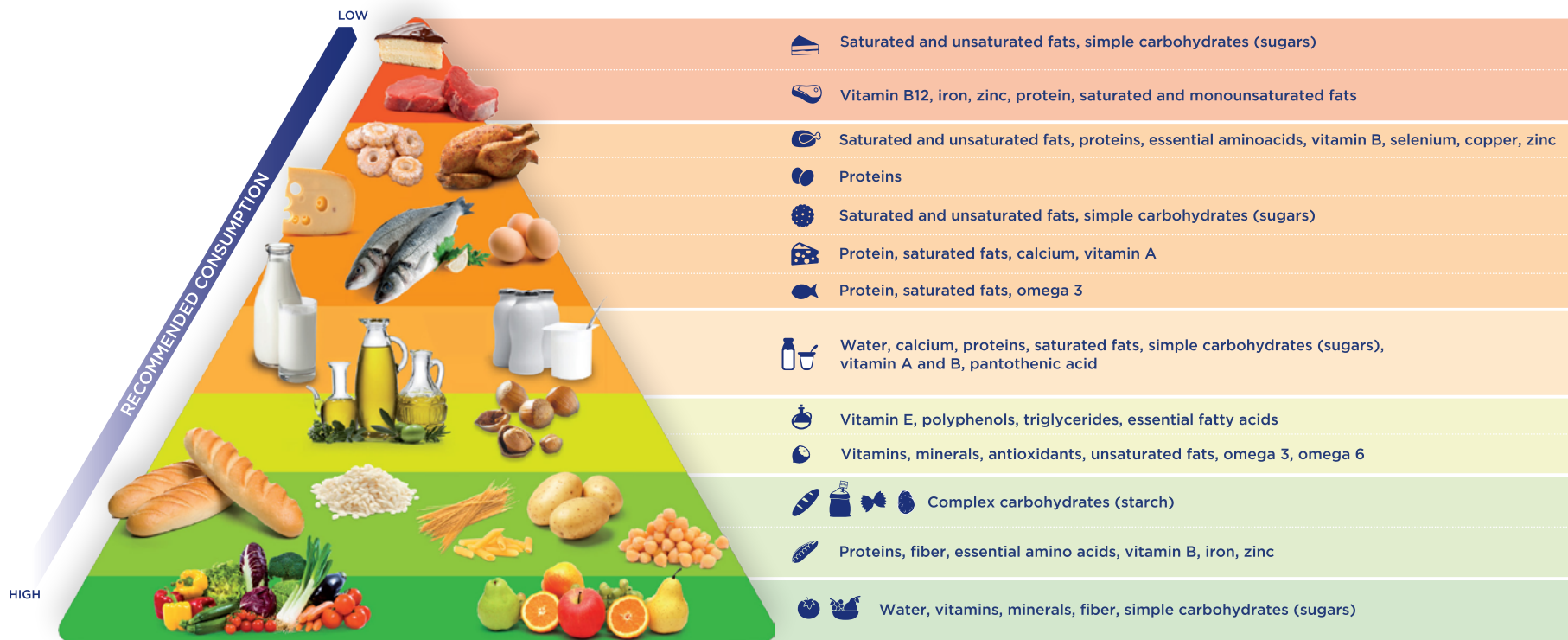
foods.

Cookies are made from multiple ingredients and their composition in terms of nutrients and energy value varies greatly. In general, the simple sugar content is the most important component, while the fat content varies widely with an average between approximately 9% and 25%.

Meat consumption, particularly lean meat, is often deemed important as it provides high-quality

protein necessary for children's growth and muscle development. About half of the protein in meat is made up of amino acids which are essential for humans; it also contains B vitamins (especially B12), selenium, copper, and zinc. The fat content is variable - it can range from zero to about 30%, depending on the type of meat - and consists mainly of saturated and monounsaturated fats with only a little polyunsaturated fat.

Therefore, consumption of white meat is recommended, alongside a moderate consumption of red meat, as shown in the many versions of the Food Pyramid developed by the various national and international institutions - that put meat consumption, along with sweets, at the vertex due to the high content of fat and simple sugars. The latest foods are to be consumed in moderation.



The Food Pyramid



## The nutritional requirements of children and adolescents

Science has already established the relationship between an unhealthy diet, excessive body weight, and incidence of chronic diseases for adults: this relationship is sufficiently widespread and known to a vast majority of the population. However, when it comes to children's nutrition, this connection is not so commonly known: this is why it is necessary to disseminate the results of several studies that show how incorrect eating habits and lifestyles during growth can lead to an increased risk of contracting diseases later in life, such as the onset of chronic diseases (cancer, cardiovascular disease, and diabetes). This need is even stronger in the light of overweight and childhood obesity figures registered in many Western countries, a phenomenon which has increased rapidly and seriously in the last few decades. In Italy, 20.9% of children are overweight and 9.8% are obese, with 2.2% of such children affected by severe obesity. The highest prevalence is recorded in southern and central regions. A major cause of this phenomenon lies in the spread of unhealthy eating habits, which do not promote a harmonious development and cause a tendency to weight gain<sup>13</sup>.

During early childhood - characterized by rapid growth - it seems more necessary than ever to provide the child with an adequate amount of energy. The macronutrients contained in food that are able to provide the child with energy are fats, carbohydrates, and proteins. To understand the

importance of energy intake - especially in the initial years of life - (for each gram of macronutrients taken per unit of body weight), the quantity of protein ingested by a child is almost the same as that of an adult, but carbohydrate intake is almost double and fat intake quadruples in comparison to intake during adulthood.

Energy is necessary to maintain vital phenomena (respiration, cardiovascular activity, renal function, and brain activity), the basal metabolism, to ensure digestion, metabolism, and nutrient storage (thermogenesis), for the growth of new tissue, and physical activity. The energy that a child should receive through diet is equal to the sum of the energy expenditure (basal metabolism, thermogenesis, and physical activity) and energy used for growth (which implies energy for generating new tissues).

The first year of life requires large amounts of energy in comparison to overall intake, but decreases rapidly, dropping from 35% in the first month of life to 5% in one year. After the first year and up to the age of 9-10, the energy output of the child is 50-60% for the basal metabolic rate, 30-40% for physical activity, 5-8% for thermogenesis, and only 2% for further growth<sup>14</sup>.

The World Health Organization<sup>15</sup> reveals that there are substantial similarities between the recommendations provided by different countries/organizations regarding the amount of energy required by preschoolers. There is, therefore, a reliable range of values derived from the product of estimated energy value required per kilogram of body weight and the average weight of the child within several macro-age ranges.

If energy intake is less than the minimum level required, serious problems may ensue (including retarded growth and impaired ability in physical activity), especially in preschoolers. Prolonged periods of energy intake deficiency can also generate malnutrition and lead to reduced protein reserves when these are used to generate energy. In contrast, an excessive intake of energy in relation to requirements promotes the deposition of excess fat, and both statural and ponderal growth acceleration. An excessive rate of growth in the immediate postnatal stages is considered a risk factor for the onset of obesity in later life.

CHILD AGE	COUNTRY/ORGANIZATION		
	ITALY	WHO	USA
1-3 years	768-1,094	906-1,088	806-1,377
4-6 years	1,417-1,667	1,204-1,398	1,453-1,613
7-10 years	1,792-2,034	1,500-1,916	1,694-1,957

Optimal Average Quantity Of Energy  
Intake Through Nutrition [kcal]

Source: Elaboration The European House - Ambrosetti processing of data from the Italian Society for Human Nutrition, "L.A.R.N.", update 1996; FAO Nutrition and consumer protection division, "Nutritional requirements reports"; Food and Nutrition Board (Institute of Medicine of the National Academies), "Dietary Reference Intakes", 2006.

<sup>13</sup> Italian Ministry of Health, 2014

<sup>14</sup> FAO, 2004

<sup>15</sup> WHO, 2003



The table shows the mean values of energy requirements for children and varies according to weight, body composition, and average level of physical activity.

Aside from the main macronutrients, the essential elements of proper nutrition for preschool and school-age children, vitamins and minerals, represent two other prime elements of importance. In young children, an adequate intake of vitamin A is necessary to develop proper eyesight, to ensure healthy epithelial tissues, and to develop and differentiate tissues. B vitamins, like vitamin A, play a fundamental role in child growth and contribute to proper maintenance and development. Vitamin C is essential for optimal functioning of the immune system and the synthesis of collagen. In addition, vitamin C holds antioxidant properties and plays a significant role in supporting iron absorption. Vitamin D plays an essential role in calcium metabolism (by stimulating intestinal absorption), in muscle function, in cellular proliferation and maturation, and in proper functioning of the immune system. Lastly, minerals are essential elements in the diets of preschool and school-aged children, particularly iron, calcium, magnesium, phosphorus, sodium, zinc, and iodine.

The table lists the main food sources of these vitamins and minerals<sup>16</sup>.

<sup>16</sup> The relevant quantities are reported in detail in the specific BCFN paper dedicated to child nutrition *Healthy growth and nutrition in children*.

VITAMINS AND SALTS	MAIN FOOD SOURCES
VITAMIN A	Liver, dairy goods eggs, fish
VITAMIN B1	Wholemeal cereals, legumes, peanuts, meat
VITAMIN B2	Green leafy vegetables, meat, eggs, milk
VITAMIN B3	Wholemeal cereals, peanuts, legumes, poultry, fish
VITAMIN B9	Yeast, liver, green salad, oranges
VITAMIN B12	Meat, eggs, fish, poultry, milk
VITAMIN C	Spinach, tomatoes, potatoes, broccoli, citrus fruit
VITAMIN D	Fatty fish, fish oils, dairy goods, eggs, liver, beef
IRON	Cereals, legumes, legumes, fruits and vegetables
CALCIUM	Milk and milk products, peanuts, fish
MAGNESIUM	Toasted nuts, dried fruit, raw spinach
PHOSPHORUS	Milk, cheese, shrimp, salmon, sardines, herring, green leafy vegetables
SODIUM	Sausages, bread, ham, sauces, pickled vegetables
ZINC	Red meat, liver, fish, milk and dairy goods, grains, rice
IODINE	Fish, milk, meat, eggs

Main Food Sources of Vitamins and Mineral Salts  
Source: BCFN. *Healthy growth and nutrition in children*.



Adolescence is the period of life in which the change from the prepubertal condition to adulthood takes place; it is characterized by the appearance of major physical, psychological, and social changes. Adolescence can be divided into two phases: first and second adolescence. First adolescence is when the body develops and completes the acquisition of reproductive capacity, roughly between 10 and 15 years of age, while second adolescence marks the completion of the mental and physical development, between approximately 15 and 18/22 years. Adolescence is a period characterized by intense metabolic activity. At this time there is, in fact, a strong acceleration of growth rate in both males and females. During this stage, somatic growth is accompanied by rapid psychological and behavioral development, which leads the male/female to feel a progressive and growing need for independence (and this also significantly involves eating habits). The important physical changes associated with rapid growth and changes induced by puberty are accompanied by increased quantitative nutritional needs (carbohydrates, proteins, and fats), vitamins, minerals, fibre, and water. During adolescence, the daily intake of food should be rich enough to meet the increased demands of growth processes but, at the same time, attention should be directed to preventing metabolic diseases - degenerative features of adulthood: hypertension, diabetes, atherosclerosis, and cancer. Nutritional issues and the adoption of a proper diet and lifestyle play a major role in adolescence. At this age, when full physical and mental development is

reached, the foundations of a healthy diet must be firmly established to prevent many diseases in later life. Adequate nutrition for actual needs, in fact, helps prevent diseases that may arise in both short- and long-term periods. Over-eating or nutritional deficiency will, on the other hand, further the development of diseases. These include:

- Obesity, with its complications;
- Anorexia and bulimia, which have their own peak incidence in adolescence;
- Osteoporosis, resulting in poor bone mineralization;
- Hypertension, supported by the high amount of sodium in food;
- Potential acceleration of atherosclerotic lesions, already present in young people.

Although nutrition during adolescence is an issue of great interest, few studies have actually analyzed the nutritional needs of this particular age group. The data published in various studies by national and international associations is, instead, often simply extrapolated from research on childhood and adulthood. Given the lack of detailed and sufficiently large studies (both in terms of number of patients observed and time reference) on the energy requirements during adolescence, it is difficult to establish the needs of any individual subject to rapid fluctuations in growth rate from one year to another; one other neglected factor concerns the considerable gender differences. The table shows the energy requirements in

adolescents, which are strongly influenced by factors such as weight, body composition, and physical activity level. A healthy diet should also vary in types of food

AGE	MALES	FEMALES
11/12	1,993-2,343	1,739-2,048
13/14	2,277-2,794	1,864-2,297
15/16	2,393-2,976	1,898-2,338
17/18	2,515-3,215	1,942-2,411

Adolescent Male And Female Energy Requirements [kcal]  
Source: BCFN. Healthy growth and nutrition in children.

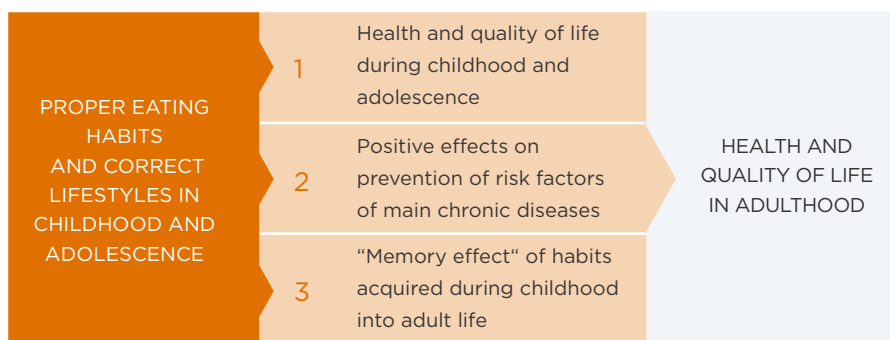
consumption. Variety in the diet means eating different types of food, comprising foods both of plant origin (fruit, vegetables, legumes, cereals, seeds, etc.) and of animal origin (meat, cheese, dairy products, ham, etc.), and alternating the two types throughout the week. A varied diet can easily provide the nutrients required for adolescent growth. It is important to emphasize the fact that proper eating habits and healthy lifestyles have a major role not only in the health and quality of life during childhood and adolescence, but also in reducing the risk of contracting or developing major non-transmittable diseases; this period can act as an important basis by creating a memory effect of these healthy habits to be continued during adulthood.





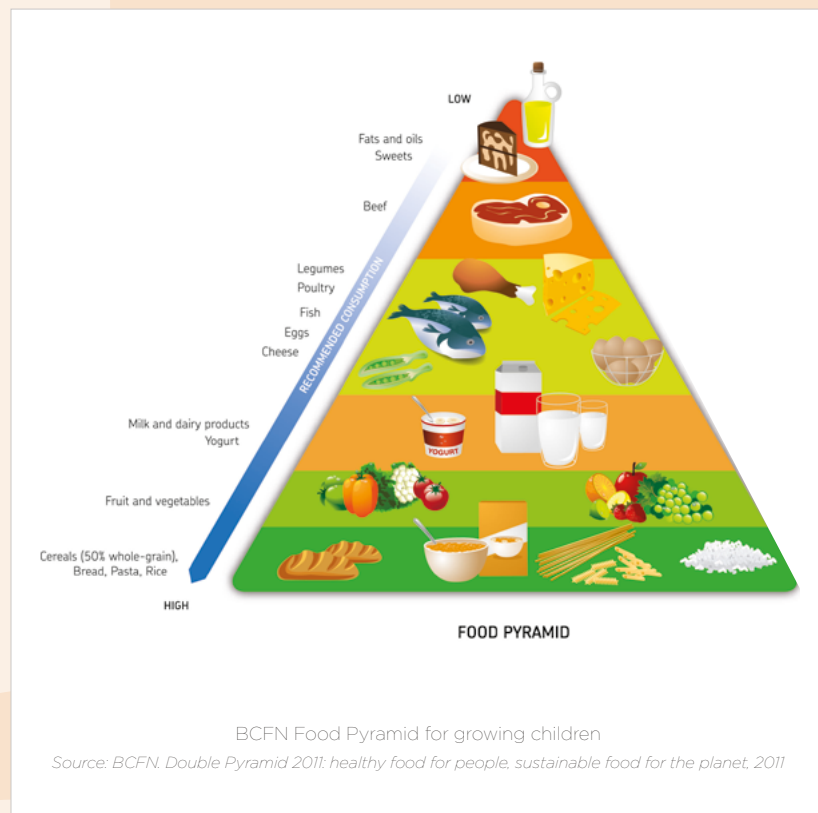
FOODS	IMPORTANT NUTRIENTS FOR ADOLESCENTS
CEREALS	Carbohydrates, B vitamins (vitamin B1, B2, B3, B6), fiber
LEGUMES	Protein, B vitamins (vitamin B1, B3, B6, B9), zinc, calcium
FRUIT AND VEGETABLES	Fiber, potassium, calcium, iron, zinc, vitamin C, vitamin B9, vitamin K, carotenoids, flavonoids and phenolic compounds
FRESH FRUIT	Vitamin C (especially citrus fruits, kiwis and strawberries), carotenoids
DRIED FRUIT	Protein, iron, zinc, selenium, calcium
MEAT	Protein, B vitamins (including B12), iron, zinc, copper and selenium
FISH	Protein, vitamin A, vitamin D, long-chain polyunsaturated fatty acids; some species of marine fish and shellfish are rich in sodium and fluorine
EGGS	Protein, B vitamins
MILK AND DAIRY GOODS	Protein, vitamins (riboflavin, retinol, carotene), calcium, magnesium, phosphorus, zinc, selenium

Division of Daily Calorie intake for Adolescents  
 Source: BCFN, Healthy growth and nutrition in children.



Benefits from "good habits" about food during adulthood  
 Source: BCFN, Healthy growth and nutrition in children





## SUMMARY OF GUIDELINES FOR GROWING CHILDREN

**1** Choose a **HEALTHY** and balanced **DIET** daily alternating the main foods



**2** Avoid consuming excess calories, and **BALANCE** nutrition with physical activity



**3** **ALTERNATE** animal and vegetable proteins and fats, simple and complex sugars



**4** **REDUCE** the consumption of **ADDITIONAL SALT** to a minimum, to prevent the development of hypertension



**5** **DISTRIBUTE FOOD CONSUMPTION** over 5 times during the day: three meals and two snacks



**6** Avoid eating food outside the **5 DESIGNATED TIMES**



**7** Engage in **PHYSICAL ACTIVITY** for at least an hour a day (sport or play activities)



**8** **CURTAIN A SEDENTARY LIFESTYLE** spent in front of the television and electronic devices



BCFN. Double Pyramid 2011: healthy food for people, sustainable food for the planet, 2011



## Diet and life expectancy

Over the last two hundred years, life expectancy has increased by about two years per decade, and this trend shows no signs of ending. Such an increase is due mainly to reduced child mortality rates caused by infectious diseases. However, since the second half of the twentieth century, there has also been a progressive increase in life expectancy, due to economic growth and improved health services, as well as public health policies<sup>17</sup>.

Ageing is the main risk factor for the most common chronic diseases such as tumors, cardiovascular diseases, strokes and dementia. As a result, the improved life expectancy figures are often accompanied by an increased number of years in poor health, a factor which plays a large part in health service costs. Measures to reduce morbidity in old age can affect not only the individual's wellbeing but also bring significant benefits in economic and social terms. The challenge is to promote continued health throughout the ageing process and to reduce the costs of chronic disease in old age<sup>18</sup>.

### *Physiological aspects*

Ageing is characterized by progressive loss of physical function and, as time goes on, a higher probability of death.

Ageing is the result of progressively accumulating damage to cell macromolecules, such as DNA, proteins and lipids. Damage to DNA is not limited only to the nuclear genome – there is also evidence

of increased mitochondrial DNA mutations as people grow older<sup>19</sup>.

Damaged proteins also increase with age, and those proteins with a slower turnover are at greater risk of damage.

The structure and functioning of all cells depends on the composition and integrity of phospholipid cell membranes. These phospholipids are rich in polyunsaturated fatty acids which are susceptible to oxidation damage and peroxidation, which speed up the ageing process<sup>20</sup>.

### *The effects of diet on ageing*

In the last few decades, much evidence has been found regarding the effects of diet on the ageing process. The first proof of this correlation arrived with studies on rodents, which showed how diet-restriction (DR), i.e. the administration of a reduced quantity of food as compared with what the animal would eat in normal conditions, increased its life expectancy and reduced (or delayed) the development of chronic diseases connected with age.

Obese individuals, or carriers of FTO gene polymorphism (fat mass and obesity associated), a genetic factor thought to be a potential hereditary cause of obesity, are subject to quicker brain ageing, and numerous epidemiological studies show that being overweight and obesity in middle age are factors associated with a higher risk of dementia<sup>21</sup>. Obesity and a sedentary lifestyle are linked to a higher risk of cellular and molecular damage, and

thus to a higher risk of all common chronic diseases, thanks to the damaging effects of chronic silent inflammation<sup>22</sup>.

Various studies<sup>23</sup> supply proof of the beneficial effects for health of calorie restriction for human beings. A study carried out on non-obese people recently showed that two years of 25% calorie restriction is feasible and offers significant health benefits. A brief period of calorie restriction under strict medical control, followed up with a normal diet, may reactivate staminal cells and reduce the levels of IGF-I hormone, glucose and C-reactive protein circulating in the blood<sup>24</sup>. With this measure, not only is the risk of diabetes and cardiovascular disease reduced, but the ageing process is also slowed down, improving productivity and quality of life as people get older.

As well as the levels of energy intake compared with energy requirements, there are other dietary factors such as specific nutrients and other bioactive non-nutrients which influence the accumulation of macromolecular damage within cells, and the process of ageing.

The Mediterranean diet is the best proof of an existing correlation between diet and ageing. The Mediterranean diet is characterized by large

<sup>17</sup> Kirkwood, 2008

<sup>18</sup> Mathers, 2015

<sup>19</sup> Lopez-Otin et al. 2013

<sup>20</sup> Mathers, 2015

<sup>21</sup> Handschin et al. 2008

<sup>22</sup> Handschin et al. 2008

<sup>23</sup> Ravussin et al. 2015; Holloszy et al. 2007; Changhan et al. 2016

<sup>24</sup> Redman et al. 2014





quantities of fruit, vegetables, legumes, nuts and whole grains, with a moderate quantity of fish, poultry and wine, and limited quantities of red meat and its by-products. The adoption of this dietary pattern is linked to low mortality rate and a reduced risk of chronic diseases such as cancer, metabolic syndrome and depression as well as cardiovascular and neurodegenerative diseases<sup>25</sup>.

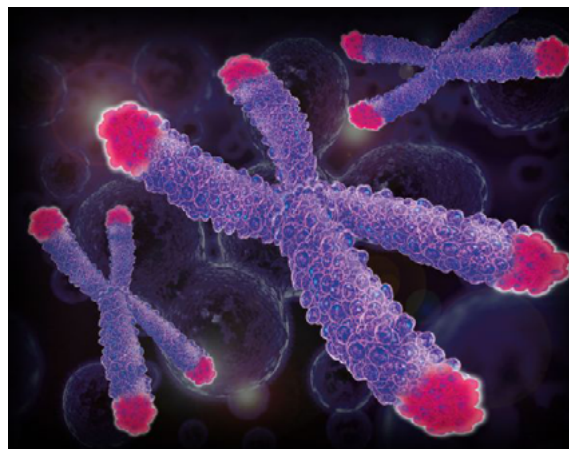
This evidence is backed up by recent studies which show effective primary prevention of cardiovascular diseases thanks to a Mediterranean diet<sup>26</sup>.

Finally, a diet which promotes healthy cardiovascular function, such as the Mediterranean diet with its high level of omega-3 fatty acids and moderate consumption of alcohol, can also produce benefits for the brain by reducing the risk of Alzheimer's Disease, a chronic-degenerative disease which affects around five percent of individuals over the age of 65<sup>27</sup>.

#### *The Mediterranean diet and telomere length*

A recent study conducted in the United States examined the association between adherence to the Mediterranean diet and length of telomeres, small pieces of DNA that are located at the ends of chromosomes. Telomeres shorten with aging, leading to senescence (i.e. the progressive decay) of the cell: in other words, shorter telomeres are associated with a shorter life expectancy and an increase in the rates of chronic diseases.

The study showed that the difference in telomere length changes by one point in adherence to the



Telomeres, marked in purple in the illustration, are small pieces of DNA at the ends of chromosomes

Mediterranean model, evaluated with the aMED scale (alternating Mediterranean Diet Score), which corresponds on average to 1.5 years of aging. A change of three points in adherence to the Mediterranean model, which corresponds on average to 4.5 years of aging, is comparable to the difference observed between smokers and non-smokers<sup>28</sup>.

In addition to studies on the effects of the Mediterranean diet as a whole, the effects of the individual components have also been studied. The consumption of extra virgin olive oil, due to its concentration of polyunsaturated fatty acids, has been associated with a reduced risk of cardiovascular disease, obesity, metabolic syndrome, type 2 diabetes, and hypertension; it also improves blood circulation, thereby promoting healthy aging and

longevity. The consumption of fruit and vegetables has been linked to reduced mortality in the elderly population, for their content of compounds such as polyphenols, carotenoids, folic acid, and vitamin C. An epidemiological study conducted on longevity in Ikaria, Greece, showed that the consumption of fish, thanks to its content of antioxidants and omega-3 fatty acids, has been linked to a lower prevalence of depressive symptoms and an improvement in renal function.

#### *"Blue Zones": the places of longevity*

Further confirmation of the link between the Mediterranean diet and the aging process comes from studies conducted since 2004 on the so-called "blue zones", i.e. a group of geographic locations where people live much longer and the incidence of chronic diseases, on average, is very low. The concept was coined 12 years ago by the scholars Gianni Pes and Michel Poulain, who had discovered that the province of Nuoro in Sardinia was an area with a high concentration of centenarians<sup>29</sup>. However, the media coverage of the study was thanks to the reporter Dan Buettner, who in the following years, in collaboration with Poulain himself and National Geographic, launched a project to identify the areas in the world where longevity is higher and to study their features.

<sup>25</sup> Chrysoshoou et al. 2006

<sup>26</sup> Mathers, 2015

<sup>27</sup> Uauy et al. 2006; World Alzheimer Report 2015

<sup>28</sup> Cros-bou et al., 2014

<sup>29</sup> Poulain et al., 2004



In time, four other natural blue areas were added to Sardinia: the island of Ikaria in Greece, Okinawa in Japan, the Nicoya Peninsula in Costa Rica, and the village of Loma Linda in Southern California. According to Buettner, the populations of these

places have some things in common<sup>30</sup>, including a diet that is very close to the Mediterranean model (providing for a high consumption of fruit and vegetables and a low consumption of meat), daily physical activity, and a positive attitude towards life.

<sup>30</sup> For further information, see: Buettner, 2008; Poulain et al., 2013



Mapping the "Blue Zones"  
©BCFN FOUNDATION 2016

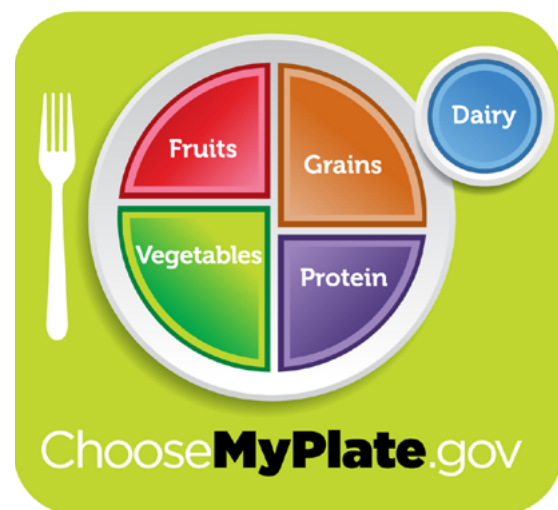


## Nutritional models around the world

However, the Mediterranean Diet pyramid is not the only graphic representation used to provide consumers with nutritional advice. Some alternative models promoted around the world will now be considered.

### Choose my plate – United States

*ChooseMyPlate* is a graphic representation that visually illustrates the recommendations contained in the Dietary Guidelines for Americans, developed every five years by USDA and HHS for healthy people aged 2 and above.



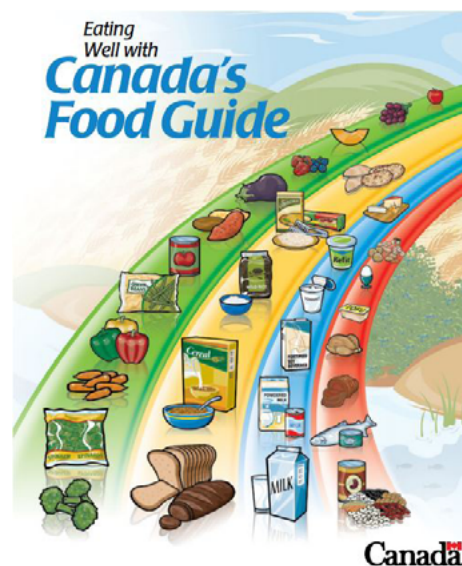
Graphic representation  
of dietary advice prepared by USDA

Source: USDA, [ChooseMyPlate.org](http://ChooseMyPlate.org)

American nutritionists recommend following a diet that consists mainly of fruit, vegetables, whole grain cereals, and low-fat dairy products. Meat, fish, pulses, eggs, and nuts should be consumed in smaller quantities, paying attention to food that has already been salted or sweetened and saturated fat content, as well as sugary beverages. In addition to nutritional awareness, constant physical activity and greater attention in calculating daily calorie requirements are also recommended.

### Food Guide - Canada

*Canada's Food Guide* is illustrated by using an image of a rainbow. The rainbow graphic classifies the food



Graphic representation  
of Canadian dietary recommendations

Source: Ministry of Health, Canada

products into four groups (grain products, fruit and vegetables, dairy, and protein foods (meat, seafood, pulses, and processed soy products)). It includes recommendations on the quantity of food for different age and sex groups, and guidelines to orient the quality of food choices. Other messages include advice for specific life stages, added fats and oils, foods and beverages to limit, water, the importance of variety, physical activity, and nutrition labelling.

### The Family Pot - Guatemala

The *dietary guidelines for Guatemala* are published by Guatemala's Ministry of Public Health and Social Assistance under the approval of a National Dietary



Graphic representation  
of Guatemalan dietary recommendations

Source: Ministry of Public Health and Social Assistance of Guatemala

Guidelines Committee (comprising representatives from ministries, the Secretariat of Food and Nutritional Security, universities, consumer groups, NGOs, and the food industry). Guatemala's food guide is represented as a clay pot: the bottom of the pot contains cereals, whole grains, pulses and tubers, followed by vegetables and fruit. On the next layer, there are foods of animal origin and dairy products. Fats (including avocado and nuts) and sugars are at the top. Above the pot are images of physical activity and water, which should be used to complement a balanced diet. The advice focuses on a varied diet, eating pulses, vegetables, and nuts daily, and reducing salt consumption.

### The New Food Wheel – Spain

*The Spanish New Wheel of Foods* (La Nueva Rueda

de los Alimentos) has been published by the Spanish Society for Dietetics and Food Science (SEDCA). The wheel has six segments representing different food groups. The size of the segments represents the recommended quantity of each food group in a healthy diet, with foods that should be consumed only in limited amounts placed towards the center in a highlighted section. Physical activity and water are in the axis of the wheel, emphasizing that they are basic requirements for a healthy lifestyle.

### The Food Circle – Sweden

The goal of the *Swedish Food Circle* is to help people consume all the nutrients and the energy they need daily. The foods are subdivided into seven groups to be eaten in the indicated proportions. It advises eating larger servings of fruit and vegetables, along

with bread and cereals, and a more moderate use of foods containing fat is recommended. Furthermore, it suggests a seasonal selection of fruit and vegetables, eating the vegetables preferably cooked, and whole grain cereals, without neglecting lesser-known cereals such as couscous or bulgur. As far as protein is concerned, the consumption of low-fat cheeses and condiments is advised, as is increasing the consumption of fish. For meat, the Food Circle suggests rediscovering meats that are not regularly consumed, such as lamb, and other nutritious parts of animals, such as the giblets.

### The Food House – Hungary

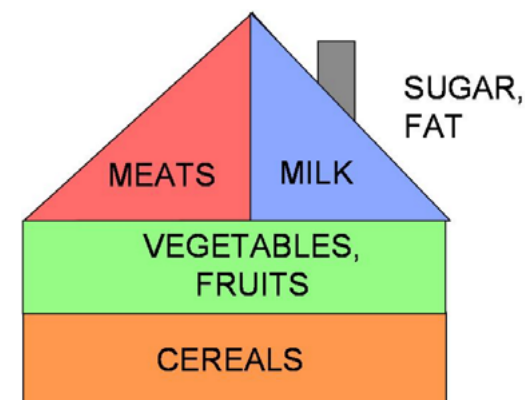
The “*Dietary guidelines for the adult population in Hungary*” are published by a multi-sectoral team including the Ministries of Health, Agriculture and



Graphic representation  
of Spanish dietary recommendations  
Source: Sedca 2007



Graphic representation  
of Swedish dietary recommendations  
Source: Sweden National Food Agency



Graphic representation  
of Hungarian dietary recommendations  
Source: The Ministry of Health of Hungary





Education, with the contribution of institutions of nutrition and food hygiene, sports health and obesity. They are endorsed by the Ministry of Health. Hungary's food guide consists in the 'house of healthy nutrition', which has cereals at the base and vegetables and fruits on the second level. The roof is made of animal source products (i.e. meats and dairy products). Foods from these groups should be part of the daily diet. Products high in sugar and fat should be eaten sparingly, and this is the reason why they are placed outside of the house.

### Temel Besin Gruplar – Turkey

The Turkish guidelines, the *Temel Besin Gruplar*,



Graphic representation  
of Turkish dietary recommendations

Source: The Ministry of Health of Turkey, Public Health Institution

explain the nutritional content of each food group, their advantages, and recommendations on how to prepare them to make the most of their nutritional potential.

For example, for protein intake, consumption of white meat and fish is recommended, along with consumption of pulses, which should be consumed along with cereals (preferable whole grain) and eaten up to six times a day. A maximum of one daily serving of eggs is recommended as a substitute for meat. For milk and dairy products (especially low-fat cheeses), two servings a day are recommended for adults; four servings of dairy products are recommended for menopausal women and children. The color of fruit and vegetables indicates the presence of different nutrients and for this reason, it is better to eat different varieties daily. Finally, it is advisable to eat fruit complete with its peel, and raw vegetables, because the vitamins and minerals are concentrated in their outside layers and are lost when cooked.

### The Pagoda – China

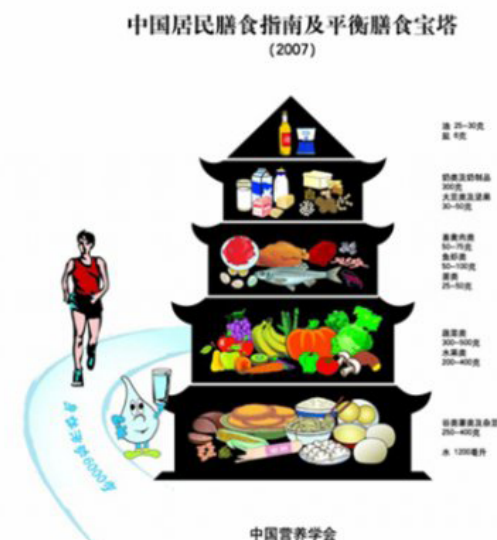
The five levels of the *Pagoda* contain all the main food groups present in the Chinese diet: the position of the food and the area of each level reflect the proportions recommended for daily food consumption.

At the bottom of the Pagoda are cereals (flours, rice, corn, sorghum, etc.), which represent the main source of energy and protein, especially in the diet of individuals in rural areas. Recommended consumption is listed for the various cereals, and

varies according to how they are combined with pulses. Fruit and vegetables are found at the middle level, while fish, meat, and eggs, the main sources of protein, important minerals, and vitamins, are found at the third level. The Chinese Pagoda also suggests a limited consumption of meat, emphasizing more lean white meat and one egg per day, at the most. Milk and its by-products, beans, condiments, and sugar are found at the top of the Pagoda.

The Pagoda's recommendations were conceived for a healthy Chinese adult, but obviously vary according to age, sex, and lifestyle.

Three different diets are defined, based on calorie intake:



Graphic representation  
of Chinese dietary recommendations  
Source: Chinese Nutrition Society

- 1,800 kcal/day, for the elderly;
- 2,400 kcal/day, for an adult male with a sedentary lifestyle; and 2,000 kcal/day for an adult woman;
- 2,800 kcal/day, for an adult male with an active lifestyle.

The recommended daily amounts for each food are indicated for each diet.

### The Food Balance Wheel - Korea

The *Food Balance Wheel*, the most commonly used food guide in Korea, was developed by the Korean Nutrition Society in 2002 and recently updated in 2010. The food guide is represented as a bicycle, underlining the principle that a healthy diet should be paired with proper physical activity. The food guide is made up of six food group categories; “grains and starchy foods”, “fish and meat dishes”,



Graphic representation  
of Korean dietary recommendations  
Source: Korean Nutrition Society

“vegetables”, “fruits”, “milk and dairy products”, and “oils and sugars”. The wheel is accompanied by a glass of water, emphasizing the fact that plain water should be preferred over sugary beverages. The Korean guidelines recommend daily consumption of foods from several food groups, being active, and moderate food consumption in order to maintain a healthy weight. They also recommend avoiding food products rich in salt and saturated fats, such as fried foods and fatty meat.

### The Spinning Top - Japan

The *Japanese Food Guide Spinning Top* is a pictorial guide released in 2005 by the Ministry of Agriculture, Forestry and Fisheries of Japan, to help people implement the Dietary Guidelines for the Japanese. The spinning top classifies food products



Graphic representation  
of Japanese dietary recommendations  
Source: Japanese Ministry of Health, Labour and Welfare and Ministry of  
Agriculture, Forestry and Fisheries

into five categories (grain dishes, vegetable dishes, fish and meat dishes, milk, and fruit) and indicates approximately how many servings of each food group should be consumed daily. For example, healthy individuals with low physical activity require energy intake of around 2,000 – 2,400 kcal per day; this corresponds to<sup>31</sup>:

- 5-7 serving sizes (sv) from the grain dishes,
- 5-6 sv from the vegetable dishes,
- 4-6 sv from the fish and meat dishes,
- 2 sv from the milk and milk products,
- 2 sv from fruit.

In addition, water and physical activity stand at the apex of the top. The message is that no single food is superior, and that the important thing is to follow a balanced and varied diet.

### Food Guide - Australia

The *Australian Guide to Healthy Eating* is a tool to inform consumers about the correct types and quantities of food that must be eaten for a balanced diet to maintain good health. In general, Australian nutritionists recommend paying special attention to diversified diet, consuming a variety of foods daily and in the right proportions.

In the guidelines, the foods are subdivided into five groups based on their nutritional resemblance, and the minimum daily recommended serving for each one is indicated:

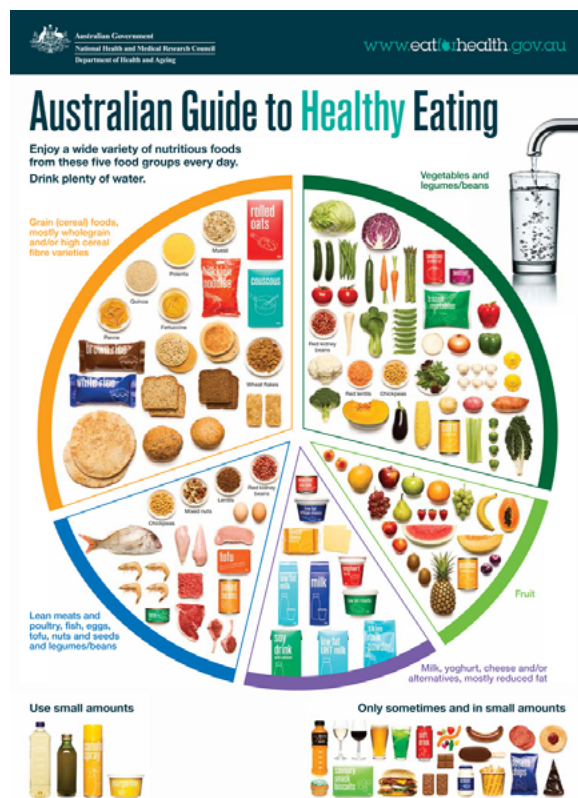
<sup>31</sup> Nakamura, 2011



- Vegetables: from 5 to 7 servings;
- Fruit: 2 servings;
- Grains: 6 servings (from 3 to 9);
- Meat, fish, eggs, dried fruit, and pulses: from 2 to 3 servings;
- Milk and dairy products: from 2 to 4 servings.

It is important to underline that although the number of servings recommended varies according to an individual's age, sex, and health condition, most food guides indicate the need to increase the consumption of cereals (preferably whole grain), pulses, vegetables, and fruit, while consuming

meat, fish, and dairy products in lower quantities. They also advise a restricted consumption of foods and beverages containing added salt or sugars. Furthermore, the intake of large amounts of water and a low consumption of alcoholic beverages are recommended.



Graphic representation  
of Australian dietary recommendations

Source: Australian Government, Department of Health and Ageing





## THE OLDWAYS PYRAMIDS

In 1993, the non-profit U.S. association Oldways, along with the Harvard School of Public Health and the WHO, introduced the Mediterranean Diet pyramid. The pyramid has long been used by consumers, educators, and professionals to promote healthier eating habits in America. As there are people from many different cultures in the United States, Oldways later decided to promote additional healthy foods which the various ethnic groups can accept more easily. This led to the creation of the new pyramids, in collaboration with researchers, nutritionists, and public health experts. Finally, a model for the growing number of vegetarians has also been proposed. Let's look at the different elaborations.

### The Latin American Diet Pyramid

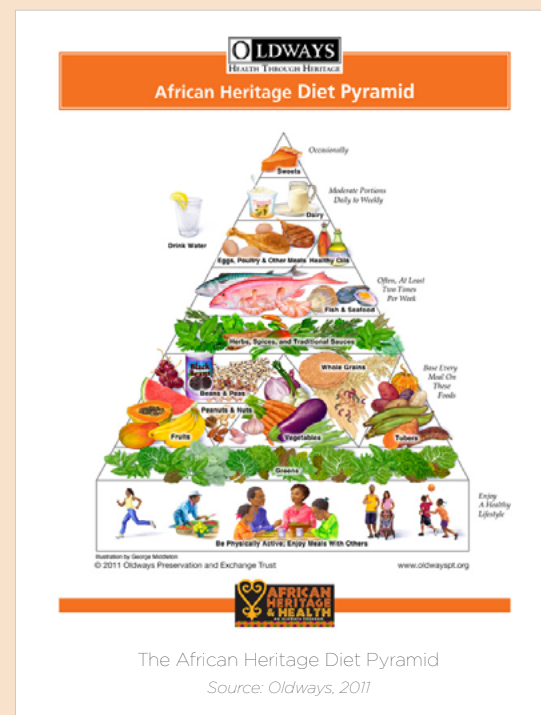
This pyramid was originally presented at the conference for the Latin American diet, in Texas in 1996. The model offers a tasty diet with foods that are easy to prepare and affordable, while reflecting the wide variety of culinary traditions of this vast area that includes South and Central America. The Latin American diet is rich in whole corn, beans, rice, quinoa, vegetables, and tubers (cassava, cabbage, eggplant, garlic, onions), fruit (agave, avocado, coconut, mango), herbs, and spices (jalapeno, cilantro, parsley, cinnamon).

### The African Diet Pyramid

This model reflects the culinary traditions of the African diaspora, thus including the eating habits of the African continent, the Caribbean, and Central and South America (especially Brazil). The pyramid of the African diet includes mostly fresh foods such as fruit (bananas, mango, papaya, cherries), leafy vegetables in particular,

tubers such as potatoes and sweet potatoes, beans of all kinds, nuts and peanuts, rice, oats, grains (especially whole grains), homemade sauces, herbs and spices, fish, eggs, poultry, and yogurt.

African cooking offers food rich in nutrients and is naturally low in sugar, unsaturated fats, and sodium.





### The Asian Diet Pyramid

This pyramid was developed by Oldways in collaboration with the Cornell-China-Oxford Project on Nutrition, Health and Environment along with the Harvard School of Public Health. The model was presented at the International Conference on Asian diets held in San Francisco in 1995.

Like the pyramid of the Mediterranean Diet, this diet was proposed as a model for healthy eating thanks to the discovery of a low historical incidence of related chronic diseases in Asian countries.

The geographical basis of this diet is quite broad: it comprises countries ranging from Bangladesh and China to India and Japan, including Mongolia and the Philippines.

Although each country and region has its own culinary style, almost all have a staple food at the base of every meal: rice. Other typical foods of the traditional Asian diet are plant-based, including vegetables (broccoli, mushrooms, bamboo shoots), fruit (pineapple, mango), pulses (soybeans, lentils), and nuts.

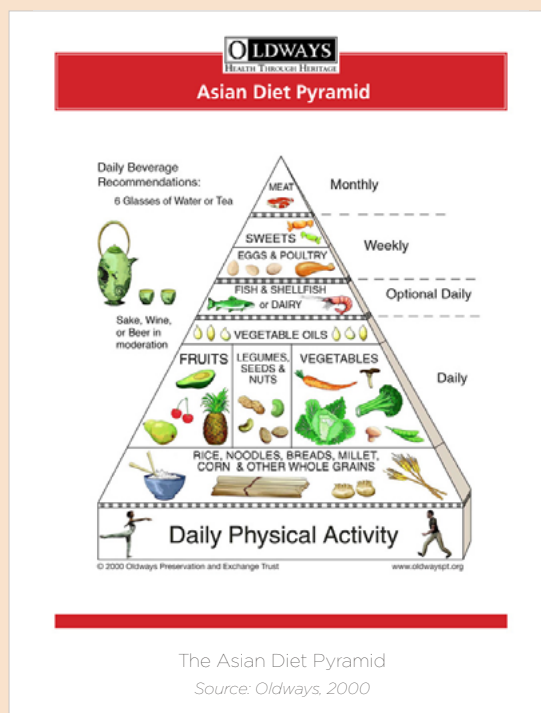
Several areas also consume dairy products (e.g., India), while inhabitants of the insular and peninsular countries eat sizeable quantities of fish and seafood.

### The Vegetarian Diet Pyramid

This pyramid was presented at the International Conference on Vegetarian Diets held in Texas in 1997 and includes several variations of this diet. A diet based on vegetables, eggs, and dairy products can be equally healthy and, if correctly followed, can provide all the nutrients to live healthily (proteins, fat, carbohydrates, vitamins,

minerals, and amino acids). Consuming a wide variety of food at every meal and eating protein foods such as pulses is suggested.

After working with a committee of ten high-level nutritionists and dieticians, Oldways proposed a Vegetarian Diet Pyramid at the annual conference of the Academy of Nutrition and Dietetics Food on October 19, 2013.



## Guidelines for “living well”

In addition to the various graphical representations of dietary recommendations, it is important to note how most authoritative scientific research studies on the relationship between diet and chronic diseases highlight how the Mediterranean Dietary model must be considered the benchmark for proper diet and that “healthy” lifestyles should be associated with it.

Adequate physical activity is another basic element which should always accompany a healthy diet. In fact, physical activity helps to burn calories, relieves tension and stress, and improves our mood and psychological well-being.



The Italian physical activity Pyramid proposed by the Sapienza University of Rome

Source: BCFN elaboration on image from University La Sapienza, Rome

Regular physical activity and sports aid the cardiovascular and skeletal systems as well as the metabolism. Moreover, regular physical activity helps us maintain a healthy body weight and composition; it encourages the adolescent to lead a healthy lifestyle, which will lead to a better state of health during adulthood.

In the Italian Physical Activity Pyramid, the Wellness Quantity (WQ) of reference for physical activity is classed as 15 minutes. As shown in this pyramid, at least 2 WQ a day are recommended, equal to 30 minutes of walking, to combat inactivity, as well as more intense physical activity (swimming, soccer, tennis, etc.) several times a week, for a more active lifestyle.

## INSTRUCTIONS FOR LIVING WELL HEALTHY DIET AND LIFESTYLE FOR EVERYONE



## USDA DIETARY GUIDELINES FOR AMERICANS 2015

Every five years, the U.S. Department of Health and Human Services (HHS) and the Department of Agriculture (USDA) revise, update, and publish the Dietary Guidelines for Americans, keeping them updated with the latest scientific discoveries. The process begins with the work of the Advisory Committee, a group of fifteen international experts in nutrition and medicine, who submit the Guidelines to a strict process of review and publish a scientific report which details new or revised findings that support the selected guidelines. After a period of public consultation, USDA translates the “technical” contents of the report into food-based dietary guidelines that are easy to understand.

The 8th edition of the Dietary Guidelines for Americans, published on December 2015, reflects advancements in scientific understanding about healthy eating choices and health outcomes over a lifetime. This edition recognizes the importance of focusing not on individual nutrients or foods in isolation, but on the variety of what people eat and drink—healthy eating patterns as a whole—to bring about lasting improvements in individual and population health. People indeed do not eat food groups and nutrients in isolation but rather in combination, and the totality of the diet forms an overall eating pattern. The components of the eating pattern can have interactive and

potentially cumulative effects on health. These patterns can be tailored to an individual's personal preferences, enabling Americans to choose the diet that is right for them. The 2015-2020 Dietary Guidelines provide five comprehensive guidelines and a series of additional recommendations that encourage healthy eating patterns, recognize that individuals will need to make shifts in their food and beverage choices to achieve a healthy pattern, and acknowledge that all of our society has a role to play in supporting healthy choices.

The Guidelines also embody the idea that a healthy eating pattern is not a rigid prescription, but rather, an adaptable framework in which individuals can enjoy foods that meet their personal, cultural, and traditional preferences and fit within their budget. Since “there are many paths that lead to a healthy diet”, the national dietary guidelines should provide several examples of balanced diets, in order to make dietary recommendations more adaptable to the needs of the population. For this reason, the new Dietary Guidelines propose three different examples of diet: the (healthy) American Diet, the Mediterranean Diet, and the Vegetarian Diet. The choice of taking the Mediterranean and the vegetarian diets as nutritional models is due to the high number of scientific studies that have shown

the health benefits these dietary patterns offer.

In short, here are the messages of the 2015 guidelines for the North American population<sup>32</sup>:

1. Maintain a healthy and balanced diet, one that is suitable to your needs.
2. Pay attention to what and how much you eat: opt for variety and moderate portions.
3. Eat less food that is high in added sugar, saturated fat, and salt.
4. Make the right choice: choose nutritious and healthy food and beverages, avoid ‘empty calories.’
5. Change your eating habits with small steps: it will seem less difficult!
6. Remember to exercise regularly.
7. Promote healthy food choices among the people around you (in the workplace, school, etc.).

<sup>32</sup> U.S. Department of Health and Human Services and U.S. Department of Agriculture, 2015.



According to the Guidelines, a healthy eating pattern includes a variety of vegetables from all of the subgroups; fruits, grains (at least half of which should be whole grains), fat-free or low-fat dairy, a variety of protein foods (including seafood, lean meats and poultry, eggs, legumes, nuts, seeds, and soy products). A healthy eating pattern limits saturated fats and trans fats, added sugars, and sodium.

Key (quantitative) Recommendations are provided for several components of the diet that should be limited. These components are of particular public health concern in the United States, and the specified limits can help individuals achieve healthy eating patterns within calorie limits:

- Consume less than 10 percent of calories per day from added sugars
- Consume less than 10 percent of calories per day from saturated fats
- Consume less than 2,300 milligrams (mg) per day of sodium[4]
- If alcohol is consumed, it should be consumed in moderation—up to one drink per day for women and up to two drinks per day for men—and only by adults of legal drinking age.

In tandem with the recommendations above, Americans should aim to achieve and maintain a

healthy body weight. The relationship between diet and physical activity contributes to calorie

balance and managing body weight.





## NUTRITIONAL RECOMMENDATIONS: INRAN GUIDELINES

In order to provide more specific nutritional advice, the Italian National Research Institute for Food and Nutrition [INRAN, now CREA] has focused on the topic over the years and has published a list of guidelines to help understand what is meant by *healthy eating*.

In particular, the publication makes several references to **nutritional balance**; therefore, it is appropriate to briefly outline this term.

In general, nutritionists recommend a daily intake of a certain amount of calories – 2,000 on average<sup>33</sup> – in a composition defined by the WHO as consisting of **15% protein-derived, 55% carbohydrate-derived, and 30% fat-derived**. The calculation is made by considering a contribution of calories equal to 4 per gram of protein and carbohydrates and 9 per gram of fat and is restricted to macro-nutrients.

The document from the 2003 *Guidelines for a Healthy Italian Diet*<sup>34</sup> is particularly interesting, as INRAN proposes the recommended servings of each food type for a healthy and balanced diet.

The following tables list the grammes recommended per serving and the total servings per food. Lastly, a BCFN elaboration based on data by INRAN is presented.

<sup>33</sup> The total amount of calories varies depending on the gender, age, work, and sport of the individual.

<sup>34</sup> INRAN, 2003.

FOOD GROUP	FOOD	SERVING	WEIGHT [g]
CEREALS AND TUBERS	Bread	1 small roll/1 average slice	50
	Baked goods	2-4 biscuits/2.5 crisp breads	20
	Pasta or rice*	1 average portion	80
	Egg pasta*	1 small portion	120
	Potatoes	2 small portion	200
FRUIT AND VEGETABLES	Salad	1 average portion	50
	Vegetables	1 fennel / 2 artichokes	250
	Fruit and juice	1 avg. size fruit (orange/apple)	150
		2 small fruits (apricot/mandarin)	150
MEAT, FISH, EGGS, LEGUMES	Fresh meat	1 small slice	70
	Cured meat (salami)	3-4 avg. slices ham	50
	Fish	1 small portion	100
	Eggs	1 egg	60
	Dried legumes	1 avg. portion	30
	Fresh legumes	1 avg. portion	80-120
MILK AND DAIRY PRODUCTS	Milk	1 glass	125
	Yogurt	1 small container	125
	Fresh cheese	1 avg. portion	100
	Aged cheese	1 avg. portion	50
FATTY CONDIMENTS	Oil	1 tbl. spoon	10
	Butter	1 portion	10
	Margarine	1 portion	10

(\*) half serving in soup

Size of standard portions in the Italian diet

Source: INRAN, *Linee guida per una sana alimentazione italiana*



FOOD GROUP	FOOD	RECOMMENDED DAILY SERVINGS		
		1,700 kcal	2,100 kcal	2,600 kcal
CEREALS TUBERS	Bread	3	5	6
	Baked Goods	1	1	2
	Pasta, Rice or Egg pasta	1	1	1-2
	Potatoes	1 (week)	2 (week)	2 (week)
FRUIT AND VEGETABLES	Vegetables	2	2	2
	Fruit or fruit juice	3	3	4
MEAT FISH EGGS LEGUMES	-	1-2	2	2
MILK AND DAIRY PRODUCTS	Milk and Yogurt	3	3	3
	Fresh Cheese or Aged Cheese	2 (week)	3 (week)	3 (week)
FATTY CONDIMENTS	Oil, Butter or Margarine	3	3	4

Number of recommended servings  
 INRAN, Linee guida per una sana alimentazione italiana

FOODS	SERVING SIZE	NUMBER SERVINGS RECOMMENDED	DAILY QUANTITY RECOMMENDED	MACROCATEGORIES
	[g]	[servings/week]	[g /day]	
Bread	50	35	330	CEREALS
Pasta/rice	80	7		
Potatoes	200	2	60	POTATOES
Salad	50	5	357	VEGETABLES AND FRUITS
Vegetables	250	9		
Fruit	150	21	450	
Fresh meat	70	5	57	MEAT
Cured meat	50	1		
Fish	100	3	43	FISH
Eggs	60	2	18	EGGS
Pulses	30	3	28	LEGUMES
Fresh legumes	100			
Milk/Yogurt	125	21	404	MILK AND DAIRY PRODUCTS
Fresh cheese	100	1		
Aged cheese	50	2		
Oil	10	11	16	OIL

BCFN elaboration based on CRA-NUT<sup>35</sup> recommended daily servings  
 Source: BCFN Elaboration on CRA-NUT data

<sup>35</sup> To calculate the recommended daily amounts of food, the elaborations simply multiplied the grams of a portion by the number of servings recommended daily. For some major categories an average was calculated from multiple foods, such as between salad and vegetables, fresh and dried vegetables, fresh and matured cheese. The recommended portions of potatoes and cheese,

reported per week, were broken up over seven days so as to be uniform with the other data. Of course, the daily portions of meat, fish, eggs, and pulses should be regarded as two daily servings of protein food alternately.



## FOOD CONSUMPTION IN ITALY IN THE LAST 36 YEARS

In order to evaluate whether nutritional recommendations suggested by experts are (and to what extent) effectively adopted by the population, it is useful to analyze the food consumption data provided by INRAN, which over the past twenty years has conducted several comprehensive studies on the dietary habits of the Italian population. These studies are finalized for food surveillance and diet monitoring, to help increase awareness on food consumption. The most recent study, published in 2008, presents data collected in 2005/2006 and provides a useful tool for assessing the average Italian diet<sup>36</sup>.

Below, following a brief description of the methodology involved, we report the results of the study and the assessment of trends over the last thirty years thanks to previous studies conducted in 1980/1984 and 1994/1996<sup>37</sup>. The data here reported cannot be considered as an exact portrayal of today's food consumption, but some important conclusions can still be drawn.

## Data collection method

To identify the representative sample, the national territory was divided into four main geographical areas<sup>38</sup>, then the provinces were divided into three groups<sup>39</sup>, and the municipalities were classified into two groups based on the number of inhabitants<sup>40</sup>

and the latest census data available at the time of the study<sup>41</sup>. The choice of the municipalities was random but each area had to be a metropolitan city and the distribution of the families in each municipality was proportional to the number of families residing in the area and the number of family members. Lastly, families were randomly selected from the telephone directory<sup>42</sup> of the towns selected for the study. In total, the data recorded the eating habits of **3,328 individuals** (including 11% children), representing 1,300 families. The study was conducted in the period from October 2005 to December 2006 and the survey was interrupted in periods characterized by an atypical diet, such as Christmas and Easter.

Consumption was measured with the help of a food diary which described in detail the types and quantities of foods consumed for each meal<sup>43</sup>, as well the details relating to individual habits, such as the observation of a specific diet or possible changes in behaviour due to special circumstances (holidays, illness, guests, etc.). Particular attention was paid to the quantification of food, condiments, and any supplements, as this is considered the most important component to a survey conducted with a nutritional perspective. Through the support of a photographic atlas depicting examples of portions and of household units (cups, spoons, etc.) and packaged units (ice cream, sugar packets, etc.), the individual was enabled to accurately estimate the portions consumed. Another interesting aspect was to evaluate the type of food preparation, i.e., “fresh”, “industrial”, “handmade”, or “home.”

In the INRAN study, food and drinks are grouped into 15 major categories and 51 subcategories for each of which there is the mean, the standard deviation, the average, 95% and 99% percentile based on the actual consumers and the total population surveyed. This data made it possible to elaborate data for assessment of the average diet of the population and the real impacts on the environment of the Italian diet.



Territorial sample distribution  
Source: Leclercq, C., et al. 2008

<sup>36</sup> Leclercq, C., et al. 2008.

<sup>37</sup>Turrini, A., et al. 2001.

<sup>38</sup> North-West; North-East; Centre; South; Islands.

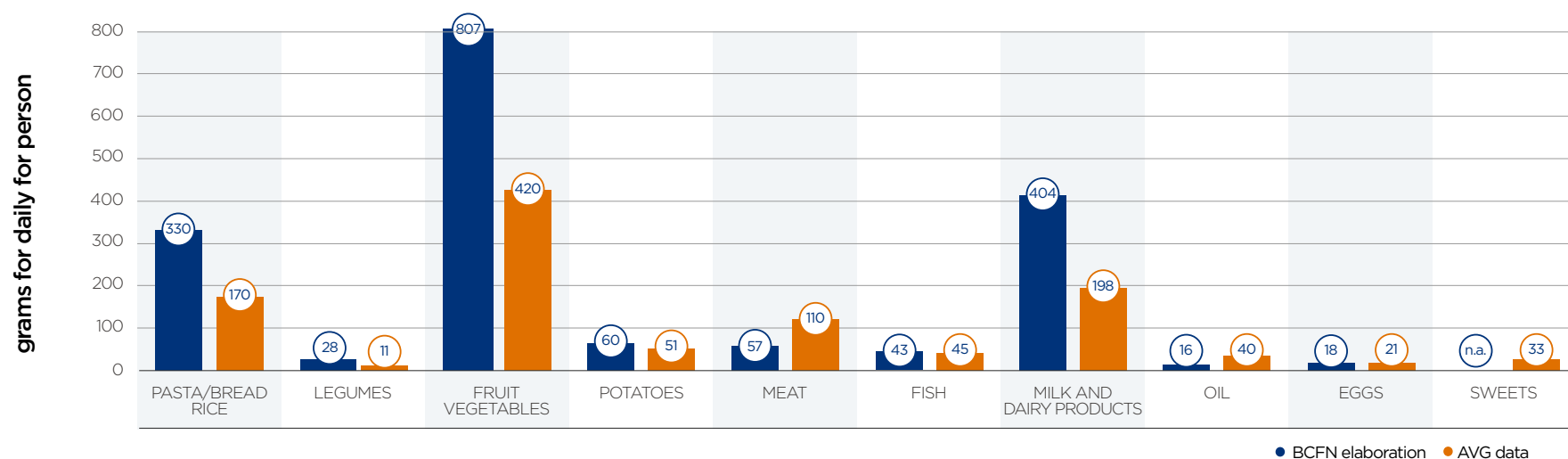
<sup>39</sup> Up to 100,000 families; 100,000-350,000 families; more than 350,000 families

<sup>40</sup> Large municipalities, with at least 50,000 families; middle-small municipalities, with fewer than 50,000 families.

<sup>41</sup> ISTAT, 2001.

<sup>42</sup> TELECOM. 2005.

<sup>43</sup> Breakfast; morning snack; lunch; afternoon snack; dinner; evening snack.



Average daily food consumption during the period 2004/05 by a consumer in Italy<sup>45</sup> and comparison with BCFN elaboration on CRA-NUT recommended daily servings<sup>46</sup>

Source: Leclercq, C., et al. 2008; INRAN, 2003

## Consumption of the 2000s

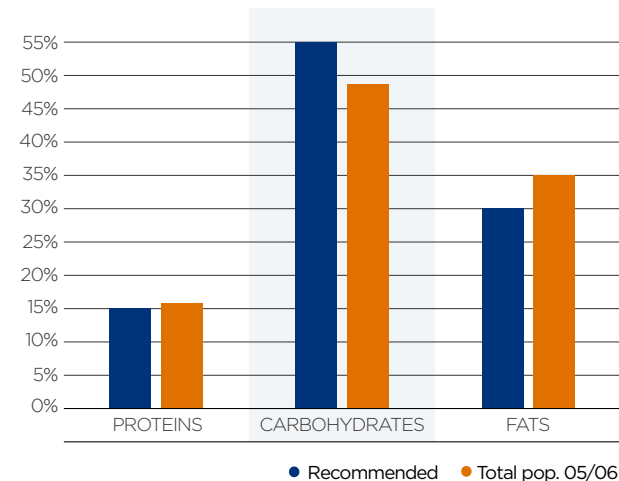
The consumption data published by INRAN clearly reveals the quantities consumed on average by each person in one day: the values relating to the most relevant foods are shown in the Figure and compared with the amount suggested by nutritionists<sup>44</sup>, so as to provide a meter of comparison only.

The conversion of the amount of food into the basic nutrients (carbohydrates, proteins, fats) shows a relative balance with respect to the composition of the average diet recommended, although the lack of calories from carbohydrates is compensated by a greater energy intake through foods containing fats.

<sup>44</sup> For more details, see chapter on Nutritionists' recommendations: INRAN guidelines

<sup>45</sup> Data based on an average consumption of 3323 individuals for 2004/2005

<sup>46</sup> Values recommended for a daily diet of 2,100 kcal, suitable for a female adult having a physically active job or an adult male with a sedentary job. The study data for potatoes and cheese is for weekly servings, whereas the paper expresses daily amounts.



Average diet analysis on data from INRAN studies

Source: BCFN elaboration on data by Leclercq, C., et al. 2008; INRAN, 2003



Trend Analysis

Since the INRAN performed the same study in 1980/84 and 1994/96<sup>47</sup> rather than discussing the data in a single period it is interesting instead to analyze how food consumption has changed over the last thirty years. Initial information concerns the quantities of the main foods, which are compared in the Figure.

From mean to median

So far, the average values calculated over the entire sample interviewed for 2005/2006 have been taken into account. This procedure may be helpful in identifying a general trend of food consumption but to interpret the data more correctly and thoroughly, care must be taken to differentiate between **mean** and **median**<sup>48</sup>.

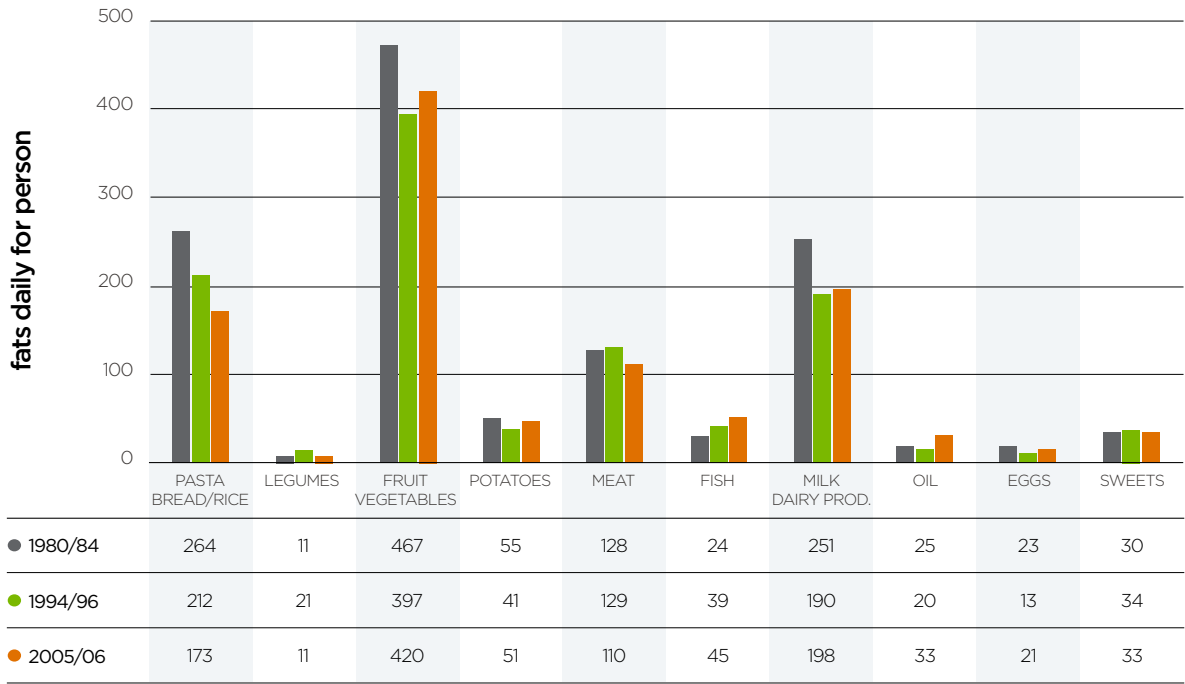
Reviewing the INRAN 2005/2006 study data with this in mind, we find that foods with a mean value of consumption in line with the recommended values actually represent a very restricted sample because the median is very different from mean or even equal to zero. In practice, few people use those food types, but those who do consume it in greater quantities than the mean sample. If this data is reported on the total sample, it can then yield a balanced average but one that is not representative. It therefore becomes important to evaluate the actual percentage of consumers who consume that food, and the real amount of mean per capita quantity, according to

the analysis of some data characterized by these different elements. To highlight the meaning of this data, it is best to keep in mind:

- When the median is 0, less than half the sample interviewed usually consumes the product;
- The percentage of the sample shown represents the part of the population that usually consumes that product;
- The actual mean is calculated on the number of people that comprises the sample consuming the food.

<sup>47</sup> Turrini, A., et al. 2001

<sup>48</sup> In statistics, the arithmetic MEAN (aka AVERAGE) is defined as the sum of all the values and their subsequent division by the total number of elements. The MEDIAN, on the other hand, represents the 50 percentile or the value which, in a list of values sorted in ascending order, bisects the distribution: one on the left of the MEDIAN constituted by the half of the units whose mode is less than or equal to the one on the right and MEDIAN constituted by the half of the units whose mode is greater than or equal to MEDIAN. In practice, this means that a value with MEDIAN that is substantially different from the MEAN is a sign of an uneven sample. In the particular case of a MEDIAN equal to zero, it means that the element concerned is not representative of at least half of the sample.



Food consumption trend over the last 30 years as surveyed by INRAN  
Source: Turrini, A., et al. 2001; Leclercq, C., et al. 2008; INRAN, 2003

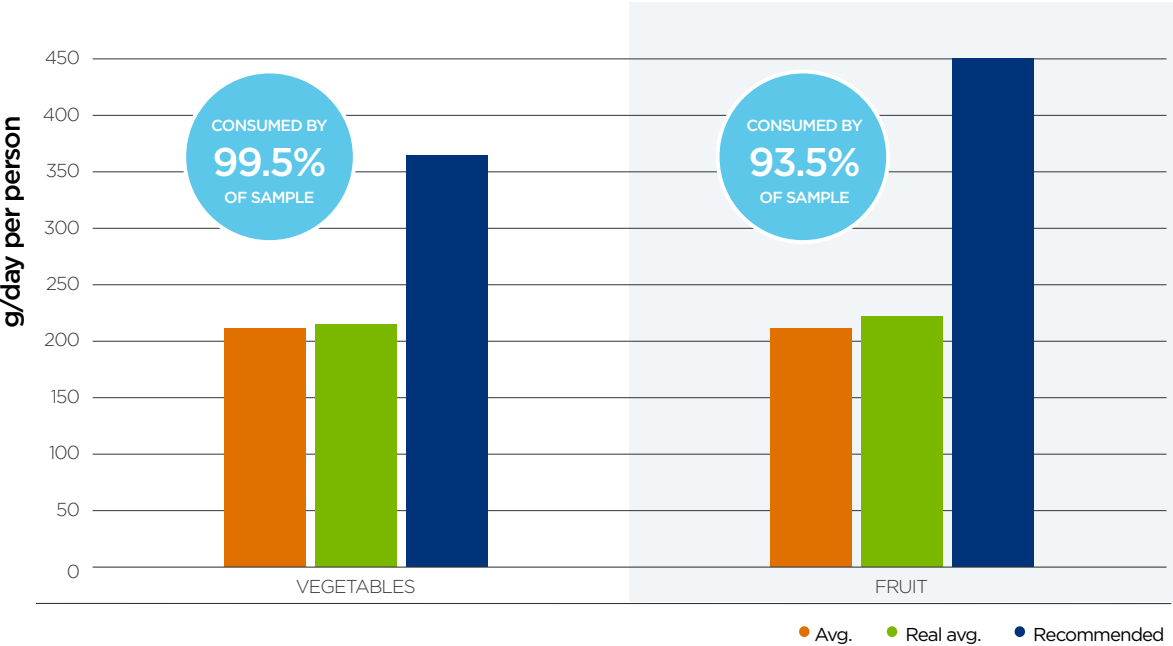


To better illustrate this concept, two examples follow: the first refers to two food types (fruit and vegetables) consumed by almost all of the population, the second relates to foods that have a low sample of consumers and therefore with a large difference between total mean and real mean.

Consumption of fruit and vegetables

As can be seen from the Figure, the real sample of vegetable consumers tends towards 100%, and

is slightly more than 90% for fruit: this constitutes a substantial equality of the mean values on total consumers and of the mean for real consumers. The consumption of fruit and vegetables is still well below the recommended average daily quantity. However, below are two interesting comparative analyses, in which the median is different from the mean since the real sample of consumers is low. The first is a comparison of the main food sources of protein: meat, fish, and pulses. The second assesses the consumption of tap water and bottled water.



Fruit and vegetable consumption analysis  
Source: Leclercq, C., et al. 2008; INRAN, 2003

FOOD CATEGORY	MEAN g/day	MEDIAN g/day	SAMPLE %	ACTUAL MEAN g/day
Poultry meat	20.8	0.0	42.4	49.0
Pork meat	12.7	0.0	31.4	40.6
Vegetables	11.3	0.0	34.6	32.6
Fish	44.7	32.2	68.0	65.8
Beef meat	42.7	35.2	75.2	56.8
Milk	119.3	112.5	78.6	151.8
Yogurt	20.6	0.0	23.9	86.3
Cheese	57.0	50.8	96.7	58.9
Pasta	54.2	53	91.1	59.5
Rice	15.8	0.0	41.2	38.2
Butter	4.1	0.0	45.7	9.0
Olive oil	32.7	31.5	99.7	32.9
Tap water	196.4	62.5	57.1	344.1
Bottled water	452.2	413.3	76.5	591.3

Data on the main foods with a significant difference between mean and median. The values refer to the study INRAN 2005/06  
Source: Leclercq, C., et al. 2008



Consumption of protein foods

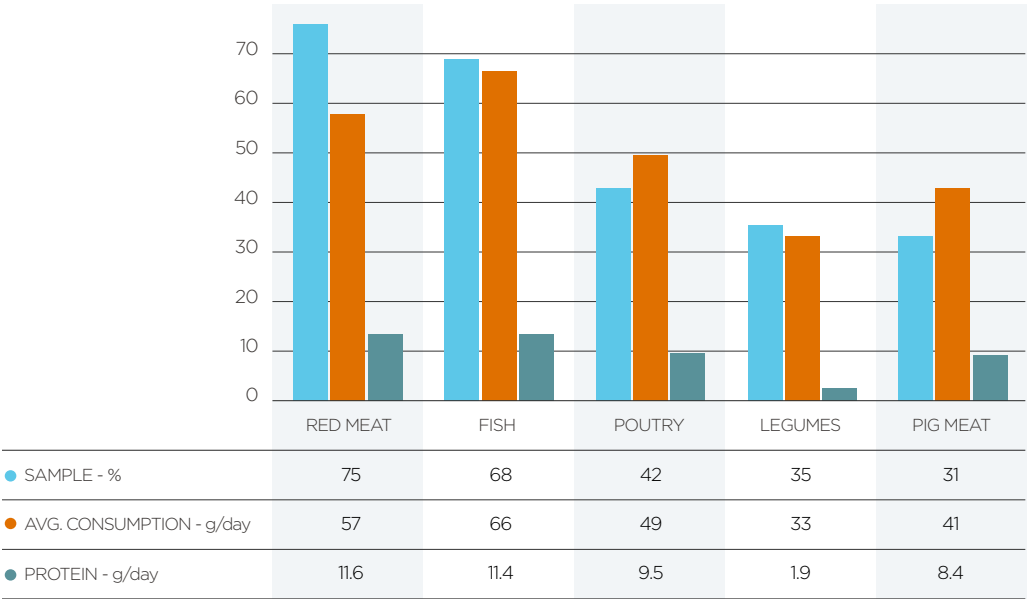
An initial analysis was made of the data on sources of protein, assumed as being meat, fish, and legumes. Although it is not possible to make a direct comparison (mainly because the categories are not exclusive, i.e., a person could be included in one or more of the surveys), one of the most relevant pieces of information concerns the distribution of the percentage of consumers between the various foods considered.

In particular, it is important to observe how

approximately 75% of the population normally eats red meat while almost the same percentage never eats pulses.

As regards the actual quantities, i.e., the means determined on the consumer sample, the values also decrease in this case in a similar way, with the highest values for red meat and fish, and smaller ones for pulses.

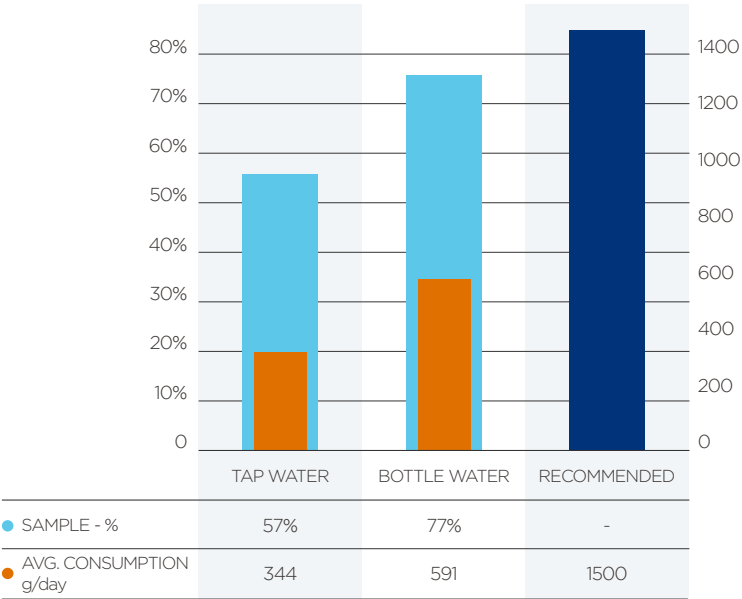
Transforming the quantities of food into proteins reveals, lastly, how beans are by far the food which least contributes to the nutritional needs of the sample analyzed.



Analysis of data on foods that contribute to protein requirements  
Source: BCFN elaboration on data by Leclercq, C., et al. 2008; INRAN, 2003

Consumption of tap and mineral water

The information relating to the consumption of mineral water and tap water is particularly striking for its relevance from an environmental point of view. The INRAN data, in fact, shows that more than 70% of consumers use bottled water, while 40% do not consume tap water. These considerations, whilst “negative” from an environmental point of view, also enjoy a positive aspect in that the actual consumption of mineral water is greater than that reported by nutritionists.



Water consumption analysis  
Source: Leclercq, C., et al. 2008; INRAN, 2003



## FOOD CONSUMPTION AROUND THE WORLD

There are two approaches to estimating food consumption: the analysis of real consumption, and the estimation of food availability.

The first method is normally used by organizations specialized in the analysis of statistical data, such as INRAN, Nielsen, or Eurisko. The analysis of real consumption provides specific and concrete data, but is very expensive and generally a lengthy process.

The second method consists in estimating the amount of food resources available for human consumption in a country in a given period of time, using public databases published by international organizations such as the FAO. This method is definitely more practical and allows cross-country analysis, but the estimate of consumption is much less accurate than when the first method is applied. Similarly to the Italian situation, insights have been made into the dietary habits of populations from different countries. Here below we describe the results of two different analyses carried out by the BCFN. The first consists in a comparison between real food consumption in Europe and in the United States, while the second provides an insight into food availability for human consumption in different world regions. This information is accompanied by an extract from the publication *Hungry Planet*<sup>49</sup> in which the eating habits of a number of families around the world are compared.

## Dietary habits in Europe and in the United States

In 2011, the European Food Safety Authority developed *The EFSA European Food Consumption Database*, at the end of which a document was published summarizing food consumption in 22 European countries. The data utilized arrived mainly from monitoring programs set up by governmental bodies and/or scientific studies.

For the evaluation of this work, we decided to compare the habits of Italian consumers with those of France, Germany, and Sweden. The data analyzed relates to the population aged from approximately 3 to 60 years of age, and refers to 2005/2007 for France, 2005/2008 for Germany, and 2003 for Sweden. The data is the most recently available and is organized according to the main macro-categories of foods.

Similarly to the European study, in the United States, USDA conducted research on the eating habits of Americans. As it arrives from a different source, the data is not fully comparable but it is possible to make some macroscopic considerations. The study refers to the years 1994/96 and the sample considered includes all age groups<sup>50</sup>.

The following are the real mean amounts of 8 main categories of food consumed in Italy, France, Germany, Sweden, and the USA: the data is based on the percentage of actual consumers of that food as shown in the Figure. The comparison with the quantity recommended by INRAN is shown

as an example, since these suggestions relate to Italian diets and therefore are not fully applicable to countries which do not follow the Mediterranean Diet and have different sources of carbohydrates, proteins, and fats.

In general, all countries have a tendency to consume few pulses and little fish, as opposed to others where the coverage is often more than 90%. A particular case is France, which has a high percentage of consumers per macrocategory: this figure means that the diet of the French consumer is indeed broad, and individuals have eating habits that include all foods. However, we can also observe how the average French quantities are the lowest, which means that almost the entire population consumes all foods but in small quantities.

The U.S. is the biggest consumer of meat (almost one pound daily per capita), followed by Italy, France, Germany, and Sweden, which consumes a smaller amount (75 g/day).

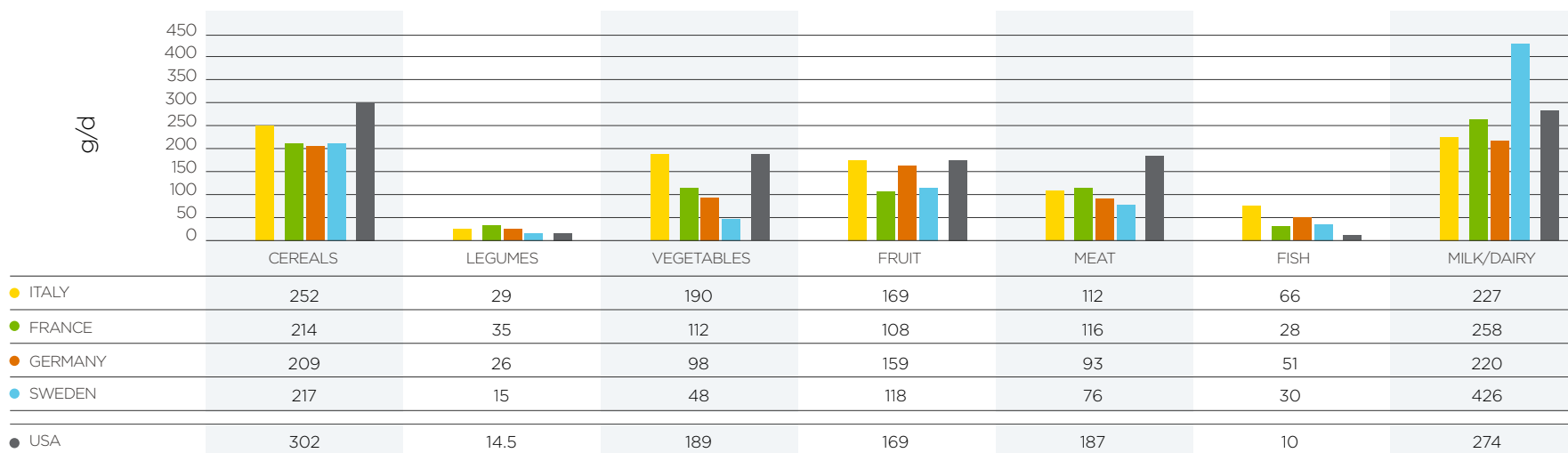
Unfortunately, in the absence of a breakdown of the data on meat consumption (beef, poultry, pork), it is not possible to estimate the consumption of red meat as opposed to white meat. Another finding is the particularly high consumption of milk and dairy products in Sweden (more than 400 g/day).

<sup>49</sup> Menzel, P., F. D'Aluisio, 2005

<sup>50</sup> EPA 2007







Real mean of the eight main food categories in four European countries and U.S.

Source: INRAN, 2003; Leclercq, C., et al. 2008; EFSA, EPA, 2007



Percentage of actual consumers of foods in six main macrocategories across four European countries and U.S.

Source: BCFN elaboration on data by Leclercq, C., et al. 2008; EFSA, EPA, 2007

## Dietary habits around the world: an overview from the FAOSTAT database

The second analysis was carried out as an extension of the study into dietary habits in other areas of the world (including South America and Asia). For each of the worldwide regions, some exemplifying countries were chosen which could offer a geographically heterogeneous perspective of food consumption around the world: Italy, Germany, Sweden and Turkey in Europe; the United States, Mexico and Brazil for North America and Latin America; the Korean Republic, China and Japan for Asia; and finally Australia.

The areas in question are classified by the World Bank<sup>51</sup> as countries with medium to high income per capita. Africa was excluded from the analysis, along with other countries which generally register low income, as such areas often suffer from seriously imbalanced distribution of wealth and, consequently, food. In such countries, it is not unusual to come across the “double burden of malnutrition”, i.e. the co-presence of a large part of the population suffering from a serious food scarcity and a minority affected by cardiovascular conditions and obesity. Seriously imbalanced distribution of wealth could distort the results of the analysis, thus the decision was made to focus solely on “richer” countries<sup>52</sup>.

### Data sources

To analyze the food consumption of the population in the countries in question, the database FAOSTAT

belonging to the FAO was consulted, particularly with reference to the Food Balance Sheets (FBS). Food Balance Sheets are the tables which provide an overview of food supply in a country, both in absolute terms and pro-capita, for a specific period of time.

As already detailed by various authors<sup>53</sup>, Food Balance Sheets are a useful and valuable tool, providing a general overview of food quantities in various countries at a specific given time, but their use can incur some disadvantages. In order to contain the size of the database, the number of processed products are replaced instead with quantities of pre-processed or raw ingredients. Thus, it is not possible to obtain information on, for example, the quantity of pasta, bread or cheese consumed by Italian households, but it will be possible to know how much grain or milk is needed to produce the aforesaid items. The lack of information on the quantity of transformed products made it impossible to explore nutritional aspects of food consumption – it would not have been possible to estimate the quantity of saturated and unsaturated fats, or cholesterol and salt consumption. Furthermore, the FBS does not supply data on the effective food consumption of the population, but instead offers an estimate<sup>54</sup> of the amount of food available per individual. The availability of food does not correspond to the actual food consumption since to achieve a precise evaluation of consumption figures, it would be necessary to cancel all domestic wastage from the figures referring to actual

availability<sup>55</sup>. For this reason, the Food Balance Sheets unavoidably overestimate food consumption figures. Finally, the FBS data does not reflect the diversification that may feature throughout a country's population, but instead assumes that the entire country will display the same nutritional status and food availability in each area. This obviously implicates a simplification and possible distortion of estimated figures regarding nutritional values. However, despite the weaknesses outlined above, the Food Balance Sheets data do actually represent a valid source of reference for comparative studies of international contexts, and remain still today one of the most popular tools in scientific studies in this field<sup>56</sup>.

The table below details the average daily quantities of eight food macro-groups available to the population, referring to 2011. The data could overestimate by up to 50% the actual food consumption figures, but it is still possible to draw some general conclusions.

It is generally clear that, in all the countries examined, legumes and fish are those food types consumed by

<sup>51</sup> [http://data.worldbank.org/about/country-and-lending-groups#Lower\\_middle\\_income](http://data.worldbank.org/about/country-and-lending-groups#Lower_middle_income)

<sup>52</sup> It should be noted, however, that similar situations occur (to a greater or lesser extent) in all countries. Several studies realized by the epidemiologist Drewnowski in the United States and France, suggest that there is a clear connection between socio-economic status and quality of diet.

<sup>53</sup> Srinivasan 2006, Tukker, 2009

<sup>54</sup> Srinivasan 2006

<sup>55</sup> the term “domestic wastage” here refers to both non-edible waste and to food that is wasted when it is not consumed by the purchaser. BCFN, 2012

<sup>56</sup> Srinivasan 2006, Tukker 2009



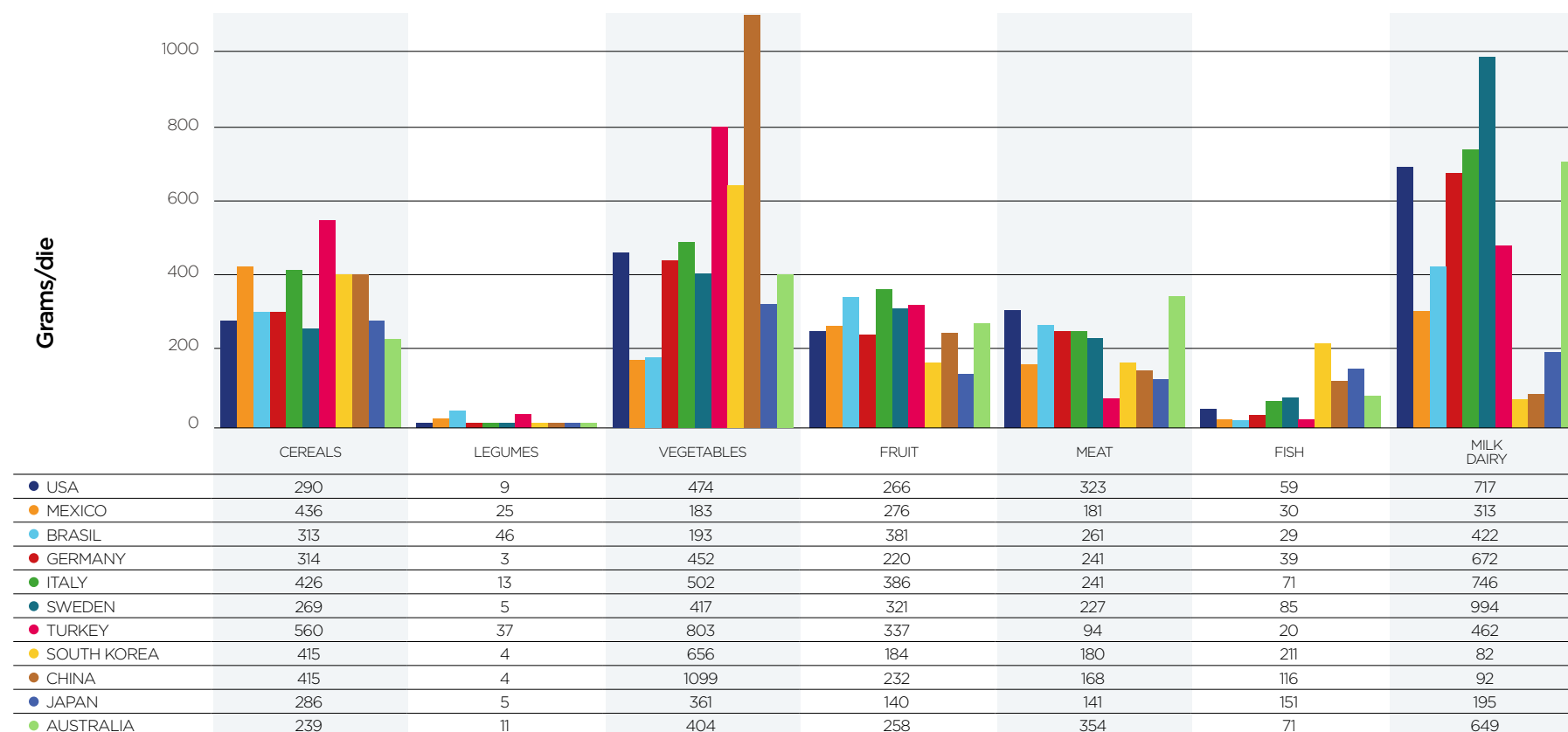
the smallest part of the population, unlike other food types where consumption is more evenly distributed throughout the population.

China, Turkey and South Korea boast the highest consumption of vegetables (more than six hundred grams of vegetables per head, before waste) whilst

the consumption of cereals is fairly homogenous throughout the countries. Australians are the highest consumers of meat (345 g/day), followed by the Americans (323 g/day), the Brazilians (261 g/day), Italians and Germans (241 g/day).

Little fish is eaten everywhere except South Korea

and Japan, countries which have traditionally consumed this food in large quantities due to geographic reasons. Regarding the consumption of milk and dairy products, European consumers top the list, with Sweden at the top, followed by Americans and Australians.



Food availability in different countries  
 Source: BCFN elaboration on FAOSTAT data



What households eat around the world

For a deeper analysis of the relationship between eating habits and the environment, BCFN decided to estimate the environmental impacts of different dietary patterns adopted around the world. Starting from Hungry Planet by Peter Menzel, the weekly grocery shopping of families from all over the world was analyzed and the environmental impact per

capita was estimated using the same database as the Double Pyramid 2016<sup>57</sup>.

It is important to underline that the weekly shopping reported is an index of the habits of an individual family and therefore cannot be considered as representative of the average diet in a specific country, nor is it necessarily balanced from a nutritional point of view. In addition, the families do not have the same number of family members,

though the impacts were traced back to food consumption per capita.

This initial analysis, derived from the percentage

<sup>57</sup> Beverages and condiments (despite being present only in very negligible amounts) were excluded from the calculation. As regards foods prepared and consumed at restaurants (e.g. fast-food), impacts were estimated under a coverage of approximately 100% in terms of data availability. For details of the assumptions and assimilations, see Appendix

DOMESTIC CONSUMPTION AROUND THE WORLD	
FRANCE	The Le Moinde family purchases approximately 44 kg of food products weekly, of which 36% are fruit and vegetable products, and 14% are meat, fish, and eggs. The Carbon Footprint of their weekly shopping is about 119 kg of CO <sub>2</sub> -eq.
ITALY	The Manzo family purchases approximately 54 kg of food products every week, of which 28% are fruit and vegetable products, and 26% are cereal products. The Carbon Footprint of their weekly shopping is about 116 kg of CO <sub>2</sub> -eq.
TURKEY	The Celik family purchases approximately 74 kg of food products weekly, of which 52% are cereal products and 33% are fruit and vegetable products. The Carbon Footprint of their weekly shopping is about 93 kg of CO <sub>2</sub> -eq.
UNITED STATES	The Revis family purchases approximately 41 kg of food products weekly, of which 28% are fruit and vegetable products, and 17% are meat, fish, and eggs. The Carbon Footprint of their weekly shopping is about 132 kg of CO <sub>2</sub> -eq.
ENGLAND	The Bainton family purchases approximately 56 kg of food products every week, of which 32% are milk and dairy products, and 27% are fruit and vegetable products. The Carbon Footprint of their weekly shopping is about 85 kg of CO <sub>2</sub> -eq.
JAPAN	Every week, the Ukita family purchases approximately 56 kg of food products, of which 47% are fruit and vegetable products, and 18% are meat, fish, or eggs. The Carbon Footprint of their weekly shopping is about 102 kg of CO <sub>2</sub> -eq.
AUSTRALIA	Every week, the Molloy family purchases approximately 49 kg of food products, of which 34% are fruit and vegetable products, and 26% is meat, fish, and eggs. The Carbon Footprint of their weekly shopping is about 122 kg of CO <sub>2</sub> -eq.
MEXICO	The Casales family purchases approximately 80 kg of food products a week, of which 43% are fruit and vegetable products, and 18% are cereal products. The Carbon Footprint for their weekly shopping is about 118 kg of CO <sub>2</sub> -eq.

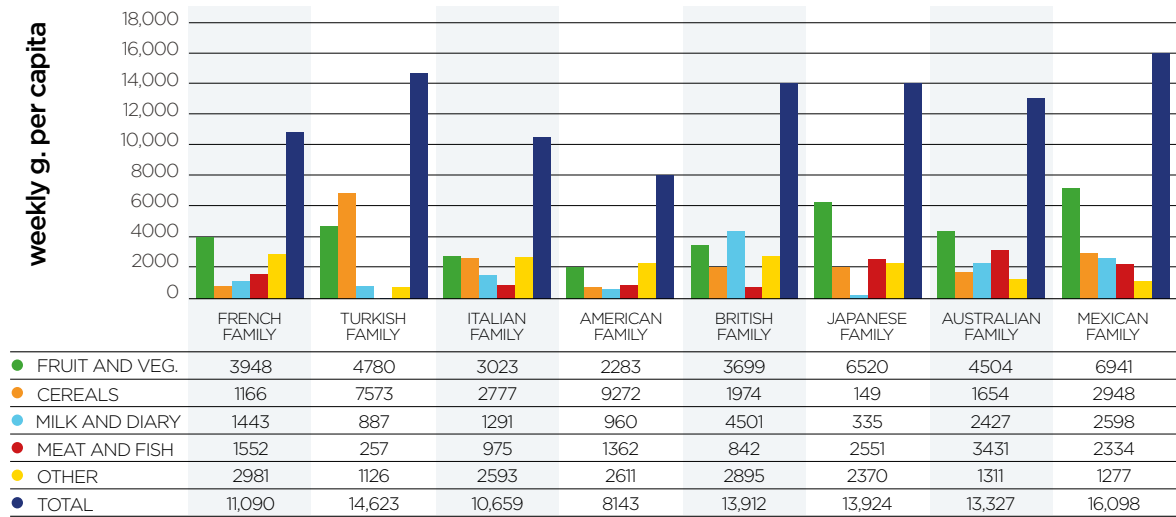
Domestic consumption around the world  
Source: Menzel P, F. D’Aluisio, 2005





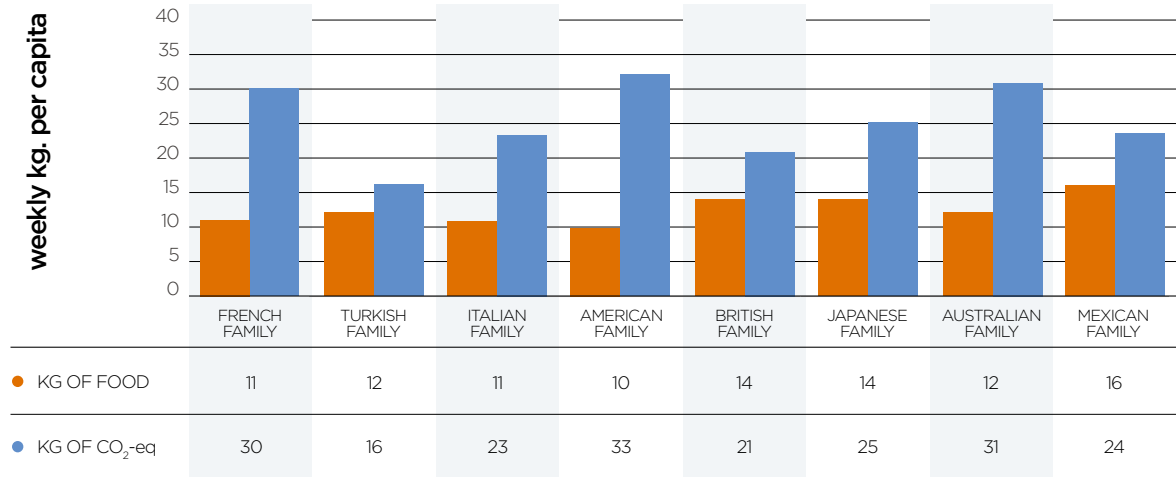
of the composition of food macrocategories (fruit and vegetables, cereals, dairy products, etc.) leads to some conclusions: for example, a diet composed mainly of fruit and vegetables has a lower impact than a diet which includes a large quantity of meat.

Without venturing too far into considerations of a nutritional nature, it is interesting to evaluate how the diets analyzed featured a marked difference in terms of the food consumed. In spite of all this, however, starting with the data on the environmental impact of food, it does not have a directly proportional effect on impacts; for example, in the study of the Turkish family, the consumption of a large quantity of food (especially that of plant origin), involves a lower impact on the environment.



Quantity of food consumed weekly by the members of the eight families analyzed. The data relates to personal consumption, estimated by dividing the total by the number of family members

Source: BCFN elaboration on data by Menzel, P., F. D'Aluisio, 2005



Environmental impact and amount of food consumed weekly by each member of the families analyzed

Source: BCFN elaboration on data by Menzel, P., F. D'Aluisio, 2005



# LIFE CYCLE ASSESSMENT AND ENVIRONMENTAL INDICATORS



THE LIFE CYCLE ASSESSMENT

CARBON FOOTPRINT

WATER FOOTPRINT

ECOLOGICAL FOOTPRINT

TOXICITY INDICATORS



# LIFE CYCLE ASSESSMENT AND ENVIRONMENTAL INDICATORS

*Not everyone knows that farming and animal husbandry activities are among the main sources of greenhouse gas emissions. This is why, as explicitly suggested in the document entitled *Climate Smart Food*<sup>1</sup> – published in November 2009 by the Swedish Institute for Food and Biotechnology [SIK] under the Swedish presidency of the European Union –, environmental variables must also be taken into consideration in food and dietary choices. From this standpoint, the various food groups can be evaluated in terms of their environmental impact, i.e., in terms of greenhouse gas emissions (Carbon Footprint), use of water resources (Water Footprint), and society's use of natural assets (Ecological Footprint).*

*The life cycle analysis and explanation of these three indicators are discussed in this chapter, which aims to explain the scientific methodology behind the construction of the Double Pyramid's environmental section.*

## THE LIFE CYCLE ASSESSMENT

The environmental impact related to food products is represented with indicators calculated on the basis of the Life Cycle Assessment (LCA) methodology,

acknowledged and regulated internationally by the standards ISO 14040:2006 and ISO 14044:2006. These standards allow a systematic overview of the production processes and products, by analysing their constituent environmental aspects (energy and raw material consumption, emissions in air and water, solid waste produced, etc.) throughout the product lifecycle.



The LCA analysis method is regulated by International ISO standards 14040 and 14044, which define its specific characteristics

Source: BCFN, Double Pyramid 2011: *Healthy food for people, sustainable for the planet*, 2011.

The complexity of the analysis at hand, both in terms of execution and reporting of results, implies the use of appropriate environmental indicators selected on the basis of the system analysed. There are many studies that set out to determine a set of environmental indicators, of which the following are deemed worthy of mention in this paper:

- *Core Set of Indicators* [CSI]<sup>2</sup>, financed by the European Environmental Agency [EEA];
- *Sustainable Development Strategy* [EU SDS]<sup>3</sup>, defined by the European Union to assess the efficiency and quality of the policies enacted by each Member State; project Indicators [SDIs] for monitoring the EU SDS.

The choice of indicators used to represent a production system is particularly important and must be made by focusing on the main environmental aspects. It is also difficult to achieve the complex balance between simplicity (necessary in communicating complex concepts) and scientific rigor.

Taking a specific and detailed look at the food production chains, process analysis highlights how the main environmental impacts are represented by the emission of GHGs (greenhouse gases), use of water resources, and ability to regenerate the

<sup>1</sup> Sjöberg, 2009

<sup>2</sup> EEA, 2005

<sup>3</sup> COM(2009) 400, 24.7.2009



land resources consumed. Though not representing all environmental impacts, the combination of these elements comprises a balanced set in terms of simplicity and scientific rigor, especially as LCA studies are much more reliable when assessing overall impact (greenhouse effect, resource consumption, etc.) as opposed to those relegated to a local system (such as the release of toxins). This second case implies the examination of other aspects linked more closely to local characteristics, such as dominant winds, terrain morphology, water tables, etc. For these reasons, the BCFN has opted to use the following impact indicators in relation to food production: the **Carbon Footprint**, the **Ecological Footprint**, and the **Water Footprint**.

The relative environmental pyramids were constructed on the basis of each of these indicators,

which classify foods in regard to their specific footprint.

It is necessary to specify that the Double Pyramid was composed in relation only to the **Ecological Footprint** for two main reasons:

- the ability to report data in a simple manner that is also easy to visualize (everyone can easily visualize 10 m<sup>2</sup> of terrain);
- the fact that it is the only indicator that takes into account (even if only partially) several environmental aspects simultaneously.

#### *Concept differences of the indicators employed*




These three indicators were selected in view of their complementary views that also allow researchers to produce a sufficiently detailed

picture of the environmental impacts caused by the food production system. The Carbon Footprint measures the amount of gas accountable for climatic change; the Ecological Footprint relates the ability to regenerate land resources used while absorbing waste generated; while the Water Footprint concerns the consumption of water resources.

The **Carbon Footprint** is an indicator that quantifies the greenhouse gas (GHG) emission generated by the processes that, as far as agri-food chains are concerned, is mostly due to carbon dioxide (CO<sub>2</sub>) emissions generated by fossil fuels, methane (CH<sub>4</sub> produced mainly from the enteric fermentations of cattle and manure management), and nitrous oxide (N<sub>2</sub>O, caused by nitrogen-based fertilizers). This indicator, therefore, is also intended to provide an illustration of energy consumption, with a focus on the use of fossil fuels.

The **Ecological Footprint** represents land occupancy, both real and virtual, by the system under examination. Though a section of this land is destined to the theoretical absorption of system-generated CO<sub>2</sub> (energy land), other GHG emissions are not accounted for. This is why this indicator must be coupled with the Carbon Footprint to provide more detailed information.

The water element is treated by the Ecological Footprint solely as water surface occupied by fishing, excluding its use as a resource. This is why the **Water Footprint** is required to complete the set of indicators.

INDICATOR	WHAT IT MEASURES	UNIT OF MEASURE
 CARBON FOOTPRINT	The emission of gas held responsible for climate change	Weight [kg] of CO <sub>2</sub> equivalent
 WATER FOOTPRINT	Water resource consumption and use by the production system	Volume [liter or m <sup>3</sup> ] of water
 ECOLOGICAL FOOTPRINT	Land (or ocean) surface biologically productive that is required to supply resources and absorb the emissions associated to a production system	Global area [m <sup>2</sup> or hectares]





## CURRENT ENVIRONMENTAL INDICATORS

The decision to assess environmental sustainability with the Carbon Footprint, Water Footprint, and Ecological Footprint was made after evaluating various alternatives. The scientific community and the institutions have provided other effective and specific indicators. The European Environmental Agency, for example, has identified several indicators<sup>4</sup> able to assess environmental impact in relation to the various areas:

- Agriculture (Area under organic farming; Gross nutrient balance);
- Atmospheric pollution (Emissions of acidifying substances; Emissions of ozone precursors; Emissions of primary particles and secondary particulate matter precursors; Exceedance of air quality limit values in urban areas; Exposure of ecosystems to acidification, eutrophication, and ozone);
- Biodiversity (Designated areas; Species diversity; Threatened and protected species);
- Climate change (Atmospheric greenhouse gas concentrations; Global and European temperature; Greenhouse gas emission projections; Greenhouse gas emission trends; Production and consumption of ozone depleting substances);
- Energy (Final energy consumption by sector; Primary energy consumption by fuel; Renewable electricity consumption; Renewable

primary energy consumption; Total primary energy intensity);

- Fisheries (Aquaculture production; Fishing fleet capacity; Status of marine fish stocks);
- Land (Land take; Progress in management of contaminated site);
- Transport (Freight transport demand; Passenger transport demand; Use of cleaner and alternative fuels);
- Waste (Generation and recycling of packaging waste; Municipal waste generation);
- Water (Bathing water quality; Chlorophyll in transitional, coastal, and marine waters; Nutrients in freshwater; Nutrients in transitional, coastal, and marine waters; Oxygen-consuming substances in rivers; Urban waste water treatment; Use of freshwater resources).

<sup>4</sup> Sjöberg, 2009



CARBON FOOTPRINT



The Carbon Footprint value represents the quantity of greenhouse gases emitted by a system that generates a product or service<sup>5</sup>. Numerous substances contribute to the greenhouse effect, albeit in differing ways and magnitudes. Two factors govern the

contribution of each substance to the greenhouse effect: the quantity released into the atmosphere (e.g., tons per year) and their emission factor (i.e. impact per unit of weight). The emission factor is measured by comparing the substance in question with carbon dioxide. Methane, for example, has a factor equal to 28, meaning that releasing 1 kg of methane into the atmosphere is equivalent, in terms of impact, to 28 kg of CO<sub>2</sub>.

Many substances identified as responsible for the greenhouse effect have high emission factors (even greater than 1,000) but, fortunately the quantities are so low that their contributions are deemed negligible. Carbon dioxide, with the lower emission factor, is characterized by conspicuous quantities and is, thus, the most monitored substance.

The Intergovernmental Panel on Climate Change [ICPP] has prepared and regularly updates a list of substances and their impact in terms of contribution to the environmental impact<sup>6</sup>. Many of these are

extremely limited in diffusion and pose no real concern. Therefore, it is important to select the most impacting substances and concentrate monitoring and mitigation efforts in that direction. The attention of scientists is mostly focused on six substances:

- Carbon dioxide (CO<sub>2</sub>), mostly generated by combustion;
- Methane (CH<sub>4</sub>), which originates mostly from landfills and livestock;
- Nitrous oxide (N<sub>2</sub>O), strongly present in agriculture when using nitrogen fertilizers;
- Sulfur hexafluoride (SF<sub>6</sub>), frequently used as electrical insulation for industrial transformers;
- Hydrofluorine carbons (HFC) and Perfluorinated Carbons (PFC), used in particular industrial applications.

With regard to agricultural systems at the base of

food production, nitrous oxide and methane (in addition to carbon dioxide), also require attention, as shown in the table.

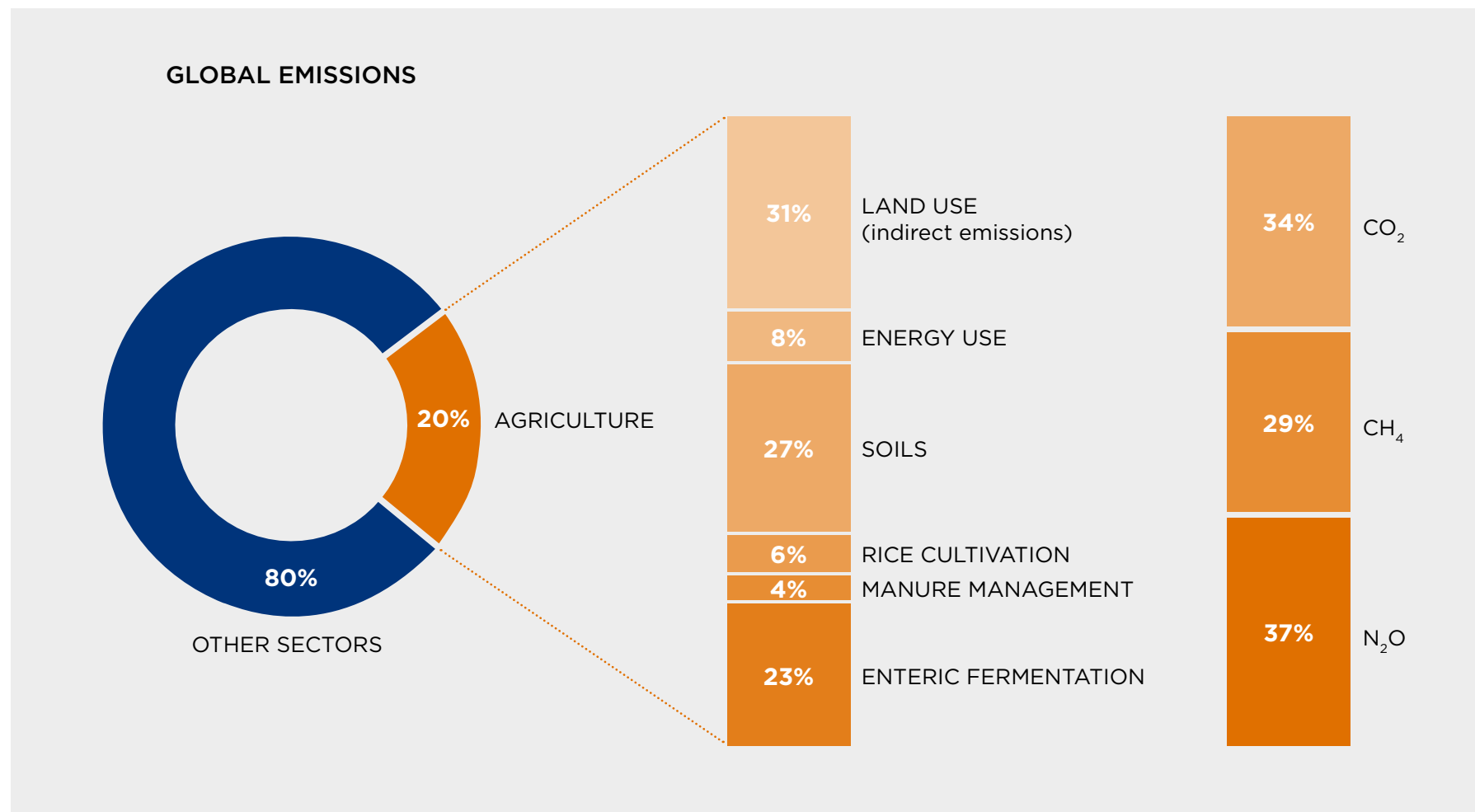
The Carbon Footprint assessment methods refer to different internationally recognized standards, which define the calculation criteria. The various calculation protocols are merely alternatives and are not conflicting. Hence, reference to various standards can be made in an effort for integration.

<sup>5</sup> JRC, 2009  
<sup>6</sup> The most updated version was published in 2013

SUBSTANCE	CHARACTERIZING FACTORS	SOURCE
Carbon dioxide (CO <sub>2</sub> )	1	Combustion
Methane (CH <sub>4</sub> )	28	Landfills and livestock
Nitrous oxide (N <sub>2</sub> O)	265	Nitrogen fertilizers

Characterizing factors of some greenhouse gases by agrifood production chains  
Source: IPCC, 2013





The major greenhouse gases originating from agriculture<sup>7</sup>  
 Source: Elaboration by BCFN on FAOSTAT data 2014 and WRI (CAIT 2.0 project) 2014

<sup>7</sup> Elaboration by BCFN on FAOSTAT 2014 and WRI 2014 data



APPROVED STANDARD	DESCRIPTION	TYPE OF REGULATION	THIRD PARTY REVIEW	AREA
ISO/TS 14067:2013 Greenhouse gases - Carbon Footprint of products - Requirements and guidelines for quantification and communication	Carbon Footprint of products	Standard	Critical review	International
ISO 14064:2006 Carbon Footprint	Carbon Footprint of companies	Standard	Critical review	International
PAS 2060:2010 Specification for the demonstration of carbon neutrality	Demonstration of carbon neutrality actions	Standard	-	National (UK)
PAS 2050:2011 Specification for the assessment of the life cycle greenhouse gas emissions of goods and services	Carbon Footprint of products	Standard	-	National (UK)
PAS 2050-1:2012 Assessment of life cycle greenhouse gas emissions from horticultural products (Supplementary requirements for the cradle to gate stages of GHG assessments of horticultural products undertaken in accordance with PAS 2050)	Carbon Footprint of products	Standard	-	National (UK)
PAS 2050-2:2012 Assessment of life cycle greenhouse gas emissions (Supplementary requirements for the application of PAS 2050:2011 to seafood and other aquatic food products)	Carbon Footprint of products	Standard	-	National (UK)
INTERNATIONAL EPD® SYSTEM General Programme Instructions (GPI) Version 2.0 - 2013-06-04	Environmental product declaration	Program rules	Certification	International
GHG PROTOCOL Product Life Cycle Accounting and Reporting Standard - 2011 published version	Carbon Footprint of products	Standard	Certification	International
AFNOR BPX 30-323 FRANCE French Standard for PCF accounting - General principles for an environmental communication on mass market products	Carbon Footprint of products	Standard	-	National (FR)
TS Q 0010 JAPAN Calculation rules, labeling and CO <sub>2</sub> accounting (GHG)	Carbon Footprint of products	Standard	-	International

Some of the reference standards currently used for the Carbon Footprint calculation  
 Source: Elaboration by BCFN





The different protocols include the International guidelines of the Joint Research Centre [JRC] on *LCA application Life Cycle data System – ILCD Handbook*,<sup>8</sup> which contains specific paragraphs on the CO<sub>2</sub> and CH<sub>4</sub> calculation methods of great interest. In 2013, the International Organization for Standardization released a new set of standards (ISO 14067) that specify principles, requirements, and guidelines for the quantification and communication of the carbon footprint of products, based on International Standards on life cycle assessment (ISO 14040 and ISO 14044) for accounting and on environmental labels and declarations (ISO 14020, ISO 14024 and ISO 14025) for communication.

*Accountable elements*

The Carbon Footprint is simple to communicate and is accessible, which has led to its rapid diffusion as an instrument to measure product environmental impact. Nonetheless, it does not represent the overall picture of a system's impact on the environment. For example, the production of nuclear energy generates much lower CO<sub>2</sub> emission levels than electricity produced by burning fossil fuel. Through the JCR, the European Commission highlighted how assessments based solely on carbon footprint (climate change) could lead to incorrect conclusions<sup>9</sup>. This fact must be borne in mind particularly when environmental assessments support strategic decisions, or when implementing product improvement actions. Attribution of equal importance

to the various environmental aspects (GHG emission, energy consumption, etc.) in order to correctly evaluate the impacts without the risk of overlooking less evident but important aspects is the only way to avoid the so-called “shifting of burdens” effect.

WATER FOOTPRINT



The Water Footprint measures the use of water resources in terms of volume (expressed in litres or cubic metres) of water consumed and/or polluted by the entire chain – from production to direct consumption of goods/services. The water footprint also

differentiate the source of water used to produce that good (green or blue water). The indicator is closely linked to the concept of virtual water, theorized in 1997 by Professor John Anthony Allan of the School of Oriental and African Studies (SOAS) and King's College London, which indicates the volume of fresh water consumed to produce a product (a commodity, good, or service) by summing all phases of the production chain. The term “virtual” refers to the fact that the vast majority of water used to make the product is not physically contained in said product, but has been consumed during its entire life cycle. The methodology used for the measurement of the indicator was developed by the Water Footprint

Network [WFN], a nonprofit organization that operates at the International level to standardize the calculation and use of this impact indicator. According to the protocol published in a version updated in 2011, the Water Footprint of a system is the sum of three specific components, geographically and in terms of time, and corresponds to a different impact on the environment.

<sup>8</sup> Wolf et al., 2012  
<sup>9</sup> JRC, 2009  
<sup>10</sup> Allan, 1997  
<sup>11</sup> Hoekstra et al., 2011

COMPONENTS	DESCRIPTION
 GREEN WATER	Volume of rainwater evapotranspired from the ground and cultivated vegetation
 BLUE WATER	Volume of freshwater, which originated from surface or ground water sources, used throughout the entire chain under observation that is not replenished into the basin or origin. This footprint includes both irrigation and process water consumption
 GREY WATER	Volume of polluted water originating from the production of goods and services measured as the volume of water (theoretically) required to restore water to standards of natural quality

Water Footprint components  
Source: WFN



When looking at the details of agri-food chains, the most characteristic item (but also the most complex to evaluate) is the green water component, given its close ties to local climatic conditions and species cultivated, as well as its productive yield. This component is particularly important for agricultural cultivations (it encompasses plant transpiration and other forms of evaporation).

Green water is calculated utilizing the following equation:

$$\text{Greenwater} \left[ \frac{1}{\text{Kg}} \right] = \frac{(\text{ETO}[\text{mm}] * \text{Kc} * 10)}{\text{yield} \left[ \frac{\text{t}}{\text{ha}} \right]}$$

where:

- **ETO** is dependent upon local climate characteristics;
- **Kc** is dependent upon cultivated plant species;
- **yield** is dependent on the plant species under consideration and the climate characteristics of where it is grown.

As can easily be supposed, the value of green water of a product can vary greatly both from region to region and from year to year, as much depends on the value of ETO. The availability of public databases and tools, made available by FAO<sup>12</sup>, allows simple retrieval of the necessary factors for the calculation of this contribution.

The consumption of green water per se does not contribute to water scarcity. Until it becomes blue water, green water does not contribute to

environmental flows which are needed for the health of freshwater ecosystems, nor is it accessible for other human uses. Green water is only accessible through occupation of land. Indeed, green water is only one of the many resources acquired through land occupation, therefore it is argued that the consumption of green water in agri-food product life cycles would be better considered in the context of the land use impact category.

The blue water component represents surface and groundwater and it is mainly utilised in agri-food production as irrigation water in farming and process water in factories. Water for irrigation and industrial production compete directly with water for domestic use.

Lastly, the evaluation of the gray water component takes into account both the characteristics of water released from the system, as well as the natural conditions of the receiving body in which it is released. With regard to crops, factors that should be considered include the amount of fertiliser used, the fraction that actually leaches into the soil, and the yield of the crop, in addition to the maximum concentration admissible by law and the natural concentration, which in some cases may be set to zero.

The formula to calculate the volume of grey water is:

$$\text{Greywater} \left[ \frac{1}{\text{Kg}} \right] = \frac{(\alpha [\%] * \text{AR} \left[ \frac{\text{Kg}}{\text{ha}} \right])}{\text{yield} \left[ \frac{\text{Kg}}{\text{ha}} \right] \cdot \frac{c_{\text{max}} - c_{\text{nat}}}{c_{\text{max}}}}$$

where:

- **$\alpha$  [%]** is the fraction of fertilizer subject to leaching percolating in the subsoil;
- **$\text{AR} \left[ \frac{\text{Kg}}{\text{ha}} \right]$**  is the quantity of fertilizer used to fertilize that crop;
- **$c_{\text{max}}$**  is the maximum concentration of acceptable water as pursuant to the law in force in the area;
- **$c_{\text{nat}}$**  is the concentration of that contaminant naturally present in the area (this number is set cautiously equal to zero if the data is unavailable);
- **yield** depends on the plant species cultivated and the climate characteristics of the area.

Gray water calculation method is imperfect, as a litre of water extracted directly from a resource is not physically or conceptually the same as a litre of water assimilating an emission. Nevertheless, it is considered beneficial to include the gray water calculation rather than completely neglect the impacts of water quality degradation. In the context of a life cycle assessment, emissions to freshwater would normally be considered under other impact categories (eutrophication, acidification, and ecotoxicity).

<sup>12</sup> FAO, 2015



### Accountable elements

As a water consumption indicator, the water footprint differs from simple water consumption in three parameters:

- It does not consider the amount of water consumed, but accounts for the water that does not return to the same source from which it was drawn;
- It is not a mere water consumption indication, but also accounts for the volumes absorbed by the product and those polluted during the production process;
- It does not only account for direct water consumption, but also considers that used indirectly.

The water footprint, thus, offers a broader and better vision of water consumption by a consumer or producer. However, it does not measure how conspicuous water consumption truly is, nor does it measure localized pollution.

Local environmental impact due to a given consumption and successive water pollution depends on the vulnerability of the local water system; in other words, it varies depending on the number of users that rely on a water source, thus causing pollution.

## WATER FOOTPRINT: AN EVOLVING INDICATOR TO ASSESS LOCAL ENVIRONMENTAL IMPACTS

The concept of Virtual Water Content was introduced for the first time by Professor Tony Allan in 1997. Since then, its communication to the general public has played a crucial role in raising public awareness about an issue which is sometimes forgotten: the importance of the protection of water resources, its important role in food production,<sup>13</sup> and the impact of food choices each of us can make.

As with all kinds of indicators, it is important both to appreciate its advantages and be aware of its limits, especially when dealing with communication activities. Its strength is that it is measured in litres of water; hence it is a very intuitive indicator: everyone can easily imagine what corresponds to one, ten, or one hundred litres of water.

The main limitation is that it does not provide, by itself, any information on local effects.

It is easy to understand that the same amount of water taken from an area where this resource is abundant (for example, from a large river) will cause a lower impact than in an area where there is water scarcity (for example, in a desert area).

Similarly, it is important to distinguish the “colour”, which represents the source of the water used, specifying whether it is rain water (green) or ground water (blue). The distinction

is important because the impact of a crop grown in a place where no watering is needed (as rainwater is sufficient) is definitely lower than that of a crop which needs to be watered (and thus requires a significant amount of groundwater). The local impact will also be different in this case. The scientific debate is evolving towards a greater understanding of the impacts of water use. Newly developed concepts are the water footprint caps of water basins, water footprint benchmarks of products, and fair water water footprint of communities<sup>14</sup>. For this reason, ISO 14046<sup>15</sup>, approved in 2014, proposed a new methodology for assessing the Water Footprint that considers not only water use, but also the potential environmental impacts associated with the local consumption (taking into account, for example, the possibility of setting a maximum withdrawal limit according to the source in which the withdrawal occurs).

<sup>13</sup> The main contributions come from Hoekstra and Mekonnen, founders of the Water Footprint Network. In 2012 they estimated that the agri-food system is responsible for 92% of the global water footprint (understood as virtual water content). [Reference: Mekonnen; Hoekstra, 2012; Hoekstra, 2014]

<sup>14</sup> Hoekstra, 2014

<sup>15</sup> The Standard was published on 01/08/2014



## ECOLOGICAL FOOTPRINT



The Ecological Footprint is an indicator used to represent the environmental impact of a production process, quantifying the total area of land and aquatic ecosystems

necessary to provide all the resources consumed in a sustainable manner and absorb, again in a sustainable manner, all emissions produced<sup>16</sup>. The indicator was introduced by William Rees, an ecologist at the University of British Columbia in Canada, and his colleague Mathis Wackernagel<sup>17</sup>, the

current director of the Global Footprint Network [GFN], which aims to promote the dissemination of this instrument and coordinate its standardization. Looking at the technical details, the Ecological Footprint represents the impact of the system studied by dividing the sum value of land occupied, based on the purpose for said occupation. In essence, the calculation protocol identifies six components that are added after a standardization process that takes into account the different productivity of these lands. Though the indicator accounts for different types of territory, the parameters of forest and built-up land can usually be deemed negligible, considering that the first regards timber, which does not enter

the food chain, and the second refers to the land required to accommodate infrastructure for industrial food processing, which is limited when compared with the amount of food produced. Hence, the Ecological Footprint is a composite indicator that measures, through conversion factors and specific equivalencies, the different ways of using environmental resources through a single unit of measure: ecologically productive hectare of surface or global hectare [gha]. To this end, coefficients called equivalence factors and yield factors were implemented, which take into account the difference in productivity with regard to the various types of land in comparison to the average global primary production of biomass in a given year. This unit is the global hectare per hectare [gha/ha]. The equivalence factors for each type of land are supplied annually by GFN<sup>18</sup>.

The power factor indicates how much the local productivity of a given type of land differs from the reported global average productivity of the same type of land. This factor is specific only for the land type for each country and also comes from the GFN<sup>19</sup>. The use of these factors is necessary to compile a sum of terms that would otherwise be inconsistent. Both these factors are based on the potential land yield established for the Global Agro-ecological Zones [GAEZ] from the International Institute for Applied Systems Analysis [IIASA] and from FAO.<sup>20</sup>

COMPONENT	DESCRIPTION
CROPLAND	Area of cultivated land necessary for the production of food and other non-edible resources of plant origin (cereals, fruit, vegetables, tobacco, cotton, etc.)
GRAZING LAND	Area required to produce food and non-edible resources of animal origin (meat, milk, wool, etc.)
FOREST	Forest areas, either cultivated or wild, that are able to generate wood based products
BUILT-UP LAND	Land occupied for the construction of roads, homes and other infrastructures
FISHING GROUND	Marine and freshwater surface area required for fisheries
ENERGY LAND - CARBON UPTAKE LAND	Forest area required to absorb the carbon dioxide produced by fossil fuel burning and power for the production of that good

Ecological Footprint components  
 Source: GFN 2014

<sup>16</sup> Global Footprint Network, 2010

<sup>17</sup> Wackernagel & Rees, 1996

<sup>18</sup> Global Footprint Network, 2010 Footprint Basics- Methodology

<sup>19</sup> Ibidem

<sup>20</sup> FAO, 2011



The final value expressed by the indicator does not indicate the area actually occupied, but rather a virtual land required to regenerate the resources consumed and to absorb the waste generated.

The Ecological Footprint of a single consumable is determined by the formula:

$$EF = \sum_{j=1}^6 \frac{Q}{Y_L} * YF_j * EQF_j$$

Where:

- $j$  indicates the six types of land (cropland, grazing land, forest, fishing ground, built-up and energy land);
- $Q$  is the amount of product consumed, generally in tons per year;

- $Y_L$  is the local yield of the product consumed, generally in annual tons per hectare;
- $YF$  is the land yield factor  $j$ ;
- $EQF$  is the specific yield factor of the land  $j$ .

On the basis of the definition of yield factor as a ratio between national and global yields, the equation is simplified as:

$$EF = \sum_{j=1}^6 \frac{Q}{Y_w} * EQF_j$$

Where:

- $Y_w$  is the global yield of the consumable, generally expressed in annual tons per hectare.

#### Accountable elements

The calculation of the cropland component is rather general using this method, since the consumption of resources at local level cannot be evaluated; however, directly comparable results can be obtained. On one hand, exclusive use of local factors would have the advantage of reflecting the effective management of resources at a local level, employing the production yields of the area. On the other hand, this would create difficulties for the comparison of worldwide values since the units of measure accounted for are different.



\* This value is calculated in consideration of the equivalence factor (0.207 ha/tCO<sub>2</sub>) and equivalence factor relative to the Forest component (equal to 1.26 gha/ha). It must be kept in mind that for energy land calculation, only CO<sub>2</sub> emissions are accounted, excluding those of CO<sub>2</sub> equivalent.

COMPONENT	UNIT OF MEASURE	EQUIVALENCE FACTOR
CROPLAND	gha/ha	2.51
GRAZING LAND	gha/ha	0.46
FOREST	gha/ha	1.26
BUILT-UP LAND	gha/ha	2.51
FISHING GROUND	gha/ha	0.37
ENERGY LAND - CARBON UPTAKE LAND	gha/CO <sub>2</sub>	0.27*

Equivalence Factors used to calculate the Ecological Footprint  
 Source: GFN 2014





## ECOLOGICAL FOOTPRINT: SOME POINTS OF CRITICISM

The Ecological Footprint is an indicator with a solid scientific basis. This is shown by its widespread use amongst the scientific community, as well as the decision of the European Union<sup>21</sup> to invest in the development and improvement of the methodology on which it is based.

Nevertheless, the Ecological Footprint is not exempt from criticism<sup>22</sup>. In particular, it has been noted<sup>23</sup> that the basic assumptions behind the methodology for calculating the indicator result in a measure of sustainability that is not entirely correct. For example, in high and medium income countries, energy consumption has a significant impact on the calculation method (it is estimated that the influence is at least 50%), producing a fairly substantial impact on the final result. The second relevant criticism raised by Van den Bergh (2014) concerns the incompleteness of the EF in capturing relevant environmental pressure. Although the EF is an aggregate environmental indicator, it excludes certain relevant and important environmental pressures created by humans and their activities; hence, it underestimates human impact on the biosphere. For example, water pollution, emissions of toxic substances (including heavy metals), noise pollution, depletion of the ozone layer, acid rain, fragmentation of ecosystems resulting from land use and road infrastructure, and, more generally, biodiversity are

not considered.

Another problem is the aggregation of distinct environmental problems, which are weighted with arbitrary pounds. These weights do not correspond to physical or chemical logic, or to social or economic values. In other words, some inputs of the EF have equal weights, even though their environmental impacts are not identical and sometimes even different in magnitude. For example, 1 km<sup>2</sup> of road infrastructure does not have the same environmental impact as CO<sub>2</sub> emissions captured by 1 km<sup>2</sup> of forest, but they are nevertheless treated as identical<sup>24</sup>.

Finally, other authors have pointed out that the ecological footprint might be unable to capture degradation or unsustainable use of any kind, since it does not take into consideration the intensity of the resource use (for example, it does not make any distinction between intensive and extensive land use and farming)<sup>25</sup>.

<sup>21</sup> Giljum et al., 2008

<sup>22</sup> For a more detailed discussion of this point, please refer to: Van den Bergh, et al. 2014; Giampietro & Saltelli 2014; Bloomqvist et al., 2013, Fiala 2008

<sup>23</sup> Van den Bergh, 2014

<sup>24</sup> idibem

<sup>25</sup> Bloomqvist et al., 2013, Fiala 2008



## TOXICITY INDICATORS

The evaluation of toxicity<sup>26</sup> is becoming an increasingly important topic in the study of the impacts of the life cycle of products, especially those that result from agricultural supply chains. Currently, there are various methods for calculating impacts related to toxicity; however, the method to use for each specific case study often remains dubious, especially due to the differences involved in their application. The international scientific community has started several studies aimed at providing appropriate recommendations on the various methods in order to obtain comparable results. Difficulty of data interpretation has led to the decision to disregard this indicator in the construction of the environmental pyramids, although it is still considered important to provide a brief overview of the characteristics and calculation methods of the most popular methods: Impact 2002+, Recipe 2008, and USEtox™.

### *IMPACT 2002+*

The method was developed in 2002 by the Swiss Federal Institute of Technology [EPFL] of Lausanne and has fourteen categories of impact (midpoint) grouped into four categories of damage (endpoint)<sup>27</sup>. The characterization factors for the different impact categories are based on a principle of equivalence, i.e., the scores assigned to the different substances are expressed in kilo equivalent of a reference substance. The damage factors of the substances

are obtained by multiplying the characterization factors by those relative to damage of the reference substances.

The Human Toxicity impact category is a major aspect of the innovation introduced by IMPACT 2002+, which differentiates it from previous methodologies through a new model of computation. Human toxicity responds to the need to estimate the toxicological risk and potential cumulative impacts associated with a given quantity of a substance in the environment. This bond is explained by the use of a calculation code named IMPACT 2002 (Impact Assessment of Chemical Toxics), which is able to model the risk and potential impact of thousands of chemical substances, calculating the factors at Western European level with spatial differentiations for fifty European watersheds and air cells. For Ecosystem Quality, the Terrestrial Acidification, Terrestrial Nutrification, and Land Occupation impact categories were taken from the previous Eco-indicator 99 method and their impact is determined as a fraction of potential disappearing unit (Potentially Disappeared Fraction) in a certain area and in a given time interval per kilogram of emitted substance (in  $\text{PDF} \cdot \text{m}^2 \cdot \text{yr} / \text{kg}_{\text{emission}}$ ). For ecotoxicity, assessment of damage is based on the Potentially Affected Fraction (PAF) of species integrated in time and volume, expressed in  $\text{PAF} \cdot \text{m}^3 \cdot \text{yr} / \text{kg}$ . To convert PAF into PDF, the direct extrapolation factor of 10 between the NOEC (No Observed Effect Concentration) of the PAF and the NOEC of the PDF was used. Finally, as regards Resources, the two categories of

impact are Mineral Extraction and Non-renewable Energy Consumption. The damage due to the extraction of minerals is calculated using the concept of Surplus Energy (in MJ). It is based on the assumption that the extraction of a material determines an increase of the energy requirement for each additional amount of the substance extracted from the ground in the future.

### *ReCiPe 2008*

In 2000 in Brighton, following a conference of the Society of Environmental Toxicology and Chemistry [SETAC], fifty LCA practitioners concluded that it would be important to define a method that comprises a common structure in which both midpoint and endpoint indicators are used.

This conclusion, supported by a common consensus, underpins the foundations of the ReCiPe 2008 method<sup>28</sup>, which was built on the basis of the already familiar methods Eco-indicator 99 (following the midpoint approach) and CML (based on endpoint). The ReCiPe method was created with the aim of implementing LCIA methodology that is harmonized in terms of modelling the principles and choices to be made for an assessment of any product or

<sup>26</sup> In the context of the food chain, "toxicity" implies mainly that related to pollution of the ecosystem and the threat to human health in connection with the application of pesticides during the agricultural phase

<sup>27</sup> The reference publication is: Margni et al., 2003

<sup>28</sup> The reference publication is: Goedkoop et al., 2009



activity, presenting the results in terms of midpoint level and endpoint level.

ReCiPe 2008 includes two sets of impact categories appropriately associated with the characterization factors.

The midpoint method involves eighteen impact categories and the endpoint converts the eighteen midpoint categories, aggregating them in the following categories:

1. harm to human health (HH);
2. damage to ecosystem diversity (ED);
3. damage to resources availability (RA).

Evaluations must be made on the important issue that environmental mechanisms, such as acidification, eutrophication, photochemical ozone formation, toxicity, and the use of soil and water, depend significantly on the regional conditions and various parameters that differ from region to region. The ReCiPe 2008 model has often employed European scale models of such mechanisms, searching for a proper development in order to generalize these models as widely as possible for all developed countries in the temperate regions.

Finally, we can conclude that while the midpoint indicators are quite specific in relation to the impacts they represent, the endpoint indicators are more general and represent damage estimated from impact calculations in terms of midpoint. Moreover, while the midpoint approach for the assessment of impacts presents calculations subject to a relatively

low level of uncertainty, the endpoint approach to damage calculations is subject to a higher degree of uncertainty.

#### *USEtox™*

USEtox™, an environmental model for the toxicological characterization of the impact of chemicals on humans, was developed in 2008 by a team of researchers on the initiative of the United Nations Environment Program [UNEP] in collaboration with SETAC, and has the purpose of describing the fate, exposure, and effects of chemical compounds released into the environment<sup>29</sup>.

The USEtox™ method proposes formulating guidelines for the determination of characterization factors (CF) of toxicity using a relatively simple methodology so that it can be used on a global scale for a large number of substances, while remaining a model that respects a widely-accepted scientific methodology. The method also proposes making all collected results available to all users through the creation of an information system available online<sup>30</sup>.

USEtox™ investigates two issues: human toxicity and aquatic ecotoxicity. Determining the toxicological effects of a chemical released into the environment implies the study of a relationship that links emissions to impacts through three factors: environmental fate, exposure, and effects. The result of this report is a set of characterization factors with units of measurement in cases/kg of substance released.

USEtox™ calculates ecotoxicological characterization of chemicals through an environmental fate factor (FF), an exposure factor (XF), and an effect factor (EF), which share the following relationship:

$$CF=FF*XF*EF$$

The fate factor represents the persistence of a chemical in the environment, while the exposure factor represents its bioavailability in relation to the fraction of compound that dissolves in the environment. The effect factor, however, reflects the change in the Potentially Affected Fraction (PAF), i.e., the number of species that may be affected by the change in concentration of the substance in the environmental compartment ( $PAF*m^3*kg^{-1}$ ).

With regard to the characterization factor, the toxicity of chemicals in relation to Man is calculated using the same three factors taken into consideration for ecotoxicity, according to the same formula. For human toxicity, the fate factor and the exposure factor are combined to determine the intake fraction (iF), which represents the fraction of the volume of substance released that comes into contact with the human population:

$$iF=FF*XF$$

<sup>29</sup> The reference publication is Rosenbaum et al., 2008

<sup>30</sup> Rosenbaum et al., 2008



Calculation of the impact factor (iF) considered two modes of substance intake by humans: inhalation and ingestion. The fate factor is calculated in the same way as ecotoxicity. The exposure factor, however, describes the ways in which the chemical

passes from the environment to the human body (i.e., by inhalation or ingestion). The effect factor reflects the varying probability of contracting diseases due to increases or decreases in the amount of a certain substance ingested throughout life. The USEtox™

model separately identifies the effect factor for chemicals that are carcinogens and for those which are not.





## PRODUCT & ORGANIZATION ENVIRONMENTAL FOOTPRINT

In order to communicate the environmental performance of products, including foods, companies can use different schemes and certifications in order to obtain a trademark or an environmental label. The problem is that there are too many proposals today: on the European market alone, there are more than 130 sustainability labels for food products.

This means that companies need to know how to juggle the different calculation and communication methods, which are often very different even within the EU itself. And the consumers, who may not always understand the differences between the various labels and messages, find it difficult to make choices.

To overcome these problems, in 2008 the European Commission launched a project for the creation of a European method of calculating the environmental impact of products, based on their life cycle and a large number of environmental indicators. The initiative, which is part of a broader strategy aimed at creating a single European market for “green products”, has led to the development of two methods (published in 2012) applicable in all Member States. The first relates to the environmental footprints of products (Product Environmental Footprint – PEF); the other relates to the environmental footprint of organizations (Organization Environmental Footprint – OEF).

### The methodology

The assessment methodology is based on the life-cycle assessment technique and the International Reference Life Cycle Data System (ILCD) handbook, as well as other existing standards and guidance documents. In total, 14 different impact categories are assessed. Specific rules for each products group (Product Environmental Category Rules, PCR) and for each sector (Organization Environmental Footprint Sector Rules) must be developed.

A very important and innovative concept is the development of a reference product in each product group. This reference product, which does not need to exist in the market, carries the median impact scores of the product group. Once identified, the reference product can be used by companies as a benchmark when communicating the impacts of their product.

### The Pilots

In 2013, a pilot phase was launched, involving some companies in the food sector, with the following objectives:

- a) to test the process for developing product- and sector-specific rules (PEFCR and OEFCR);
- b) to make the application of the method simple and accessible to all businesses;
- c) to identify the most effective communication

vehicle for communicating results.

The ongoing pilot project will culminate in testing of the tools for communicating the environmental footprint of both the product and the organization to business partners, consumers and other company stakeholders.

The complete list of the food categories involved in the pilot phase is available at the website <http://ec.europa.eu/environment/eusds/smgp/>

#### FOOD PRODUCTS INCLUDED IN THE PILOT TEST

BOTTLED WATER

BEER

COFFEE

BEEF, PORK, AND MUTTON

PET FOOD

FEED FOR LIVESTOCK

OLIVE OIL

PASTA

FISH AND SEAFOOD PRODUCTS

DAIRY PRODUCTS

WINE







# THE FOOD CHAIN AND THE ENVIRONMENT



## THE FOOD SUPPLY CHAIN

### AGRICULTURAL TECHNIQUES

- 🌿 Cultivation techniques
- 🌿 Organic farming
- 🌿 Seasonality

### TRANSPORT

### THE COLD CHAIN

- 🌿 The importance of the cold chain in food preparation
- 🌿 Cold chain: phases and plants
- 🌿 Domestic refrigerators and transportation
- 🌿 Calculation of the impact for the storage of different food products

### FOOD COOKING TECHNIQUES

- 🌿 Energy consumption and relative emissions during cooking
- 🌿 Household cooking
- 🌿 Professional cooking





## THE FOOD CHAIN AND THE ENVIRONMENT

*Food consumption is affected not only by the production phase in terms of impact but also by issues of transport, storage at low temperatures, and cooking. The Environmental Pyramid was built according to the LCA methodology, taking into account all the environmental impacts generated by different food products throughout their entire life cycle, from farm to fork. This chapter sets out to present the scientific underpinning of the Environmental Pyramid model, analyzing each phase of the food chain, their characteristics, and main environmental impacts. The agricultural phase is often the link in the*

*supply chain which causes the highest burden in terms of impact. This chapter details the importance of cultivation techniques, with a focus on organic farming. It is important to remember that, along with cultivation methods, seasonality can also significantly influence the environmental impact of different food products.*

*As for the impact of transport and the cold chain, these factors were omitted in developing the Environmental Pyramids despite being relevant to certain foods. These issues have, however, been thoroughly analyzed and this paper will provide the most important data*

*regarding some estimates of environmental impacts of storage at low temperature and transport of food according to distance. Finally, the paper presents assumptions made and adopted to calculate the impacts related to cooking.*

*Numerous variables are linked to food production and are quite difficult to fully calculate; however, a brief explanation of the main variables can help in assessing their significance and contribution to the impact of the final product.*



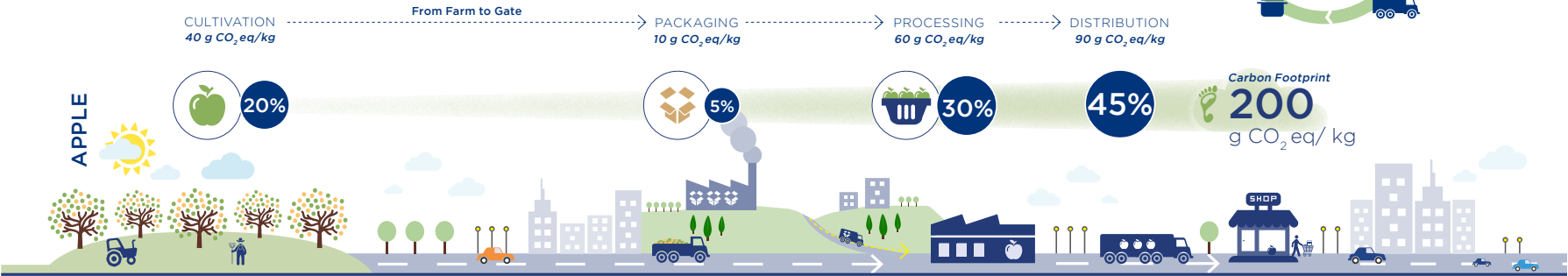
# THE FOOD CHAIN AND THE ENVIRONMENT

## The Life Cycle Assessment of Apples, Pasta and Red Meat

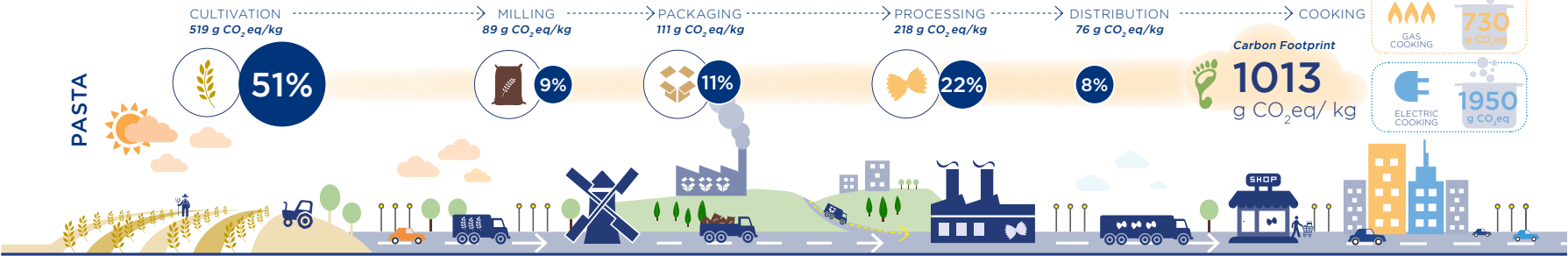
For these three foods the CO<sub>2</sub> emissions of the specified supply chain are shown both with an absolute value per kg of product and the percentage relative to the single stage of the life cycle. Where required, an estimate of the impact due to cooking is also given.



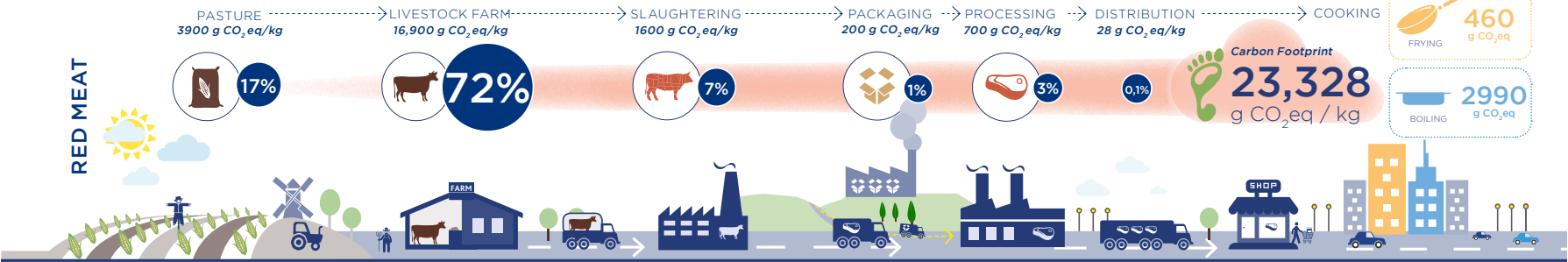
Source: EPD Assomela S-P-00369, 2015



Source: EPD Pasta Barilla S-P-00217, 2014



Source: EPD Carne di Bovino Adulto COOP S-P-00495, 2015



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## THE FOOD SUPPLY CHAIN

The food supply chain has a complex structure that can be summarized in seven steps, which are associated with specific environmental impacts that vary according to the characteristics and efficiency of the system.

## AGRICULTURAL TECHNIQUES

Food production generally involves a fairly complex supply chain that brings together very different activities, from farming to the industrial processes (which in some cases complete the preparation of food before putting it in distribution chains).

Analysis of the environmental impacts of the entire supply chain shows that the most important steps are in fact those associated with agricultural operations. Therefore, the agricultural techniques adopted for land cultivation are relevant: from the quality and safety of food products, to the environmental aspects generated.

In this context, many different aspects are involved that require thorough analysis. This chapter analyzes some of the main aspects concerning cultivation techniques, organic farming, and seasonal products.

## THE SEVEN PHASES OF THE AGRI-FOOD CHAIN



### CULTIVATION OF RAW MATERIAL

The agricultural phase is the stage in which the raw materials to be used for human consumption or as fodder for farm animals are produced. Several factors are responsible for the impacts of this phase, including: seed production, the use of fertilizers (both natural and chemical) and pesticides for protecting the crops, diesel oil used for agricultural practices, and the water used for irrigation.

The agricultural phase is usually the link in the chain that creates the most impacts. Cultivation techniques may substantially influence the impact of the agricultural phase, although in many cases the benefit is not immediately apparent. Typical examples are crop rotation and organic farming, which, if carried out correctly, reap great benefits over the years.



### FIRST TRANSFORMATION

Many agricultural raw materials must be transformed before they can be used in a production process. A classic example is grain cereals, which must be ground in a mill before use.



### PRODUCT PROCESSING

In the second stage of the production chain, the raw material is transported to a factory where it is transformed into the finished product. In this phase, the impacts are caused by the factory's consumption of energy and water, and vary according to the type and volume of the treated product, as well as the efficiency of the production line. Consumption includes both the energy used to operate the production lines and the energy required for refrigeration.



### PRODUCT PACKAGING

Many types of materials are used for packaging finished products. The most common materials are paper, plastic, and glass. The environmental impact of packaging is usually caused by the production phase (quantity and type) and the disposal of waste, while the impact of the actual packaging itself is low.



### TRANSPORT AND DISTRIBUTION

At this stage of the food chain, the product is transported from the processing plant to the distribution point and retail outlets, creating impacts linked to the means of transport used and the distance covered. However, the impact caused by transportation is generally far less than the impact caused by the production phase, and is only notable for low-impact foods such as vegetables and fruit when they are transported over long distances or with high-impact means of transport, as in the case of airfreight.



### COOKING

Assessing the impacts associated with the preparation of a food product is particularly complex as various cooking techniques can be used, all involving different levels of environmental impact. The techniques used for the preparation of dishes vary according to the recipe, the consumer's taste, and whether the meal is cooked at home or in a commercial kitchen.



### DISPOSAL OF PACKAGING

The waste produced by packaging is an integral part of the supply chain of food production; therefore, it is important to correctly assess its impact. It is particularly difficult to evaluate the disposal of end-of-life packaging since it must account for the amount and type of material contained in the product, as well as the behaviour of the final consumer and the possible methods of disposal. The three methods of packaging disposal are: recycling, energy recovery, or landfilling.



## Cultivation techniques

The practices implemented by farmers to cultivate raw materials include agricultural (or agronomic) techniques that may have a high impact on the environment: for example, the use of fertilizers or diesel fuel for machinery. With regard to fertilizers, it is known that the use of nitrogen-based fertilizers causes the release of nitrous oxide (N<sub>2</sub>O),<sup>1</sup> which has an emission factor equal to 265 grams of CO<sub>2</sub> equivalent per gram of substance emitted<sup>2</sup>. These conditions, combined with the need to increase awareness and commitment to improving the environmental performance of production systems, have led researchers to undertake studies on agronomic activities aimed at maintaining high quality standards of products and at preserving both farm income and the environment. These studies<sup>3</sup> shed light on the fact that agriculture comprises closely correlated, complex systems, which require strategic decisions that must be made with ample margins of time. The crop sown in one season, for example, substantially affects what is to follow and, in turn, is influenced by what has gone before in terms of nutrients (fertilizers) both in regards to crop protection and weed control, which are necessary to maintain quality and safety of products obtained.<sup>4</sup> An example of these studies comes from a path laid down by Barilla, following the results of analysis of the environmental impacts of pasta in relation to the Carbon, Water, and Ecological Footprints: even such a simple product clearly makes an impact contribution from its agricultural phase.

In this context, Barilla started a project, Barilla Sustainable Farming, to promote more efficient cropping systems in order to obtain safe and high-quality agricultural products whilst protecting and improving the environment and the social and economic conditions of farmers.

The first part of the project was focused on identifying potential improvements in the most diffused cropping systems for the cultivation of durum wheat in Italy, while maintaining high levels

of quality and food safety standards. Results show that a more efficient input management and correct agronomic practices are environmentally friendly (up to -30% GHG) and economically advantageous for farmers (up to +30% of income).

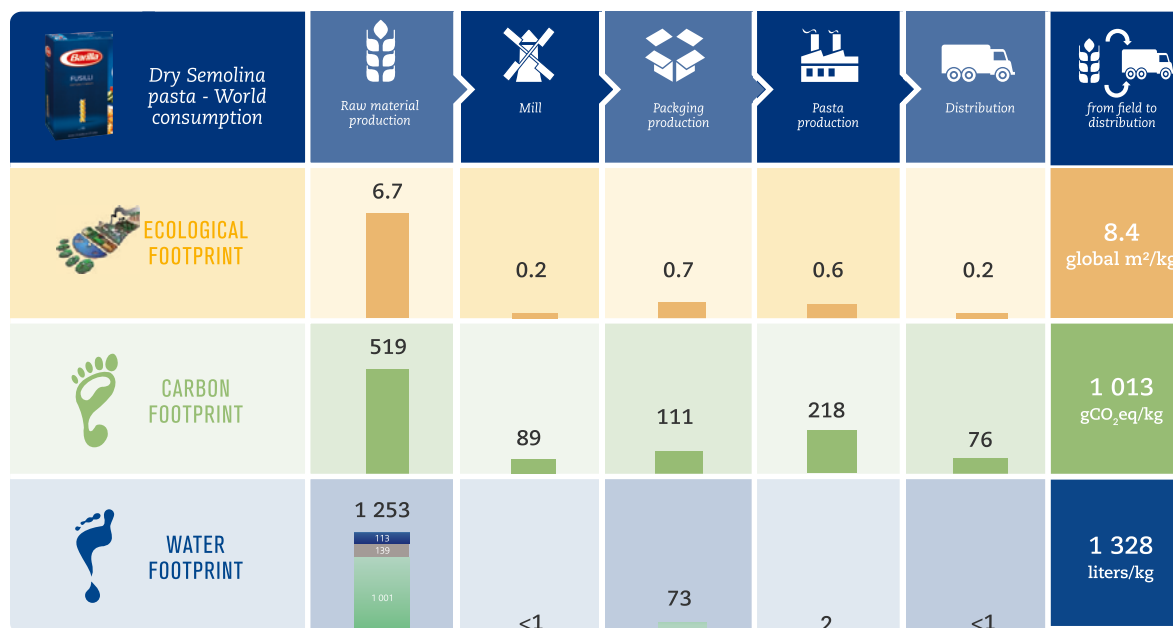
<sup>1</sup> IPCC, 2006.

<sup>2</sup> IPCC, 2013

<sup>3</sup> Ruini et al. 2013

<sup>4</sup> Tilman, et al. 2002

<sup>5</sup> The data represents the Barilla pasta global average



Footprints in the life cycle of durum wheat semolina pasta<sup>5</sup>

Source: Barilla. EPD S-P-00217, 2014



In a second phase, Barilla gave 25 farmers a Decalogue and a decision support system (DSS) called *granoduro.net*, to help them in reducing production costs and environmental impacts. Results, over two years of monitoring, show that merely adopting the DSS contributes to reducing the carbon footprint (-10%), and costs for pesticides and fertilizers (-10%).



Barilla is now signing contracts with farmers for the large-scale cultivation of durum wheat according to the sustainability criteria identified. In the first year, the target of 70,000 t was reached but the aim is to increase this amount, year by year.

At the same time, Barilla is fostering the integration of different supply chains. For the cultivation of

sustainable durum wheat, one of the most important techniques is the management of rotation cycles. To help farmers in planning multiyear sustainable cultivation systems, Barilla has projects under way with other groups or organizations that apply similar criteria to achieve sustainable cultivations, guaranteeing commercial possibilities for all the crops in the rotation cycle.

### Organic farming

Organic farming is a way of producing food that respects the agro-ecosystem while attempting to keep intact and exploit the natural fertility of the

soil, promote biodiversity of the system in which it operates, and limit or completely exclude synthetic products and Genetically Modified Organisms (GMOs). This technique differs from conventional farming in the limited use of auxiliary energy from chemical processes, and promotes the use of additives which are mostly in the form of organic substances.

Organic agricultural methods are internationally regulated by many nations, based in large part on the standards set by the International Federation of Organic Agriculture Movements (IFOAM), an international umbrella organization for organic farming entities established in 1972. The original definition of “organic farming” given by IFOAM is: “A production system that sustains the health of soils, ecosystems and people. It relies on ecological processes, biodiversity and cycles adapted to local conditions, rather than the use of inputs with adverse effects. Organic Agriculture combines tradition, innovation and science to benefit the shared environment and promote fair relationships and a good quality of life for all involved”.<sup>6</sup>

Organic production shall pursue the following objectives<sup>7</sup>:

- Create a sustainable management system for agriculture that respects the natural systems and cycles in order to maintain and improve the characteristics of the soil, water quality, plant growth, and animal welfare; a system which contributes to a high level of biodiversity, and

which makes responsible use of energy and natural resources such as water, soil, organic matter, and air, while respecting the strict criteria relating to animal welfare and meeting, in particular, the specific behavioural needs in relation to animal species in question;

- Aim at producing high-quality products;
- Aim at producing a wide variety of foods and other agricultural products that satisfy the demands of consumers who prefer products made with processes that do not harm the environment, human health, plant health, or the health and welfare of animals.

The principles underlying organic farming are:

- The methods used for designing and managing biological processes based on ecological systems using natural resources present within the system, must use living organisms and mechanical production methods, and practice crop cultivation and livestock production related to land or aquaculture practices that respect the principle of sustainable exploitation of fisheries and reject the use of GMOs;
- The use of chemical products must be rigorously restricted and adopted only in exceptional cases, where appropriate management practices are not

<sup>6</sup> IFOAM. Organic Agriculture definition

<sup>7</sup> For further information, please refer to the specific section of the European Commission - Agriculture and Rural Development



possible, or where the use of natural products or fertilizers of low solubility represent higher impact options.

Companies operating in organic farming should rely on renewable energy resources. Waste and by-products of plant and animal origin should be recycled to produce organic matter that will help improve the soil characteristics, returning nutrients to the land. Organic plant production should contribute to maintaining and enhancing the natural fertility of the soil and preventing soil erosion. Damage by diseases, pests, and parasites is prevented through protection from natural enemies, choice of species and varieties, and appropriate cultivation techniques.

### Organic labelling

Most countries have established a regulatory framework that defines the principles and requirements of organic farming and produce, in order to clearly identify what is “organic” and how a product can be labelled as such. The main purpose of the labelling regime for organic products is to ensure that products which are labelled as organic have been produced according to set requirements or their equivalent, thereby protecting both consumers and produce from food fraud. National legislation usually regulates the use of the word “organic” and associated terms.

In Europe, for example, organic farming and production has been regulated since 1991. Today,

the European requirements for organic production are set by Council Regulation (EC) No. 834/2007 defining the official EU aims, objectives, and principles of organic farming and production, and by two implementing regulations (No. 889/2008 and No. 1235/2008) detailing the rules on organic production, labelling, and imports. All products labelled as organic and sold in the EU must be produced in accordance with these regulations. According to the regulation, foods may be labelled “organic” only if at least 95% of their agricultural ingredients meet the necessary standards. The legislation also prohibits terms or practices in labelling and advertising that are liable to mislead consumers, such as “bio” or “eco”<sup>8</sup>.

In the United States, organic farming is regulated



EU logo for organic farming. On the left, the old logo used until July 2010; on the right, the current logo

by federal legislation under the framework of the National Organic Program (NOP). The NOP defines three levels of organic foods:<sup>9</sup> products made entirely with certified organic ingredients and methods can be labelled “100% organic”, while products with at least 95% organic ingredients may be labelled

“organic”. A third category, containing a minimum of 75% organic ingredients, can be labelled “made with organic ingredients.”<sup>9</sup>



USDA logo for organic farming

In Canada, the Philippines, and South Africa, multi-ingredient products with at least 95% organic ingredients may be labelled as organic, whereas multi-ingredient products with 70–95% organic ingredients can only be labelled with the statement “made with organic ingredients”. Products with less than 70% organic ingredients may only make reference in the ingredients list to “ingredients that are organic”<sup>10</sup>.

<sup>8</sup> [http://ec.europa.eu/agriculture/organic/index\\_en.htm](http://ec.europa.eu/agriculture/organic/index_en.htm)

<sup>9</sup> FAO, 2012. Organic agriculture and the law

<sup>10</sup> Ibidem



### The impact of organic farming

Recently, a growing number of life cycle assessment (LCA) studies have compared the environmental impacts of the same products produced in organic vs. conventional agriculture.<sup>11</sup> Most of these studies show that organically produced products cause a lower environmental burden on a per-area basis, but they might have higher impacts when evaluating emissions per product unit, since organic farming is usually associated with lower yields.<sup>12</sup> Nevertheless, it is important to state that the indicators adopted for the construction of the Double Pyramid (and, more generally, the LCA methodology) might be inaccurate in comparing the environmental impacts of organic farming. These indicators do not allow comprehensive quantification of the benefits of organic practices since the impact values, although lower, are spread over productions with lower yields than those obtained using intensive methods. On the other hand, the environmental benefits associated with organic practices are enhanced when using indicators of their agronomic practices such as measurement of soil fertility, especially if evaluated over a period of ten years.

### Seasonality

The seasonality of agricultural products is important both for qualitative and environmental aspects because “off-season” cultivation yields lower production and, in some cases, additional energy

resources may be required, thereby increasing the footprint.

If we consider a very simple case, such as salad, we can observe that, depending on whether one is in a greater or lesser period of production, the yield can range from 41 to 33 tons of product per hectare. Estimating that the cultivation of a one-hectare field requires a constant fuel consumption equal to about 300 liters (about 900 kg of CO<sub>2</sub> equivalent), the carbon footprint due to fuel consumption per ton of salad rises from 22 to 27 (20%) kg CO<sub>2</sub>. Of course, all the other environmental aspects involved must then be factored in (fertilizers, water, chemicals).

To increase consumer awareness and to help them

choose foods respecting the rhythms of the seasons, so-called seasonal calendars have gained increasing popularity. These calendars quickly and intuitively show what to eat, month by month, to elicit the most nutritional value and flavour from foods while spending less due to their seasonality. One of these, available online, was produced as part of the Seasonably Eat campaign, supported by the UK Department for Environment, Food and Agriculture<sup>13</sup>.

<sup>11</sup> Meier et al. 2015

<sup>12</sup> Meier et al., 2015

<sup>13</sup> DEFRA

#### THE EAT SEASONABLY CALENDAR

EVERY FRUIT OR VEGETABLE HAS ITS SEASON. THE TIME OF THE YEAR WHEN YOU CAN GROW IT AT ITS VERY BEST. THIS SIMPLE TOOL WILL GUIDE YOU THROUGH WHAT'S IN SEASON WHEN SO YOU CAN ENJOY THE BEST AND THE MOST NUTRITIOUS, TASTIER AND CHEAPER.

APRIL	BRUSSELS SPROUTS	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR
MAY	ASPARAGUS	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY
JUN	BROAD BEANS	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN
JUL	CUCUMBERS	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL
AUG	BRUSSELS SPROUTS	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG
SEP	CARROTS	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
OCT	CARROTS	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT
NOV	CARROTS	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV
DEC	CARROTS	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
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FEB	CARROTS	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB
MAR	CARROTS	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR
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AUG	CARROTS	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG
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FEB	CARROTS	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB
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SEP	CARROTS	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
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DEC	CARROTS	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
JAN	CARROTS	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN
FEB	CARROTS	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB
MAR	CARROTS	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR
APR	CARROTS	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR
MAY	CARROTS	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY
JUN	CARROTS	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN
JUL	CARROTS	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL
AUG	CARROTS	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG
SEP	CARROTS	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
OCT	CARROTS	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT
NOV	CARROTS	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV
DEC	CARROTS	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
JAN	CARROTS	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN
FEB	CARROTS	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB
MAR	CARROTS	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR
APR	CARROTS	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR
MAY	CARROTS	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY
JUN	CARROTS	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN
JUL	CARROTS	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL
AUG	CARROTS	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG
SEP	CARROTS	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
OCT	CARROTS	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT
NOV	CARROTS	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV
DEC	CARROTS	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
JAN	CARROTS	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN
FEB	CARROTS	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB
MAR	CARROTS	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR
APR	CARROTS	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR
MAY	CARROTS	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY
JUN	CARROTS	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN
JUL	CARROTS	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL
AUG	CARROTS	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG
SEP	CARROTS	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
OCT	CARROTS	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT
NOV	CARROTS	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV
DEC	CARROTS	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
JAN	CARROTS	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN
FEB	CARROTS	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB
MAR	CARROTS	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR
APR	CARROTS	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR
MAY	CARROTS	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY
JUN	CARROTS	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN
JUL	CARROTS	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL
AUG	CARROTS	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG
SEP	CARROTS	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
OCT	CARROTS	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT
NOV	CARROTS	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV
DEC	CARROTS	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
JAN	CARROTS	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN
FEB	CARROTS	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB
MAR	CARROTS	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR
APR	CARROTS	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR
MAY	CARROTS	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY
JUN	CARROTS	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN
JUL	CARROTS	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL
AUG	CARROTS	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG
SEP	CARROTS	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
OCT	CARROTS	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT
NOV	CARROTS	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV
DEC	CARROTS	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
JAN	CARROTS	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN
FEB	CARROTS	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB
MAR	CARROTS	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR
APR	CARROTS	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR
MAY	CARROTS	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY
JUN	CARROTS	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN
JUL	CARROTS	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL
AUG	CARROTS	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG
SEP	CARROTS	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
OCT	CARROTS	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT
NOV	CARROTS	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV
DEC	CARROTS	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
JAN	CARROTS	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN
FEB	CARROTS	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB
MAR	CARROTS	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR
APR	CARROTS	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR
MAY	CARROTS	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY
JUN	CARROTS	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN
JUL	CARROTS	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL

TRANSPORT

The question of food distribution is interesting both for the social aspects related to the protection of local communities and traditions, and for its environmental issues (given that the popularity of the zero km food concept is on the rise). This concept is associated with the simplistic equation “zero km product = product with a low environmental impact”. Leaving aside the social aspect of the discussion, this paper aims to analyze in greater depth the environmental aspects related to the distribution of food. Adopting ‘intended use’ as an analytical approach, albeit in a preliminary manner, is always relevant to life cycle analysis, in order to link environmental issues concerning transport to the production of raw materials. Again, the analysis is

limited to the study of the carbon footprint, which is still considered sufficiently representative to measure the transport impact on a global scale. Taking examples similar to those presented in the previous edition of the paper<sup>14</sup>, a set of analyses on the transport impacts for different foods are shown below: fruit, milk, and meat. The figures presented make it clear that transport plays a major role only for those foods which have a low impact, and only when exceeding a certain distance. However, air transport is a case unto itself. This phenomenon is explained by the fact that although the use of a truck involves high emissions of CO<sub>2</sub> per kilometre, it is also true that the amount of goods transported is high and, thus, the impact per kg of product is actually quite low. The data used for calculating the impacts of transport originate from

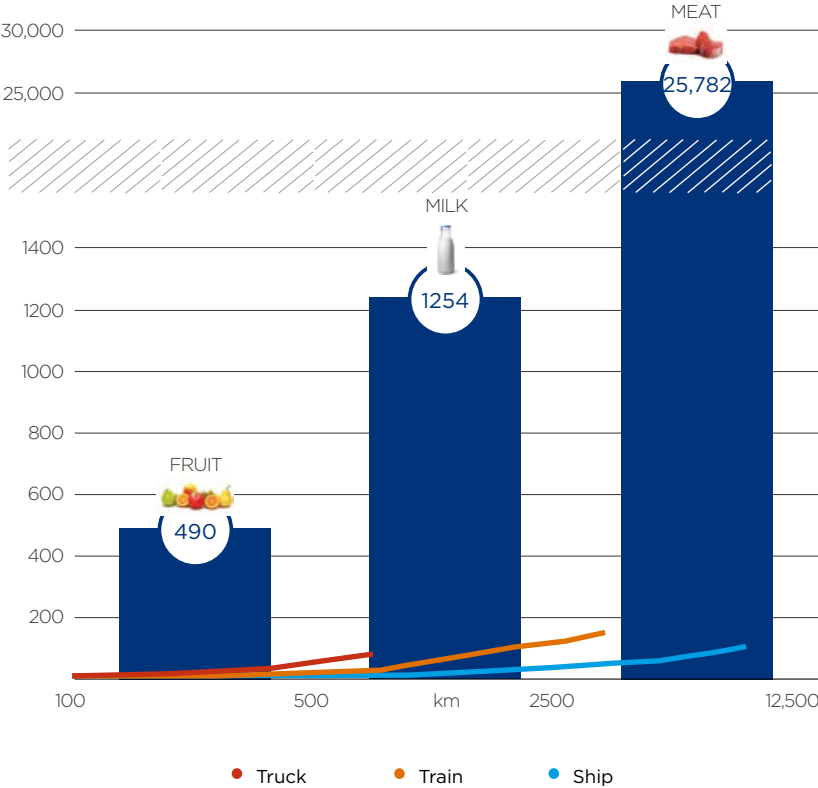
the EcolInvent database<sup>15</sup> and are presented in terms of CO<sub>2</sub> equivalent per km per ton transported. These considerations show that “local” products are not necessarily characterized by a lower environmental impact than those from industrial farming, because the production phase (with its higher environmental impact) is not necessarily more efficient and therefore characterized by minor impacts.

<sup>14</sup> BCFN, 2015  
<sup>15</sup> EcolInvent V31, 2015

MEANS OF TRANSPORT	g CO <sub>2</sub> /tkm	HYPOTHESIS
Truck	82	The emissions at stake were calculated on the basis of the database relative to a 32 ton vehicle (EURO 4) that ships a freight of 70% transport capacity and accounting for a one-way route
Train	29	European average for freight trains; includes electrical and diesel train
Plane	1040	Intercontinental flight
Ship	9	Trans-oceanic transport

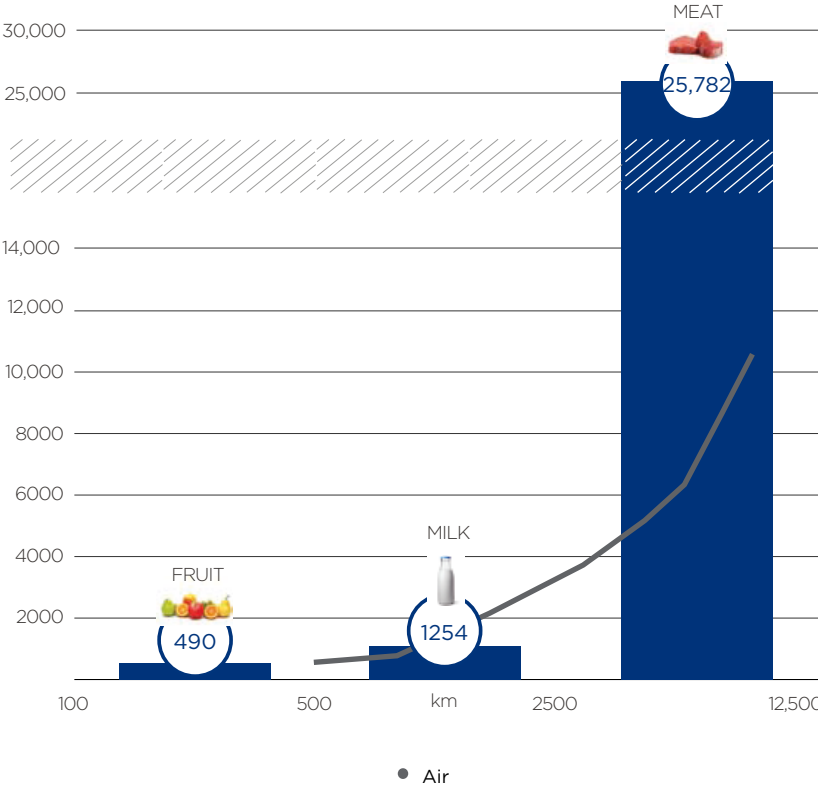
Hypotheses used for the calculation of CO<sub>2</sub> equivalent associated with transport  
Source: EcolInvent database V31, 2015





Transport by truck, train or ship. Emissions of CO<sub>2</sub> equivalent for the transport phase is always much lower than those related to the production phase, with the exception of fruit, where long-distance transport (5 or 10 thousand kilometers) will result in a significant increase on overall impact

Source: BCFN, 2016



Transport by plane: in most cases, if food is transported by air this entry represents the highest level of emissions from the entire supply chain. The exception is red meat production, where the production impact represents a significant value in terms of GHG emission

Source: BCFN, 2016



## THE COLD CHAIN

The term “cold chain” refers to the processes aimed at keeping a product at low temperatures, from only a few degrees centigrade down to 20 or 30 below zero, from production until consumption. The estimate of the impacts generated by this phase, essentially linked to the consumption of energy and therefore likely to influence the carbon footprint and – in part – the ecological footprint, is in truth rather complex because it depends on numerous factors.

The most important of these are:

- The temperature at which the product is stored;
- The distance between the product production site and the place of product consumption, as well as the means of transport;
- The time that elapses between preparation and consumption;
- The type of technologies used in the cold chain;
- System operating modes, with particular regard to defrosting cycles that must perform efficiently in order to avoid reduced performance.

The aim of this chapter is to further detail the preliminary information provided in the first edition of the Double Pyramid<sup>16</sup>. In this case again, information was taken from the public databases available and at times is supported by simple processing.

## The importance of the cold chain in food preparation

Most food requires particular conditions in order to be preserved without undergoing irreversible deterioration. Different techniques to allow deferred consumption of food have been developed throughout history: for example dehydration, lyophilization (freeze-drying), use of the cold, canning, heat, and vacuum sealing. This chapter wishes to further examine one of these methods – cold storage – and assess the impacts that it can generate on the environment.

When speaking about the preservation of perishable food, an approach that analyzes the entire lifecycle of the food itself, i.e., from the production of raw materials to the end consumption, is of fundamental importance. The sequence of measures designed to ensure the preservation of perishable food at low temperatures is called the cold chain. This differs depending on the food product and indicates the mandatory path that perishable food must follow until it reaches final consumption under initial quality standards.

### *Why the cold to preserve food*

Food in nature is constantly changing and altering its state, giving rise to processes of mold and rot. The culprits of these processes are microorganisms (yeasts, molds, or bacteria, some pathogens), oxygen, water, light, and heat. The use of the cold in order to avoid the above-mentioned processes is part

of the so-called physical methods of storage. This method of preservation is based on the ability of the cold to interfere with the vital functions of the microorganisms and enzymes present in food. The cold slows down degradation reactions until these have completely subsided, thus extending the life of the product.

There are basically three methods for preserving food at low temperatures:

- **Refrigeration** consists of lowering the temperature of food to a range that varies between about -1°C and 12°C. This type of storage can be considered as a short-term option for highly perishable products such as meat and fish, while plant-based products can be preserved for several months. Refrigeration does not alter the nutritional value of the food and only slows down deterioration;
- **Freezing** consists of bringing food to temperatures below the crystallization temperature of the water. There are two cases: slow freezing and quick freezing (deep-freezing). Slow freezing consists of solidifying the water inside the food, regardless of how long it takes. This causes the formation of very large crystals which rupture cell membranes. Upon thawing, the food loses intracellular fluids, vitamins, and minerals, resulting in a significant loss of nutritional value, as well as a loss of flavour and texture. For this reason, simple freezing is of no

<sup>16</sup> BCFN, 2010



industrial interest;

- **Deep-freezing**, on the other hand, consists of the sudden lowering of temperatures (-30°C, -50°C) with stabilization at -18°C. Bacteria, molds, and yeasts cannot grow at this temperature. The rapid solidification of the water, occurring as microcrystals that do not break any membranes, prevents the leakage of intracellular fluid upon thawing. The food, once thawed, regains the original appearance and taste it had when fresh, with no alteration in nutritional value. A study<sup>17</sup> conducted by the British Frozen Food Federation (BFFF) has shown that there are no statistically significant differences between the taste of fresh and frozen foods, with the exception of blueberries. This is why deep-freezing is the method used industrially for the long-term storage of perishables.

#### *Fresh and frozen food market*

Today, the global market of fresh and frozen products represents a fundamental share of the entire food market. Though refrigeration is an excellent method for the deferred consumption of perishable products, food freezing and its market - with regard to the peculiarities of this kind of product - has undergone major and continuous evolution. This has been dictated primarily by the need for greater safety and convenience of this type of preservation. In Italy, as in the rest of the world, the market for frozen products is growing and is subject to continuous development concerning both processes and products. Freezing

food, in fact, is no longer only a safe and effective method of preservation, but often an actual form of food habit: the frenzy of modern life and less available time has stimulated the development of full restaurant menus that can be stored for months on end in the freezer.

In terms of revenue, the global frozen food market was valued at USD 241.72 billion in 2014 and is projected to witness a significant growth over the forecast period owing to increasingly higher standards of living, along with lifestyle shifts of people across the globe<sup>18</sup>. Instant foods, frozen foods and ready-to-eat meals have gained popularity over the forecast period, owing to the rapid consumer shifts for meals: frozen ready meals were the largest segment valued over USD 84.00 billion in 2014, and this segment is expected to register even higher figures over the next seven years on account of their convenience and time-saving attributes. A rise in the number of employed people, increasing expendable income and improved lifestyles of consumers is expected to drive demand for frozen food over the forecast period. Frozen meat products are the second largest product segment, which is expected to witness a rise owing to increasing beef consumption, especially in the Middle East and Asia Pacific. The removal of beef consumption bans in China is projected to drive market growth over the forecast period.

North America has the largest market region for the frozen food market, due to the hectic lifestyle of the population and fast utilization of the products in the region. Europe's frozen food market was valued at over USD 92 billion in 2014, and is projected to

witness moderate growth over the coming years, especially in countries such as Germany, Denmark, Spain, U.K., Italy, Switzerland, Norway and France.<sup>19</sup> In the future, Asian countries such as India and China are expected to have the fastest-growing frozen food market due to higher disposable income and increasing urban population in these regions.<sup>20</sup>

#### *Cold chain costs*

In food & drink industries, refrigeration accounts for a significant proportion of overall site energy costs. A study<sup>21</sup> published by the Carbon Trust has presented an estimate of the energy costs associated with the management of the cold chain for certain types of businesses; this elaboration shows energy costs ranging from 30% for public venues (such as pubs) up to 50% for supermarkets and hitting 90% for refrigerated storage warehouses.

The same paper provides a qualitative analysis of the effectiveness of possible actions for the improvement and reduction of impacts. Notwithstanding the fact that 50% of these reductions are achieved by establishing efficient plants, it is interesting to note that 20-25% of the savings can be attributed to simple optimization of plant management procedures, without the need to resort to substantial technological investments.

<sup>17</sup> BFFF, 2009

<sup>18</sup> GVR, 2014

<sup>19</sup> PR Newswire, 2016

<sup>20</sup> PR Newswire, 2016

<sup>21</sup> Carbon Trust, 2006.



SECTOR	TYPICAL PROPORTION OF ENERGY COSTS
COLD STORAGE	90%
FOOD SUPERMARKETS	50%
SMALL SHOPS WITH REFRIGERATED CABINETS	70% or over
PUBS AND CLUBS	30%

Estimates of energy costs for cold chain management  
 Source: BCFN elaboration

how the environmental aspects of a refrigeration system include not only those associated with the consumption of energy, but also those associated with the use of coolants. Although this paper provides an analysis of the different coolants used and their potential associated environmental impacts, in estimating the environmental impact in terms of carbon footprint, we will focus only on the “energy” aspect of the environmental impact. This paper shall not take into account the impact of atmospheric emissions related to any refrigerant gas leaks during use. As in the case of cooking, the estimate is relatively complex and is only possible by adopting assumptions on the conditions of use, mainly related to the time and amount of the stored product. In

other words, while it is relatively easy to estimate the power draw of a refrigerator for a given time of operation (e.g., kWh per day), relating the impact – for example - to one kilogram of food requires an estimate of how much food is in the fridge and the length of preservation.

Below are some examples of calculations using different equipment in the cold chain, differentiating between domestic and industrial use, and with transparent and clear assumptions in each case.

#### *Cold chain organization*

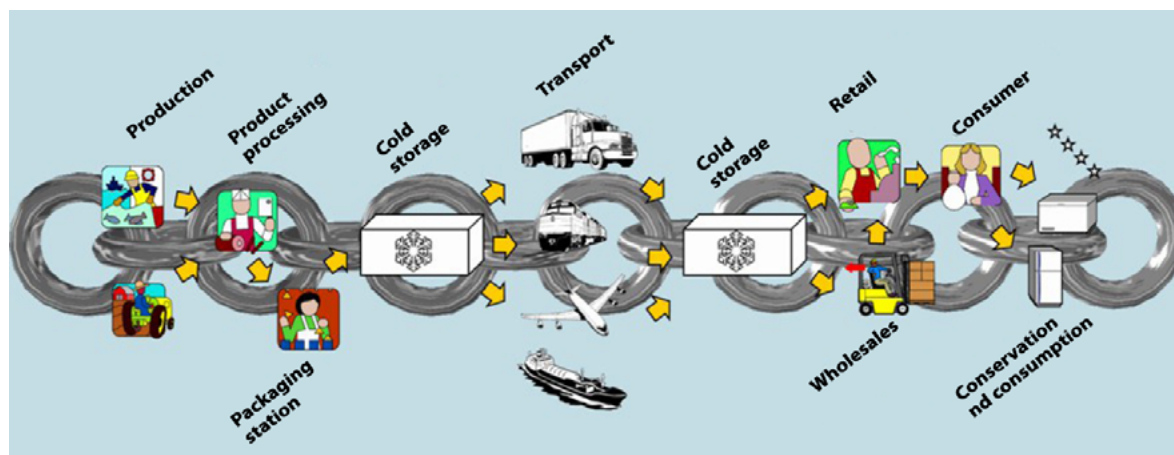
Although the cold chain varies in relation to food, it can be organized as follows:

- Initial storage of the freshly harvested product (in

One example of this management procedure could regard defrosting, which is an extremely important aspect in terms of the improvement of energy transmission efficiency. Some technologies used specifically to manage energy savings are eligible for financial incentives.

#### **Cold chain: phases and plants**

This section sets out to provide the basis for calculation of a preliminary estimate of the environmental impacts associated with the cold chain. In this regard, it is important to observe



Random cold chain diagram  
 Source: BCFN elaborations



- the case of a plant-based food);
- Processing of the product (animal or plant) in a refrigerated environment;
  - Storage in a cooled warehouse at the producer's plant;
  - Transportation from the production centres to the refrigerated warehouse;
  - Storage in refrigerated warehouse;
  - Delivery to distribution centres and sales points;
  - Conservation at sales points in special refrigerated counters and cabinets;
  - Transportation from the point of sale to the point of consumption;
  - Storage at the consumer's home in domestic refrigerators.

The main equipment used during the cold chain is:

- Static storage elements (refrigerated warehouses and storage);
- Static sales elements;
- Refrigeration systems for product processing (quick freezing machine);
- Chilled transportation elements;
- Domestic storage elements.

#### *Refrigerated warehouses and cold rooms (Static storage elements)*

A refrigerated warehouse is a prefabricated cooled structure, consisting of one or more rooms with a total volume of generally not less than 500 m<sup>3</sup>. Cold rooms have a lower value and differ from refrigerated warehouses both in their structural characteristics

and purposes. As regards the refrigerated warehouses, in addition to preliminary classifications based on temperatures (for fresh food, frozen food, for curing or maturation), it is also possible to classify them according to their use::

- Production center warehouse;
- Storage warehouse;
- Distribution center warehouse.

The production centre warehouses receive the goods produced by the primary production centres and ensure their storage for a highly variable period of time, which can range from a few days up to a few months.

The storage warehouses are used for long periods of storage, even several months. These warehouses often perform "third party" services for large manufacturers, distributors, and wholesalers and adopt specific layouts depending on the storage temperature required and their territorial presence. Finally, distribution centre warehouses are smaller than the previous two warehouse types, and house the foodstuffs intended for retail sale.

Cold rooms (volume less than 500 m<sup>3</sup>) are small storage areas that qualitatively are placed just below the small storage warehouses of distribution centres, and above large refrigerators/freezers. They are for the storage of moderate amounts of foodstuffs.

They are often used in medium-sized supermarkets, restaurants, hotels, pubs, butchers'/fish markets, and fruit and vegetable stores, where simple household refrigerators (even with a large capacity) would not allow long-term storage of supplies. However, in

practice, large supermarkets and hypermarkets also prefer to use medium and large cold rooms rather than larger warehouses so that product rotation can be implemented directly in chilled cabinets. There is a preference for small daily loads of goods which are stored for a few hours and immediately put on sale, rather than having large weekly or monthly loads that must be stored for several days inside larger supermarket warehouses<sup>22</sup>.

#### **Impact estimates**

As far as storage in large warehouses such as supermarkets or distribution centres is concerned, the estimate was based on a formula found in the LCA food database, which allows an evaluation of the impact of a cold room in chilled (4°C) and freezing conditions (-18°C):

$$E_{\text{cold}} = E_s \cdot \frac{100}{u} \cdot V \cdot t$$

To summarize, the calculation is performed using the equation:

Where:

- E is the energy required for storage expressed in KWh per m<sup>3</sup> each day;
- u is the degree of cold room use (100% cold room full, 0% cold room empty);
- V is the volume in m<sup>3</sup> of product stored;
- t is the storage time in days;
- E<sub>s</sub> is the specific energy of both systems and

<sup>22</sup> Confidential information provided by the manager of refrigeration systems and the cold chain of a large Italian food distributor

<sup>23</sup> LCA FOOD, 2002



according to this approach equals:

- 0.59 kWh/m<sup>3</sup> day for cool storage (5°C);
- 0.63 kWh/m<sup>3</sup> day for frozen storage (-20°C).

The impact assessment relies on the hypothesis of different scenarios depending on whether the products in question are fresh or frozen. As regards frozen products, storage time is usually fairly long (this calculation hypothesised six months), with cells filled more efficiently (90%); many scenarios may come into play for fresh goods, accounting for the different types.

An initial rough classification reveals:

- For products such as milk, dairy products, and deli takeaway, the storage time of the finished product can be up to 24-48 hours;
- For pastas, fresh sauces, and cold cuts, storage

may be more than 3 days;

- For butter, whole salami, and portioned cheese, storage time can even be up to 1 week.

Extreme scenarios were adopted for impact assessment:

- Fresh food: 2 day storage with cold storage at 90%;
- Frozen food: 180 day storage with frozen storage at 90%.

The energy required for storage expressed in kWh per m<sup>3</sup> each day is:

- Fresh foods: <0.1 kWh per kg;
- Frozen foods: 0.6 kWh per kg.

In short, under these hypotheses the following impacts were estimated for the industrial storage phase:

- Fresh foods: impact <0.1 kg of CO<sub>2</sub>eq per kg;
- Frozen foods: impact 0.3 kg of CO<sub>2</sub>eq per kg.

PARAMETER	COLD - 5°C	FROZEN - 20°C	UoM	NOTE
ES	0.59	0.63	kWh/m <sup>3</sup> d	specific energy
U	90	90	%	cold storage degree of use
V	0.005	0.005	m <sup>3</sup>	volume of one kilogram of food
PS food	200	200	kg/m <sup>3</sup>	specific weight of food
Time	3	180	days	days of storage
Carbon Footprint Electricity	0.457		kg CO <sub>2</sub> -eq/kWh	calculated for Italian energy mix

*Hypotheses adopted for the calculation of CO<sub>2</sub>eq associated with industrial conservation<sup>24</sup>*

*Source: BCNF elaborations*

### Refrigerated transportation

Refrigerated transport of perishable foodstuffs must be performed as standard in all the main transport methods used. The cold storage can be built into the transportation itself, or be provided by refrigerated containers that are loaded onto the vehicle and subsequently unloaded.

**Refrigerated transport by sea** may use appropriate refrigerated ships or containers. In recent years, use of this type of transport has been increasing, thanks to substantial improvements in reefers (refrigerated containers). Different types of perishable goods are shipped by sea. These include, but are not limited to, citrus fruits, bananas, meat, and fish. Bananas, with a commercial steady stream during the whole year, are the most common refrigerated product transported by sea. It should also be pointed out that the transport of fish has increased significantly due to increasing demand in Western countries and to the use of fisheries at increasing distances from the consumer countries<sup>25</sup>.

**Refrigerated air transport** of food, given its high cost, is used exclusively for specific goods, such as sought-after items, delicacies, and flowers. The goods are placed in insulated isothermal containers (without refrigeration), which are suitable for air transport.

<sup>24</sup> The Carbon Footprint of the electricity is referred to the Italian energy mix (medium voltage) based on the IEA Bluebook 2014 (2013 data) and is calculated with the IPCC 2013 factor.

<sup>25</sup> Panno, G. La catena del freddo dei prodotti alimentari. (Food Products' cold chain)





Maintaining the temperature during loading, unloading, and landing is assured by the addition of a load of dry ice to the product at the beginning of the transport phase.

**Rail transport** of perishable goods uses insulated chilled cars or wagons. The isothermal car is made with insulated walls and the internal temperature is kept constant thanks to the thickness of insulation in the walls. The refrigerated car, on the other hand, as well as being insulated like the isothermal version, is fitted with a system capable of maintaining the required internal temperature conditions. There are two types of refrigerated cars: the chilled car and the reefer. The first has two caissons placed at the two ends of the car, into which ice is loaded at the start of the journey; as it melts or absorbs heat, it cools the environment. The refrigerator car (reefer) is an insulated car that contains a refrigeration system activated electrically by the rail network or an internal combustion engine.

Lastly, **road transport**, has increased greatly in recent decades due to the vast flexibility of roadway vehicles and the high quality standards it can offer<sup>26</sup>. Aside from refrigerator trucks, the market also proposes vehicles with simple insulation (isothermal vehicles).

### Estimate of impacts

When setting out to assess the environmental impacts of refrigerated transportation, it is essential to estimate the amount of energy required to keep the refrigeration systems running. The Food transport refrigeration - approaches to reduce energy consumption and environmental impacts of road

transport report<sup>27</sup> contains the energy consumption figures for road vehicle transport with and without an active refrigeration system. It is therefore possible to extrapolate from this data the consumption in l/km required exclusively for the activation of a refrigeration system. This data represents an average value for the transport of frozen, chilled, and mixed foods. This shows us how a refrigeration system consumes anywhere between 20 and 24% more than when no refrigeration system is running.

Despite the fact that lab tests reveal greater consumption for the transport of frozen foods (approximately 6%), the report highlights that consumption due to transport of fresh food is often higher than for frozen foods: this is due to a more accurate temperature control, to the product

breathing, and to greater airflows inside the vehicle keeping the temperature constant.

Taking into account the data of Ecoinvent,<sup>28</sup> emissions of CO<sub>2</sub> equivalent are shown as 775 g per km<sup>29</sup>. To estimate the impacts per kg of food transported, the amount for each load is estimated to be 20 tons, imagining that the medium does not travel at full load (factor 1). In this way, the specific emission becomes equal to 0.039 gCO<sub>2</sub>eq/km per kg. An additional impact of 20% was estimated for refrigeration systems (0.047 gCO<sub>2</sub>eq/km per kg).

<sup>26</sup> UNEP 2011

<sup>27</sup> Tassou, S.A., et al., 2008.

<sup>28</sup> V2.2 of 2010. Data referred to a truck from 16-32 t EURO 4.

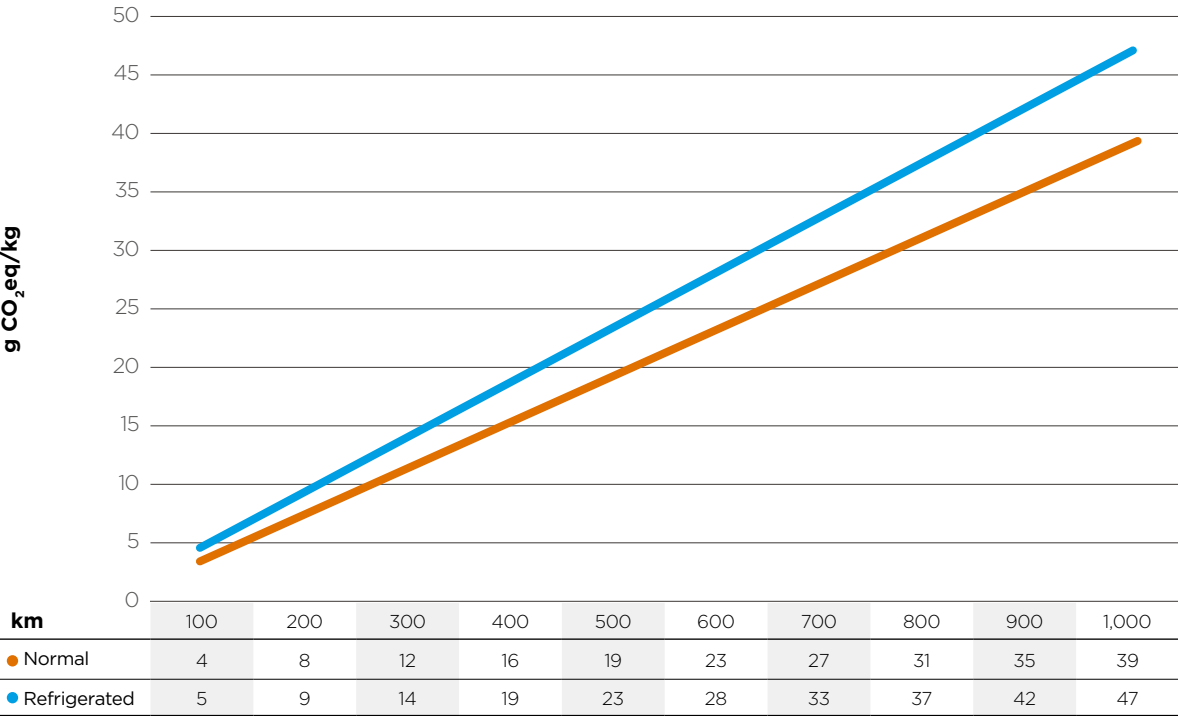
<sup>29</sup> Calculated with IPCC 2013 factor.

VEHICLE CLASS	FUEL EFFICIENCY (only motive)	FUEL CONSUMPTION (only motive)	OVERALL VEHICLE FUEL EFFICIENCY (motive plus refrigeration)	FUEL CONSUMPTION (motive plus refrigeration)	FUEL CONSUMPTION (only refrigeration)
	km/liter	liter/km	km/liter	liter/km	liter/km
Medium Rigid	3.70	0.27	3.09	0.32	0.05
Large Rigid	3.15	0.32	2.63	0.38	0.06
City Articulated	2.98	0.34	2.42	0.41	0.08
32 tonne articulated	2.97	0.34	2.40	0.42	0.08
38 tonne articulated	3.04	0.33	2.52	0.40	0.07

Fuel consumption for road vehicle travel and refrigeration systems

Source: Tassou, S.A., et al. 2008.





Estimates of CO<sub>2</sub>eq emission for the transport of 1 kg of food by truck  
Source: BCFN elaborations

Supermarket refrigerated display cases

Static elements of supermarkets and hypermarkets - installations for the display and sale of products - represent the most critical and paradoxical point of the entire cold chain. The objective of a good cold chain is to avoid product temperature variations and, paradoxically, the best way to protect refrigerated/

frozen products from temperature variations is to store them away from sources of heat such as lighting and external airflows, which means keeping them out of customers' reach. The display cases must therefore be able to reconcile these two opposing aspects: keeping the cold chain intact and providing a visually appealing display. The most important features of a good refrigerated

display case are correct temperature control of products (regardless of external environmental conditions), good visibility and accessibility to products (in order to facilitate purchases and loading/unloading operations by staff), and low operating costs.

There are different criteria for the classification of display equipment. Various display options include open or doored island showcases, open display showcases, and upright showcase cabinets. Open **island showcases** are equipped with a forced convection evaporator positioned on the bottom. They feature an air barrier device to limit warm air inflows. The island showcases can also have sliding doors - a physical barrier is important for energy saving and food safety.

On the other hand, **open display showcases** have shelves to display products. The evaporator located on the top parts of the shelf allows the formation of an air barrier, protecting the products from dangerous inflows of external warm air. Lastly, **upright display cabinets** contain several shelves and are often similar to the previous upright display showcases. The difference lies in the glass doors that allow the cabinet to be closed. The evaporator is located on the bottom section, and a fan allows air circulation inside the showcase. Large supermarkets and hypermarkets often install large showcases connected to a centralized refrigeration unit. This allows important energy rationalization and, often, condensation heat recovery in order to produce hot water.



### Impact assessment

Impact assessment of static refrigerated showcase elements depends on many factors. An initial assessment can be made using the formula that was provided previously for the assessment of cold warehouses and cold storage consumption.

An important factor to bear in mind from the energy consumption point of view is that the showcase may either be open or closed-door. Refrigerator units that can be closed with doors allow energy savings that total approximately 1/4 in comparison with models without doors. Furthermore, a barrier between product and consumer does not negatively influence the customer in that sector; related studies have not detected any sales decreases following the introduction of doors<sup>30</sup>.

#### *Deep freezing systems for food products*

Deep freezing, in comparison to home freezing processes, is linked to two fundamental requirements: the need for extremely low temperatures and the obligation to complete the process extremely quickly. Deep freezing can be carried out only in facilities authorized by health agencies, and the products must undergo the following operations:

- Preparation which includes washing, sorting, and, for plant-based products, scalding to inhibit enzymes;
  - Packaging;
  - Fast freezing by lowering the product's temperature to -30°C/-50°C;
  - Storage at a temperature equal to, or less than -18°C.
- Currently, three types of systems are used for deep

freezing food: linear tunnels, spiral freezers, and cold boxes<sup>31</sup>.

**Linear tunnel freezers** are machines composed of a conveyor belt on which food is placed, and a super-isolated tunnel in which the products are frozen; while travelling down the conveyor belt, the food is enveloped by what is known as cryogenic gas, which is usually nitrogen or carbon dioxide. The food then enters the tunnel at room temperature and, after a given amount of time has elapsed, it exits the tunnel completely frozen. The use of these tunnels is common for meat, fish, pasta, pre-cooked food, pastry, cakes, fruit, and vegetables.

**Spiral freezers** are similar in principle to linear tunnels, with the only difference being that the conveyor belt is in a spiral shape. This type of freezer is particularly useful for medium-high quantity productions, and where space is limited.

**Cold boxes**, externally similar to large refrigerators, are static elements in which deep freezing conditions are created. The working principle of this cabinet is rather simple since only the temperature of the cabinet and the cycle length require regulation.

### Impact assessment

This process consumes enormous amounts of energy: mean energy assessments for freezing vegetable products stand at approximately 2 kWh/kg<sup>32</sup>. This operation not only includes temperature decrease but also initial scalding.

### Domestic refrigerators and transportation

The last link in the cold chain is the transport of the product by the customer and subsequent storage in the refrigerator/freezer at home. This last stage is the most dangerous of the entire chain, because once in the hands of the final consumer, the food is no longer subject to any control. It is therefore the responsibility of the buyer to be able to maintain proper food temperature in order to avoid its deterioration.

Energy consumption of domestic refrigerators can vary highly depending both on the presence of specific technologies such as automatic defrosting (NoFrost) and the bad habits of users who open the refrigerator too often.

Like many other appliances, in compliance with a specific directive of the European Community<sup>33</sup>, refrigerators and freezers must bear a label stating their energy efficiency class. The labelling is based on an energy efficiency index EEI, which is an indication of the annual power consumption based on the storage volume and the type of appliance (refrigerator or freezer). The directive divides the products into the categories shown in the table.

According to the European Directive commonly called the Ecodesign Directive<sup>34</sup> the sale of refrigerators and freezers lower than class A is prohibited.

<sup>30</sup> Lindberg, U.M., et al., 2008

<sup>31</sup> Gruppo Sapio. (In Italian)

<sup>32</sup> Pimentel, D. 2008

<sup>33</sup> Commission Delegated Regulation (EU) No 1060/2010 of 28 September

<sup>34</sup> Directive 2009/125/EC.

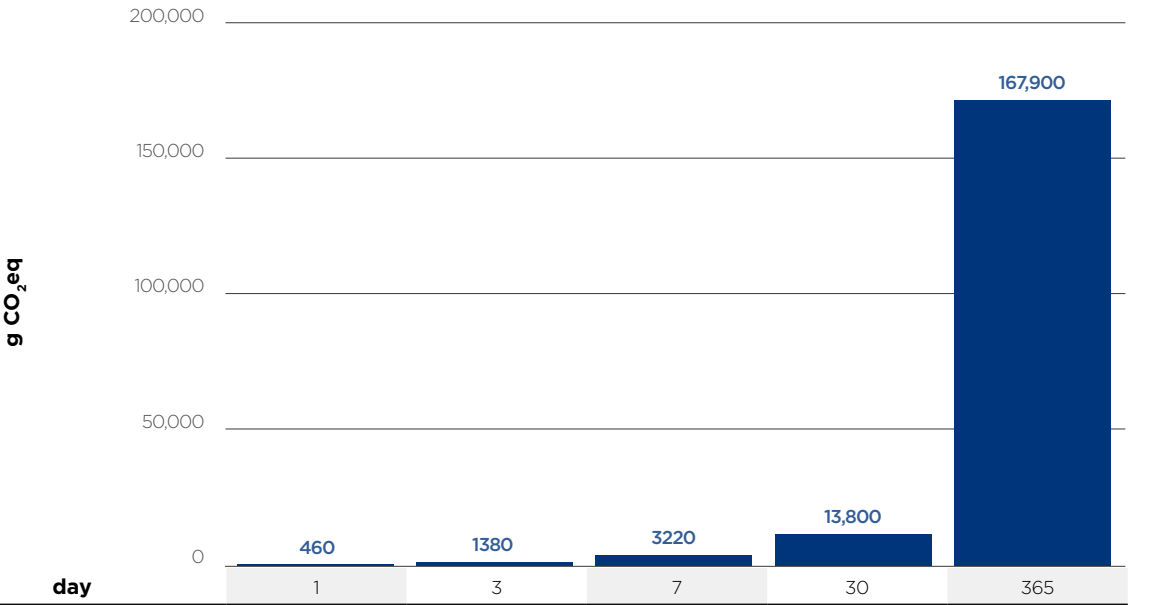


ENERGY EFFICIENCY CLASS	ENERGY EFFICIENCY INDEX
A+++ (most efficient)	EEI < 22
A++	22 ≤ EEI < 33
A+	33 ≤ EEI < 42
A	42 ≤ EEI < 55
B	55 ≤ EEI < 75
C	75 ≤ EEI < 95
D	95 ≤ EEI < 110
E	100 ≤ EEI < 125
F	125 ≤ EEI < 150
G (least efficient)	EEI ≥ 150

Refrigerator and freezer classes<sup>35</sup>  
Source: BCFN elaboration

Impact assessment

Regarding home storage, let us consider the case of a medium-size refrigerator that is class A+. Based on the data sheets of major household appliances, we can assume that a refrigerator with a gross capacity of about 410 litres (fridge and freezer) involves consumption in real operating conditions of about 365 kWh/year. This value, significantly higher than the theoretical consumption for class A+ shown in the table above, takes into account the actual conditions of use (opening/closing the doors, storage of foods initially at room temperature, amount of food stored, efficiency of defrosting operations, etc.), which are



CO<sub>2</sub> equivalent emissions associated with the use of a refrigerator A + class characterized by a consumption of 365 kWh/year<sup>36</sup>  
Source: BCFN elaborations

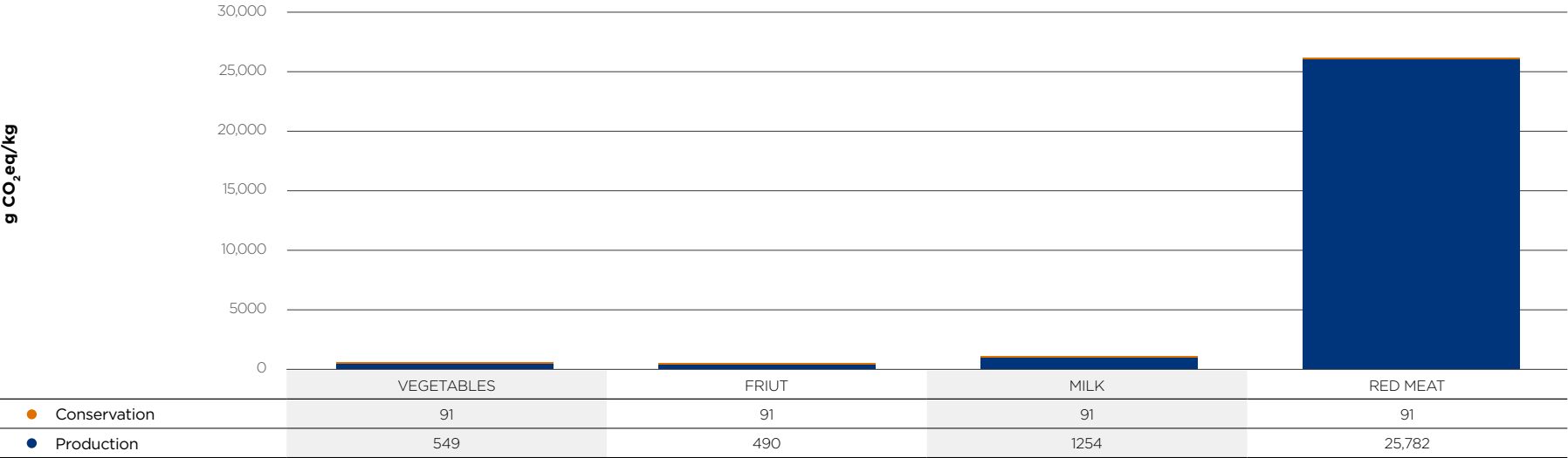
not considered in the calculation of the theoretical consumption of the European directive. Thus, this value is variable, depending on the conditions of use, but can be considered a reasonable estimate for the calculation of the impact in terms of CO<sub>2</sub> equivalent emissions. To refer that impact to a specific amount of food, it is necessary to estimate how much food is stored and the storage period. As regards the amount, a value equal to 15 kg is assumed, which leads to an estimated average impact of the entire home appliance consuming approximately 24 kWh/year per kg. Delving into the specificity of the type of storage,

the LCA Food database<sup>37</sup> provides a differentiated energy consumption of the compartment for fresh and frozen foods. The proposed coefficients, valid for Class A equipment, are:

- 24 kWh/(kg\*day) for preservation of fresh food;
- 60 kWh/(kg\*day) for the conservation of frozen products.

<sup>35</sup> Commission Delegated Regulation (EU) No 1060/2010  
<sup>36</sup> The conversion into carbon dioxide was conducted assuming the Italian energy mix and then with a specific emission of 460 gCO<sub>2</sub>eq/kWh. (Report IEA 2015; IPCC 2013 emission factor)  
<sup>37</sup> LCA Food Database





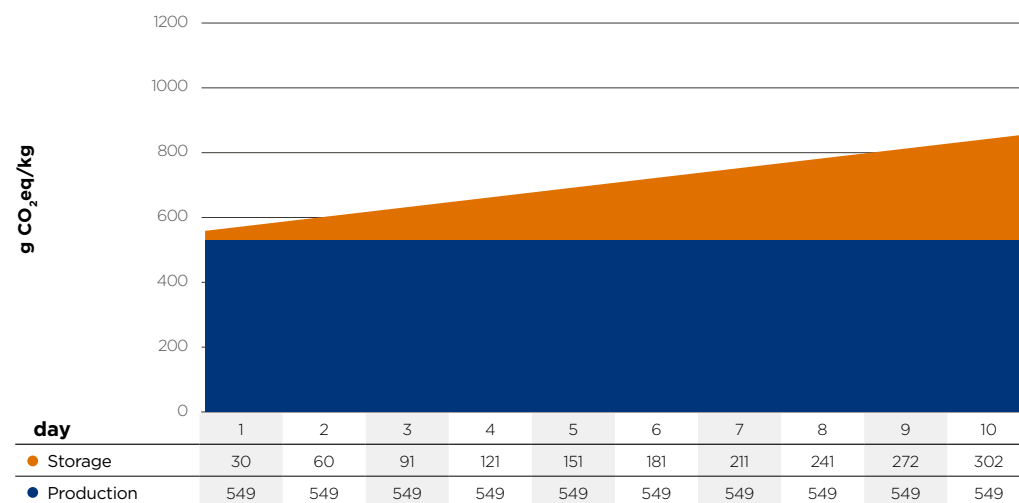
Environmental impacts for the production and domestic storage in the refrigerator of some fresh food. The data was calculated by reference to storing 15 kg of food for 3 days in a class A refrigerator.  
Source: BCFN elaborations on data by BCFN, Double Pyramid 2016

GROSS VOLUME	410	liters
YEARLY CONSUMPTION	365	kWh/year
AVERAGE QUALITY OF FOOD CONSERVED	15	kg
AVERAGE CONSERVATION DENSITY	27	liters/kg
AVERAGE CONSUMPTION PER KG YEAR (fresh foods)	27	kWh/year*kg
AVERAGE CONSUMPTION PER KG YEAR (frozen foods)	24	kWh/year*kg
CARBON FOOTPRINT OF ELECTRICITY	0.46	kgCO <sub>2</sub> eq/kWh

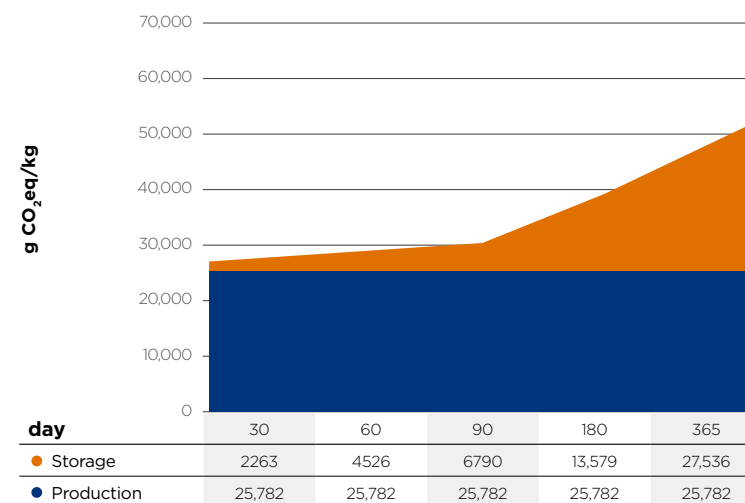
Assumptions adopted for calculating the emissions CO<sub>2</sub>eq associated with the use of a home refrigerator  
Source: BCFN elaborations



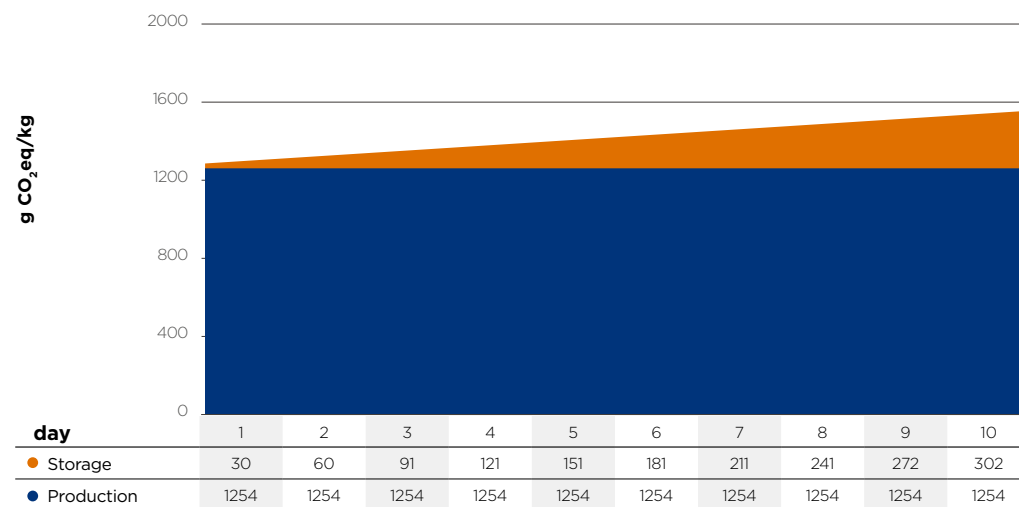




Carbon footprint of the production and storage of vegetables in a domestic refrigerator.<sup>38</sup>  
 Source: BCFN elaboration on data by BCFN, Double Pyramid 2016



Carbon footprint of the production and storage of red meat in a domestic freezer.<sup>40</sup>  
 Source: BCFN elaboration on data by BCFN, Double Pyramid 2016



Carbon footprint of the production and storage of milk in a domestic refrigerator.<sup>39</sup>  
 Source: BCFN elaboration on data by BCFN, Double Pyramid 2016

A further elaboration associates these impacts with storage time, to check how it affects the shelf life of food. This case also takes into account two extreme hypotheses, considering vegetables, milk, and red meat. The following figures reveal that the storage phase for low impact foods can become significant, while for red meat this begins to be significant only after many months of freezer storage.

<sup>38</sup> The impacts were calculated based on the Italian energy mix. (Report IEA 2015; IPCC 2013 emission factor)

<sup>39</sup> The impacts were calculated based on the Italian energy mix. (Report IEA 2015; IPCC 2013 emission factor)

<sup>40</sup> The impacts were calculated based on the Italian energy mix. (Report IEA 2015; IPCC 2013 emission factor)



### Refrigerants and relative impacts

Refrigerant fluid – given its special thermodynamic properties – is used to absorb heat from a cold tank and, after being compressed, release it to a hot one, thereby ensuring heat transfer.

Attention to these fluids from an environmental point of view is essential, as they can generally contribute to two serious problems:

- The depletion of the ozone layer: an important gas in the ozonosphere - a layer of the atmosphere located above the troposphere, at an altitude of 15-35 km. The dynamic balance between solar radiation, ozone, and oxygen allows absorption of certain frequencies of radiation which are very harmful to humans<sup>41</sup>;
- The increase in the greenhouse effect: the equilibrium that has established itself over time - thanks to the presence of greenhouse gases naturally present in the atmosphere - between solar radiation inbound from space and radiation emitted from the Earth's surface, has created a system whereby seasonal temperatures on Earth reach stable values that vary from area to area. The introduction of new anthropogenic greenhouse gases alters the thermal balance of the planet, increasing the temperature<sup>42</sup>.

During the industrial history of refrigeration, various refrigerants have progressively been used:

- CFCs (Chlorofluorocarbons);
- HCFCs (Hydrochlorofluorocarbons);
- HFCs (Hydrofluorocarbons);

- Natural Refrigerants (water, ammonia, etc.).

CFC substances consist of extremely complex molecules containing chlorine, fluorine, and carbon in varying proportions. All CFCs have important properties, as they:

- Are chemically stable;
- Are not toxic to humans;
- Are not flammable;
- Ensure good refrigeration;
- Generally possess a low boiling point at atmospheric pressure;
- Do not pose particular problems of use (for example, of solubility with mineral oils lubricating the compressor, compatibility with the electrical insulating materials of the motor, in the procedures of fluid charging and reintegration, etc.);
- Have relatively low costs.

Due to these excellent properties, CFCs were used without problem from the 1930s onwards in refrigeration and air conditioning. Producers and users of these refrigerants never considered the impact that these could have on the environment and on the fluid dynamics of the atmosphere once they were released into it. Due to the combination of fluorine and chlorine, the chemical composition of CFCs is so stable that it can remain unchanged for decades<sup>43</sup>. In this period of time, the gas released into the environment reaches the more "external" zone of the atmosphere where the chlorine reacts with the ozone, thus reducing the amount and contributing to its progressive thinning. These gases are also

powerful greenhouse gases (up to 14,000 times more powerful than CO<sub>2</sub>)<sup>44</sup>. Therefore, following the Protocol of Montreal and with the approval of the European Regulation<sup>45</sup> of 1994, CFC production was banned that same year.

Over the years, research and development of new refrigerants ensued, developing substances such as HCFCs (hydrochlorofluorocarbons), whose management is regulated by the aforementioned Montreal Protocol. However, although to a lesser degree than CFCs, these also contribute directly to the thinning of the ozone layer. The use of HCFCs in new production was prohibited in the European Union as of January 1, 2010.

The current market of refrigerants has therefore shifted to other types of fluids: HFCs (hydrofluorocarbons) and natural refrigerants. HFCs are refrigerants that contain no chlorine; therefore they do not contribute to ozone layer depletion. In terms of the greenhouse effect, however, the impact turns out to be non-zero. Many of these refrigerants are flammable and thus require mixing. This category includes<sup>46</sup>:

- R134a: the only fluid that can be used as a refrigerant in pure form, an alternative to R12;

<sup>41</sup> EPA. Phaseout of Ozone – Depleting Substances. <https://www.epa.gov/ods-phaseout>

<sup>42</sup> Ramanathan, 1975

<sup>43</sup> EPA. Phaseout of Ozone – Depleting Substances. <https://www.epa.gov/ods-phaseout>

<sup>44</sup> IPCC 2013

<sup>45</sup> Reg (CEE) 3093/94.

<sup>46</sup> Halozan, H., 2004. (In Italian)



- R404A and R507: both are used as an alternative to R502;
- R407C: is an alternative to R22;
- R410A: is an extremely efficient working fluid, more than R22 and R407C. It requires the installation of technology that can deal with its high working pressures of up to 40 bars.

Atmospheric observations show that the abundance of HFCs in the atmosphere is increasing rapidly, as are the emissions from high-GWP HFCs (about 10-15% per year). If no measures are taken, it has been estimated that HFCs will amount to 9-19% of total CO<sub>2</sub> emissions by 2050<sup>47</sup>. This rapid increase of emissions from HFCs has aroused the interest of the international community, and tackling HFC emissions is a priority of the Climate and Clean Air Coalition to Reduce Short-Lived Climate Pollutants (CCAC), a government-led coalition created in 2012 by the UNEP.

The fate of HFCs is a heated debate which brings together major global associations<sup>48</sup>, the European Commission, and various Italian, European, and non-European ministries to a common table. The common objective is to predict and plan for a gradual reduction of the use of HFCs<sup>49</sup>. The administration of this phase, however, is not defined by a single party or entity: HFCs are currently controlled by the Kyoto Protocol and the European Regulation which regulates the use of fluorinated greenhouse gases<sup>50</sup> but the possibility of handling the gradual reduction, as for CFCs and HCFCs, under the supervision of the Montreal Protocol is being considered. The

Montreal Protocol is now acclaimed as one of the most successful environmental agreements for its achievements over the years, and because it is the first (to date) to have reached international agreement, with Universal Ratification by 196 countries in 2009. Another alternative is represented by natural refrigerants (coolants used in the earliest history of refrigeration), such as water and ammonia. This category also comprises hydrocarbon refrigerants such as propane and isobutane. Ammonia is currently one of the most common refrigerants used in the food industry, along with R502, which is among the most widely used refrigerants in supermarkets and refrigerated transport<sup>51</sup>. Another coolant fluid which is often used in the food industry, particularly in supermarkets, is water mixed with glycol. This is used as a secondary fluid in direct expansion systems by circulating a traditional coolant in the primary circuit<sup>52</sup>.

<sup>47</sup> [http://www.ccacoalition.org/docs/pdf/factsheets/Fact\\_Sheet\\_1-HFC\\_FINAL\\_Digital\\_May2015.pdf](http://www.ccacoalition.org/docs/pdf/factsheets/Fact_Sheet_1-HFC_FINAL_Digital_May2015.pdf)

<sup>48</sup> Such as ASHRAE, AHRI, EPEE, AREA, UN, UNEP, IIR and UNIDO.

<sup>49</sup> Buoni. (In Italian) <http://www.centrogalileo.it/nuovaPA/Articoli%20tecnici/buoni/phase%20out%20e%20phase%20down.htm>

<sup>50</sup> Regulation (EU) No 517/2014 of the European Parliament.

<sup>51</sup> Fundamentals of Refrigeration: <http://free-ed.net/free-ed/Courses/05%20Building%20and%20Construction/050207%20HVAC%20Refrig/RefrigFund00.asp?INum=0>

<sup>52</sup> Del Ventura et al. 2007

## THE MONTREAL PROTOCOL

In 1987, the adoption of the Montreal Protocol by the 1985 Vienna Convention established the objectives and measures to reduce production and use of substances harmful to the stratospheric ozone layer.

The Protocol establishes the deadline by which the signatories undertake to contain the levels of production and consumption of harmful substances (chlorofluorocarbons, carbon tetrachloride, 1,1,1-trichloroethane, Halons, HCFCs, methyl bromide), and governs trade, communication data monitoring, research, information exchange, and technical assistance. Regarding the deadlines, containment levels of production and consumption of harmful substances in developing countries have an extended “period of grace”, ten years more than industrialized countries.

### *Margins of improvement in the cold chain*

There are several areas where improvements can be made. In general terms, these include the study and identification of innovative technologies and processes with the aim of minimizing energy consumption, and the study of the logistics of the cold chain to identify measures for improving its management.



Using only technologies currently available on the market, there are different possibilities of energy saving potential. According to the study carried out by the U.S. Department of Energy (DOE) Energy Savings Potential and R&D Opportunities for Commercial Refrigeration<sup>53</sup>, there are nine points of intervention for improving the efficiency of the cold chain:

- Thermal insulation;
- Fans (High Efficiency Fan Motors): for fluid circulation;
- Compressors: use of high-efficiency compressors;
- Thermal exchanges: with considerations of thermokinetics and thermofluid dynamics, the heat exchange at the evaporator and the condenser must be improved;
- Doors to be improved: opening systems that connect refrigerated areas and non-refrigerated areas. It may include the use of self-closing doors;
- Anti-sweat heaters (ASH): use of anti-fog heaters;
- Defrost: defrost systems allow automatic defrosting of the evaporator;
- Lighting: action is required on lighting systems in coolers. To avoid wasting energy, systems are needed that minimize the heat released by the lighting system. It should include the use of LED (light emitting diode) or HEF (high efficiency fluorescent lighting) systems;
- Control systems.

The U.S. Department of Energy has also identified a number of innovative technologies that can be introduced in the future (with varied marketing

times). These technologies apply to eight categories: overall system, compressors, insulation, heat transfer, cooling, lighting, fans, and modelling/monitoring. In addition, the study of the Carbon Trust,<sup>54</sup> already mentioned above, shows a qualitative analysis of the effectiveness of possible actions for improvement and reduction of impacts related to refrigeration. Notwithstanding the fact that 50% of these reductions are achieved by efficient systems, it is interesting to note that 20-25% of the savings can be attributed to simple optimization of procedures for facilities management, without the need to resort to heavy technological investments.

Once the most efficient technologies available on the market to reduce energy consumption have been identified, it is then essential to plan the entire cold chain logistics in the best way possible. Poorly calibrated logistics not only subject the perishable product to a huge potential of possible changes in temperature, with consequent possibility of deterioration, but also nullify all the efforts made previously to ensure a technologically efficient cold chain.

#### *The various impacts in the cold chain*

As regards the food conservation chain, some comments can be made about the impacts of the various phases. In short, we can highlight the following considerations:

- The cold chain is a source of significant impact, especially in the home and storage for frozen products;

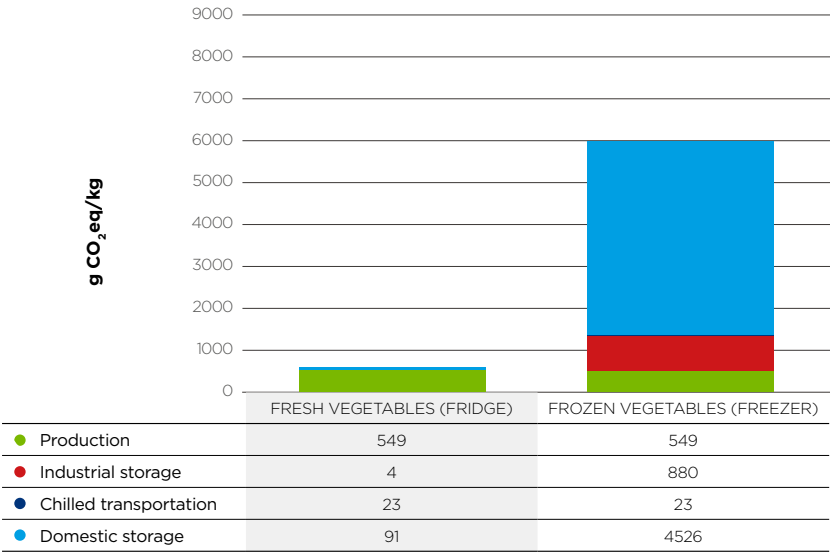
- Products labelled “fresh” are characterized by a very short conservation time especially in the industrial context, and for this reason the environmental impacts associated with the storage phase are generally very low and may sometimes be overlooked when assessing the overall footprint of a kilogram of product;
- The impacts related to food freezing were not considered in this chapter, assuming that they fall into the industrial segment; therefore, in terms of life cycle analysis, they are included in the phase that goes from the cradle or cultivation of raw materials, to the gate, i.e., when the manufacturer ships the product to distribution platforms;
- Refrigerated transport leads to increased environmental impacts which, when considered as part of the impact of the finished product, can be considered negligible.

All the considerations and processes that have been presented in this chapter are useful for estimating the impacts of the entire chain, estimates which are valid according to the assumptions made. This is why these values are believed to be useful for determining the magnitude of the environmental impacts of the cold chain per kilogram of food considered.

<sup>53</sup> Goetzler et al., 2009

<sup>54</sup> Carbon Trust, 2006





Assessment of CO<sub>2</sub> equivalent emissions associated with the cold chain<sup>55</sup>  
Source: BCFN elaborations on data by BCFN, Double Pyramid 2016

Calculation of the impact for the storage of different food products

This section of the paper sets out to assess how consumer choices affect the environmental impacts of food. To do so, we performed an analysis of how the carbon footprint of different foods varies depending on different storage scenarios (fresh, frozen, and canned foods). The products chosen for the study are French fries, peas, and meat.

In the life cycle analysis of the various products, which will consider as a functional unit one kilogram of edible food, all the stages from primary production of the plant or animal to the moment immediately before cooking by the consumer will be accounted for.

General hypotheses and assumptions

The general assumptions used to calculate the impacts in relation to different case studies are shown below.

<sup>55</sup> The data was calculated on the basis of the assumptions made and assuming the use of electricity according to the Italian energy mix. (Report IEA 2015; IPCC 2013 emission factor)

PHASE	FRESH FOODS	FROZEN FOODS
DOMESTIC STORAGE	LENGTH OF STORAGE: 3 days 2.7 Wh/(liter*day) APPLIANCE GROSS WEIGHT: 310 l APPLIANCE GROSS CAPACITY: 15 kg	LENGTH OF STORAGE: 60 days 6 Wh/(liter*day) APPLIANCE GROSS WEIGHT: 310 l APPLIANCE GROSS CAPACITY: 15 kg
TRANSPORT	500 kg FUEL CONSUMPTION +20% 20 ton load	
INDUSTRIAL CONSERVATION	LENGTH OF STORAGE: 2 days CELL FULL to 90% CONSUMPTION ASSESSMENT with LCA FOOD MODEL	LENGTH OF STORAGE: 60 days CELL FULL to 90% CONSUMPTION ASSESSMENT with LCA FOOD MODEL (fast freezing process not included)

Assumptions used to calculate the CO<sub>2</sub> equivalent emissions associated with different case studies  
Source: BCFN elaborations





### Impacts of potatoes

The period of harvesting of potatoes comprises approximately two months, September and October. Most of the production is then placed on the market gradually for a period of time that can extend for up to nearly one year; it is therefore very important to store potatoes in an appropriate manner to limit loss of weight and prevent both sprouting and the development of diseases, thus preserving the quality of the tubers. Good storage depends on the

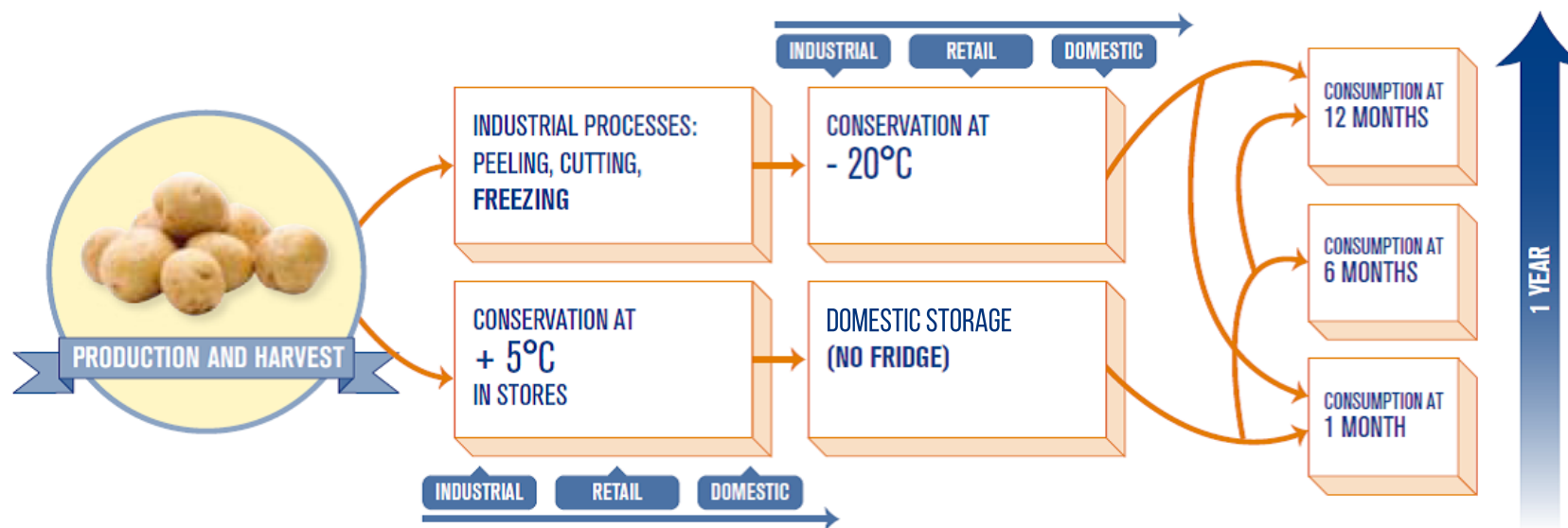
conditions of local storage, the ideal temperature of which is around 5-6°C<sup>56</sup>.

The following diagram shows several possible production, conservation, and distribution scenarios for potatoes.

The carbon footprint of the crop phase of potatoes refers to the Double Pyramid 2016, obtained by averaging 24 different impact data items. The calculation of emissions shows impacts depending on the time of consumption, the distance

from the point of consumption, and the production and storage system chosen. Analysing the specific stages of the life cycle of the potato, one can see how the crop field appears influential in the consumption of a fresh product, while for the frozen product the largest share of impact is due to freezing.

<sup>56</sup> Agraria.org. (In Italian)



Possible scenarios for the consumption of potatoes  
 Source: BCFN 2012



DISTRIBUTION TYPE	CONSERVATION	STORAGE TIMES								
		1 MONTH			6 MONTHS			12 MONTHS		
		CARBON FOOTPRINT (kg CO <sub>2</sub> eq)	PHASE	%	CARBON FOOTPRINT (kg CO <sub>2</sub> eq)	PHASE	%	CARBON FOOTPRINT (kg CO <sub>2</sub> eq)	PHASE	%
LOCAL (<200 km)	FRESH	0.241	Field	73%	0.329	Field	53%	0.438	Field	40%
			Refrig	10%		Refrig	34%		Refrig	51%
			Transport	17%		Transport	12%		Transport	9%
	FROZEN	1.605	Field	11%	1.878	Field	9%	2.213	Field	8%
			Freeze	83%		Freeze	71%		Freeze	60%
			Refrig	4%		Refrig	18%		Refrig	30%
				3%		Transport	2%		Transport	2%
200 - 1000 km	FRESH	0.312	Field	56%	0.400	Field	44%	0.509	Field	35%
			Refrig	9%		Refrig	29%		Refrig	44%
			Transport	35%		Transport	27%		Transport	21%
	FROZEN	1.676	Field	10%	1.949	Field	9%	2.284	Field	8%
			Freeze	79%		Freeze	68%		Freeze	57%
			Refrig	4%		Refrig	17%		Refrig	30%
				6%		Transport	5%		Transport	5%
SHIP (10,000 km)	FRESH	0.333	Field	53%	0.422	Field	42%	0.531	Field	33%
			Refrig	9%		Refrig	28%		Refrig	43%
			Transport	39%		Transport	30%		Transport	24%
	FROZEN	1.698	Field	10%	1.971	Field	9%	2.306	Field	8%
			Freeze	78%		Freeze	67%		Freeze	57%
			Refrig	4%		Refrig	17%		Refrig	29%
				8%		Transport	7%		Transport	6%

Impact due to consumption of potatoes per 1 kg of edible food  
 Source: Sordi, 2011 updated with BCFN data, 2016



### Impacts of peas

The harvesting period generally falls between April and the end of June, and seasonal consumption is therefore from April to early July.

The diagram presents a few possible scenarios for the production, storage, and distribution of peas.

As regards the calculation of the environmental impacts, the main assumptions are as follows:

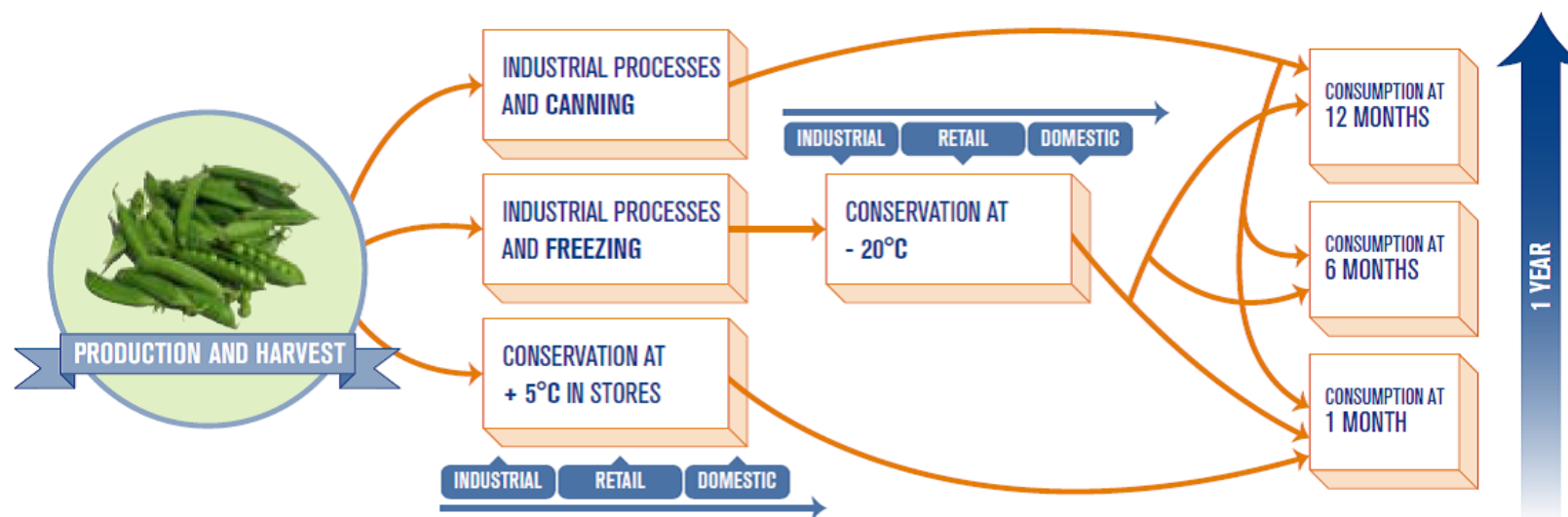
- The carbon footprint of the peas crop phase refers to the Double Pyramid 2016, obtained

by averaging 4 different values on impact data, regarding studies that state the impact per kilo of fresh product;

- 3 kg of fresh peas (pod + peas) are produced from 1 kg of seeds intended for human consumption;
- With regard to the calculations for storage, a specific weight of 500 kg of frozen seeds/m<sup>3</sup> is assumed.

Impacts also show a rising trend for peas as storage time increases. It should, however, be noted that fresh peas yield equal, and sometimes even more, impact

than their canned counterparts. This is due to the fact that all operations carried out on fresh peas regard large volumes: it takes 3 kg of pods to produce 1 kg of shelled peas. This translates - in equal product consumed - into greater volumes to be refrigerated and transported, thus entailing higher impacts.



Possible scenarios for the consumption of peas  
 Source: BCFN 2012



DISTRIBUTION TYPE	CONSERVATION	STORAGE TIMES								
		1 MONTH			6 MONTHS			12 MONTHS		
		CARBON FOOTPRINT (kg CO <sub>2</sub> eq)	PHASE	%	CARBON FOOTPRINT (kg CO <sub>2</sub> eq)	PHASE	%	CARBON FOOTPRINT (kg CO <sub>2</sub> eq)	PHASE	%
LOCAL (<200 km)	FRESH	0.941	Field	54%	/	/	/	/	/	/
			Refrig	34%						
			Transport	13%						
	CANNED	0.965	Field	52%	0.965	Field	52%	0.965	Field	52%
			Canned	44%		Canned	44%		Canned	44%
			Transport	4%		Transport	4%		Transport	4%
	FROZEN	1.955	Field	26%	2.337	Field	22%	2.806	Field	18%
			Freeze	68%		Freeze	57%		Freeze	47%
			Refrig	4%		Refrig	20%		Refrig	33%
			Transport	2%		Transport	2%		Transport	1%
200 - 1000 km	FRESH	1.153	Field	44%	/	/	/	/	/	/
			Refrig	28%						
			Transport	28%						
	CANNED	1.032	Field	49%	1.032	Field	49%	1.032	Field	49%
			Canned	41%		Canned	41%		Canned	41%
			Transport	10%		Transport	10%		Transport	10%
	FROZEN	2.026	Field	25%	2.408	Field	21%	2.877	Field	18%
			Freeze	66%		Freeze	55%		Freeze	46%
			Refrig	4%		Refrig	20%		Refrig	33%
			Transport	5%		Transport	4%		Transport	4%
SHIP (10,000 km)	FRESH	1.160	Field	43%	/	/	/	/	/	/
			Refrig	23%						
			Transport	33%						
	CANNED	1.053	Field	48%	1.053	Field	48%	1.053	Field	48%
			Canned	40%		Canned	40%		Canned	40%
			Transport	12%		Transport	12%		Transport	12%
	FROZEN	2.033	Field	25%	2.336	Field	22%	2.708	Field	19%
			Freeze	65%		Freeze	57%		Freeze	49%
			Refrig	4%		Refrig	16%		Refrig	28%
			Transport	6%		Transport	5%		Transport	5%

Impact due to consumption of peas per 1 kg of edible food  
 Source: Sordi, 2011 updated with BCFN data, 2016



### Impacts of beef

Beef comes from calves and cows. The following diagram presents a few possible scenarios for the production, storage, and sale of red meat.

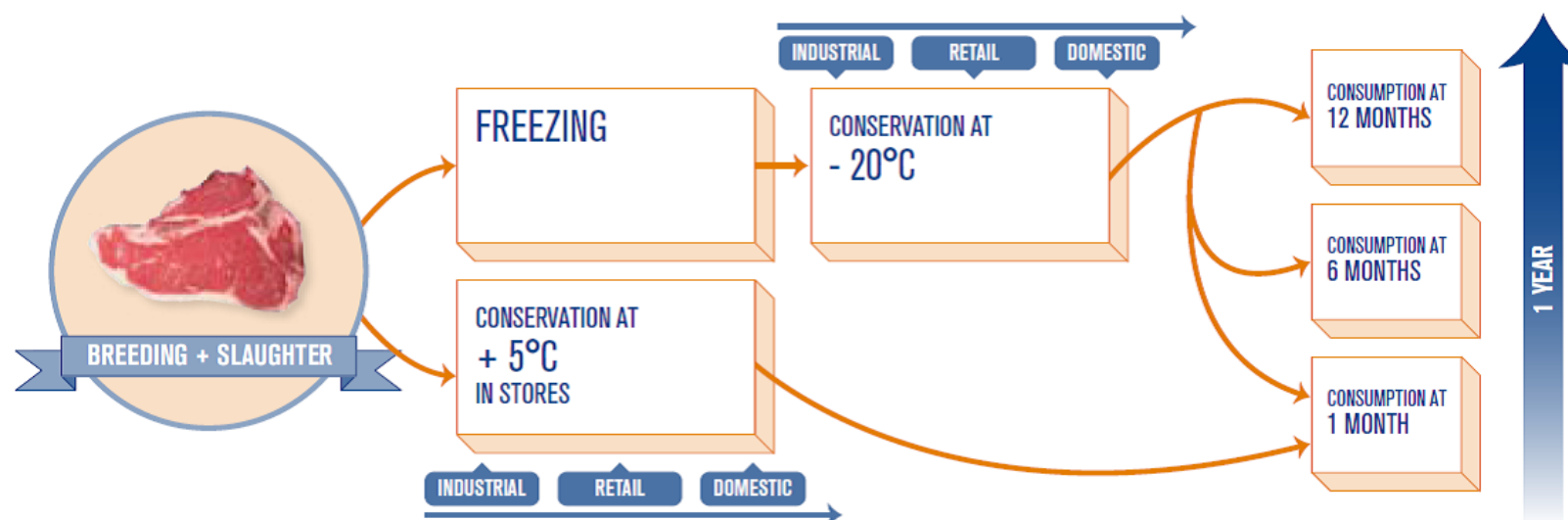
As regards the calculation of the environmental impacts, the main assumptions are as follows:

- The carbon footprint of the production phase of the meat refers to the Double Pyramid 2016 figures obtained by averaging 73 different impact data items.

- For the sake of calculation relating to storage, a specific weight equal to  $950 \text{ kg/m}^3$  was hypothesized;
- Storage time for fresh meat is assumed respectively at 15 days (industrial), 2 days (supermarket), and 2 days (domestic), respectively.

Meat is a totally different food type from the two products of plant origin previously considered, as breeding is characterized by almost negligible impacts as far as transport and storage are concerned. Deep-freezing, a phase which has a

great impact on plant-based foods, here involves a percentage of little significance, with maximum values of about 5%. In this case, too, the data for the storage of frozen products appears to increase significantly with the passing of the months of storage.



Possible scenarios for the consumption of beef  
Source: BCFN 2012



DISTRIBUTION TYPE	CONSERVATION	STORAGE TIMES								
		1 MONTH			6 MONTHS			12 MONTHS		
		CARBON FOOTPRINT (kg CO <sub>2</sub> eq)	PHASE	%	CARBON FOOTPRINT (kg CO <sub>2</sub> eq)	PHASE	%	CARBON FOOTPRINT (kg CO <sub>2</sub> eq)	PHASE	%
LOCAL (<200 km)	FRESH	25.839	Breed + Slaugh	99.8%	/	/	/	/	/	/
			Refrig	0.1%						
			Transport	0.2%						
	FROZEN	27.196	Breed + Slaugh	94.8%	27.398	Breed + Slaugh	94.1%	27.644	Breed + Slaugh	93.3%
			Freeze	4.9%		Freeze	4.8%		Freeze	4.8%
			Refrig	0.2%		Refrig	0.9%		Refrig	1.8%
			Transport	0.1%		Transport	0.1%		Transport	0.1%
	FRESH	25.910	Field	99.5%	/	/	/	/	/	/
			Refrig	0.1%						
			Transport	0.4%						
200 - 1000 km	FROZEN	27.267	Breed + Slaugh	94.6%	27.469	Breed + Slaugh	93.9%	27.715	Breed + Slaugh	93.0%
			Freeze	4.9%		Freeze	4.8%		Freeze	4.8%
			Refrig	0.2%		Refrig	0.9%		Refrig	1.8%
			Transport	0.4%		Transport	0.4%		Transport	0.4%
	FRESH	25.924	Breed + Slaugh	99.5%	/	/	/	/	/	/
			Refrig	0.1%						
			Transport	0.5%						
	FROZEN	27.281	Breed + Slaugh	94.5%	27.442	Breed + Slaugh	94.0%	27.688	Breed + Slaugh	93.1%
			Freeze	4.9%		Freeze	4.8%		Freeze	4.8%
			Refrig	0.2%		Refrig	0.9%		Refrig	1.8%
			Transport	0.5%		Transport	0.3%		Transport	0.3%

Impact due to consumption of meat per 1 kg of edible food  
 Source: Sordi, 2011 updated with BCFN data, 2016



Comparison of foods considered

The following figures show the contribution to the total impact from the technologies that come into play in the cold chain for each food item and for each

scenario.  
**Orange** indicates the amount of total impact due to the conservation of the food. The impacts related to refrigerated shipping containers, refrigeration systems on road vehicles, warehouses, cold rooms,

display cabinets, and home refrigerators all contribute to this amount. **Blue** indicates the share of impact attributable to deep freezing.



Food comparison relative to the cold chain technology  
Source: Sordi, 2011 updated with BCFN data, 2016



In brief, we see that:

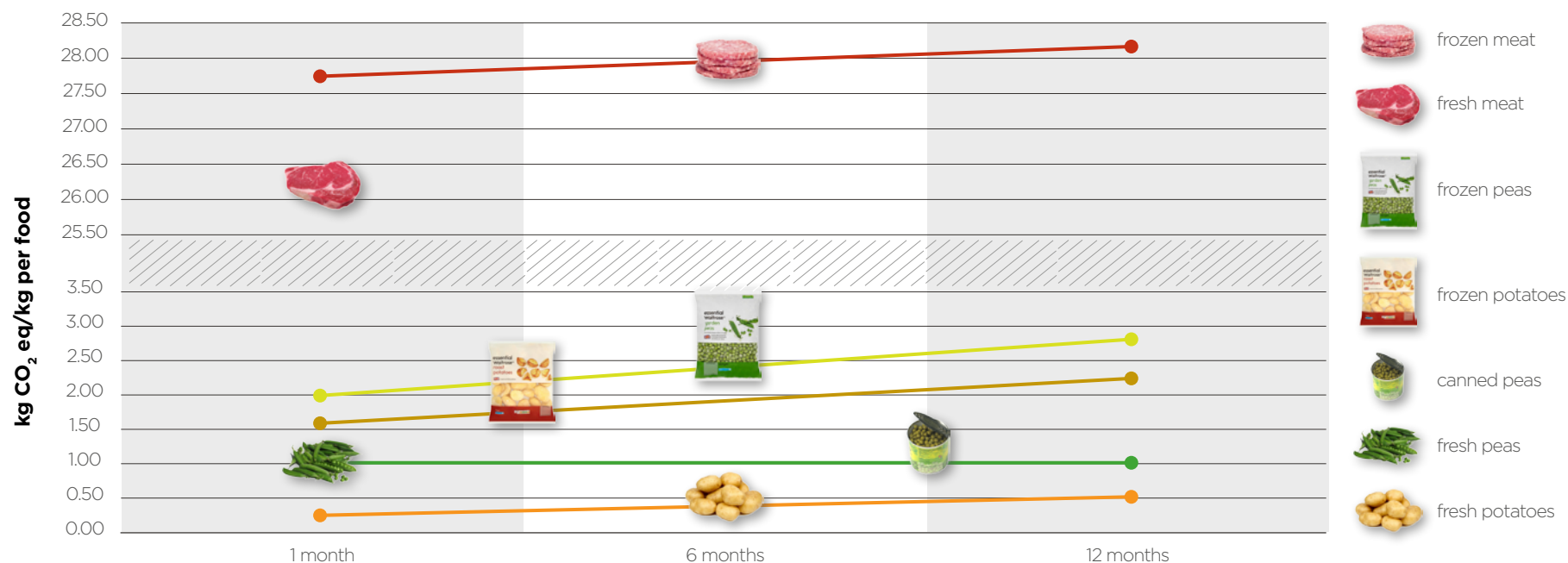
- For **potatoes and peas**, CO<sub>2</sub>eq emitted to activate the various refrigeration technologies is rather high, especially in the case of frozen food. A very high proportion is, in fact, due to freezing. In the long-term, storage time also plays a fundamental role;
- For meat, given that the initial impact is especially high, the duration of the cold chain is an almost negligible factor when considered as part of the total result. In this case, detailed analysis of the

cold chain is uncalled for, as the largest share of the impact comes from the primary production of meat.

The considerations presented, albeit of a preliminary nature, have shown quite clearly how the cold chain is an important factor. In particular, it should be noted that - from a purely environmental point of view - products of vegetable origin should always be consumed when in season and fresh.

However, this discussion should not be generalized:

certain foods such as meat have a low relative impact on transport and conservation as compared with the impact of its production; this is therefore important when considering the environmental characteristics of a product.



Food comparison of the share relative to the cold chain technology

Source: Sordi, 2011 updated with BCFN data, 2016

FOOD COOKING TECHNIQUES

Cooking techniques can be widely diverse, according to the recipe, the consumer’s own personal tastes (e.g. steamed or boiled vegetables, underdone or well-cooked meat), and whether the dish is homemade or cooked in a professional kitchen. It is, therefore, not simple to objectively quantify the environmental impact of cooking per food kilogram. The estimate of environmental impacts associated with the cooking phase of foods was further detailed by analyzing the literature available and integrating

it with several contributions made by companies operating in the sector.

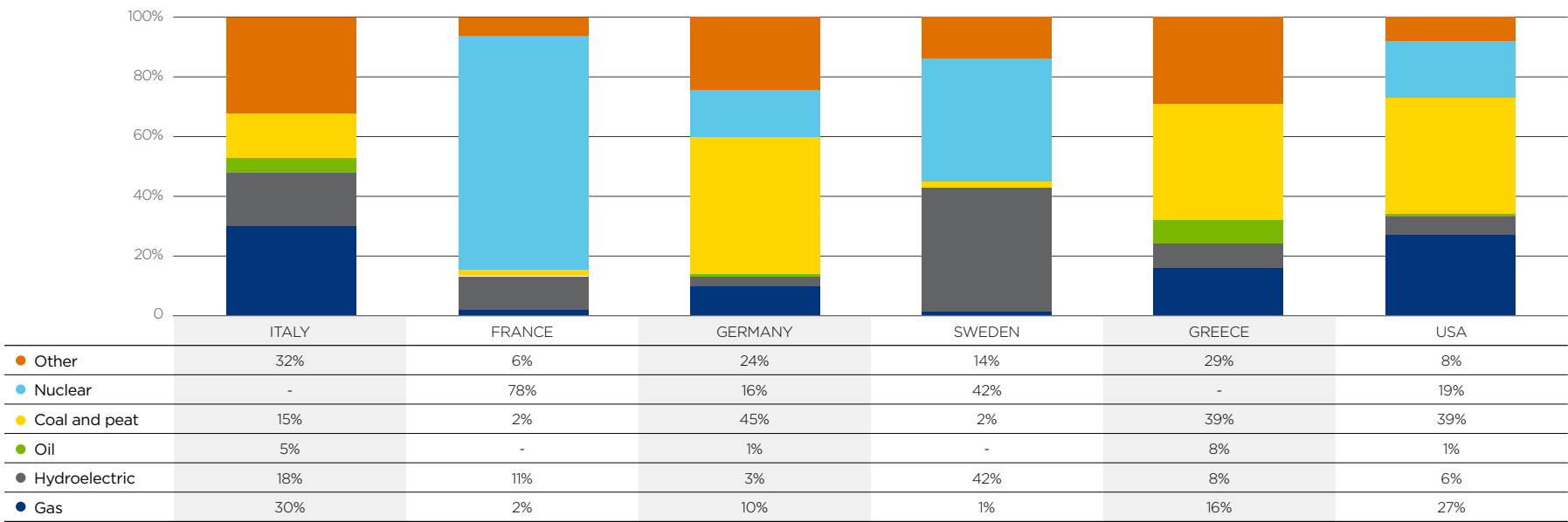
Energy consumption and relative emissions during cooking

The cooking phase involves the use of thermal energy obtained using gas or electricity. Environmental impacts, mainly carbon dioxide emissions, vary according to the technology and reference mix employed. Therefore, before looking at individual

assumptions, it is best to provide information on emissions of CO<sub>2</sub> equivalent in all the cases considered.

In the case of **electricity**, calculations are certainly more complex given that the assessment must be based on resources used in each country for the production of energy. The energy mixes of reference presented below are taken from the International Energy Agency [IEA]<sup>57</sup>.

<sup>57</sup> IEA, 2015



Energy mix used to calculate the impacts associated with the production of electricity in the reference countries. The data is taken from the IEA report and refers to the production year 2014  
Source: BCFN elaboration on IEA data, 2016



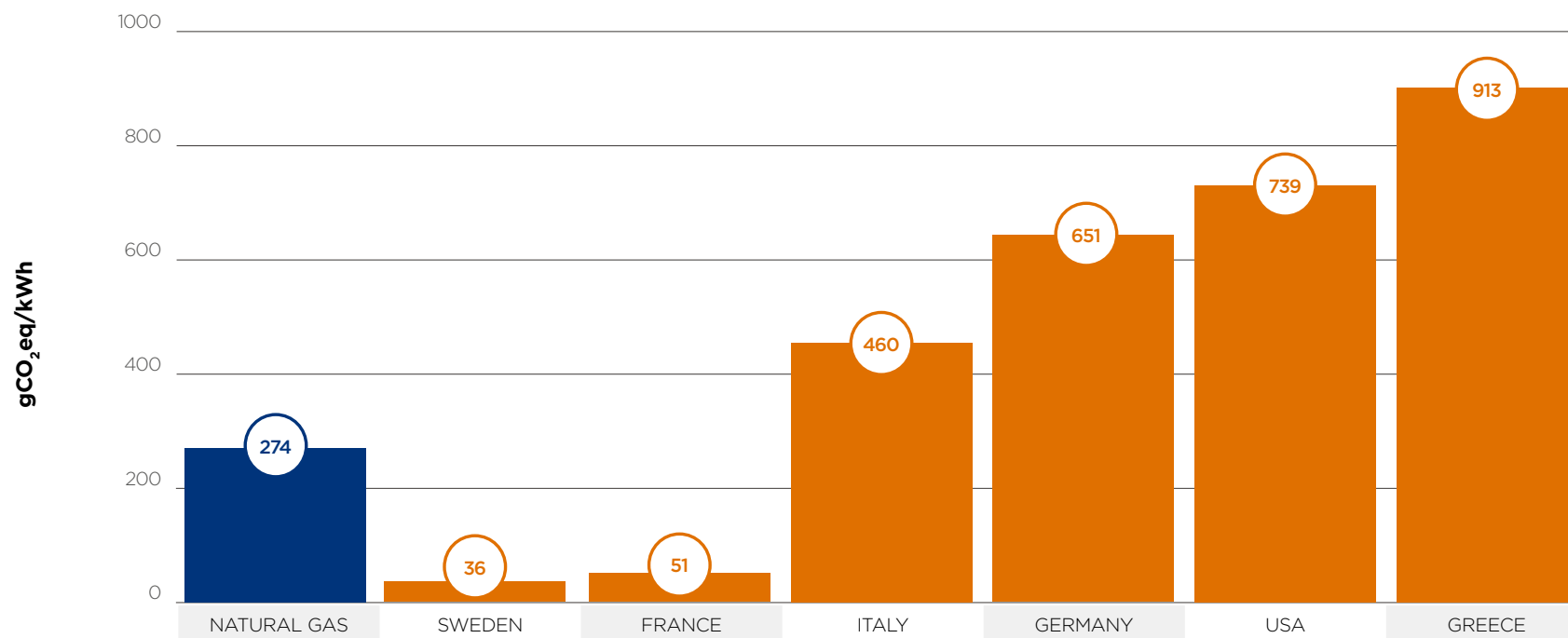
For a natural gas stove, an average figure was used, in light of the limited differences between countries. Basing calculations on CO<sub>2</sub> equivalent conversion coefficients published by the International Panel on Climate Changes [IPCC] in 2013<sup>58</sup>, the values expressed in grams per kWh of gas show an advantage for almost all countries except those where fossil fuel sources are minimized at the expense of renewable or nuclear energy. The figures

take into account the entire life cycle of kWh, from the extraction of primary fuels to energy distribution to the end user.

This analysis makes it possible to assess the variability of impacts related to cooking procedures depending on the energy mix of electricity in the various countries considered. In particular, in all cases based on an electricity system, the emissions of greenhouse

gases in countries such as Greece or the United States are greater in comparison with countries using the same technology, such as Sweden or France. Gas cooking yields average value impacts.

<sup>58</sup> IPCC, 2013.



Emission factors accounted for in the study  
 Source: BCFN elaborations on IEA 2014 & IPCC 2013





## Household cooking

Calculations for determining the environmental impact related to household cooking use an approach that starts from the installed power in the various systems and, based on cooking time, leads to the calculation of energy consumption, which in turn yields the environmental impacts for each form of technology and food involved. An important

distinction concerns boiling, in that the amount of energy consumed before reaching the boiling point can be quite significant.

The technologies considered are gas and electric stoves, the electric oven, and the microwave. In all cases, it must be pointed out that the figures below are purely indicative, as there are many variables that constitute the basis of household cooking and

these depend largely on the habits of the consumer. The aim of this study is a first analysis of the topic, followed by considerations about the environmental impact of consumer behaviour.

COOKING TECHNIQUE	ENERGY SOURCE						
	NATURAL GAS	ELECTRICITY					
		ITALY	SWEDEN	FRANCE	GERMANY	GREECE	USA
PAN PREPARATION	YES	YES	YES	YES	YES	YES	YES
BOILING	YES	YES	YES	YES	YES	YES	YES
OVEN	NO	YES	YES	YES	YES	YES	YES
MICROWAVE	NO	YES	YES	YES	YES	YES	YES

Energy production systems considered for the assessments of environmental impacts in the various cooking techniques

Source: BCFN elaborations



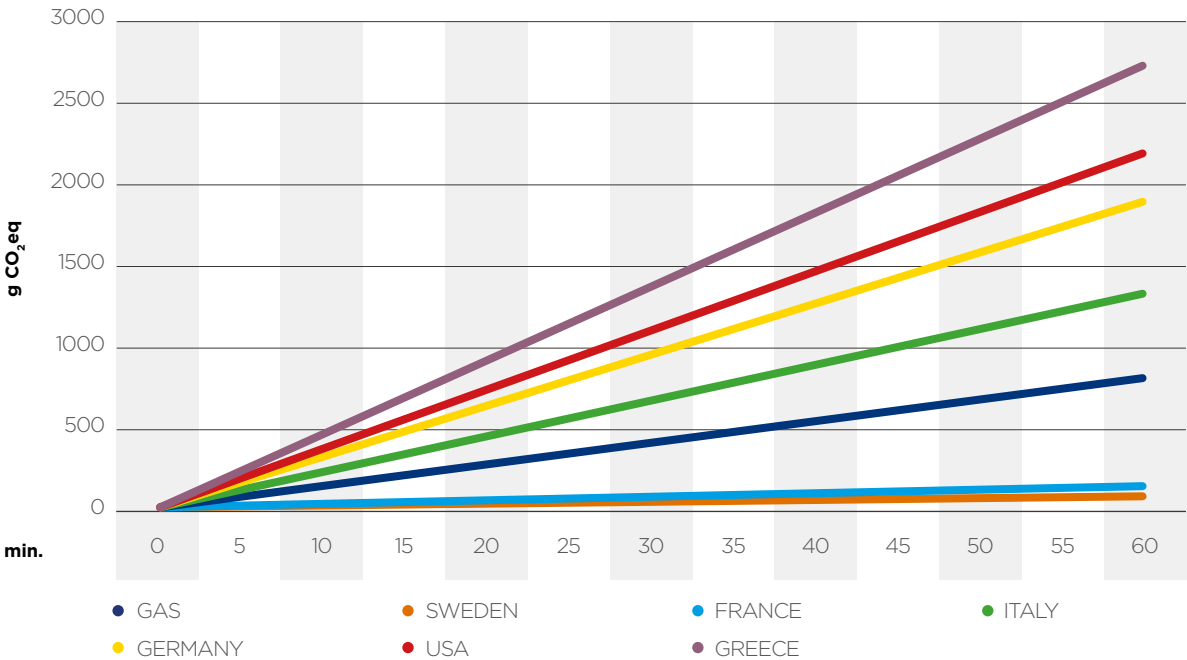
Stove – Pan preparation

When cooking with an electric or gas stove, the power varies according to the type of stove in question: the typical values range from about 1 kW of auxiliary burner (small saucepan burner) to about 4 kW for a larger model. The value considered in this paper is 3 kW. To simplify calculations, the stove is hypothesized at the maximum available power. In addition, the time necessary to heat the pan is overlooked, given that it is negligible.

Based on these assumptions, it is possible to calculate the energy required for different cooking times and, therefore, its carbon footprint. The scenarios illustrated in the table concern gas and electrical stoves in Italy, and the hotplate for some European countries (Sweden, France, Germany, and Greece) and the United States. The decision to illustrate more than one case for the electrical system is useful in order to show the difference in impacts when using the same system in countries where electricity is produced with very different technologies.

STOVE POWER	3	kW
TRANSMISSION EFFICIENCY	55%	-
PREHEATING	-	minutes
USE FACTOR (POWER USED/TOTAL)	100%	-

Assumptions for the calculation the environmental impact for pan preparations  
Source: BCFN elaborations, 2016



Energy consumption and environmental impacts for the use of a gas and electric power of 3 kW  
Source: BCFN elaborations on IEA 2014 & IPCC 2013



COOKING MINUTES	TOTAL MINUTES	kWh	gwp GAS	GWP electric ITALY	GWP electric SWEDEN	GWP electric FRANCE	GWP electric GERMANY	GWP electric GREECE	GWP electric USA
1	1	0.05	14	23	2	3	33	46	37
2	2	0.10	27	46	4	5	65	91	74
3	3	0.15	41	69	5	8	98	137	111
4	4	0.20	55	92	7	10	130	183	148
5	5	0.25	68	115	9	13	163	228	185
6	6	0.30	82	138	11	15	195	274	222
7	7	0.35	96	161	13	18	228	320	259
8	8	0.40	109	184	14	20	260	365	296
9	9	0.45	123	207	16	23	293	411	333
10	10	0.50	137	230	18	26	326	457	370
15	15	0.75	205	345	27	38	488	685	554
20	20	1.00	274	460	36	51	651	913	739
30	30	1.50	410	690	54	77	977	1370	1109
45	45	2.25	616	1035	81	115	1465	2054	1663
60	60	3.00	821	1380	108	153	1953	2739	2217
90	90	4.50	1231	2070	162	230	2930	4109	3326
120	120	6.00	1642	2760	216	306	3906	5478	4434

Energy consumption and environmental impacts for the use of gas and electric power at 3 kW  
 Source: BCFN elaborations on IEA 2014 & IPCC 2013



### Stove – boiling

Boiling is one of the different cooking methods for which stoves/hotplates are used and shall be examined (omitting the time needed to reach the boiling point, which depends primarily on the amount of water used). In this case, too, consumer habits are important (such as salting water only after boiling or using a lid). For the sake of simplicity, the only option considered is using the same stove at full 3 kW power. The calculation is then made by dividing the process into two phases:

- Boiling, whose impact on the calculation in this paper depends only on the quantity of water;
- Cooking, whose impact depends on the amount of time the appliance is used.

With regard to boiling, the impact calculation was carried out by applying the rules of thermodynamics with the following formula:

$$Q = m * c_p * \Delta T$$

Where:

- **Q** is the theoretical energy requirement;
- **m** is the mass of water;
- **c<sub>p</sub>** is specific heat (at constant pressure) of the water;
- **ΔT** is the temperature difference considered.

Based on the assumptions presented below, and taking into account a stove – pot system transmission efficiency of 55%, energy requirement assessment stands at 0.18 kWh per litre of water.

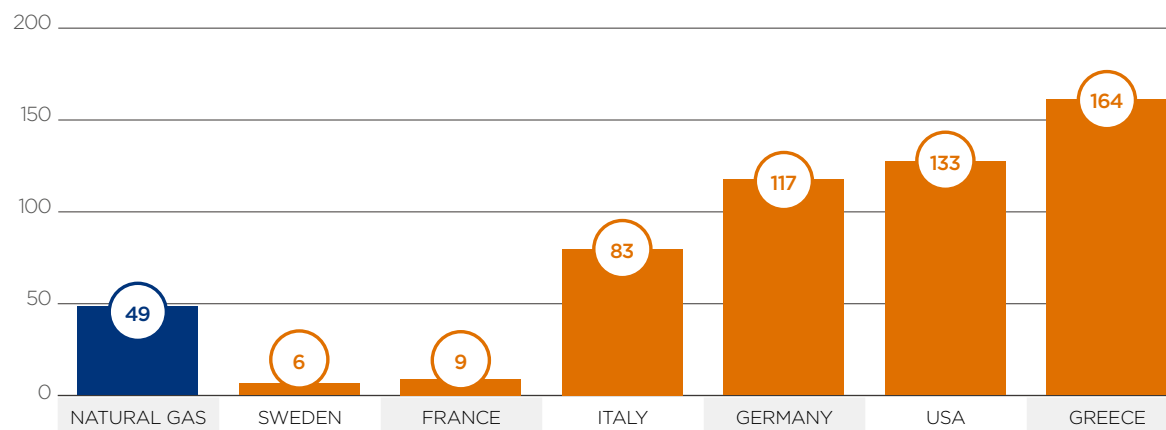
STOVE POWER	POWER INSTALLED	3	kW
	TRANSMISSION EFFICIENCY	0.55	-
ENERGY TO REACH BOILING POINT	SPECIFIC HEAT OF WATER (25-100°C)	4.181	J/kg*K
	TEMPERATURE CHANGE (FROM 15 TO 100 °C)	85	K
	THEORICAL EXAMPLE (PER KG)	0.36	MJ/kg
		0.10	kWh/kg
	ACTUAL ENERGY (PER KG)	0.18	kWh/kg

Assumptions for calculating the energy required to boil 1 liter of water (1 kg = 1 liter)

Source: BCFN elaborations, 2016

The Carbon Footprint is calculated on the basis of this energy consumption value and under the same assumptions as previously stated. Once the water has reached the boiling point and the actual cooking process begins, energy consumption and the resulting environmental impact are calculated in proportion to cooking time.

The analysis of these calculations reveals that the quantity of water used in the boiling process is extremely significant for the calculation of the environmental impact. An interesting example of this is provided by pasta cooking, which is dealt with below.



Carbon footprint for boiling 1 liter of water under the same assumptions stated previously

Source: BCFN elaborations on IEA 2014 & IPCC 2013

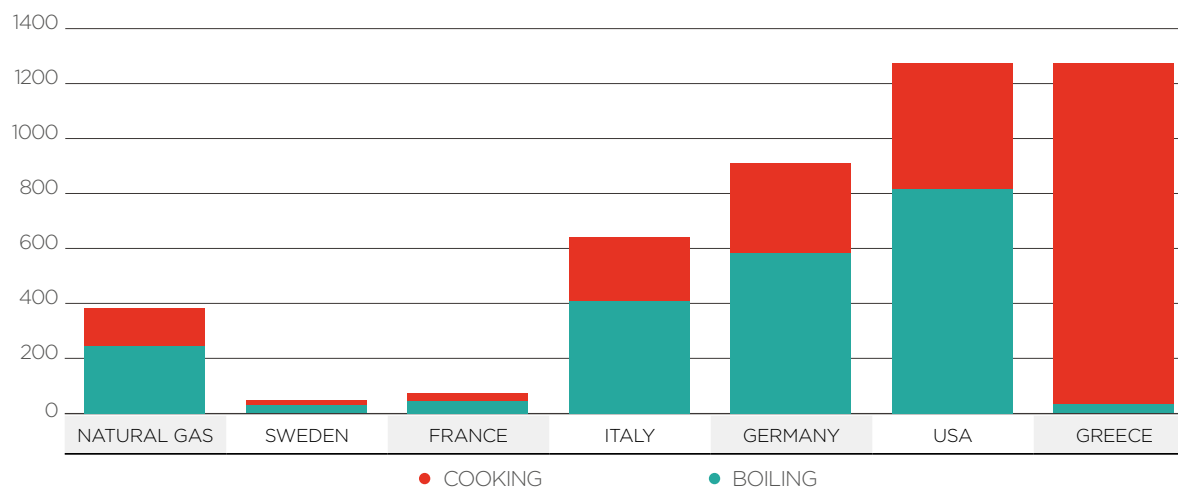
## Cooking pasta

The standard advice of pasta makers is to use a quantity of water equal to ten times the amount of product being cooked: 500 grams should therefore use 5 litres of water. It is interesting to consider how the use of different amounts can affect energy consumption and their impacts in terms of CO<sub>2</sub> equivalent.

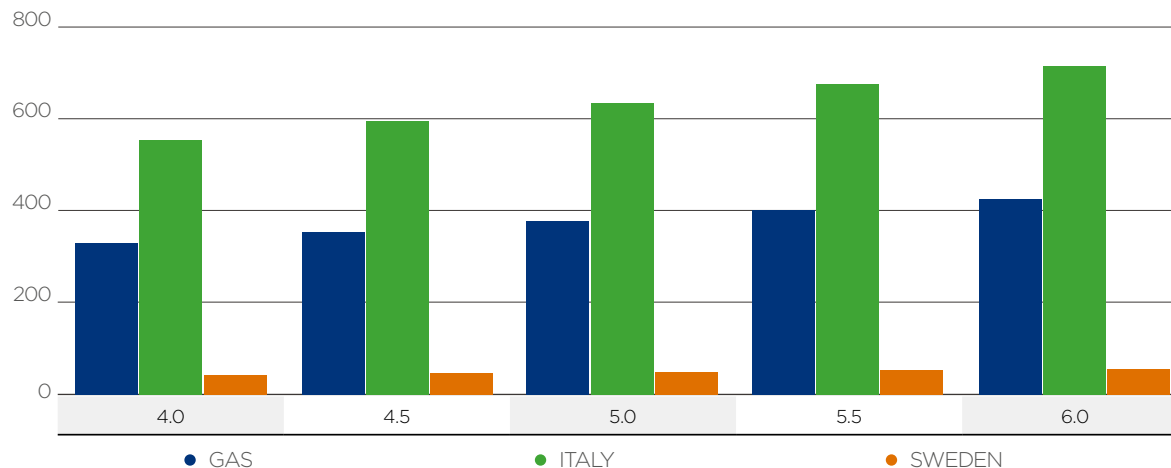
Assuming a factor of 1:10 and cooking time of 10 minutes, and adopting the assumptions already made concerning boiling water, it is possible to calculate the impacts associated with cooking pasta, (in this case, 500 grams of pasta).

At this point, it is interesting to examine how, notwithstanding the assumptions and the model used, the various environmental impacts vary in relation to the amount of water used for cooking. The diagram below shows the impact for a smaller and a larger amount of water used for cooking 500 grams of pasta. In addition to the case of water usage, substantially different energy mixes for gas cooking (in this case, in Italy and Sweden) were taken into account.

It is interesting to assess how a variation of the quantity of water used yields significant differentiations of impact: -20% water corresponds to -13% GHG emissions for gas cooking procedures.



Carbon footprint for cooking 500 grams of pasta with 5 liters of water in 10 minutes  
 Source: BCFN elaborations on IEA 2014 & IPCC 2013



Carbon footprint for cooking 500 grams of pasta assuming a variable pasta/water ratio of ± 20% and a cooking time of 10 minutes.  
 The 5 litres of water were held to adhere to typical cooking recommendations  
 Source: BCFN elaborations on IEA 2014 & IPCC 2013





### Traditional electric oven and microwave

For baking and roasting in an electric oven, the calculation is performed with an approach similar to that for boiling, as it is necessary to divide the impact into two consecutive phases:

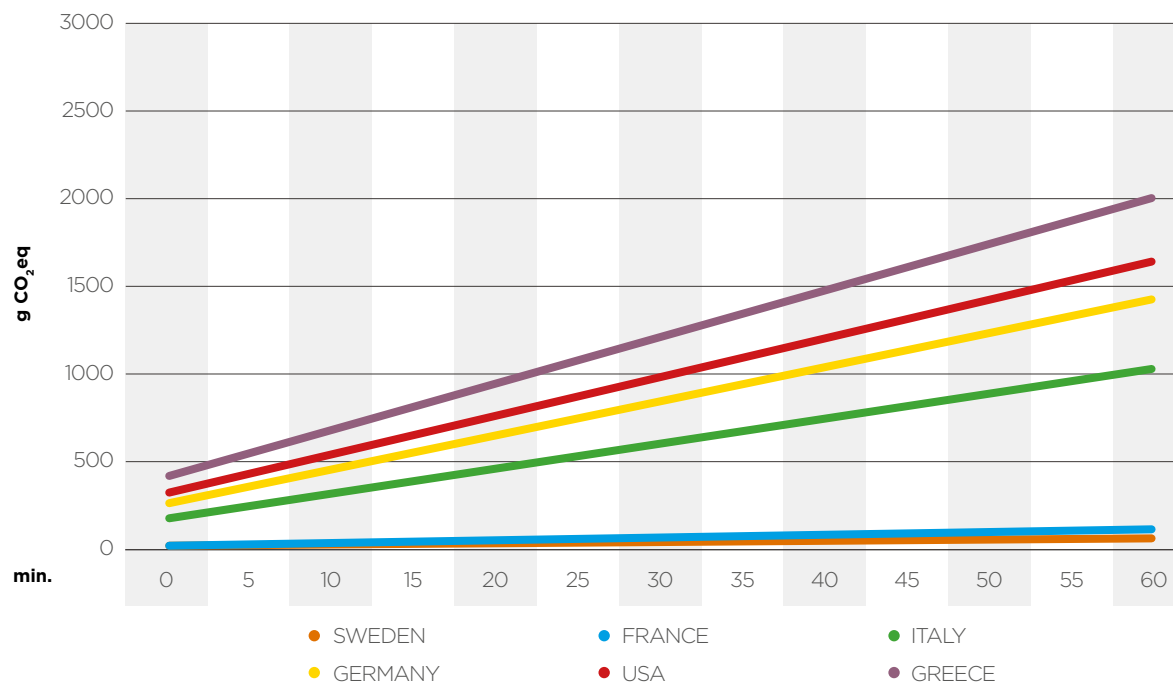
- Pre-heating the oven to the required temperature for use;
- Cooking phase where the oven is used to prepare the food.

Again, the impact assessment is carried out by adopting the simplifying assumptions that are summarized below:

- Installed capacity of the oven: 2.5 kW;
- Average power user factor: 70%. This percentage represents the assumption of the actual amount of power which the oven is using;
- Pre-heating time: 15 minutes.

OVEN POWER	2.5	kW
PREHEATING	15	minutes
USE FACTOR (POWER USED/TOTAL)	70%	-
TRANSMISSION EFFICIENCY	100%	-

Hypotheses for the calculation of the impacts using an electric oven  
 Source: BCFN elaborations, 2016



Carbon Footprint for the use of a traditional electric oven - country comparison  
 Source: BCFN elaborations on IEA 2014 & IPCC 2013

MINUTES	TOTAL MINUTES	kWh	GWP electric ITALY	GWP electric SWEDEN	GWP electric FRANCE	GWP electric GERMANY	GWP electric GREECE	GWP electric USA
0	15	0.44	201	16	22	285	399	323
1	16	0.47	215	17	24	304	426	345
5	20	0.58	268	21	30	380	533	431
10	25	0.73	335	26	37	475	666	539
15	30	0.88	403	32	45	570	799	647
20	35	1.02	470	37	52	665	932	754
25	40	1.17	537	42	60	760	1065	862
30	45	1.31	604	47	67	854	1198	970
35	50	1.46	671	53	74	949	1331	1078
40	55	1.60	738	58	82	1044	1465	1185
45	60	1.75	805	63	89	1139	1598	1293
50	65	1.90	872	68	97	1234	1731	1401
55	70	2.04	939	74	104	1329	1864	1509
60	75	2.19	1006	79	112	1424	1997	1617
90	105	3.06	1409	110	156	1994	2796	2263
120	135	3.94	1811	142	201	2563	3595	2910

Energy consumption and environmental impact for use of an electrical oven

Source: BCFN elaborations on IEA 2014 & IPCC 2013

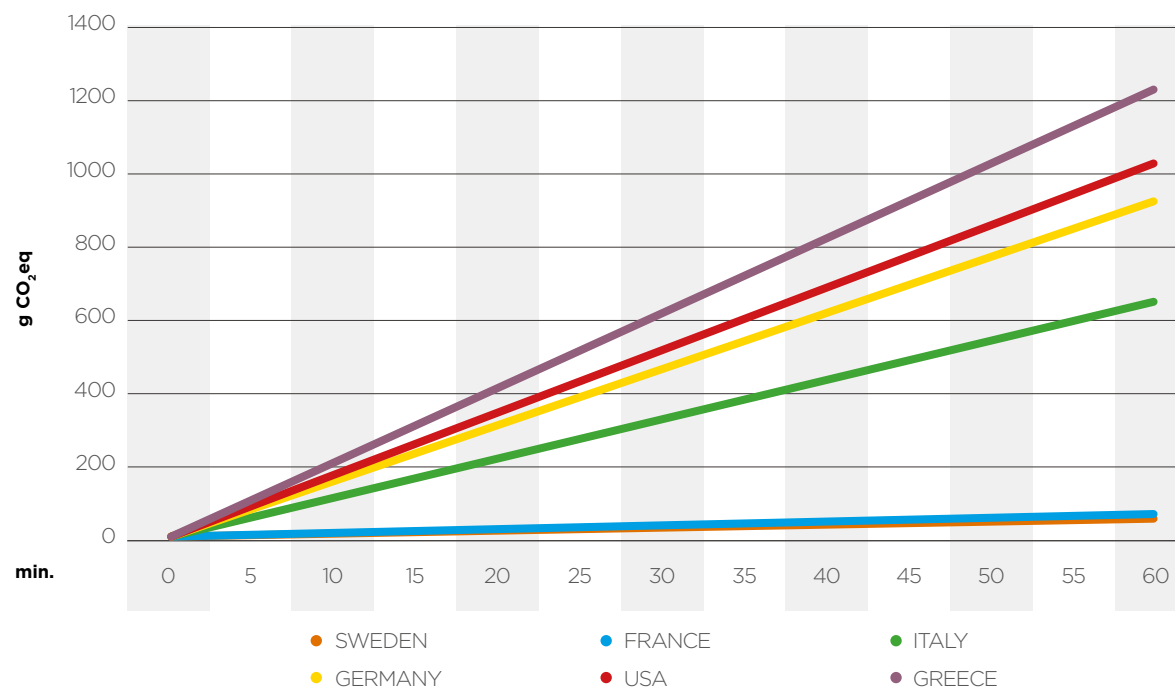


Based on the same calculation approach used for traditional ovens, an assessment was made for cooking with a microwave oven. The detailed assumptions are as follows:

- Power considered: 2 kW;
- Average power use factor: 70%.

OVEN POWER	2	kW
PREHEATING	0	minutes
USE FACTOR (POWER USED/TOTAL)	70%	-
TRANSMISSION EFFICIENCY	100%	-

Hypotheses for the calculation of the impacts of microwave cooking  
 Source: BCFN elaborations, 2016



Carbon Footprint for the use of a microwave oven - country comparison  
 Source: BCFN elaborations on IEA 2014 & IPCC 2013

MINUTES	TOTAL MINUTES	kWh	GWP electric ITALY	GWP electric SWEDEN	GWP electric FRANCE	GWP electric GERMANY	GWP electric GREECE	GWP electric USA
1	1	0.02	11	1	1	15	21	17
5	5	0.12	54	4	6	76	107	86
10	10	0.23	107	8	12	152	213	172
15	15	0.35	161	13	18	228	320	259
20	20	0.47	215	17	24	304	426	345
25	25	0.58	268	21	30	380	533	431
30	30	0.70	322	25	36	456	639	517
35	35	0.82	376	29	42	532	746	604
40	40	0.93	429	34	48	608	852	690
45	45	1.05	483	38	54	684	959	776
50	50	1.17	537	42	60	760	1,065	862
55	55	1.28	590	46	65	835	1,172	948
60	60	1.40	644	50	71	911	1,278	1,035
90	90	2.10	966	76	107	1,367	1,917	1,552
120	120	2.80	1,288	101	143	1,823	2,556	2,069

Energy consumption and environmental impact for use of a microwave oven  
 Source: BCFN elaborations on IEA 2014 & IPCC 2013



### Comparison between different cooking methods

After presenting each case, it is interesting to compare the different cooking techniques to form an idea of how the impacts vary from case to case and on the basis of cooking time. Once again, it is necessary to reiterate that such comparisons are purely indicative and preliminary, especially considering that in many cases the cooking techniques are not alternatives, with results that vary greatly. The graphs shown below were prepared in the light of the assumptions presented above. Boiling is set at 3 litres of water, which is deemed useful for almost all processes

related to the preparation of four portions of food. The following charts show how this comparison will lead to different results depending on the country in question and, consequently, the energy mix used to produce electricity. In principle, the general considerations that arise are as follows:

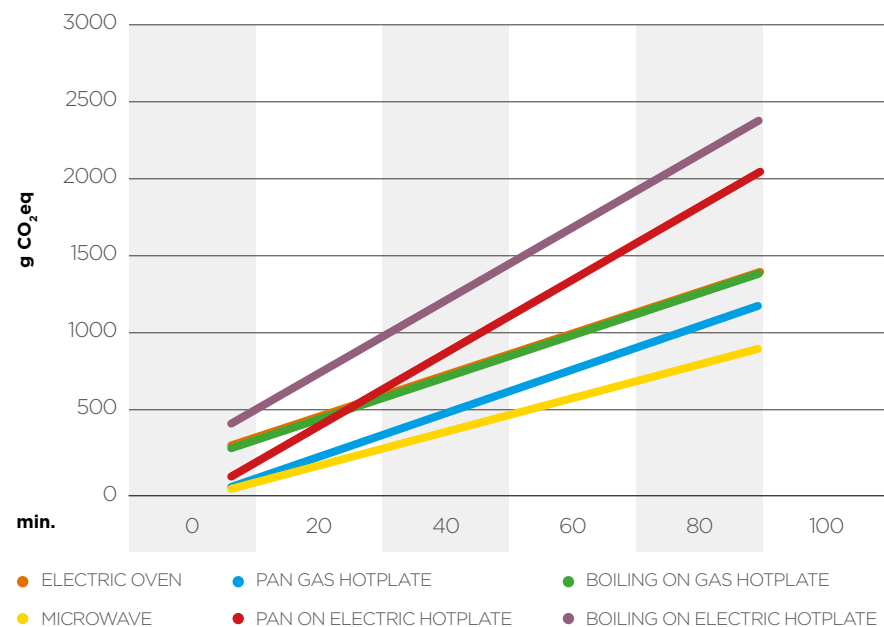
- The power system in Italy is usually the worst in terms of greenhouse gas emissions, even though less use of the microwave helps reduces the disadvantage;
- Countries such as Sweden, where energy is produced with less reliance on fossil fuels and is therefore characterized by lower values of CO<sub>2</sub>

equivalent per kWh, are those that yield lower environmental impacts than those with gas systems.

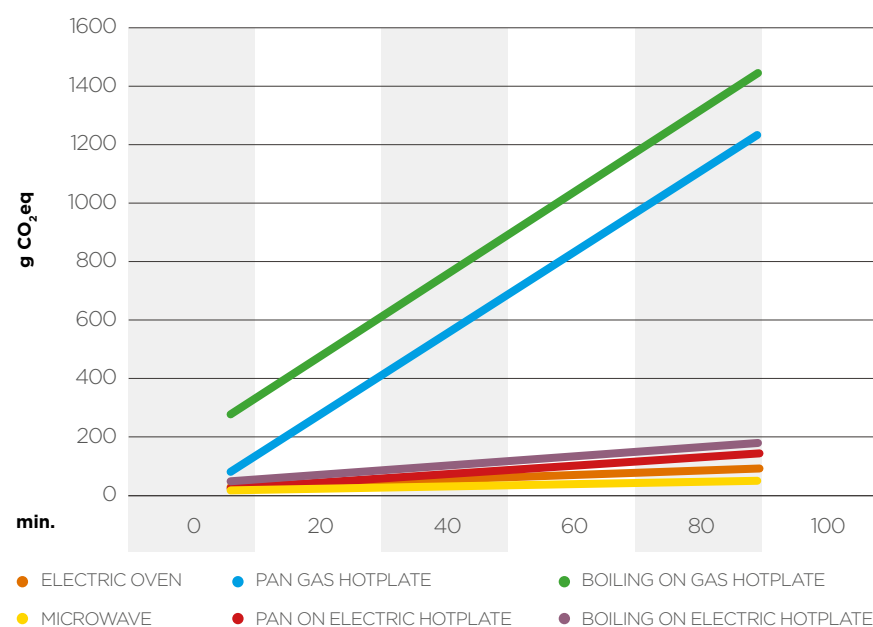
As a final comparison, reference is made to two situations that are extremely different: Italy and Sweden. The impacts in terms of CO<sub>2</sub> equivalent for these two countries, for all types of cooking analyzed, are listed below.

<sup>59</sup> For boiling and cooking in an electric oven, the minutes are counted starting from when useful cooking conditions are reached. Boiling takes 3 liters of water into account.

<sup>60</sup> For boiling and cooking in an electric oven, the minutes are counted starting from when useful cooking conditions are reached. Boiling takes 3 liters of water into account.



Environmental impacts of the various cooking techniques in Italy<sup>59</sup>  
 Source: BCFN elaborations on IEA 2014 & IPCC 2013



Environmental impacts of the various cooking techniques in Sweden<sup>60</sup>  
 Source: BCFN elaborations on IEA 2014 & IPCC 2013





### Impacts due to cooking

In order to correlate the environmental impacts to the quantity of food cooked and, thus, achieve results similar to those presented in the first edition of the paper, assumptions on the amount of food cooked with each technique, and its cooking time, must be made. These elaborations must also be considered indicative, as many depend on consumer habits. The assumptions used in the preparation of this paper are listed below and are defined in relation to household food preparation for four people in average conditions. In addition to those specified in

the table, the following conditions were taken into account:

- With regard to boiling, all cases make reference to three litres of water, and the cooking time commences from when the water is boiling and the food is placed in the water;
- In the case of the electric oven, cooking time starts after preheating the oven, which has been set at 15 minutes;
- The impacts were calculated by taking into account the portions shown in the table and then re-dimensioned for a quantity equal to 1 kg of food; similar to what is shown in the Double

### Pyramid Paper of 2010

By way of example, this paper will present the comparison between the environmental impacts of food cooked by gas and on a hotplate in both Italy and Sweden, given that these cases are the most distant and representative of the differences between the various energy mixes considered.

<sup>6</sup> The data is expressed in grams of CO<sub>2</sub> equivalent for the amount of each food stated. The quantities are relevant to the preparation of about 4 servings.

FOOD	QUANTITY	COOKING TECHNIQUE	HYPOTHESIS	fixed kWh	kWh min	minutes	kWh tot.	Gas [gCO <sub>2</sub> eq]	GWP electric - I [gCO <sub>2</sub> eq]	GWP electric - S [gCO <sub>2</sub> eq]
RED MEAT	600 g	Hotplate – Pan	Slice: 5 minutes	0	0.05	5	0.25	68	115	9
			Stew: 2 h	0	0.05	120	6.00	1.642	2.760	216
		Hotplate - Bolling	Boiled meat: 2 h	0.75	0.05	120	6.75	1.847	3.105	243
		Electric oven	Roast: 20 minutes	0.44	0.03	20	1.04	-	478	37
		Microwave	Pepper steak: 12 minutes	0	0.02	12	0.24	-	110	9
WHITE MEAT	600 g	Hotplate – Pan	Slice: 5 minutes	0.00	0.05	5	0.25	68	115	9
		Hotplate - Bolling	Boiled chicken: 1,5 h	0.75	0.05	90	5.25	1.437	2.415	189
		Electric oven	Roast chicken: 45 minutes	0.44	0.03	45	1.79	-	823	64
		Microwave	Lemon chicken: 12 minutes	0.00	0.02	12	0.24	-	110	9
FISH	600 g	Hotplate – Pan	Slice fish on pan (steamed)	0	0.05	10	0.50	137	230	18
		Hotplate - Bolling	Boiled fish: 5 minutes	0.75	0.05	5	1.00	274	460	36
			Fish soup: 1 h	0.75	0.05	60	3.75	1.026	1.725	135
		Electric oven	Oven fish: 10 minutes	0.44	0.03	10	0.74	-	340	27
		Microwave	Lemon sea bream: 10 minutes	0	0.02	10	0.20	-	92	7

Carbon footprint relative to the preparation of several recipes<sup>6</sup>  
 Source: BCFN elaborations on IEA 2014 & IPCC 2013



FOOD	QUANTITY	COOKING TECHNIQUE	HYPOTHESIS	fixed kWh	kWh min	minutes	kWh tot.	Gas [gCO <sub>2</sub> eq]	Enel - I [gCO <sub>2</sub> eq]	Enel - S [gCO <sub>2</sub> eq]
LEGUMES	600 g	Hotplate - Pan	-	0.00	0.05	-	0.00	-	-	-
		Hotplate - Bolling	Frozen: 5 minutes	0.75	0.05	5	1.00	274	460	36
			Fresh: from 20 to 40 minutes	0.75	0.05	35	2.50	684	1.150	90
			Dried: 1 h	0.75	0.05	60	3.75	1.026	1.725	135
		Electric oven	-	0.44	0.03	-	0.44	-	-	-
		Microwave	-	0.00	0.02	-	0.00	-	-	-
VEGETABLES	600 g	Hotplate - Pan	10 minutes	0.00	0.05	10	0.50	137	230	18
		Hotplate - Bolling	From 5 to 15 minutes depending on vegetable	0.75	0.05	10	1.25	342	575	45
		Electric oven	From 20 to 30 minutes depending on vegetable	0.44	0.03	25	1.19	-	547	43
		Microwave	Roast potatoes: 10 minutes	0.00	0.02	10	0.20	-	92	7
POTATOES	600 g	Hotplate - Pan	Fresh, 25 minutes	0.00	0.05	25	1.25	342	575	45
		Hotplate - Bolling	Frozen: 5 minutes	0.75	0.05	5	1.00	274	460	36
			Fresh: from 20 to 40 minutes	0.75	0.05	35	2.50	684	1.150	90
		Electric oven	Fresh: 35 minutes	0.44	0.03	35	1.49	408	685	54
		Microwave	Frozen: 5 minutes	0.00	0.02	5	0.10	27	46	4
PASTA	320 g	Hotplate - Pan	-	0.00	0.05	-	0.00	-	-	-
		Hotplate - Bolling	10 minutes	0.75	0.05	10	1.25	342	575	45
		Electric oven	-	0.44	0.03	-	0.44	-	-	-
		Microwave	-	0.00	0.02	-	0.00	-	-	-
RICE	320 g	Hotplate - Pan	-	0.00	0.05	-	0.00	-	-	-
		Hotplate - Bolling	20 minutes	0.75	0.05	20	1.75	479	805	63
		Electric oven	-	0.44	0.03	-	0.44	-	-	-
		Microwave	-	0.00	0.02	-	0.00	-	-	-
EGGS	8 eggs (480 g)	Hotplate - Pan	Fried egg: 1 minute	0	0.05	1	0.05	14	23	2
			Omelette: 3 minutes	0	0.05	3	0.15	41	69	5
		Hotplate - Bolling	7 minutes	0.75	0.05	7	1.10	301	506	40
		Electric oven	-	0.44	0.03	-	0.44	-	-	-
		Microwave	-	0	0.02	-	0.00	-	-	-



As might be supposed, the impacts vary not only according to the cooking technique but also in relation to the recipe prepared. It is therefore necessary to choose the most common recipes and consider only these in the calculations, in order to attribute a single value to the cooking of various foods.

FOOD	COOKING TECHNIQUE	COOKED QUANTITY [g]	IMPACT PER SERVING OF FOOD [gCO <sub>2</sub> eq]	IMPACT PER KG OF FOOD [gCO <sub>2</sub> eq]	ENERGETIC CONSUMPTION [kWh]	ECOLOGICAL FOOTPRINT [gm <sup>2</sup> year/kg]
RED MEAT	Pan - gas	600	68	114	0.42	0.3
WHITE MEAT	Pan - gas	600	68	114	0.42	0.3
FISH	Pan - gas	600	137	228	0.83	0.5
LEGUMES	Boiling - gas	600	274	456	1.67	1.1
EGGS	Boiling - gas	480	301	627	2.29	1.5
VEGETABLES	Pan - gas	600	137	228	0.83	0.5
POTATOES	Boiling - gas	600	274	456	1.67	1.1
PASTA	Boiling - gas	320	342	1,069	3.91	2.5
RICE	Boiling - gas	320	479	1,496	4.69	3.0

<sup>62</sup> The data in this table is used in the construction of the environmental food pyramids.

Calculation of impacts per kg of food cooked; the calculations are made in relation to a selection of the most typical recipes<sup>62</sup>  
 Source: BCFN elaborations on IEA 2014 & IPCC 2013 Source: BCFN elaborations, 2016



An example: the preparation of two cups of tea with a pot, kettle, or microwave

Based on the assumptions described previously, in this paragraph we present an example of how the environmental impact of a food can vary significantly depending on the cooking method chosen. The table below shows the environmental impacts, assessed in terms of emissions of CO<sub>2</sub> equivalent, caused by the preparation of two cups of tea (obtained by heating 0.5 litres of water) in three different ways: using a small pan on a gas stove, the microwave, and a kettle.

- Pan: the boiling of half a litre of water by heating

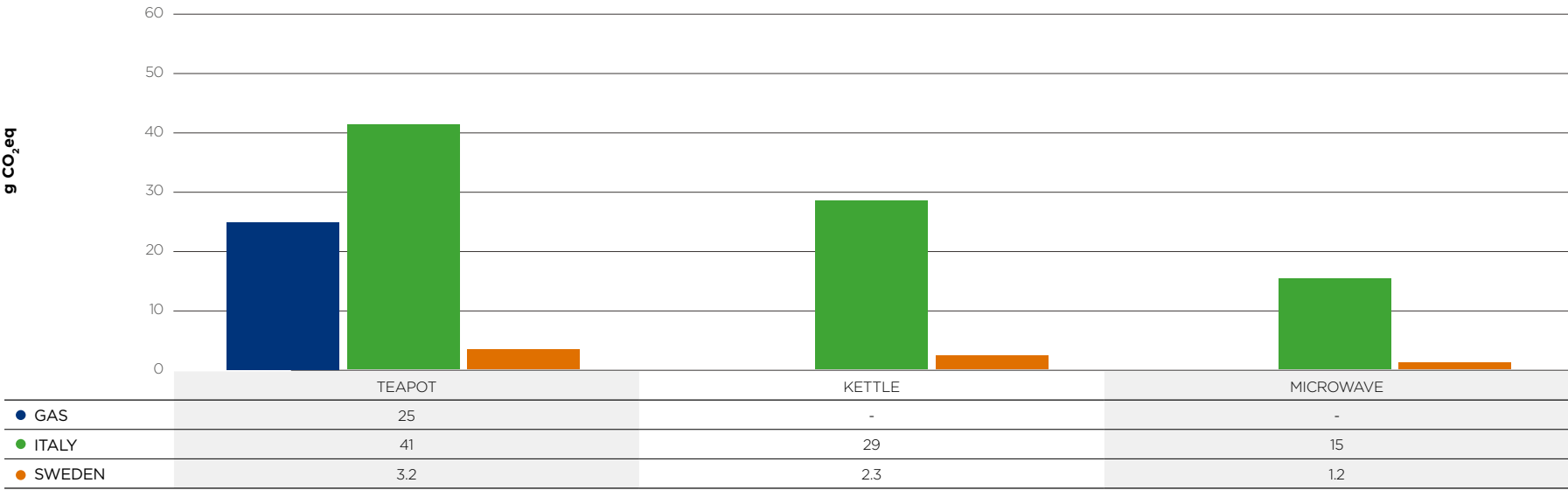
in a small pan on a 1 kW gas stove requires a direct consumption of about 0.09 kWh<sup>63</sup>;

- Microwave: the boiling of half a liter of water in a Pyrex teapot in a microwave oven using 1,000-W takes about two minutes for a total power consumption of about 0.03 kWh.
- Kettle: a 2,500-W electric kettle takes about a minute and a half to boil half a liter of water, which is the direct consumption of 62.5 watt hours (0.06 kWh).

The values of CO<sub>2</sub> equivalent can be calculated through conversion factors, thus showing how the

cooking speed of a microwave oven yields the lowest amount of GHG emission, even lower than the gas alternative.

<sup>63</sup> Hypotheses adopted: the useful energy required to bring water to the boiling point is 18 kWh/kg. A 55% transmission efficiency and utilization factor of 100% were hypothesized.



Carbon footprint for the preparation of two cups of tea in Italy and Sweden using different technologies. The teapot data for Italy and Sweden refers to the use of an electric hotplate.  
Source: BCFN elaborations on IEA 2014 & IPCC 2013



A particular case – the pressure cooker

One particular cooking technique is the use of the pressure cooker, which allows the saving of both water and energy as cooking times are typically lowered.  
Let's take a single example involving rice preparation. Assuming that the cooking time decreases from 20 to 10 minutes, and maintaining the impact for boiling water, savings about 135 grams of CO<sub>2</sub>eq for four serving (320g) can be obtained, which is about 430 grams per kg (calculated assuming the use of a gas stove).

Professional cooking

The calculation of the environmental impacts linked

to professional cooking uses an approach that starts from the installed power in the various technological systems and, based on cooking time, leads to the calculation of energy consumption and, thus, the environmental impacts for each technology and each food, as for domestic cooking.  
Before entering into the specific details, it is important to distinguish between professional and domestic cooking concerning preheating. Domestic cooking must account for certain phases of preparation (such as boiling water, or heating the oven), which can be quite significant overall. In professional cooking, however, the equipment is used for a large amount of product and this phase can thus be considered negligible.  
In this document, the technologies considered for professional cooking are pasta cookers, deep fryers, convection ovens, and braising pans. However, all

the information that follows must be considered purely indicative, as the variables that are the basis of professional cooking are manifold and depend largely on the habits of use of machinery. The data for each technology was taken from data sheets available on the website of an Italian manufacturer<sup>64</sup>.  
The aim of this study, as for that on domestic cooking, is to provide a rough analysis of the topic, as well as present several considerations about the environmental effects of professional cooking. Energy considerations regarding the mix are the same as those for domestic cooking. In this case, too, impacts related to the machinery/equipment of different countries shall be compared.

<sup>64</sup> Nilma – Mix Matic 'S'

COOKING TECHNIQUE	NATURAL GAS	ELECTRICITY					
		ITALY	SWEDEN	FRANCE	GERMANY	GREECE	USA
AUTOMATIC PASTA COOKER	YES	YES	YES	YES	YES	YES	YES
AUTOMATIC FRYER	YES	YES	YES	YES	YES	YES	YES
OVEN	NO	YES	YES	YES	YES	YES	YES
MICROWAVE	NO	YES	YES	YES	YES	YES	YES

Energy generation systems considered for the assessment of environmental impacts for various cooking techniques  
Source: BCFN elaborations, 2016



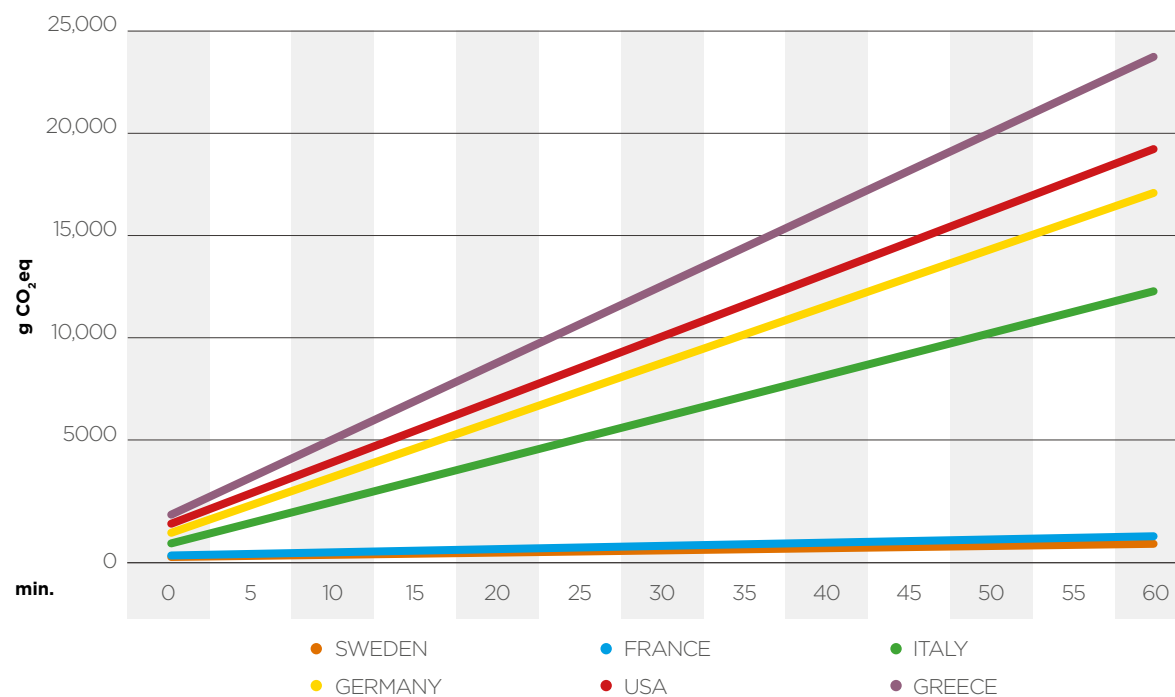
### Pasta cookers - boiling

In the case of domestic cooking, boiling was treated separately from other types of cooking, as it was necessary to take into account the time to boil water for cooking and the amount of water heated. As supposed, professional cooking shall not consider the time necessary to boil water because these machines are often calibrated in such a way as not to bring water to a boil, but rather to maintain it at a constant temperature of about 98°C.

Based on the assumptions presented below, an assessment of the energy requirement of the machines and their environmental impacts was made. The energy consumption was calculated according to the power output of the machine and its utilization factor. The environmental impacts were calculated according to the very different energy mixes already taken into account for domestic cooking.

STOVE POWER	38	kW
PREHEATING	-	minutes
USE FACTOR (POWER USED/TOTAL)	70%	-

Assumptions to calculate energy requirements for the pasta cooker DOUGH.OMAT c80<sup>65</sup>.  
 Source: BCFN elaborations, 2016



Greenhouse gas emission associated with the use of a professional pasta cooker  
 Source: BCFN elaborations on IEA 2014 & IPCC 2013

<sup>65</sup> Nilma.



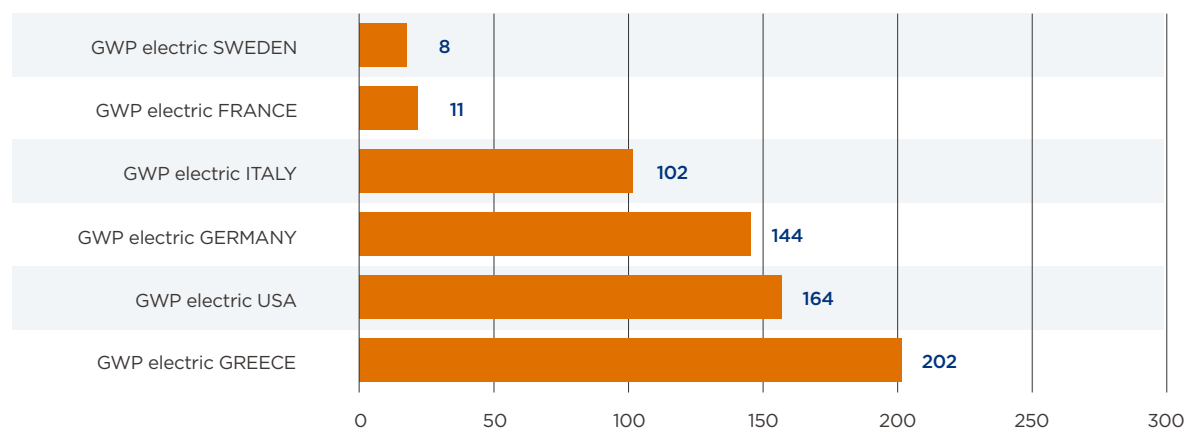
MINUTES	TOTAL MINUTES	kWh	GWP electric ITALY	GWP electric SWEDEN	GWP electric FRANCE	GWP electric GERMANY	GWP electric GREECE	GWP electric USA
5	5	2.2	1020	80	113	1443	2024	1638
10	10	4.4	2039	160	226	2886	4048	3276
15	15	6.7	3059	239	339	4329	6071	4914
20	20	8.9	4079	319	452	5772	8095	6552
30	30	13.3	6118	479	678	8658	12,143	9829
45	45	20.0	9177	718	1017	12,987	18,214	14,743
60	60	26.6	12,236	958	1357	17,317	24,286	19,657

Energy consumption and environmental impacts for the use of a 38 kW electric pasta cooker

Source: BCFN elaborations on IEA 2014 & IPCC 2013

For the calculation of the impacts involved in cooking a specific amount of food, it should be noted that this machine can cook up to 60 kg of pasta per hour (assuming 10 minutes of cooking and three cycles at full load).

To assess, in terms of CO<sub>2</sub> equivalent, the impact of the pasta in kilograms of cooked product, the amount of energy consumed by the pasta cooked in one hour is divided by the number of kg that can be cooked in one hour.



CO<sub>2</sub> equivalent emissions for cooking 1 kg of pasta using the automatic pasta cooker in different countries around the world.<sup>66</sup>

Source: BCFN elaborations on IEA 2014 & IPCC 2013

<sup>66</sup> The calculation was made assuming the use of the machine at a full load for 1 full load cycle.



Pasta preparation with the “dual cooking” technique

One of the systems used for professional pasta cooking is what is known as the “dual cooking” technique. This allows the preparation of large quantities of pasta that is “almost ready”, making it faster and easier to cook when large amounts are required in short periods of time.

In essence, this technique involves the following steps:

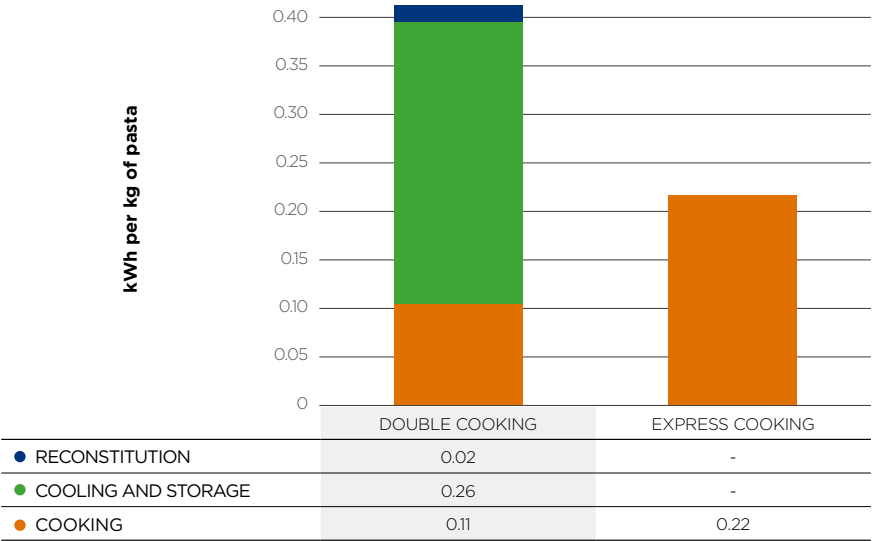
- Traditional cooking of pasta which is, however, interrupted half-way through the recommended time for thorough cooking;
- Reducing the temperature using special

- equipment, coolers, which can bring pre-cooked pasta from 90°C to 3°C in a few minutes;
- Keeping pasta at 3°C until needed (several hours);
  - Quick final boiling (40-50 seconds) when the pasta is actually required.

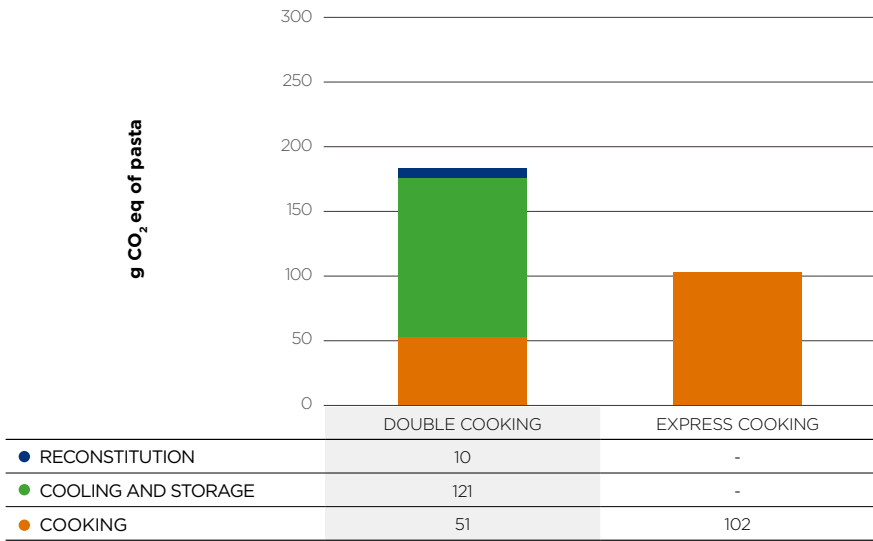
Calculation of the environmental impact considered a cooler with a capacity of 10 kg and cooling power of 850 W. Conservation time was considered equal to 3 hours. Time for the pasta cooking and tempering were set at 5 and 1 minute(s), respectively, on the basis of which the energy consumption and environmental impacts were assessed with the same

approach used for the professional pasta cooker. Summarizing the various phases of professional double cooking, at the conditions stated, reveals that this technique involves an energy consumption which is almost double that of traditional cooking. This energy impact can be transformed into GHG emissions simply by multiplying the value of specific emissions per kWh (gCO<sub>2</sub>eq/kWh): here the use of machines powered by electricity in Italy was considered.

<sup>67</sup> Calculations were made under the assumption of machines powered by electricity with consideration of relevant energy mix.



Energy consumption relative to cooking 1 kg of pasta with a traditional technique (rapid cooking) and double cooking, which includes a phase of keeping the pasta at a low temperature  
Source: BCFN elaborations on IEA 2014 & IPCC 2013



GHG emission relative to cooking 1 kg of pasta with the traditional technique (rapid cooking) and double cooking technique, which includes keeping it at low temperatures<sup>67</sup>  
Source: BCFN elaborations on IEA 2014 & IPCC 2013

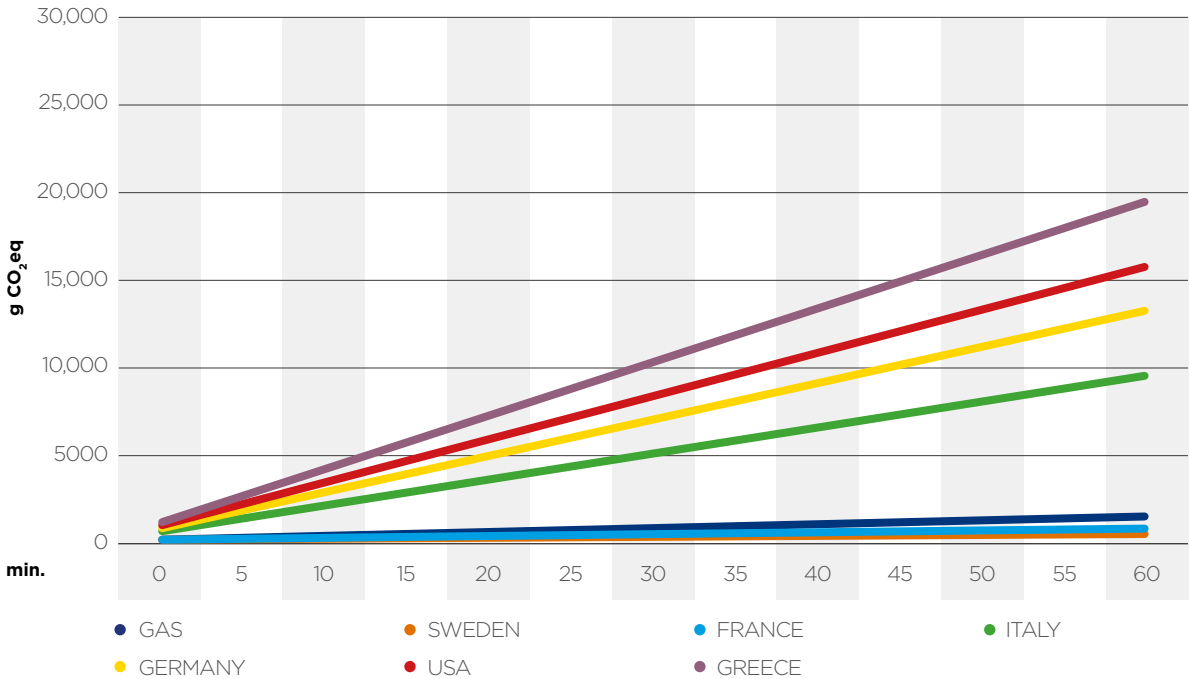


Fryer – deep oil frying

The automatic fryer is the second machine for the professional caterer considered in this part of the paper. The machine can work either by gas or electricity, as considered in the impact assessment. For the same reasons as expressed for the pasta cooker, the oil-preheating phase is omitted in this calculation.

STOVE POWER	30.5	kW
PREHEATING	-	minutes
USE FACTOR (POWER USED/TOTAL)	70%	-

Assumptions for calculating the energy requirements of FS 1 electric fryer and FS 1 gas fryer<sup>68</sup>  
Source: BCFN elaborations, 2016



<sup>68</sup> Nilma

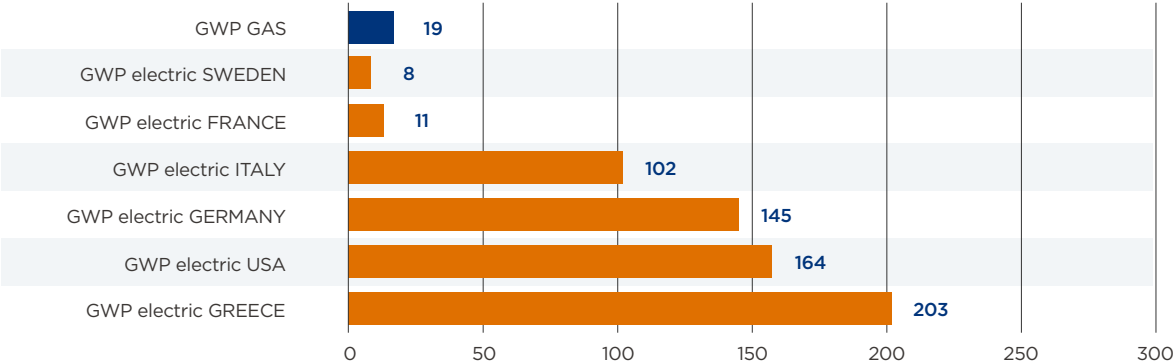
: Carbon footprint for the use of a gas and electric fryer  
Source: BCFN elaborations on IEA 2014 & IPCC 2013



MINUTES	TOTAL MINUTES	kWh electric	kWh GAS	gwp GAS	GWP electric ITALY	GWP electric SWEDEN	GWP electric FRANCE	GWP electric GERMANY	GWP electric GREECE	GWP electric USA
1	1	0.4	0.1	31	164	13	18	232	325	263
2	2	0.7	0.2	61	327	26	36	463	650	526
3	3	1.1	0.3	92	491	38	54	695	975	789
4	4	1.4	0.4	123	655	51	73	927	1300	1052
5	5	1.8	0.6	153	818	64	91	1158	1624	1315
6	6	2.1	0.7	184	982	77	109	1390	1949	1578
7	7	2.5	0.8	215	1146	90	127	1622	2274	1841
8	8	2.8	0.9	245	1309	102	145	1853	2599	2104
9	9	3.2	1.0	276	1473	115	163	2085	2924	2367
10	10	3.6	1.1	307	1637	128	181	2316	3249	2630
15	15	5.3	1.7	460	2455	192	272	3475	4873	3944
20	20	7.1	2.2	613	3274	256	363	4633	6498	5259
30	30	10.7	3.4	920	4911	384	544	6949	9746	7889
40	40	14.2	4.5	1227	6547	512	726	9266	12,995	10,518
50	50	17.8	5.6	1534	8184	641	907	11,582	16,244	13,148
60	60	21.4	6.7	1840	9821	769	1089	13,899	19,493	15,778

Energy consumption and environmental impact for a professional fryer used with gas and electricity  
Source: BCFN elaborations on IEA 2014 & IPCC 2013

Considering the use of a deep fat fryer at a full load (8 kg of food cooking cycle) with a cooking time average of 5 minutes, about 100 kg of food can be prepared in one hour. These assumptions allow the assessment of the environmental impact generated by cooking 1 kg of food in the various countries considered.



Carbon footprint for cooking 1 kg of food in the fryer, calculated by assuming cooking time is 5 minutes at full load  
Source: BCFN elaborations on IEA 2014 & IPCC 2013

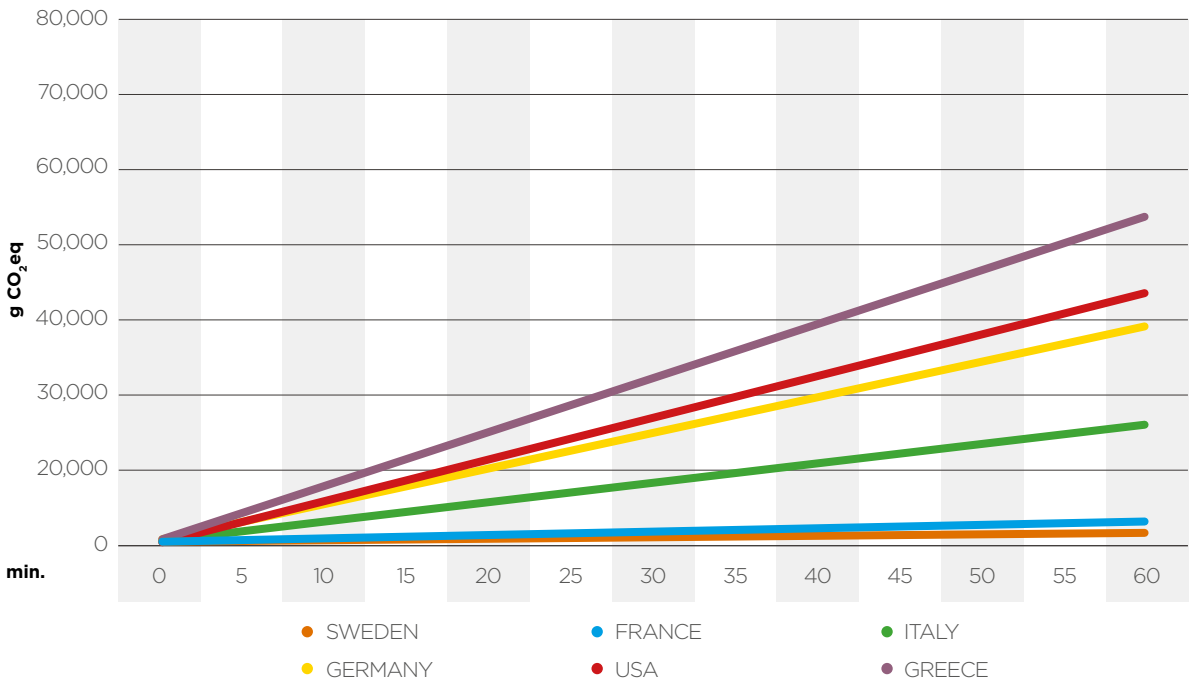


Electric convection oven

Oven preparations (baking, roasting) is another widely used type of cooking in the professional field. As in the cases outlined above, the time it takes to preheat the oven before cooking was omitted.

OVEN POWER	86	kW
PREHEATING	0	minutes
USE FACTOR (POWER USED/TOTAL)	70%	-

Assumptions for calculating the energy requirements of the electric convection oven KSP 40<sup>69</sup>  
Source: BCFN elaborations, 2016



Emissions of carbon dioxide for the use of a professional electric oven  
Source: BCFN elaborations on IEA 2014 & IPCC 2013

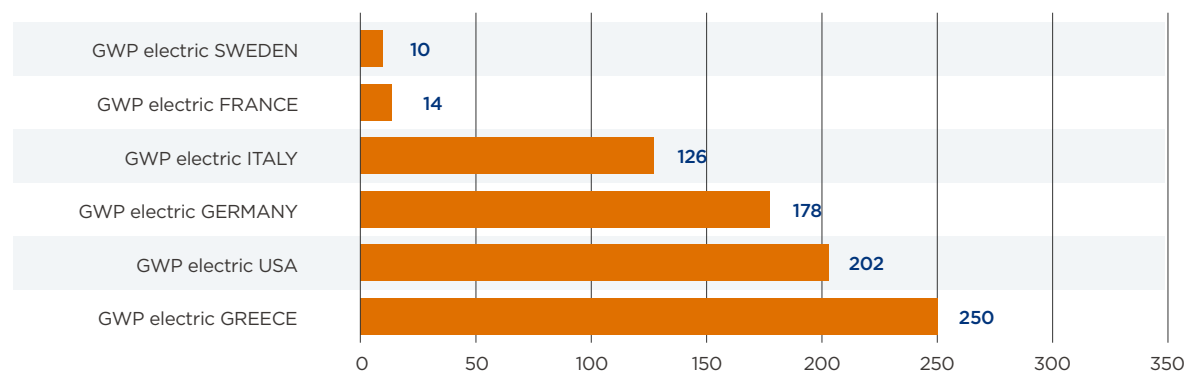
<sup>69</sup> Nilma



MINUTES	TOTAL MINUTES	kWh	GWP electric ITALY	GWP electric SWEDEN	GWP electric FRANCE	GWP electric GERMANY	GWP electric GREECE	GWP electric USA
1	1	1.0	462	36	51	653	916	741
2	2	2.0	923	72	102	1306	1832	1483
3	3	3.0	1385	108	154	1960	2748	2224
4	4	4.0	1846	144	205	2613	3664	2966
5	5	5.0	2308	181	256	3266	4580	3707
6	6	6.0	2769	217	307	3919	5496	4449
7	7	7.0	3231	253	358	4572	6412	5190
8	8	8.0	3692	289	409	5225	7328	5932
9	9	9.0	4154	325	461	5879	8244	6673
10	10	10.0	4615	361	512	6532	9160	7415
15	15	15.1	6923	542	768	9798	13,741	11,122
20	20	20.1	9231	722	1023	13,063	18,321	14,829
30	30	30.1	13,846	1084	1535	19,595	27,481	22,244
40	40	40.1	18,461	1445	2047	26,127	36,642	29,659
50	50	50.2	23,077	1806	2559	32,659	45,802	37,073
60	60	60.2	27,692	2167	3070	39,190	54,963	44,488

Energy consumption and environmental impact for an electric convection oven  
 Source: BCFN elaborations on IEA 2014 & IPCC 2013

Once again, to calculate the impacts per kg of food, an indicative average cooking time (30 minutes) and oven load (110 kg) must be established.



Carbon footprint for cooking 1 kg of food in the fryer calculated by assuming cooking time is 5 minutes at full load  
 Source: BCFN elaborations on IEA 2014 & IPCC 2013



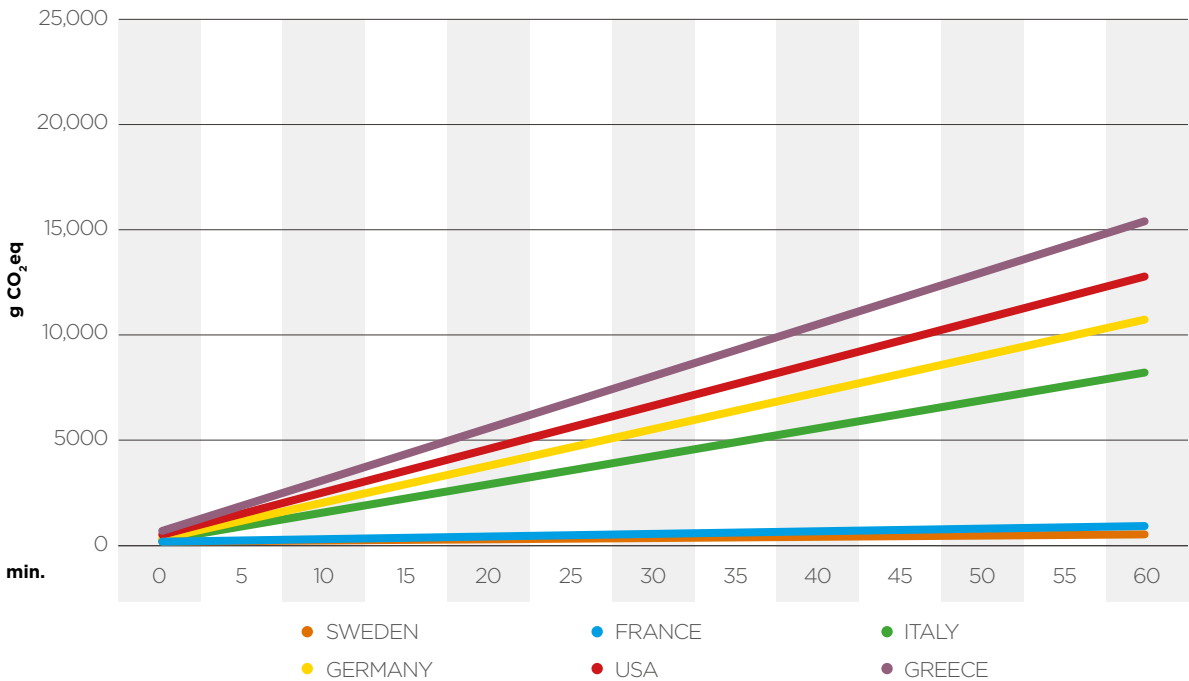


Braising pan

The braising pan is a professional machine used for long cooking procedures.  
The table below shows the conditions used for the calculation of energy consumption and environmental impacts, according to the energy mix taken into account.

PANPOWER	25	kW
PREHEATING	0	minutes
USE FACTOR (POWER USED/TOTAL)	70%	-

Assumptions for the calculation of the energy requirements of the SALSAMAT 160 electric braising pan<sup>70</sup>  
Source: BCFN elaborations, 2016



Environmental impacts for use of a braising pan analyzing the energy mix of different countries  
Source: BCFN elaborations on IEA 2014 & IPCC 2013

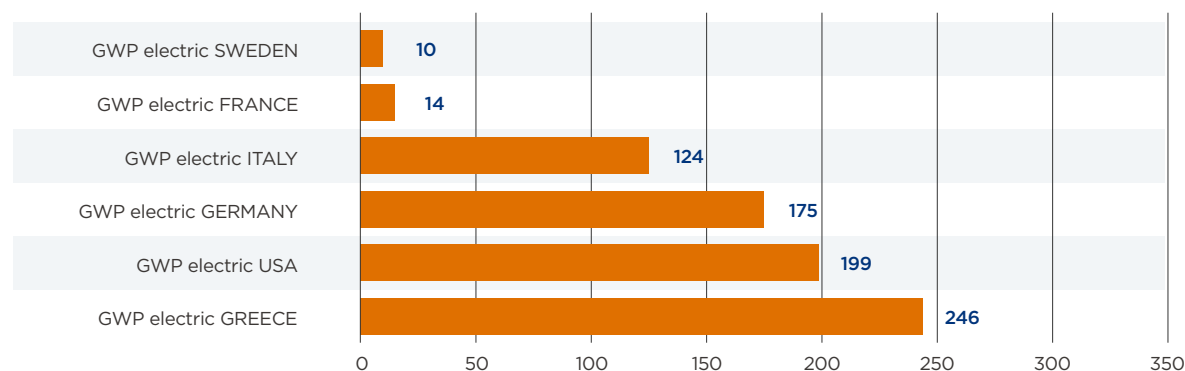
<sup>70</sup> Nilma



MINUTES	TOTAL MINUTES	kWh gas	GWP electric ITALY	GWP electric SWEDEN	GWP electric FRANCE	GWP electric GERMANY	GWP electric GREECE	GWP electric USA
5	5	1.4	663	52	73	938	1315	1065
10	10	2.9	1326	104	147	1876	2631	2130
15	15	4.3	1988	156	220	2814	3946	3194
20	20	5.8	2651	207	294	3752	5262	4259
25	25	7.2	3314	259	367	4690	6577	5324
30	30	8.6	3977	311	441	5628	7893	6389
35	35	10.1	4639	363	514	6566	9208	7453
40	40	11.5	5302	415	588	7504	10,524	8518
45	45	13.0	5965	467	661	8442	11,839	9583
50	50	14.4	6628	519	735	9380	13,155	10,648
55	55	15.8	7291	571	808	10,318	14,470	11,713
60	60	17.3	7953	622	882	11,256	15,786	12,777
90	90	25.9	11,930	934	1323	16,884	23,679	19,166
120	120	34.6	15,907	1245	1764	22,512	31,572	25,555
150	150	43.2	19,884	1556	2204	28,139	39,464	31,943

Energy consumption and environmental impact for the use of a braising pan  
 Source: BCFN elaborations on IEA 2014 & IPCC 2013

Indicative average cooking time and machine load (150 kg) must be estimated in order to calculate impacts per kg of food (meat sauce prep. time is approximately 2 hours and 20 minutes).



Carbon footprint for cooking 1 kg of food in the braising pan, assuming a load of 150 kg and a cooking time of 2 hours and 20 minutes  
 Source: BCFN elaborations, 2016



# SCIENTIFIC DATA AVAILABLE



STATISTICAL COVERAGE

THE DATABASE OF THE BCFN DOUBLE PYRAMID

IMPACT DATA

- 🍃 Food crop
- 🍃 Agricultural processed products
- 🍃 Farm products
- 🍃 Fisheries

THE ENVIRONMENTAL PYRAMIDS





## SCIENTIFIC DATA AVAILABLE

*The environmental impacts of food and its production were assessed by analyzing the three environmental indicators selected in the database and scientific publications. As for the past editions, all the data and information used in drafting this paper pertains to the public domain so that the results may be reconstructed by any reader who wishes to apply the analysis for more extensive and analytical studies. The environmental impacts of food and its production were reported in three*

*different pyramids, one of which (the Ecological Footprint) was also adopted in the creation of the BCFN Double Pyramid. As will be seen, the statistical coverage of data has greatly increased since the first edition. The environmental impact value associated with each food item was calculated as the arithmetic mean of available values. Nevertheless, for the sake of scientific completeness and precision, the entire range of values collected (with the minimum and maximum yield) are still*

*indicated.*

*This chapter explains how the information was organized in order to complete the database available on the BCFN site<sup>1</sup>. Before going into detail, we feel it is necessary to reiterate the importance of reporting publications and studies on food environmental impact in order to expand the current database.*

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<sup>1</sup> "Publications" section

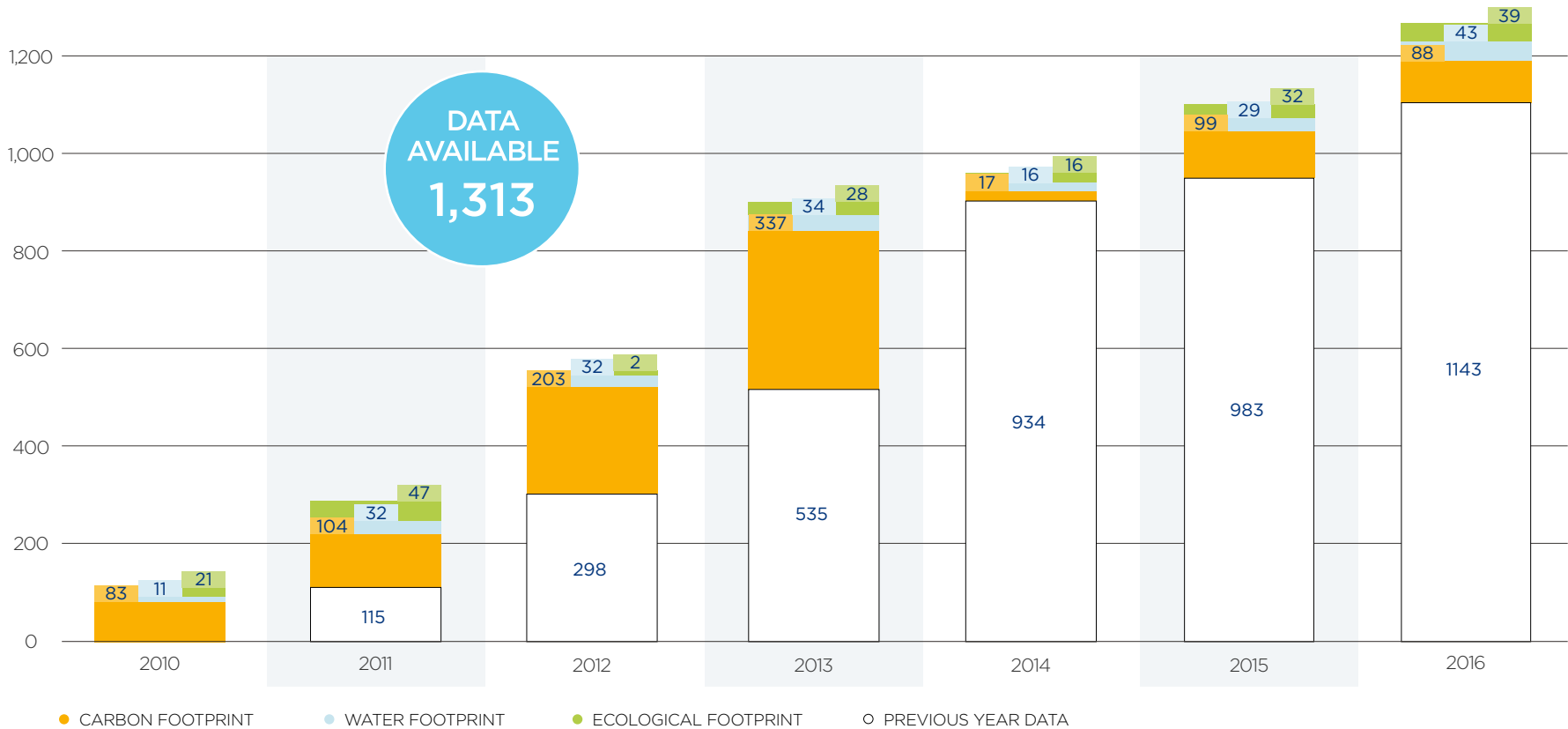


STATISTICAL COVERAGE

It is crucial to provide information on the statistical representation of information used, before describing the data and the environmental pyramids. Over

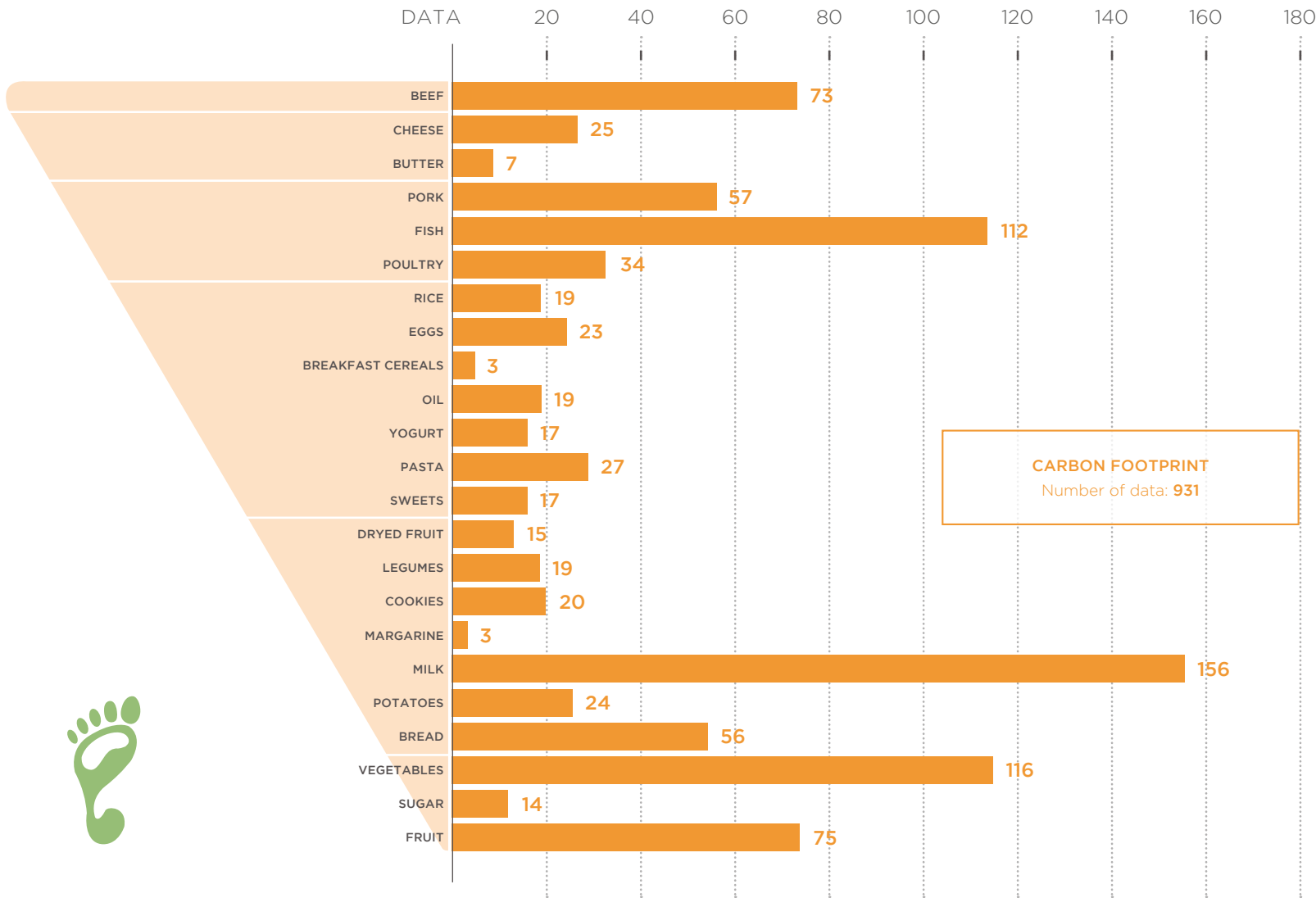
the years, the amount of available data has greatly increased, making the scientific basis much stronger and more reliable. This seventh edition features over 1,300 data items as compared with just 140 in the first edition.

For each of the three environmental indicators, the percentile distribution of each macrocategory which makes up the environmental pyramids is indicated.



Increase of data used for calculating food environmental impact averages in the seven editions of the Double Pyramid  
Source: BCFN elaboration, 2016

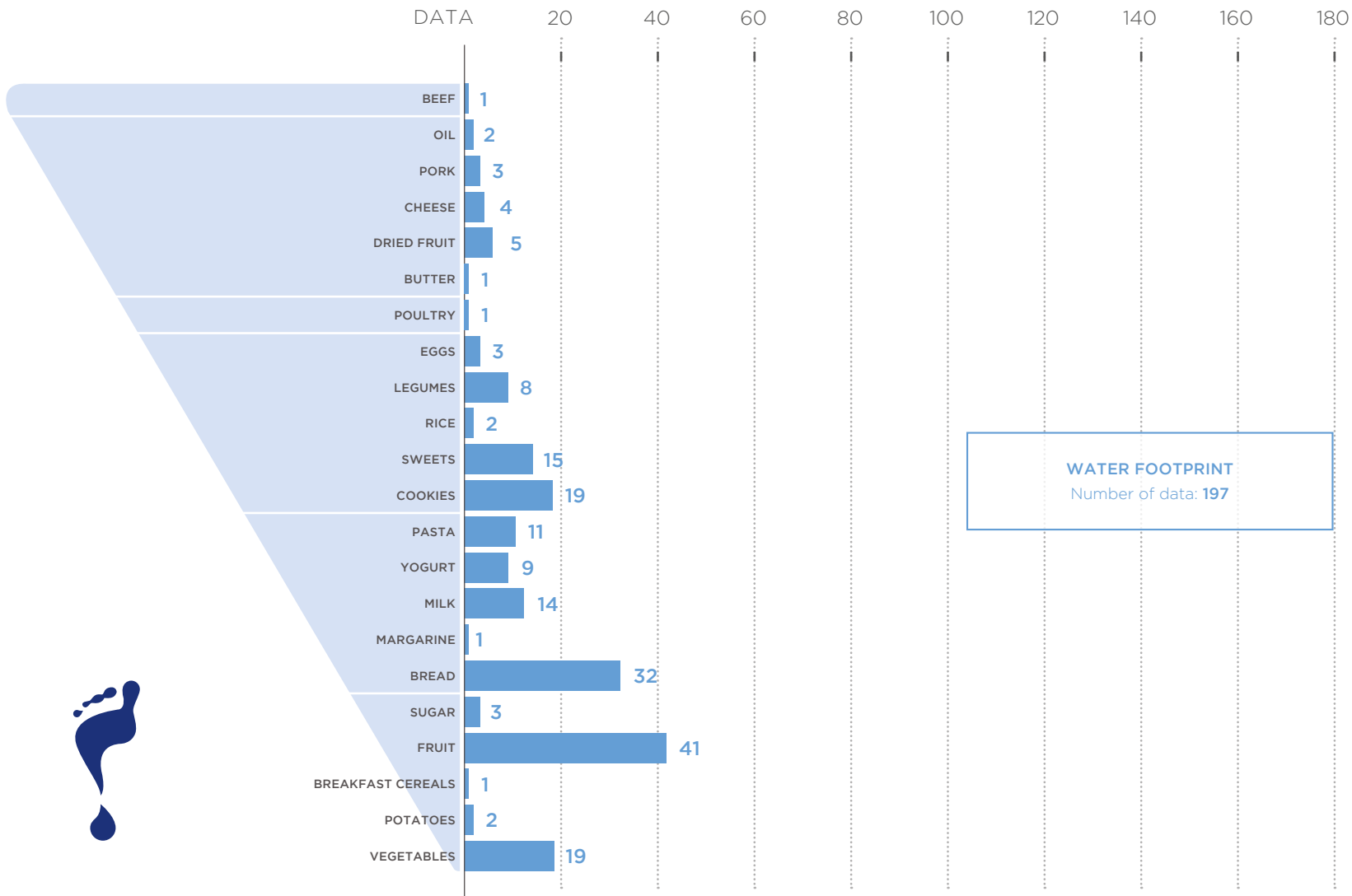




Statistical coverage of bibliographical sources relative to the Carbon Footprint  
Source: BCFN elaboration, 2016

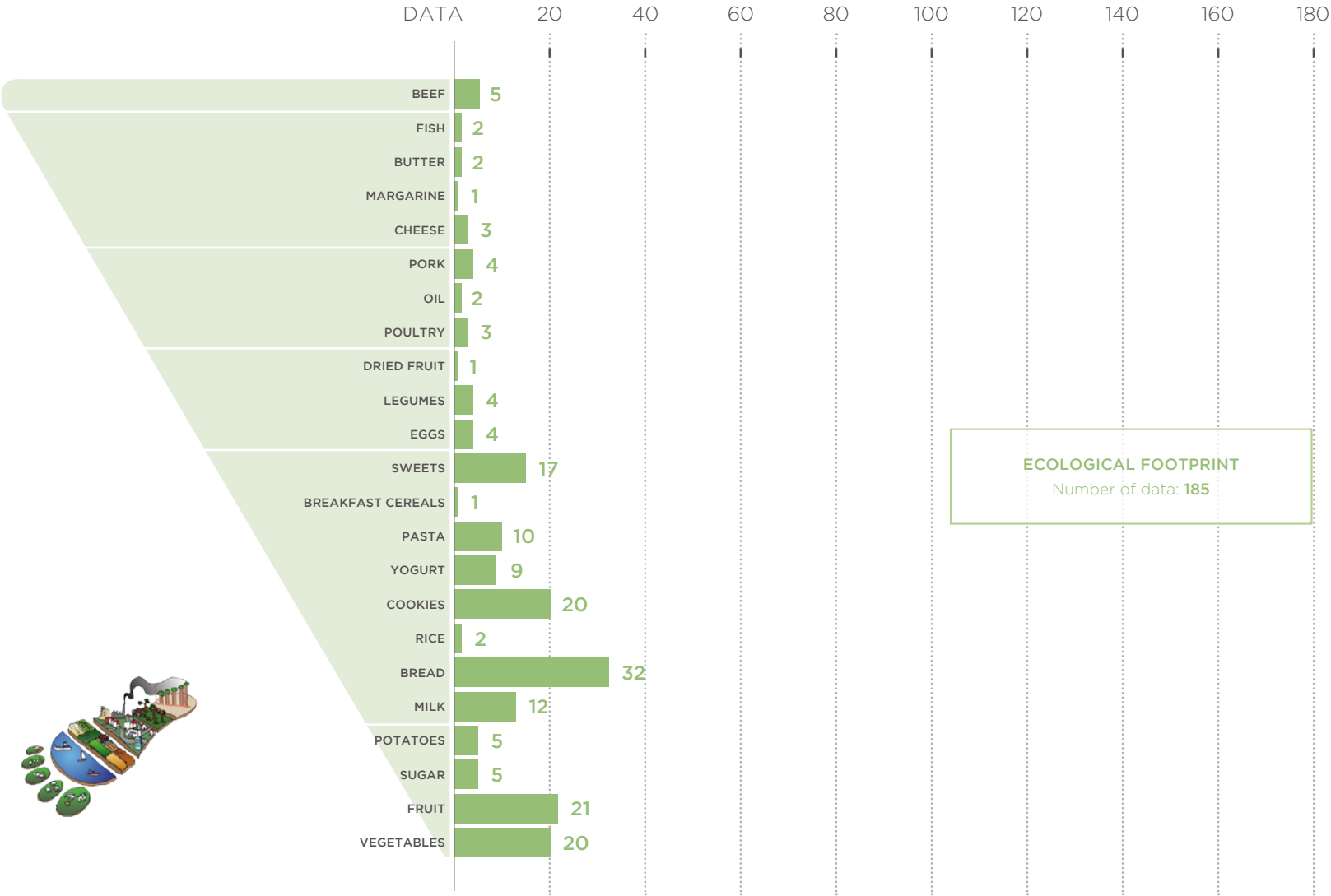






Statistical coverage of bibliographical sources relative to the Water Footprint  
Source: BCFN elaboration, 2016





Statistical coverage of bibliographical sources relative to the Ecological Footprint  
Source: BCFN elaboration, 2016



Some considerations on data distribution must be made clear. As seen from the graphs proposed (and even more clearly in the Figure above), not all foods have a comparable statistical coverage. Nevertheless,

the essential concept is the quantity of data as related to the complexity of the food, rather than simply the amount of data in itself. For example, thirty pieces of data for potatoes may be sufficient

whilst a sum of over one hundred for fish may be poor, given the extreme variety in this category.

STATISTICAL COVERAGE	CARBON FOOTPRINT									WATER FOOTPRINT									ECOLOGICAL FOOTPRINT								
	Total Data	% Total	2010	2011	2012	2013	2014	2015	2016	Total Data	% Total	2010	2011	2012	2013	2014	2015	2016	Total Data	% Total	2010	2011	2012	2013	2014	2015	2016
Beef meat	73	8%	15	8	9	27	-	6	8	1	1%	1	-	-	-	-	-	-	5	3%	1	3	-	1	-	-	-
Fish	112	12%	18	33	12	46	-	3	-	-	0%	-	-	-	-	-	-	-	2	1%	1	1	-	-	-	-	-
Butter	7	1%	-	4	-	2	-	1	-	1	1%	-	-	1	-	-	-	-	2	1%	-	1	-	1	-	-	-
Margarine	3	0%	-	3	-	-	-	-	-	1	1%	-	-	1	-	-	-	-	1	1%	-	1	-	-	-	-	-
Cheese	25	3%	1	1	3	17	1	2	-	4	2%	1	-	-	1	1	1	-	3	2%	-	1	-	-	1	1	-
Pork meat	57	6%	13	7	9	22	-	2	4	3	2%	1	-	-	-	-	-	2	4	2%	1	1	1	1	-	-	-
Oil	19	2%	1	2	4	3	-	8	1	2	1%	1	-	-	1	-	-	-	2	1%	1	1	-	-	-	-	-
Poultry meat	34	4%	9	2	5	15	-	2	1	1	1%	-	-	1	-	-	-	-	3	2%	1	1	-	1	-	-	-
Dried Fruit	15	2%	-	-	-	9	-	4	2	5	3%	-	2	3	-	-	-	-	1	1%	-	-	-	1	-	-	-
Legumes	19	2%	-	-	9	7	-	2	1	8	4%	1	6	1	-	-	-	-	4	2%	1	1	-	-	-	2	-
Eggs	23	2%	3	3	4	10	1	1	1	3	2%	1	-	1	-	1	-	-	4	2%	1	2	-	-	1	-	-
Sweets	17	2%	-	1	1	3	3	3	6	15	8%	-	-	-	3	3	3	6	17	9%	-	2	-	3	3	3	6
Breakfast cereals	3	0%	-	1	1	1	-	-	-	1	1%	-	1	-	-	-	-	-	1	1%	-	1	-	-	-	-	-
Yogurt	17	2%	-	-	1	7	-	1	8	9	5%	-	-	1	-	-	-	8	9	5%	-	1	-	-	-	-	8
Pasta	27	3%	-	1	-	5	2	9	10	11	6%	-	-	1	-	2	7	1	10	5%	-	-	-	-	2	7	1
Biscuits	20	2%	-	-	1	1	7	4	7	19	10%	-	-	-	1	7	4	7	20	11%	-	1	-	1	7	4	7
Rice	19	2%	1	5	7	4	-	1	1	2	1%	1	-	1	-	-	-	-	2	1%	1	-	-	-	-	1	-
Milk	156	17%	2	17	52	59	2	17	7	14	7%	1	-	1	-	2	2	8	12	6%	1	1	-	1	2	1	6
Bread	56	6%	8	2	6	10	-	19	11	32	16%	1	-	-	9	-	12	10	32	17%	-	1	-	9	-	12	10
Potatoes	24	3%	-	-	16	5	-	1	2	2	1%	-	-	2	-	-	-	-	5	3%	1	2	-	1	-	1	-
Sugar	14	2%	5	-	2	1	1	1	4	3	2%	1	-	1	1	-	-	-	5	3%	4	1	-	-	-	-	-
Fruit	75	8%	1	12	21	26	-	10	5	41	21%	-	15	8	17	-	-	1	21	11%	6	7	1	6	-	-	1
Vegetables	116	12%	6	2	40	57	-	2	9	19	10%	1	8	9	1	-	-	-	20	11%	1	17	-	2	-	-	-
<b>TOTAL</b>	<b>931</b>	<b>100%</b>	<b>83</b>	<b>104</b>	<b>203</b>	<b>337</b>	<b>17</b>	<b>99</b>	<b>88</b>	<b>197</b>	<b>100%</b>	<b>11</b>	<b>32</b>	<b>32</b>	<b>34</b>	<b>16</b>	<b>29</b>	<b>43</b>	<b>185</b>	<b>100%</b>	<b>21</b>	<b>47</b>	<b>2</b>	<b>28</b>	<b>16</b>	<b>32</b>	<b>39</b>
	<b>70.9%</b>									<b>15.0%</b>									<b>14.1%</b>								

Variations in number of data items used for calculating the environmental impact averages of food items in the seven editions of the Double Pyramid, and total data figures

Source: BCFN elaboration, 2016



STATISTICAL COVERAGE	TOTAL DATA ITEMS								
	Total Data	% Total	2010	2011	2012	2013	2014	2015	2016
Beef meat	79	6%	17	11	9	28	-	6	8
Fish	114	9%	19	34	12	46	-	3	-
Butter	10	1%	-	5	1	3	-	1	-
Margarine	5	0%	-	4	1	-	-	-	-
Cheese	32	2%	2	2	3	18	3	4	-
Pork meat	64	5%	15	8	10	23	-	2	6
Oil	23	2%	3	3	4	4	-	8	1
Poultry meat	38	3%	10	3	6	16	-	2	1
Dried Fruit	21	2%	-	2	3	10	-	4	2
Legumes	31	2%	2	7	10	7	-	4	1
Eggs	30	2%	5	5	5	10	3	1	1
Sweets	49	4%	-	3	1	9	9	9	18
Breakfast cereals	5	0%	-	3	1	1	-	-	-
Yogurt	35	3%	-	1	2	7	-	1	24
Pasta	48	4%	-	1	1	5	6	23	12
Biscuits	59	4%	-	1	1	3	21	12	21
Rice	23	2%	3	5	8	4	-	2	1
Milk	182	14%	4	18	53	60	6	20	21
Bread	120	9%	9	3	6	28	-	43	31
Potatoes	31	2%	1	2	18	6	-	2	2
Sugar	22	2%	10	1	3	2	1	1	4
Fruit	137	10%	7	34	30	49	-	10	7
Vegetables	155	12%	8	27	49	60	-	2	9
<b>TOTAL</b>	<b>1313</b>	<b>100%</b>	<b>115</b>	<b>183</b>	<b>237</b>	<b>399</b>	<b>49</b>	<b>160</b>	<b>170</b>
	100%								

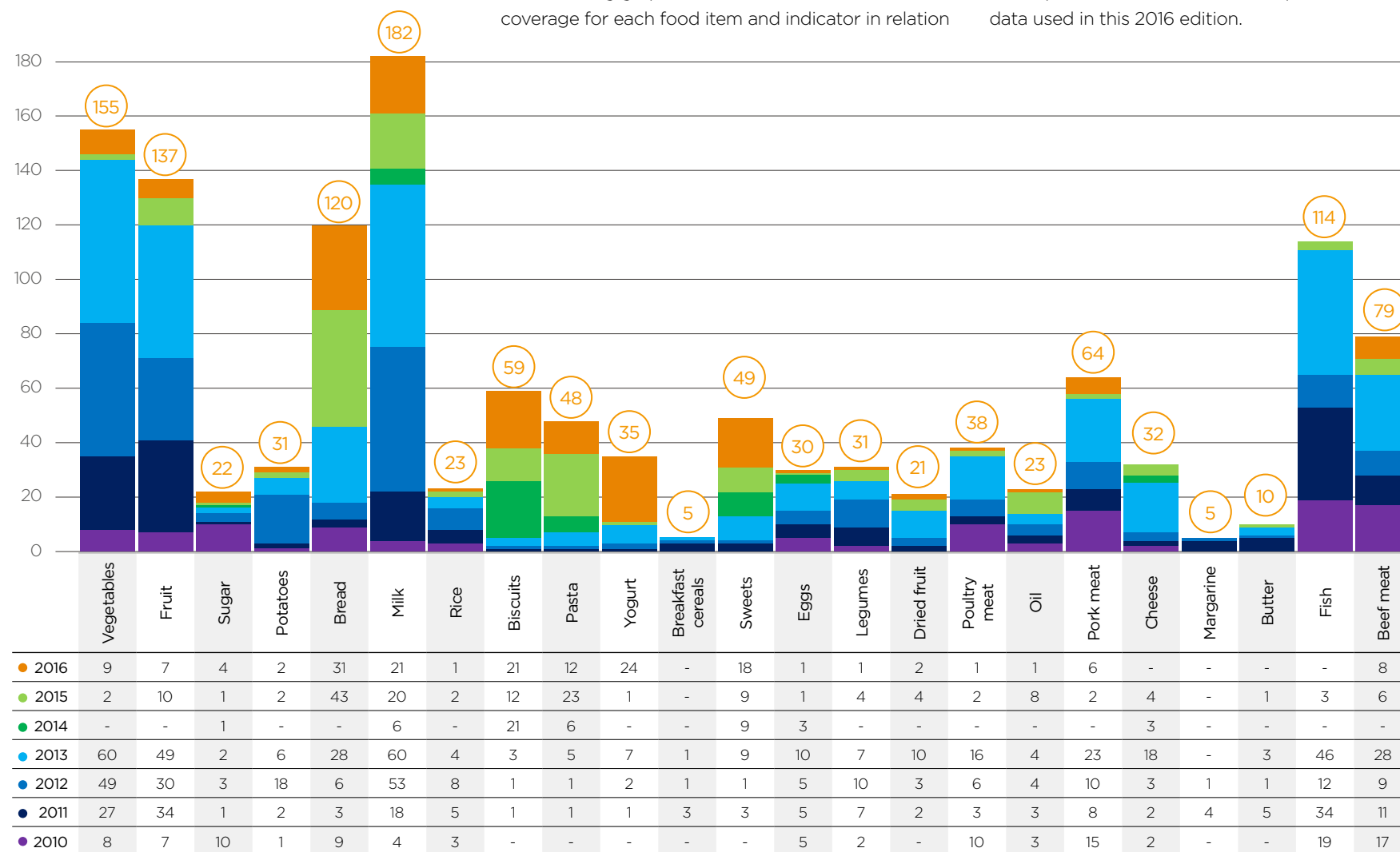
Variations in number of data items used for calculating the environmental impact averages of food items in the seven editions of the Double Pyramid, and total data figures

Source: BCFN elaboration, 2016



The following graph shows the increase of statistical coverage for each food item and indicator in relation

to the previous six editions as compared with the data used in this 2016 edition.



Total number of data items per food, classified by year of use in the Double Pyramid database

Source: BCFN elaboration, 2016

## THE BCFN DOUBLE PYRAMID: AN IN-DEPTH ANALYSIS

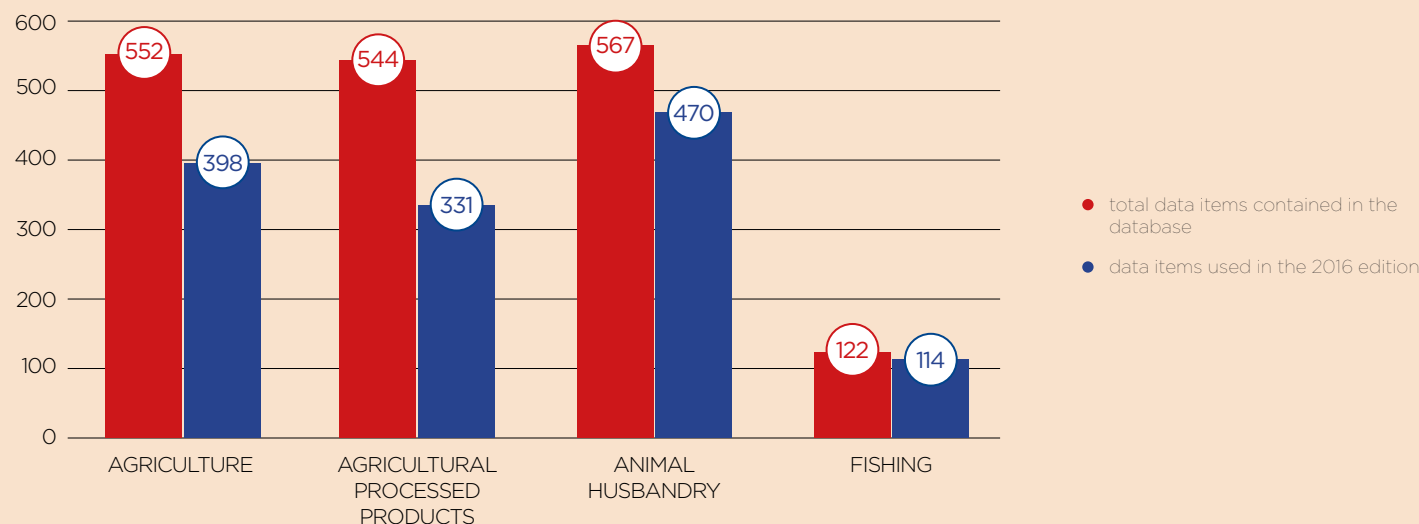
The Double Pyramid database contains far more data items than are usually used for calculating the averages reported within the Pyramid itself. To be precise, the database contains 1785 data items, as compared with the 1313 used in the Double Pyramid.

This is because many of the data items are “old”

and during the year have been removed and/or updated. However, there are also many food typologies excluded from the pyramid either because they are not present in the nutritional guidelines (e.g. butter or sugar), or because their consumption is not so common (e.g. lamb).

To make it clearer how fully comprehensive a tool

is the database, the graph below shows (firstly for the 4 categories and then for each food) the number of data items included in the database (blue) versus the data items used in the pyramid (red).

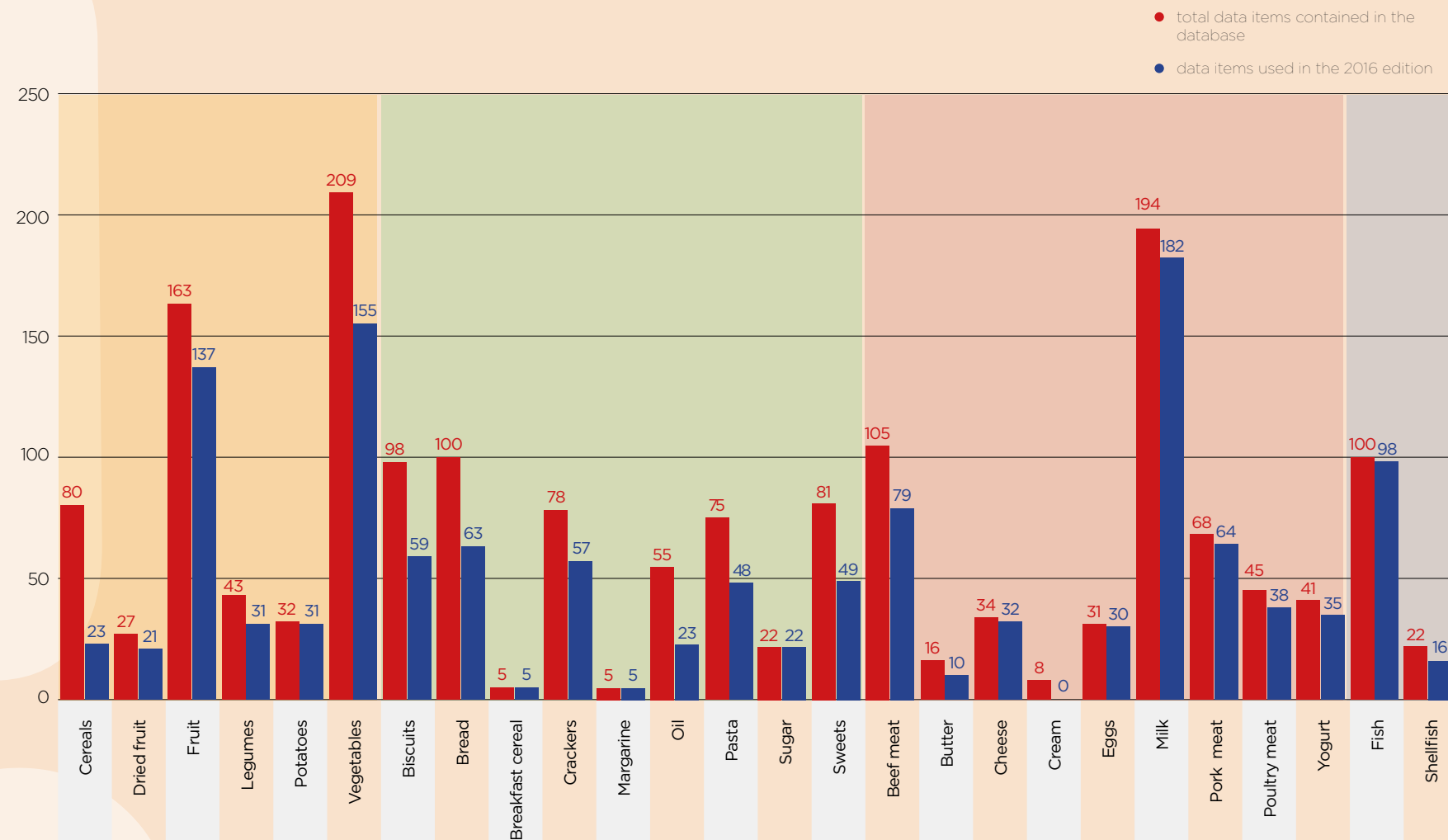


Amount of data items used in the 2016 edition as compared with the total data items contained in the database

Source: BCFN elaboration, 2016







Data items used in the 2016 edition as compared with the total data items contained in the database

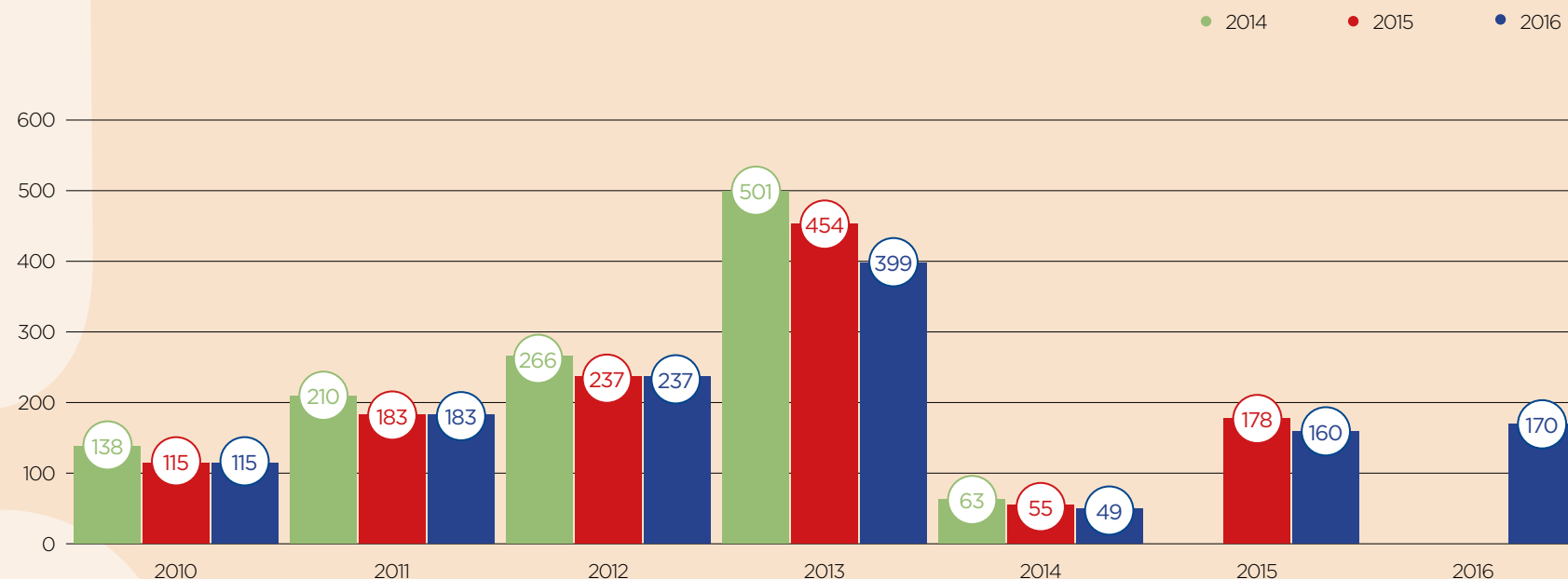
Source: BCFN elaboration, 2016

Furthermore, in this edition there was an important turnover of selected data due mainly to the substitution of expired version of the Environmental Product Declaration with the updated version, and to further refinement of the data used. For example, given the high number of data from certified sources, the working group

decided this time to eliminate values from their own personal elaboration (which had been used in the first edition in order to fill the gaps in the bibliography).

The graph below shows the distribution of data items used in the 2015 and 2016 editions of the Double Pyramid, by year of inclusion in the

database. The red bars refer to the 2015 edition and the blue ones to 2016. As can be seen, 170 new data items were added this year but many data items from previous editions have been removed. This is why the overall data increase in this edition amounts to only 91 items.



Distribution of data used in the 2014, 2015 and 2016 editions by year of inclusion in the database  
 Source: BCFN elaboration, 2016



THE DATABASE OF THE BCFN DOUBLE PYRAMID

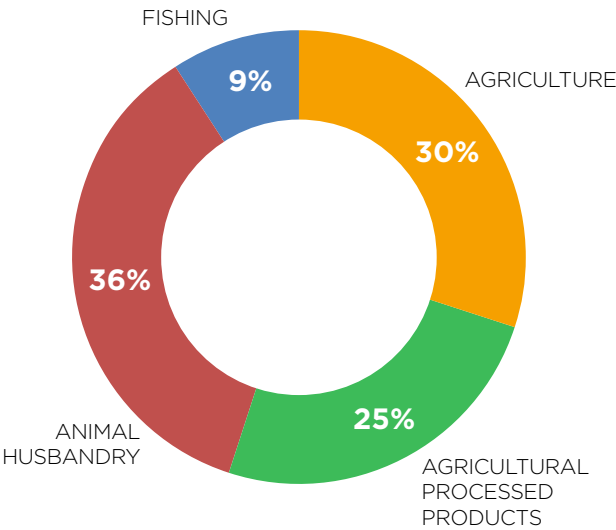
The BCFN Double Pyramid database (available only in English) was created in a Microsoft Excel® spreadsheet to make it easier for the user to consult using filters. The data items are organized into a table arranged in rows and columns: each row contains the impact

of a single food item from a single source, while each column contains an information field relating to that specific food. The following pages provide a detailed description of each field. The database was restructured in the 2013 edition of the Double Pyramid, so that certain additional information could be highlighted, as described in the sections below.

AGRICULTURE	Food crops (fruit, vegetables, potatoes, etc.)
AGRICULTURAL PROCESSED PRODUCTS	Food from processing of agricultural crops (pasta, bread, oil, etc.)
ANIMAL HUSBANDRY	Food from animal farming (meat, dairy goods, etc.)
FISHING	Food from fishery activity (fish)

Field: "Category"

The environmental information is presented by grouping foods according to a description of functional classification processes.



Distribution of data by food category



### Field: "Typology"

For each of the above categories, foods were divided into typologies.

Some exceptions can be reported:

- The typology "Legumes" in the "Agricultural processed products" category represents "Soy Milk";
- The typologies "Flour", "Juice" and "Sugar" in the "Agricultural processed products" category are not

included in the calculation of the Double Pyramid average values (because they are not present in the nutritional guidelines) but are considered in the database, for seek of completeness;

- The typologies "Bread" and "Crackers" in the "Agricultural processed products" category are grouped together in the category "Bread" of the Double Pyramid;
- The typology "Sweets" in the "Animal husbandry" category represents "Ice Cream" and is not included in the calculation of the Double Pyramid average values (because it is not present in the nutritional guidelines) but is considered in the database for seek of completeness;
- The typologies "Cream", "Honey" and "Lamb" in the "Animal husbandry" category are not included in the calculation of the Double Pyramid average values (because they are not present in the nutritional guidelines) but are considered in the database for for seek of completeness;
- The typologies "Fish" and "Shellfish" in the "Fishing" category are grouped together in the category "Fish" of the Double Pyramid.

AGRICULTURE	AGRICULTURAL PROCESSED PRODUCTS	ANIMAL HUSBANDRY	FISHING
Cereals	Cookies	Beef meat	Fish
Dried Fruit	Bread	Butter	Shellfish
Fruit	Breakfast cereal	Cheese	-
Legumes	Crackers	Cream	-
Potatoes	Flour	Eggs	-
Vegetables	Juice	Honey	-
-	Legumes (Soy milk)	Lamb	-
-	Margarine	Milk	-
-	Oil	Pork	-
-	Pasta	Poultry	-
-	Sugar	Sweets (Ice cream)	-
-	Sweets	Yogurt	-

### Field: "Food"

This column contains the name of the food.

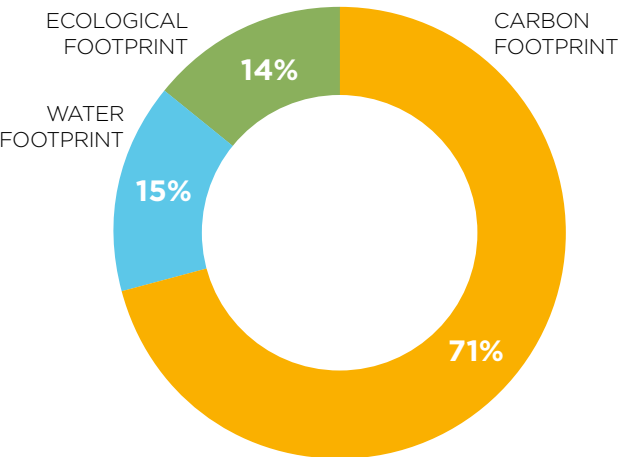


Fields: “Carbon Footprint”; “Water Footprint”; “Ecological Footprint”

The values of environmental indicators are always related to one litre or kilogram of food. In the event that the source of the data refers to a different functional unit, the BCFN working group listed the value as a unit of weight or volume to increase comparability with other data. Unfortunately, the individual indicator values for each source analyzed are not always available for all foods. Furthermore, it was noted that the percentile distribution of the number of studies per environmental indicator is not uniform: most of the bibliographic sources used refer first to the Carbon Footprint, then to the Water Footprint, and, finally, to the Ecological Footprint, which may be due to a number of reasons. The first reason is that the Carbon Footprint is the indicator which has “historically” been most commonly adopted by researchers; specifically, it is the one for which most consolidated and scientifically widespread calculation standards exist. A second reason is linked to the increasing number of reports and articles focusing on the concept of greenhouse gas emissions.

Field: “Type of source”

The information used to calculate the averages of the environmental indicators is derived from publications and databases that are most commonly consulted when performing life cycle analyses. The main sources of data are set forth below.



Distribution of bibliographical sources relative to environmental impacts

Field: “Full Reference”

This field lists the sources of the data.

Field: “System boundaries”

All information used in the construction of the environmental pyramids refers to publications produced using the LCA method. It is important to emphasize that this work does not strive to provide values valid in every situation, but organizes the data available into an environmental pyramid.

TYPE OF SOURCE	REFERENCE	RELIABILITY
LCA database	EcolInvent	Public information, used by professionals. Quality can be variable; generally, the information is not specific to a manufacturer but generalized to the product at hand.
	LCA food	
	Water Footprint Network	
	Ecological Footprint Network	
Verified publication	EPD™ Climate Declaration™	Information validated by third party. It may be specific to a single manufacturer.
Scientific publication – executive summary – working paper – presentation	Complete list in bibliography	Information on a scientific work validated by a head reviewer. Product-specific but generally reliable in terms of quality.
Internal elaboration	-	Processing executed specifically for this work. Since it is minimized as far as possible and uses only public data, it proves less reliable than the other sources cited.



For this reason, we opted to account for data contained in publications regardless of system boundaries that were not perfectly homogeneous or clearly identified, ensuring however that the data did not significantly affect the final result. Data with clearly inadequate system boundaries has not been taken into account.

To facilitate consultation of the database section related to system boundaries, seven stages in the life cycle of products have been considered:

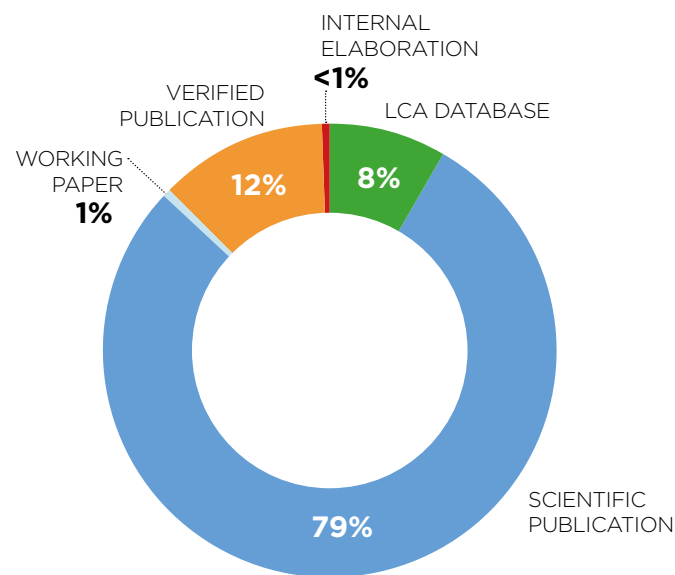
- Crop;
- Farm process;

- Industrial process;
- Transport and storage;
- Consumption;
- Final disposal.

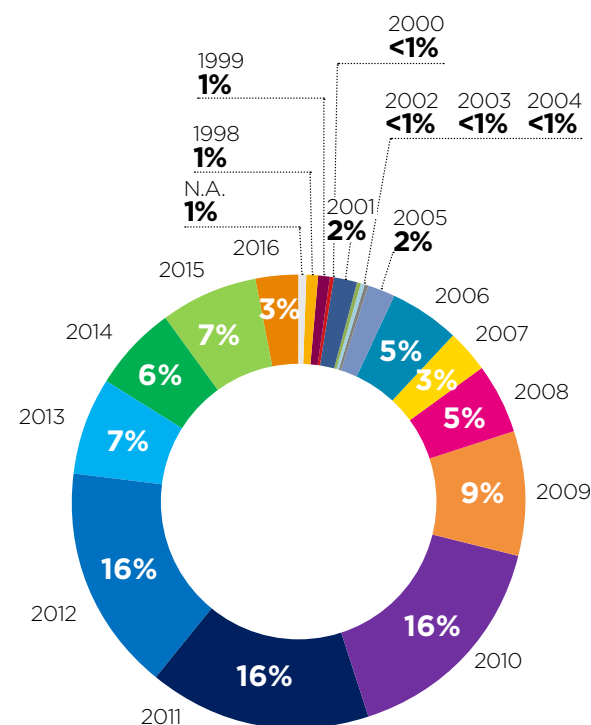
A dash indicates that the phase is not included within the boundaries of the system. The message NOT AVAILABLE indicates that the system boundaries have not been declared. Additional details are provided within the cell if the phase is included within the boundaries of the system.

#### Field: "Publication Date"

This field was adopted in the 2013 edition and indicates the date of publication of the study. This information helps the reader assess how contemporary the data is, and then try to update the oldest material. Almost 80% of the studies are "new", or have been published in the last seven years (since 2009).



Distribution of data by source type



Distribution of data by publication date



### Field: "Double Pyramid Edition"

This field reveals the year in which the data was included in the Double Pyramid calculation. A subsequent "not used" entry means that the data was not considered for the year in question but was, however, included or retained in the database for the sake of completeness.

There are several reasons for which a value may not have been used. In some cases, the working group decided not to consider data due to failure to conform to the rules of construction of the database (system boundaries, functional unit, data transparency, publication updates etc.). Other data

items are not used because they have been replaced by updated information (e.g. the EPD data, which is often revised every year) or with data that is more representative of the average (e.g. for the WFN data, all the data available for the same food in several countries is shown in the database, but for the Double Pyramid only the world average value has been considered).

### Fields: "Country"; "Region"

This column indicates the country of food production to which the data refers. The countries were then classified into seven areas bearing similar territorial

and climatic conditions, indicated in the "Region" column that made its debut in the 2013 edition.

This classification proved helpful for data elaboration, making it possible to determine whether the impact of a food changes in relation to its area of provenance.

### Field: "Note"

This field (adopted in the 2013 edition) indicates any notes relevant to the data, mainly regarding the characteristics of the functional unit or production system.

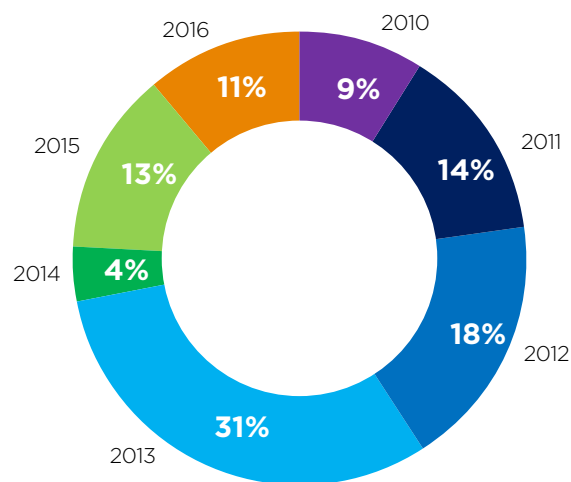
In order to elaborate data with a greater level of detail, these have been reorganized according to specific characteristics that may weigh strongly on the final impact of the food.

The main features referred to are:

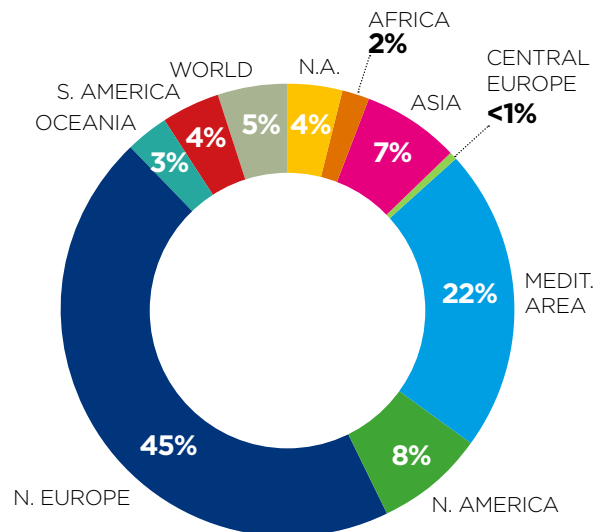
- Organic;
- Integrated agriculture;
- Greenhouse;
- Frozen;
- Farmed/Wild (referred to fish).

## IMPACT DATA

This section shows the main characteristics of data used in the construction of the pyramids, with a focus on the range of values regarding environmental indicators as well as the amount of information used in the definition of the average.



Distribution of data by year of use in the Double Pyramid document



Distribution of data by area of origin



Each food is correlated to two tables showing information in a systematic and summarized form. To

facilitate data consultation, below a detailed example of the type of table used is provided.

DATA RANGE USED TO CALCULATE AVERAGES		TYPE OF FOOD	CARBON FOOTPRINT	WATER FOOTPRINT	ECOLOGICAL FOOTPRINT	Environmental impact per kg or liter of food
	Food name		g CO <sub>2</sub> eq/kg	liters/kg	global m <sup>2</sup> /kg	
	Reference data range taken from the bibliography	Data range				
	Mathematical average assessed using only valid and reliable data	Average value				
		Cooking (boiling)				Impact relative to cooking (if applicable) and type of preparation
		Average value with cooking				Sum of average production and cooking data. This is the value used to build the environmental pyramid

DATA SOURCE, AMOUNT AND TYPE						
TYPE OF FOOD	LCA DATABASE	SCIENTIFIC PUBLICATION	VERIFIED PUBLICATION	INTERNAL ELABORATION	TOTAL	DATA INCREASE OVER 2015
CARBON FOOTPRINT						
WATER FOOTPRINT						
ECOLOGICAL FOOTPRINT						
TOTAL						



## Food crop

This category contains foods produced directly from the agricultural phase, i.e., foods that have no (or negligible) industrial phases.

Since the 2013 edition, this category also includes Rice (previously included in the “Agricultural processed products” category) as it undergoes a limited amount of processing that is much less influential than the agricultural phase.

### Dried fruit

The category Dried fruit takes into account nine different varieties, including pistachio this year. The coverage of data was greatly enhanced in the 2013 edition, which also explains why the Carbon Footprint decreased by almost half as compared with the past editions. This year, 2 new Carbon Footprint data items were collected. The value of the Carbon Footprint has decreased slightly, but not in significant percentages. The Water and Ecological Footprints remained unchanged.

In the 2013 edition, thanks to the inclusion in the database of an Ecological Footprint value, the category entered the Double Pyramid, where it was placed in the third band. In this edition, the position of dried fruit within the Double Pyramid remains unchanged (third band).

DRIED FRUIT	CARBON FOOTPRINT	WATER FOOTPRINT	ECOLOGICAL FOOTPRINT
	g CO <sub>2</sub> eq/kg	liters/kg	global m <sup>2</sup> /kg
Data range	489 - 3830	2280 - 9065	19.1
Average value	1793	6247	19.1
Cooking	0	0	0
Average value with cooking	1793	6247	19.1

DATA SOURCE, AMOUNT AND TYPE						
DRIED FRUIT	LCA DATABASE	SCIENTIFIC PUBLICATION	VERIFIED PUBLICATION	INTERNAL ELABORATION	TOTAL	DATA INCREASE OVER 2015
CARBON FOOTPRINT	0	15	0	0	15	2
WATER FOOTPRINT	2	3	0	0	5	0
ECOLOGICAL FOOTPRINT	0	1	0	0	1	0
TOTAL	2	19	0	0	21	2



Fruit

The category Fruit takes into account all the most commonly consumed fruits, including berries and some exotic varieties.

This year, 5 new Carbon Footprint data items, 1 Water Footprint data item and 1 Ecological Footprint data item were collected; globally, of the 154 data items collected in the database, 20 were not used to update the Double Pyramid average (mainly greenhouse and frozen references). Carbon, Water and Ecological Footprint remained substantially unchanged, as did the position of fruit within the Double Pyramid (first band). Since the 2013 edition, the averages do not account for out-of-season fruit, (i.e. greenhouse grown or frozen products).

FRUIT	CARBON FOOTPRINT	WATER FOOTPRINT	ECOLOGICAL FOOTPRINT
	g CO <sub>2</sub> eq/kg	liters/kg	global m <sup>2</sup> /kg
Data range	60 - 1639	47 - 3680	0.5 - 13.4
Average value	490	930	3.2
Cooking	0	0	0
Average value with cooking	490	930	3.2

DATA SOURCE, AMOUNT AND TYPE						
FRUIT	LCA DATABASE	SCIENTIFIC PUBLICATION	VERIFIED PUBLICATION	INTERNAL ELABORATION	TOTAL	DATA INCREASE OVER 2015
CARBON FOOTPRINT	0	73	2	0	75	5
WATER FOOTPRINT	7	33	1	0	41	1
ECOLOGICAL FOOTPRINT	5	14	2	0	21	1
TOTAL	12	120	5	0	137	7



Legumes

The Legumes category includes broad beans, string beans, flat beans, lentils, peas and soybeans. The data found in literature does not take into account the stage of cooking necessary for consumption. The environmental impacts of cooking by boiling were added by adopting assumptions outlined in the specific chapter “Food cooking techniques”. No condiment or dressing was accounted for.

This year, 1 new Carbon Footprint was collected. Globally, of the 41 data items collected in the database, 12 were not used to update the Double Pyramid average; these include two data items on soy milk and on frozen or pre-cooked legumes. The values of the Carbon and Ecological Footprints have decreased very slightly while the Water Footprint remained unchanged, as the position of legumes in the Double Pyramid did (third band).

LEGUMES	CARBON FOOTPRINT	WATER FOOTPRINT	ECOLOGICAL FOOTPRINT
	g CO <sub>2</sub> eq/kg	liters/kg	global m <sup>2</sup> /kg
Data range	100 - 2500	516 - 5874	6.8 - 26.0
Average value	631	2711	14.8
Cooking (boiling)	1031	0	2.6
Average value with cooking	1662	2711	17.4

DATA SOURCE, AMOUNT AND TYPE						
LEGUMES	LCA DATABASE	SCIENTIFIC PUBLICATION	VERIFIED PUBLICATION	INTERNAL ELABORATION	TOTAL	DATA INCREASE OVER 2015
CARBON FOOTPRINT	2	17	0	0	19	1
WATER FOOTPRINT	1	7	0	0	8	0
ECOLOGICAL FOOTPRINT	3	1	0	0	4	0
TOTAL	6	25	0	0	31	1



## Potatoes

Potatoes were evaluated separately from vegetables (unlike previous years) - as of this edition, it has become a separate typology in the database. The data found in literature does not take into account the stage of cooking necessary for consumption. The environmental impacts of cooking by boiling were added by adopting assumptions outlined in the specific chapter "Food cooking techniques". No condiment or dressing was accounted for.

This year, only 2 new Carbon Footprint data items were collected. Globally, of the 31 data items collected in the database, only 1 was not used to update the Double Pyramid average (a greenhouse reference).

The values of the Carbon, Water and Ecological Footprints remained unchanged, like the position of potatoes in the Double Pyramid (first band).

POTATOES	CARBON FOOTPRINT	WATER FOOTPRINT	ECOLOGICAL FOOTPRINT
	g CO <sub>2</sub> eq/kg	liters/kg	global m <sup>2</sup> /kg
Data range	46 - 400	287 - 823	0.9 - 3.0
Average value	174	555	2.1
Cooking (boiling)	1031	0	2.6
Average value with cooking	1205	555	5

DATA SOURCE, AMOUNT AND TYPE						
POTATOES	LCA DATABASE	SCIENTIFIC PUBLICATION	VERIFIED PUBLICATION	INTERNAL ELABORATION	TOTAL	DATA INCREASE OVER 2015
CARBON FOOTPRINT	1	22	1	0	24	2
WATER FOOTPRINT	1	1	0	0	2	0
ECOLOGICAL FOOTPRINT	2	3	0	0	5	0
TOTAL	4	26	1	0	31	2





Rice

Rice is the only food taken into account from the Cereals category, since it is virtually the only cereal usually consumed as a dish in itself. The data found in literature does not take into account the stage of cooking necessary for consumption. The environmental impacts of cooking by boiling were added by adopting assumptions outlined in the specific chapter “Food cooking techniques”. No condiment or dressing was accounted for.

This year, only 1 new Carbon Footprint was collected. Globally, of the 32 data items collected in the database, 10 were not used to update the Double Pyramid average (mainly data items from the Water Footprint Network on specific countries). The value of the Carbon Footprint has decreased slightly(-2%). The Water and Ecological Footprint remained unchanged, like the position of rice in the Double Pyramid (first band).

RICE	CARBON FOOTPRINT	WATER FOOTPRINT	ECOLOGICAL FOOTPRINT
	g CO <sub>2</sub> eq/kg	liters/kg	global m <sup>2</sup> /kg
Data range	785 - 6400	2497 - 2672	5.7 - 7.8
Average value	2446	2585	6.8
Cooking (boiling)	1300	0	3.2
Average value with cooking	3746	2585	10.0

DATA SOURCE, AMOUNT AND TYPE						
RICE	LCA DATABASE	SCIENTIFIC PUBLICATION	VERIFIED PUBLICATION	INTERNAL ELABORATION	TOTAL	DATA INCREASE OVER 2015
CARBON FOOTPRINT	1	18	0	0	19	1
WATER FOOTPRINT	1	1	0	0	2	0
ECOLOGICAL FOOTPRINT	2	0	0	0	2	0
TOTAL	4	19	0	0	23	1



### Seasonal vegetables

The category Seasonal Vegetables takes into account all the most commonly consumed vegetables that are naturally “in season”. The calculation data thus excludes varieties grown in greenhouses or frozen. The data found in literature does not take into account the stage of cooking, often needed for consumption. The environmental impacts of cooking by sautéing were added by adopting assumptions outlined in the chapter “Food cooking techniques”. No condiment or dressing was accounted for.

This year 9 new Carbon Footprint data items were collected. Of the 200 data items collected in the database, 51 were not used to update the Double Pyramid average (mainly greenhouse and frozen references).

The value of the Carbon Footprint has decreased by 5%. The position of seasonal vegetables in the Double Pyramid remained unchanged (first band).

Separate studies were conducted for out-of-season vegetables, i.e. those grown in greenhouses or sold frozen.

SEASONAL VEGETABLES	CARBON FOOTPRINT	WATER FOOTPRINT	ECOLOGICAL FOOTPRINT
	g CO <sub>2</sub> eq/kg	liters/kg	global m <sup>2</sup> /kg
Data range	14 - 4800	5 - 900	0.8 - 4.3
Average value	549	333	1.7
Cooking (sautéing)	225	0	0.6
Average value with cooking	774	333	2.3

DATA SOURCE, AMOUNT AND TYPE						
SEASONAL VEGETABLES	LCA DATABASE	SCIENTIFIC PUBLICATION	VERIFIED PUBLICATION	INTERNAL ELABORATION	TOTAL	DATA INCREASE OVER 2015
CARBON FOOTPRINT	3	112	1	0	116	9
WATER FOOTPRINT	5	14	0	0	19	0
ECOLOGICAL FOOTPRINT	1	19	0	0	20	0
TOTAL	9	145	1	0	155	9



## Agricultural processed products

This category encompasses products that originate from agricultural goods and are then transformed by industrial processes.

### Biscuits

The Biscuits category is comprised almost entirely of industrial products, for which data comes mainly from the Environmental Product Declarations (31 out of the 34 total data items used). Cooking procedures (baking) had already been included within the system boundaries of the databases and studies considered; therefore, it was no longer added.

This year, 7 new Carbon Footprint, 7 new Water Footprint and 7 new Ecological Footprint data items were collected. Globally, of the 34 data items collected in the database, 13 were not used to update the Double Pyramid average (old EPD).

The new data essentially confirm the internal elaborations presented in 2010, which is why, since 2015, the working group decided to exclude this elaboration from the Double Pyramid average, preferring to retain only data from public and certified sources.

The value of the Carbon Footprint and Ecological Footprint have decreased slightly, but not in significant percentages (-3% and -1% respectively). The Water Footprint remained unchanged. The position of biscuits in the Double Pyramid remained unchanged (second band).

BISCUITS	CARBON FOOTPRINT	WATER FOOTPRINT	ECOLOGICAL FOOTPRINT
	g CO <sub>2</sub> eq/kg	liters/kg	global m <sup>2</sup> /kg
Data range	1108 - 2549	1167 - 3653	8.4- 14.0
Average value	1564	2145	10.5
Cooking	0	0	0
Average value with cooking	1546	2145	10.5

DATA SOURCE, AMOUNT AND TYPE						
BISCUITS	LCA DATABASE	SCIENTIFIC PUBLICATION	VERIFIED PUBLICATION	INTERNAL ELABORATION	TOTAL	DATA INCREASE OVER 2015
CARBON FOOTPRINT	0	1	19	0	20	7
WATER FOOTPRINT	0	0	19	0	19	7
ECOLOGICAL FOOTPRINT	0	1	19	0	20	7
TOTAL	0	2	57	0	59	21



Bread and Crackers

The category Bread analyzes both homemade baked goods and industrial ones such as sliced bread, crackers, crisp bread, croutons and rusks. Most of the data comes from Environmental Product Declarations (23 out of 58 total data items used). Cooking procedures (baking) had already

been included within the system boundaries of the databases and of the studies considered; therefore, it was no longer added. This year, 11 new Carbon Footprint, 10 new Water Footprint and 10 new Ecological Footprint data items were collected. Globally, of the 58 data items collected in the database, 19 were not used to update the Double Pyramid average. These include the old

EPD and the WFN specific country data. The general impact value of bread has decreased for the Carbon Footprint (6%) and for Water Footprint, while the Ecological Footprint increased by 8%. The position of bread in the Double Pyramid remained unchanged (second band).

BREAD/ CRACKERS	CARBON FOOTPRINT	WATER FOOTPRINT	ECOLOGICAL FOOTPRINT
	g CO <sub>2</sub> eq/kg	liters/kg	global m <sup>2</sup> /kg
Data range	257 - 2332	359 - 2478	3.8 - 11.1
Average value	1052	1172	7.9
Cooking	0	0	0
Average value with cooking	1052	1172	7.9

DATA SOURCE, AMOUNT AND TYPE						
BREAD/ CRACKERS	LCA DATABASE	SCIENTIFIC PUBLICATION	VERIFIED PUBLICATION	INTERNAL ELABORATION	TOTAL	DATA INCREASE OVER 2015
CARBON FOOTPRINT	6	18	32	0	56	11
WATER FOOTPRINT	1	0	31	0	32	10
ECOLOGICAL FOOTPRINT	0	1	31	0	32	10
TOTAL	7	19	94	0	120	31

BREAD AND CRACKERS: AN IN-DEPTH ANALYSIS

Bread and crackers are evaluated together in the Double Pyramid category of Bread. But the two products are quite different. The table shows the comparison between bread (63 data items) and crackers (57 data items) for the three environmental indicators. As can be seen, bread generally has a lower impact than cracker products.

FOOD	CARBON FOOTPRINT g CO <sub>2</sub> eq/kg	WATER FOOTPRINT liters/kg	ECOLOGICAL FOOTPRINT global m <sup>2</sup> /kg
BREAD	947	1102	5.9
CRACKERS	1257	1220	9.2
"Bread" in Double Pyramid	1052	1172	10.5



Breakfast cereals

The category Breakfast Cereals was added to the database for the first time in 2011 in order to make the Pyramid relevant to child and adolescent growth. Two Carbon Footprint data items from scientific studies corroborate assumptions made internally and described in the Supplement section of this paper, while keeping the final impact value unchanged. No data was added in this edition. The position of breakfast cereals in the Double Pyramid for growing children/adolescents remained unchanged (second band).

BREAKFAST CEREALS	CARBON FOOTPRINT	WATER FOOTPRINT	ECOLOGICAL FOOTPRINT
	g CO <sub>2</sub> eq/kg	liters/kg	global m <sup>2</sup> /kg
Data range	2200 - 4167	920	13.0
Average value	3422	920	13.0
Cooking	0	0	0
Average value with cooking	3422	920	13.0

DATA SOURCE, AMOUNT AND TYPE						
BREAKFAST CEREALS	LCA DATABASE	SCIENTIFIC PUBLICATION	VERIFIED PUBLICATION	INTERNAL ELABORATION	TOTAL	DATA INCREASE OVER 2015
CARBON FOOTPRINT	0	2	0	1	3	0
WATER FOOTPRINT	0	0	0	1	1	0
ECOLOGICAL FOOTPRINT	0	0	0	1	1	0
TOTAL	0	2	0	3	5	0



Margarine

The category Margarine, added to the database in the 2011 edition, consists of only five data items. Since new information has not become available this year, its position in the three environmental pyramids remained unchanged from last year. Margarine is not included in the Double Pyramid because it is not evaluated in the nutritional guidelines.

MARGARINE	CARBON FOOTPRINT	WATER FOOTPRINT	ECOLOGICAL FOOTPRINT
	g CO <sub>2</sub> eq/kg	liters/kg	global m <sup>2</sup> /kg
Data range	1100 - 1,660	1324	66.0
Average value	1360	1324	66.0
Cooking	0	0	0
Average value with cooking	1360	1324	66.0

DATA SOURCE, AMOUNT AND TYPE						
MARGARINE	LCA DATABASE	SCIENTIFIC PUBLICATION	VERIFIED PUBLICATION	INTERNAL ELABORATION	TOTAL	DATA INCREASE OVER 2015
CARBON FOOTPRINT	0	3	0	0	3	0
WATER FOOTPRINT	0	1	0	0	1	0
ECOLOGICAL FOOTPRINT	0	1	0	0	1	0
TOTAL	0	5	0	0	5	0





Olive Oil

From this edition onwards, the working group has decided to consider only olive oil in the category Oil, in compliance with the Mediterranean diet guidelines. Of the 23 data items collected in the database, 19 were not used to update the Double Pyramid

average. 1 new Carbon Footprint data item was added this year.

Ecological and Water Footprint remained unchanged, as well as oil's position in the Double Pyramid (fourth band).

OLIVE OIL	CARBON FOOTPRINT	WATER FOOTPRINT	ECOLOGICAL FOOTPRINT
	g CO <sub>2</sub> eq/kg	liters/kg	global m <sup>2</sup> /kg
Data range	489 - 5558	4900 - 14400	14.6 - 75.4
Average value	3084	9650	45.0
Cooking	0	0	0
Average value with cooking	3084	9650	45.0

DATA SOURCE, AMOUNT AND TYPE						
OLIVE OIL	LCA DATABASE	SCIENTIFIC PUBLICATION	VERIFIED PUBLICATION	INTERNAL ELABORATION	TOTAL	DATA INCREASE OVER 2015
CARBON FOOTPRINT	0	9	10	0	19	1
WATER FOOTPRINT	1	0	0	1	2	0
ECOLOGICAL FOOTPRINT	0	1	0	1	2	0
TOTAL	1	10	10	2	23	1

OTHER VEGETABLE OILS: AN IN-DEPTH ANALYSIS

The database also includes data on oils from different sources, e.g. seed oil or palm oil. In the table, there is a comparison between their Carbon Footprint data: olive oil, seed oil (peanut, sunflower, rapeseed, soybean) and palm oil.

FOOD	CARBON FOOTPRINT global m <sup>2</sup> /kg	DATA
OLIVE OIL	3084	19
SEED OIL	2083	17
PALM OIL	2620	6



Pasta

The impact data of pasta is derived mainly from Environmental Product Declarations (37 data items out of 45).

The data found in literature does not take into account the stage of cooking necessary for consumption. The environmental impacts of cooking by boiling were added by adopting assumptions

outlined in the chapter “Food cooking techniques”.  
inserire collegamento. No condiment or dressing was accounted for.

This year, 10 new Carbon Footprint, 1 new Water Footprint and 1 new Ecological Footprint data items were collected. Globally, of the 45 data items collected in the database, 17 were not used to update the Double Pyramid average. These include the old

EPD, the WFN specific country data and the egg pasta references.

Carbon Footprint increased by 13%(bringing the category to the third band) and Water Footprint increased by 4%. Nevertheless, the position of pasta in the Double Pyramid remained unchanged (second band).

PASTA	CARBON FOOTPRINT	WATER FOOTPRINT	ECOLOGICAL FOOTPRINT
	g CO <sub>2</sub> eq/kg	liters/kg	global m <sup>2</sup> /kg
Data range	500 - 2303	1215 - 2517	6.7 - 16.1
Average value	1276	1776	10.2
Cooking (boiling)	878	0	2.2
Average value with cooking	2154	1776	12.4

DATA SOURCE, AMOUNT AND TYPE						
PASTA	LCA DATABASE	SCIENTIFIC PUBLICATION	VERIFIED PUBLICATION	INTERNAL ELABORATION	TOTAL	DATA INCREASE OVER 2015
CARBON FOOTPRINT	0	2	25	0	27	10
WATER FOOTPRINT	1	0	10	0	11	1
ECOLOGICAL FOOTPRINT	0	0	10	0	10	1
TOTAL	1	2	45	0	48	12

EGG PASTA: AN IN-DEPTH ANALYSIS

The database also includes three data items on egg pasta. In the table, there is a comparison between the Carbon Footprint of pasta and egg pasta (uncooked).

FOOD	CARBON FOOTPRINT g CO <sub>2</sub> eq/kg	DATA
PASTA	1276	27
EGG PASTA	3677	3



Sugar

In the Sugar category, the impacts of sugar from sugar beet and sugar cane have been assessed.

Sugar is not included in the Double Pyramid because it is not evaluated in the nutritional guidelines.

SUGAR	CARBON FOOTPRINT	WATER FOOTPRINT	ECOLOGICAL FOOTPRINT
	g CO <sub>2</sub> eq/kg	liters/kg	global m <sup>2</sup> /kg
Data range	176 - 1310	202 - 1782	2.4 - 7.0
Average value	602	968	3.9
Cooking	0	0	0
Average value with cooking	602	968	3.9

DATA SOURCE, AMOUNT AND TYPE						
SUGAR	LCA DATABASE	SCIENTIFIC PUBLICATION	VERIFIED PUBLICATION	INTERNAL ELABORATION	TOTAL	DATA INCREASE OVER 2015
CARBON FOOTPRINT	4	7	3	0	14	4
WATER FOOTPRINT	2	1	0	0	3	0
ECOLOGICAL FOOTPRINT	4	1	0	0	5	0
TOTAL	10	9	3	0	22	4

BEET SUGAR AND CANE SUGAR: AN IN-DEPTH ANALYSIS

Beet sugar and cane sugar are evaluated together in the Double Pyramid category of Sugar, but the two products are very different. The table shows the comparison between beet sugar (11 data items) and cane sugar (9 data items) for the three environmental indicators.

FOOD	CARBON FOOTPRINT g CO <sub>2</sub> eq/kg	WATER FOOTPRINT liters/kg	ECOLOGICAL FOOTPRINT global m <sup>2</sup> /kg
BEET SUGAR	804	920	3.3
CANE SUGAR	356	992	2.8
"Sugar" in the Double Pyramid	602	968	3.9



## Sweets

The category includes Sweets, almost all of which are entirely industrially made, with data derived mainly from the Environmental Product Declarations (24 out of a total of 33 data items used).

This year, 6 new Carbon Footprint, 6 new Water Footprint and 6 new Ecological Footprint data items were collected. Globally, of the 33 data items collected in the database, 14 were not used to update the Double Pyramid average (mainly old EPD); chocolate, cocoa and ice cream were excluded. The new data essentially confirms the internal elaboration presented in 2010. Since 2015, the working group has decided to exclude this elaboration from the Double Pyramid average, preferring to retain only data from public and certified sources.

The general impact of the value of Sweets has decreased: -6% for Carbon Footprint, -3% for Water Footprint and -3% for Ecological Footprint. The position of this category whitening has remained unchanged.

SWEETS	CARBON FOOTPRINT	WATER FOOTPRINT	ECOLOGICAL FOOTPRINT
	g CO <sub>2</sub> eq/kg	liters/kg	global m <sup>2</sup> /kg
Data range	1500 - 2943	1095 - 5466	9.4 - 21.1
Average value	2101	2335	13.7
Cooking	0	0	0
Average value with cooking	2101	2335	13.7

DATA SOURCE, AMOUNT AND TYPE						
SWEETS	LCA DATABASE	SCIENTIFIC PUBLICATION	VERIFIED PUBLICATION	INTERNAL ELABORATION	TOTAL	DATA INCREASE OVER 2015
CARBON FOOTPRINT	0	1	16	0	17	6
WATER FOOTPRINT	0	0	15	0	15	6
ECOLOGICAL FOOTPRINT	0	2	15	0	17	6
TOTAL	0	3	46	0	49	18



## Farm products

This category encompasses foods whose production involves animal farming and the use of elements derived from animals (milk and eggs), as well as direct use of meat. For meat, the Double Pyramid divided white and red types, thus keeping the data and information base transparent. Beef and pork are listed as red meat while poultry is white meat.

The system boundaries for these products include:

- The farming phase that includes agricultural production of food for feeding animals;
- The slaughter phase (for meat production);
- Processing of products (in the case of production of milk and eggs).

The data found in literature does not take into account the stage of cooking necessary for consumption. The environmental impacts of cooking meat and eggs by deep frying were added by adopting assumptions outlined in the chapter “Food cooking techniques”. No condiment or dressing was accounted for. Cheese, butter, milk, yogurt and honey are treated as foods eaten raw.

## MEAT: LIVE WEIGHT, CARCASS WEIGHT, BONE-FREE WEIGHT

Scientific studies on animal husbandry do not always use the same functional unit. In literature the studies refer to meat at different stages of the production process: live weight (at farm); carcass weight (at slaughterhouse); bone-free weight (at retail). To obtain comparable values, we reported all the values at the retail stage: this allows values consistent with the objective of the study and the addition of the cooking impact (deep frying) to the average value.

To do this, it is necessary to multiply the data by the yield referring to the specific stage of the production process: the data reported in

live weight was multiplied by the yield in order to obtain the weight of carcass; using the same method, the data shown in carcass weight was multiplied by the yield in order to obtain the weight of bone-free meat. The yields used for beef, pork and poultry are shown in the table below and come from the elaboration by the Barilla Centre for Food & Nutrition of confidential life cycle assessment data of major companies and associations of the animal husbandry sector.

TYPE OF MEAT	LIVE WEIGHT to BONE-FREE WEIGHT	CARCASS WEIGHT to BONE-FREE WEIGHT	BONE-FREE WEIGHT
BEEF	49% (60% LW to CW * 82% CW to FBW)	82%	100%
PORK	60% (75% LW to CW * 80% CW to FBW)	80%	100%
POULTRY	58% (65% LW to CW * 90% CW to FBW)	90%	100%



Beef meat

The data relating to environmental impacts associated with the production of beef (cattle and calves) is derived mainly from scientific publications (73 out of the 96 data items used).  
The position of Beef in the Double Pyramid remained unchanged,confirming this food as the one with the greatest impact and thus in the highest bracket (sixth category).

BEEF	CARBON FOOTPRINT	WATER FOOTPRINT	ECOLOGICAL FOOTPRINT
	g CO <sub>2</sub> eq/kg	liters/kg	global m <sup>2</sup> /kg
Data range	6158 - 65,041	18,799	91.5 - 207.3
Average value	25,782	18,799	145.7
Cooking (sautéing)	113	0	0.3
Average value with cooking	25,895	18,799	146

DATA SOURCE, AMOUNT AND TYPE						
BEEF	LCA DATABASE	SCIENTIFIC PUBLICATION	VERIFIED PUBLICATION	INTERNAL ELABORATION	TOTAL	DATA INCREASE OVER 2015
CARBON FOOTPRINT	4	65	4	0	73	8
WATER FOOTPRINT	1	0	0	0	1	0
ECOLOGICAL FOOTPRINT	0	5	0	0	5	0
TOTAL	5	70	4	0	79	8





Butter

Butter is not included in the Double Pyramid because it is not evaluated in the nutritional guidelines, but it is assessed in the interests of completeness. This year, no new data item were collected. Globally, out of the 14 data items collected in the database, 4 were not used to update the Double Pyramid average (extreme values). From 2015 the working group decided to exclude the internal elaboration presented in 2010 from the average, preferring to retain only data from public and certified sources.

BUTTER	CARBON FOOTPRINT	WATER FOOTPRINT	ECOLOGICAL FOOTPRINT
	g CO <sub>2</sub> eq/kg	liters/kg	global m <sup>2</sup> /kg
Data range	7100 - 9600	5553	33.3 - 115.0
Average value	8304	5553	74.2
Cooking	0	0	0
Average value with cooking	8304	5553	74.2

DATA SOURCE, AMOUNT AND TYPE						
BUTTER	LCA DATABASE	SCIENTIFIC PUBLICATION	VERIFIED PUBLICATION	INTERNAL ELABORATION	TOTAL	DATA INCREASE OVER 2015
CARBON FOOTPRINT	0	7	0	0	7	0
WATER FOOTPRINT	1	0	0	0	1	0
ECOLOGICAL FOOTPRINT	0	2	0	0	2	0
TOTAL	1	9	0	0	10	0



Cheese

This year no new data items were collected. Out of the 30 data items collected in the database, only 2 were not used to update the Double Pyramid average (extreme values).  
From 2015 the working group decided to exclude the internal elaboration presented in 2010 from the average, preferring to retain only data from public and certified sources.  
The value of the Carbon, Water and Ecological Footprint remained unchanged from the previous year, and so did the position of cheese in the Double Pyramid (fifth category).

CHEESE	CARBON FOOTPRINT	WATER FOOTPRINT	ECOLOGICAL FOOTPRINT
	g CO <sub>2</sub> eq/kg	liters/kg	global m <sup>2</sup> /kg
Data range	5300 - 14,546	2067 - 10,390	30.1 - 111.0
Average value	9252	6261	60.7
Cooking	0	0	0
Average value with cooking	9252	6261	60.7

DATA SOURCE, AMOUNT AND TYPE						
CHEESE	LCA DATABASE	SCIENTIFIC PUBLICATION	VERIFIED PUBLICATION	INTERNAL ELABORATION	TOTAL	DATA INCREASE OVER 2015
CARBON FOOTPRINT	0	23	2	0	25	0
WATER FOOTPRINT	1	0	3	0	4	0
ECOLOGICAL FOOTPRINT	0	1	2	0	3	0
TOTAL	1	24	7	0	32	0



Eggs

This year, only 1 new Carbon Footprint data item was collected. Globally, out of the 29 data items collected in the database, only 1 was not used to update the Double Pyramid average (extreme data).  
The value of the Carbon Footprint has decreased slightly (-2%), while the Water and Ecological Footprints remained unchanged, like the position of Eggs in the Double Pyramid (third category).

EGGS	CARBON FOOTPRINT	WATER FOOTPRINT	ECOLOGICAL FOOTPRINT
	g CO <sub>2</sub> eq/kg	liters/kg	global m <sup>2</sup> /kg
Data range	1239 - 5800	3220 - 3300	9.0 - 22.2
Average value	3219	3262	14.6
Cooking (boiling)	501	0	1.2
Average value with cooking	3720	3262	15.9

DATA SOURCE, AMOUNT AND TYPE						
EGGS	LCA DATABASE	SCIENTIFIC PUBLICATION	VERIFIED PUBLICATION	INTERNAL ELABORATION	TOTAL	DATA INCREASE OVER 2015
CARBON FOOTPRINT	0	22	1	0	23	1
WATER FOOTPRINT	1	1	1	0	3	0
ECOLOGICAL FOOTPRINT	0	2	1	1	4	0
TOTAL	1	25	3	1	30	1



Honey

Impact data on honey production has been available since 2013. The category has not been added to the Double Pyramid, but data is shown here for the sake of completeness.

The database contains only 2 data items about Carbon Footprint and 1 data for Ecological Footprint of Honey. No data is available for Water Footprint.

HONEY	CARBON FOOTPRINT	WATER FOOTPRINT	ECOLOGICAL FOOTPRINT
	g CO <sub>2</sub> eq/kg	liters/kg	global m <sup>2</sup> /kg
Data range	795 - 2500	na	9.0
Average value	1648	na	9.0
Cooking	0	na	0
Average value with cooking	1648	na	9.0

DATA SOURCE, AMOUNT AND TYPE						
HONEY	LCA DATABASE	SCIENTIFIC PUBLICATION	VERIFIED PUBLICATION	INTERNAL ELABORATION	TOTAL	DATA INCREASE OVER 2015
CARBON FOOTPRINT	0	2	0	0	2	1
WATER FOOTPRINT	0	0	0	0	0	0
ECOLOGICAL FOOTPRINT	0	1	0	0	1	0
TOTAL	0	3	0	0	3	1



Lamb meat

The BCFN database includes 21 data items on lamb meat. The environmental impacts of lamb meat are shown in the tables below but it's not included in the pyramids, given the limited consumption of this meat.

This year, only 1 new Carbon Footprint data item was collected.

LAMB	CARBON FOOTPRINT	WATER FOOTPRINT	ECOLOGICAL FOOTPRINT
	g CO <sub>2</sub> eq/kg	liters/kg	global m <sup>2</sup> /kg
Data range	2849 - 27,250	10,412	76.0 - 96.0
Average value	14,455	10,412	86.0
Cooking (sautéing)	112.6	0	0.3
Average value with cooking	14,567	10,412	86.3

DATA SOURCE, AMOUNT AND TYPE						
LAMB	LCA DATABASE	SCIENTIFIC PUBLICATION	VERIFIED PUBLICATION	INTERNAL ELABORATION	TOTAL	DATA INCREASE OVER 2015
CARBON FOOTPRINT	0	16	0	0	16	1
WATER FOOTPRINT	1	0	0	0	1	0
ECOLOGICAL FOOTPRINT	0	2	0	0	2	0
TOTAL	1	18	0	0	19	1



Milk

The Milk category is that with the greatest amount of data available (12% of total data used). This year, 7 new Carbon Footprint, 8 new Water Footprint and 6 new Ecological Footprint data items were collected.

Globally, out of the 174 data items collected in the database, 10 were not used to update the Double Pyramid average (mainly old EPD); a data item on goat milk was not included in the pyramids due to this product's limited consumption. The values of the Carbon and Water Footprints

have increased by 1% and 4% respectively, while the Ecological Footprint has decreased by 13%. The position of milk in the Double Pyramid has remained unchanged (second band).

MILK	CARBON FOOTPRINT	WATER FOOTPRINT	ECOLOGICAL FOOTPRINT
	g CO <sub>2</sub> eq/kg	liters/kg	global m <sup>2</sup> /kg
Data range	510 - 3120	927 - 1769	3.5 - 15.0
Average value	1254	1329	7.1
Cooking	0	0	0
Average value with cooking	1254	1329	7.1

DATA SOURCE, AMOUNT AND TYPE						
MILK	LCA DATABASE	SCIENTIFIC PUBLICATION	VERIFIED PUBLICATION	INTERNAL ELABORATION	TOTAL	DATA INCREASE OVER 2015
CARBON FOOTPRINT	0	147	9	0	156	7
WATER FOOTPRINT	2	3	9	0	14	8
ECOLOGICAL FOOTPRINT	0	3	9	0	12	6
TOTAL	2	153	27	0	182	21

CREAM: A SEPARATE CATEGORY

From this edition onwards, it has been decided not to include cream in the average value for milk, because the products are classed as two distinct foods with different characteristics and environmental yields. Cream has thus become a separate category (not included in the Double Pyramid but still of interest when compared with milk). The table below shows a comparison between milk (182 data) and cream (8 data).

FOOD	CARBON FOOTPRINT g CO <sub>2</sub> eq/kg	WATER FOOTPRINT liters/kg	ECOLOGICAL FOOTPRINT global m <sup>2</sup> /kg
MILK	1254	1329	7.1
CREAM	5920	7670	45





Pork meat

This year 4 new Carbon Footprint and 2 Water Footprint data items were collected. Globally, out of the 64 data collected in the database, only 3 were not used to update the Double Pyramid average (extreme data and a cooked reference). The value of the Carbon and Water Footprint have increased by 7% and 23% respectively, while the Ecological Footprint remained unchanged, as well as its position in the Double Pyramid (third band).

PORK	CARBON FOOTPRINT	WATER FOOTPRINT	ECOLOGICAL FOOTPRINT
	g CO <sub>2</sub> eq/kg	liters/kg	global m <sup>2</sup> /kg
Data range	2310 - 14,500	7485 - 10,600	19.0 - 101.8
Average value	5392	9062	47.0
Cooking (sautéing)	113	0	0.3
Average value with cooking	5504	9062	47.3

DATA SOURCE, AMOUNT AND TYPE						
PORK	LCA DATABASE	SCIENTIFIC PUBLICATION	VERIFIED PUBLICATION	INTERNAL ELABORATION	TOTAL	DATA INCREASE OVER 2015
CARBON FOOTPRINT	6	51	0	0	57	4
WATER FOOTPRINT	1	2	0	0	3	2
ECOLOGICAL FOOTPRINT	1	3	0	0	4	0
TOTAL	8	56	0	0	64	6



Poultry meat

This year only 1new Carbon Footprint data item was collected. Globally, out of the 45 data items collected in the database, 5 were not used to update the Double Pyramid average (extreme data and cooked reference).

The Footprint values have remained unchanged, and so did the position of Poultry in the Double Pyramid (fourth category).

POULTRY	CARBON FOOTPRINT	WATER FOOTPRINT	ECOLOGICAL FOOTPRINT
	g CO <sub>2</sub> eq/kg	liters/kg	global m <sup>2</sup> /kg
Data range	890 - 14,904	4806	16.0 - 80.0
Average value	3910	4806	43.0
Cooking (sautéing)	113	0	0.3
Average value with cooking	4022	4806	43.3

DATA SOURCE, AMOUNT AND TYPE						
POULTRY	LCA DATABASE	SCIENTIFIC PUBLICATION	VERIFIED PUBLICATION	INTERNAL ELABORATION	TOTAL	DATA INCREASE OVER 2015
CARBON FOOTPRINT	4	30	0	0	34	1
WATER FOOTPRINT	1	0	0	0	1	0
ECOLOGICAL FOOTPRINT	1	2	0	0	3	0
TOTAL	6	32	0	0	38	1



Yogurt

This year, 8 new Carbon Footprint, 8 new Water Footprint and 8 new Ecological Footprint data items were collected.

From 2015 the working group decided to exclude from the average the internal elaboration presented in 2010, preferring to retain only data from public and certified sources.

The Carbon Footprint has almost doubled (49%), while the Water and Ecological Footprint have decreased (-1% and -9% respectively). The position of yogurt in the Double Pyramid has remained unchanged.

YOGURT	CARBON FOOTPRINT	WATER FOOTPRINT	ECOLOGICAL FOOTPRINT
	g CO <sub>2</sub> eq/kg	liters/kg	global m <sup>2</sup> /kg
Data range	1170 - 4070	980 - 2070	9.7 - 17.0
Average value	2591	1485	11.5
Cooking (boiling)	0	0	0
Average value with cooking	2591	1485	11.5

DATA SOURCE, AMOUNT AND TYPE						
YOGURT	LCA DATABASE	SCIENTIFIC PUBLICATION	VERIFIED PUBLICATION	INTERNAL ELABORATION	TOTAL	DATA INCREASE OVER 2015
CARBON FOOTPRINT	0	9	8	0	17	8
WATER FOOTPRINT	1	0	8	0	9	8
ECOLOGICAL FOOTPRINT	0	1	8	0	9	8
TOTAL	1	10	24	0	35	24



Fisheries

Since 2013, the category has been divided into two types: fish, and shellfish (which includes crustaceans and mollusks). As in previous years, the average was calculated on the totality of the data. We have

excluded the unrepresentative extremes of the category (mussels and lobster), due to their high variability. This year no new data items were collected. No data could be found relating to the Water Footprint of fish. Globally, out of the 100 data items collected in

the database, were not used to update the Double Pyramid average (extreme values). Despite the new information, its position in the three environmental pyramids and Double Pyramid remained unchanged compared to last year.

FISH	CARBON FOOTPRINT	WATER FOOTPRINT	ECOLOGICAL FOOTPRINT
	g CO <sub>2</sub> eq/kg	liters/kg	global m <sup>2</sup> /kg
Data range	195 - 19,700	-	55.5 - 101.0
Average value	4179	-	78.3
Cooking (boiling)	225	-	0.6
Average value with cooking	4404	-	78.8

DATA SOURCE, AMOUNT AND TYPE						
FISH	LCA DATABASE	SCIENTIFIC PUBLICATION	VERIFIED PUBLICATION	INTERNAL ELABORATION	TOTAL	DATA INCREASE OVER 2015
CARBON FOOTPRINT	18	94	0	0	112	0
WATER FOOTPRINT	0	0	0	0	0	0
ECOLOGICAL FOOTPRINT	0	2	0	0	2	0
TOTAL	18	96	0	0	114	0

FISH AND SHELLFISH: AN IN-DEPTH ANALYSIS

Fish and shellfish are evaluated together in the Double Pyramid category Fish. But the two products are quite different. The fish typology includes over 30 different species of fish. The shellfish typology includes mainly: lobster, mussels, octopus, prawn, shrimps and squid. Lobster is the product with the highest carbon footprint value and was not included in the “fish” average because of its above- average status. In this insight, we try to analyze all the data of fish and shellfish

to understand the difference between the two products.

The comparison can be seen in the table below: fish has a much lower impact than shellfish.

FOOD	CARBON FOOTPRINT g CO <sub>2</sub> eq/kg	SOURCES
FISH	3639	96
SHELLFISH	7420	16
<i>“Fish” in the Double Pyramid</i>	4404	112



## THE ENVIRONMENTAL PYRAMIDS

The Table traces the variation in impact values since

the first edition in 2010. As can be seen, the high number of sources, which has grown exponentially over the various editions, has served to confirm

the results published in the first edition of the Double Pyramid, thus further reinforcing BCFN's considerations.

	CARBON FOOTPRINT [gCO <sub>2</sub> eq/kg]												
	2010	2011		2012		2013		2014		2015		2016	
Biscuits	2300	1913	-17%	1840	-4%	1692	-8%	1677	-1%	1609	-4%	1564	-3%
Butter	-	8606	0%	8606	0%	8547	-1%	8547	0%	8304	-3%	8304	0%
Poultry meat	4830	3600	-25%	3728	4%	3714	0%	3858	4%	4025	4%	4022	0%
Beef meat	31,415	25,893	-18%	25,672	-1%	21,721	-15%	26,170	20%	26,232	0%	25,895	-1%
Pork meat	5359	4254	-21%	4662	10%	4260	-9%	5091	20%	5129	1%	5504	7%
Breakfast cereals	-	2200	0%	3050	39%	2972	-3%	2972	0%	3422	15%	3422	0%
Sweets	3700	2000	-46%	2154	8%	2387	11%	2357	-1%	2237	-5%	2101	-6%
Cheese	8784	9478	8%	9462	0%	9225	-3%	9246	0%	9252	0%	9252	0%
Fruit	70	671	859%	874	30%	479	-45%	477	-1%	496	4%	490	-1%
Dried fruit	-	3020	0%	3020	0%	1859	-38%	1859	0%	1905	2%	1793	-6%
Milk	1138	1295	14%	1261	-3%	1296	3%	1299	0%	1242	-4%	1254	1%
Legumes	1550	1570	1%	1552	-1%	1379	-11%	1970	43%	1697	-14%	1662	-2%
Margarine	-	1360	0%	1360	0%	1360	0%	1360	0%	1360	0%	1360	0%
Oil	3897	3226	-17%	2672	-17%	2686	0%	2686	0%	3115	16%	3084	-1%
Vegetables	722	664	-8%	837	26%	812	-3%	818	1%	816	0%	774	-5%
Bread	983	932	-5%	979	5%	1102	13%	1102	0%	1125	2%	1052	-6%
Pasta	1984	2328	17%	2390	3%	2546	7%	2327	-9%	1901	-18%	2154	13%
Potatoes	584	602	3%	607	1%	626	3%	1218	94%	1208	-1%	1205	0%
Fish	4273	3911	-8%	4756	22%	4417	-7%	4422	0%	4404	0%	4404	0%
Rice	3170	3856	22%	3885	1%	3941	1%	4004	2%	3832	-4%	3746	-2%
Eggs	5233	4643	-11%	4090	-12%	4020	-2%	3882	-3%	3810	-2%	3720	-2%
Yogurt	1138	1138	0%	1569	38%	1550	-1%	1550	0%	1734	12%	2591	49%
Sugar	470	471	0%	473	0%	499	5%	499	0%	613	23%	602	-2%

Variation of environmental impacts for the categories of the Double Pyramid over the seven editions\*

\* Variations were highlighted when data changed  $\pm 15\%$  compared to the value used in the Environmental Pyramids published in previous editions.

Source: BCFN elaboration, 2016



	WATER FOOTPRINT [litres/kg]												
	2010	2011		2012		2013		2014		2015		2016	
Biscuits	1800	1358	-25%	1470	8%	1769	20%	1942	10%	2077	7%	2145	3%
Butter	-	5000	0%	5277	6%	5277	0%	5277	0%	5553	5%	5553	0%
Poultry meat	3900	3900	0%	4113	5%	4325	5%	4806	11%	4806	0%	4806	0%
Beef meat	15,500	15500	0%	15,500	0%	15,415	-1%	18,871	22%	19,523	3%	18,799	-4%
Pork meat	4800	4800	0%	5990	25%	5988	0%	7485	25%	7485	0%	9062	21%
Breakfast cereals	-	920	0%	920	0%	920	0%	920	0%	920	0%	920	0%
Sweets	-	3140	0%	2254	-28%	1983	-12%	2435	23%	2411	-1%	2335	-3%
Cheese	5000	5000	0%	3200	-36%	2623	-18%	4885	86%	6261	28%	6261	0%
Fruit	600	927	55%	1010	9%	930	-8%	930	0%	930	0%	930	0%
Dried fruit	-	8556	0%	6247	-27%	6247	0%	6247	0%	6247	0%	6247	0%
Milk	1000	1000	0%	1096	10%	1106	1%	1213	10%	1279	5%	1329	4%
Legumes	1800	3160	76%	2936	-7%	2711	-8%	2711	0%	2711	0%	2711	0%
Margarine	-	-	0%	1324	0	1324	0%	1324	0%	1324	0%	1324	0%
Oil	4900	5555	13%	5555	0%	7767	40%	7767	0%	9650	24%	9650	0%
Vegetables	106	237	124%	267	12%	308	16%	308	0%	333	8%	333	0%
Bread	-	1300	0%	1477	14%	1000	-32%	1000	0%	1088	9%	1172	8%
Pasta	1390	1774	28%	1791	1%	1890	6%	1771	-6%	1708	-4%	1776	4%
Potatoes	900	900	0%	671	-25%	555	-17%	555	0%	555	0%	555	0%
Fish	-	-	0%	-	0%	-	0%	-	0%	-	0%	-	0%
Rice	3400	3400	0%	2586	-24%	2585	0%	2585	0%	2585	0%	2585	0%
Eggs	3300	3300	0%	3283	-1%	3283	0%	3262	-1%	3262	0%	3262	0%
Yogurt	1000	1000	0%	1193	19%	1193	0%	1193	0%	1502	26%	1485	-1%
Sugar	1500	1500	0%	1351	-10%	968	-28%	968	0%	968	0%	968	0%

Variation of environmental impacts for the categories of the Double Pyramid over the seven editions\*

\* Variations were highlighted when data changed  $\pm 15\%$  compared to the value used in the Environmental Pyramids published in previous editions.

Source: BCFN elaboration, 2016



	ECOLOGICAL FOOTPRINT [m <sup>2</sup> /kg]												
	2010	2011		2012		2013		2014		2015		2016	
Biscuits	16	13	-17%	13	-4%	12	-9%	11.1	-4%	11	-4%	10	-1%
Butter	75	86	0%	86	0%	74	-13%	74.4	0%	74	0%	74	0%
Poultry meat	46	25	-46%	25	0%	41	64%	43.3	7%	43	0%	43	0%
Beef meat	105	109	4%	109	0%	119	9%	125.1	5%	127	1%	146	15%
Pork meat	49	28	-43%	28	0%	41	46%	47.3	16%	47	0%	47	0%
Breakfast cereals	-	13	0%	13	0%	13	-2%	13.0	0%	13	0%	13	0%
Sweets	30	18	-39%	17	-5%	15	-13%	15.3	1%	14.1	-8%	14	-3%
Cheese	75	93	24%	93	0%	93	0%	72.0	-23%	61	-16%	61	0%
Fruit	3	4	34%	4	-1%	3	-18%	3.2	-1%	3	-1%	3	0%
Dried fruit	-	-	0%	-	0%	19	0%	19.0	0%	19	0%	19	0%
Milk	15	15	-3%	15	0%	14	-6%	8.9	-35%	8	-9%	7	-13%
Legumes	21	19	-9%	19	0%	19	0%	20.5	8%	17	-15%	17	0%
Margarine	-	66	0%	66	0%	66	0%	66.0	0%	66	0%	66	0%
Oil	15	40	177%	40	0%	43	6%	42.7	0%	45	5%	45	0%
Vegetables	8	2	-69%	2	0%	3	6%	2.7	1%	2	-15%	2	0%
Bread	7	7	1%	8	15%	8	5%	8.2	0%	8	-2%	8	-3%
Pasta	17	15	-15%	15	0%	15	1%	13.2	-10%	12	-6%	12	0%
Potatoes	7	3	-51%	3	0%	3	0%	4.9	43%	5	-6%	5	0%
Fish	69	71	3%	71	0%	79	11%	78.8	0%	79	0%	79	0%
Rice	14	12	-11%	12	0%	12	0%	12.6	1%	10	-21%	10	0%
Eggs	14	16	14%	16	0%	16	0%	15.9	0%	16	0%	16	0%
Yogurt	15	16	7%	16	0%	16	0%	16.0	0%	13	-21%	12	-9%
Sugar	4	5	25%	5	6%	5	-8%	4.9	0%	4	-21%	4	0%

Variation of environmental impacts for the categories of the Double Pyramid over the seven editions\*

\* Variations were highlighted when data changed  $\pm 15\%$  compared to the value used in the Environmental Pyramids published in previous editions.

Source: BCFN elaboration, 2016





	CARBON FOOTPRINT [gCO <sub>2</sub> eq/kg]														WATER FOOTPRINT [liters/kg]										ECOLOGICAL FOOTPRINT [m <sup>2</sup> /kg]																			
	2010		2011		2012		2013		2014		2015		2016		2010		2011		2012		2013		2014		2015		2016		2010		2011		2012		2013		2014		2015		2016			
Biscuits	3	2	↓	2	=	2	=	2	=	2	=	2	=	2	=	2	2	=	2	=	2	=	2	=	3	↑	3	=	3	2	↓	2	=	2	=	2	=	2	=	2	=			
Butter	1	5	↑	5	=	5	=	5	=	5	=	5	=	5	=	5	6	5	↓	5	=	5	=	5	=	5	=	5	5	=	5	=	5	=	5	=	5	=	5	=	5	=		
Poultry meat	4	3	↓	3	=	3	=	3	=	3	↑	4	=	3	3	=	4	4	=	4	↑	4	=	4	=	4	=	4	3	↓	3	=	4	↑	4	=	4	=	4	=	4	=		
Beef meat	6	6	=	6	=	6	=	6	=	6	=	6	=	6	=	6	6	6	=	6	=	6	=	6	=	6	=	6	6	=	6	=	6	=	6	=	6	=	6	=	6	=		
Pork meat	4	4	=	4	=	4	=	4	=	4	=	4	=	4	=	4	4	4	=	5	↑	5	=	5	=	5	=	5	=	4	4	=	4	=	4	=	4	=	4	=	4	=		
Breakfast cereals	1	3	↑	3	=	3	=	3	=	3	=	3	=	1	1	=	1	1	=	1	=	1	=	1	=	1	=	1	2	↑	2	=	2	=	2	=	2	=	2	=	2	=		
Sweets	3	3	=	3	=	3	=	3	=	3	=	3	=	6	3	↓	3	3	↓	3	=	2	↓	3	↑	3	=	3	4	3	↓	3	=	3	=	3	=	2	↓	2	=	2	=	
Cheese	5	5	=	5	=	5	=	5	=	5	=	5	=	5	5	=	3	3	↓	3	=	3	=	4	↑	5	↑	5	=	5	5	=	5	=	5	=	5	=	5	=	5	=		
Fruit	1	1	=	1	=	1	=	1	=	1	=	1	=	1	1	=	2	2	↑	1	↓	1	=	1	=	1	=	1	1	=	1	=	1	=	1	=	1	=	1	=	1	=		
Dried fruit	1	3	↑	3	=	2	↓	2	=	2	=	2	=	1	5	↑	5	5	↑	5	=	5	=	5	=	5	=	5	1	1	=	1	=	3	↑	3	=	3	=	3	=	3	=	
Milk	2	2	=	2	=	2	=	2	=	2	=	2	=	2	2	=	2	2	=	2	=	2	=	2	=	2	=	3	2	↓	2	=	2	=	2	=	2	=	2	=	2	=		
Legumes	2	2	=	2	=	2	=	2	=	2	=	2	=	2	3	↑	3	3	=	3	=	3	=	3	=	3	=	3	3	=	3	=	3	=	3	=	3	=	3	=	3	=		
Margarine	1	2	↑	2	=	2	=	2	=	2	=	2	=	6	1	↓	2	2	↑	2	=	2	=	2	=	2	=	1	5	↑	5	=	5	=	5	=	5	=	5	=	5	=		
Oil	3	3	=	3	=	3	=	3	=	3	=	3	=	4	5	↑	5	5	=	5	=	5	=	5	=	5	=	5	2	4	↑	4	=	4	=	4	=	4	=	4	=	4	=	
Vegetables	1	1	=	1	=	1	=	1	=	1	=	1	=	1	1	=	1	1	=	1	=	1	=	1	=	1	=	2	1	↓	1	=	1	=	1	=	1	=	1	=	1	=		
Bread	1	1	=	1	=	2	↑	2	=	2	=	2	=	6	2	↓	2	2	=	1	↓	1	=	2	↑	2	=	2	2	=	2	=	2	=	2	=	2	=	2	=	2	=	2	=
Pasta	2	3	↑	3	=	3	=	3	=	3	↓	3	↑	2	2	=	2	2	=	2	=	2	=	2	=	2	=	3	2	↓	2	=	2	=	2	=	2	=	2	=	2	=	2	=
Potatoes	1	1	=	1	=	1	=	2	↑	2	=	2	=	1	1	=	1	1	=	1	=	1	=	1	=	1	=	1	2	1	↓	1	=	1	=	1	=	1	=	1	=	1	=	
Fish	4	3	↓	4	↑	4	=	4	=	4	=	4	=	6	6	=	6	6	=	6	=	6	=	6	=	6	=	5	5	=	5	=	5	=	5	=	5	=	5	=	5	=		
Rice	3	3	=	3	=	3	=	4	↑	4	↓	3	=	3	3	=	3	3	=	3	=	3	=	3	=	3	=	2	2	=	2	=	2	=	2	=	2	=	2	=	2	=	2	=
Eggs	4	4	=	4	=	4	=	3	↓	3	=	3	=	3	3	=	3	3	=	3	=	3	=	3	=	3	=	2	3	↑	3	=	3	=	3	=	3	=	3	=	3	=		
Yogurt	2	2	=	2	=	2	=	2	=	3	↑	2	2	=	2	=	2	2	=	2	=	2	=	2	=	2	=	3	3	=	3	=	3	=	3	=	2	↓	2	=	2	=		
Sugar	1	1	=	1	=	1	=	1	=	1	=	2	2	=	2	=	1	1	↓	1	=	1	=	1	=	1	=	1	2	↑	2	=	1	↓	1	=	1	=	1	=	1	=		

Variation of environmental impacts for the categories of the Double Pyramid over the seven editions\*

\* Variations were highlighted when data changed band compared to the value used in the Environmental Pyramids published in previous edition

Source: BCFN elaboration, 2016

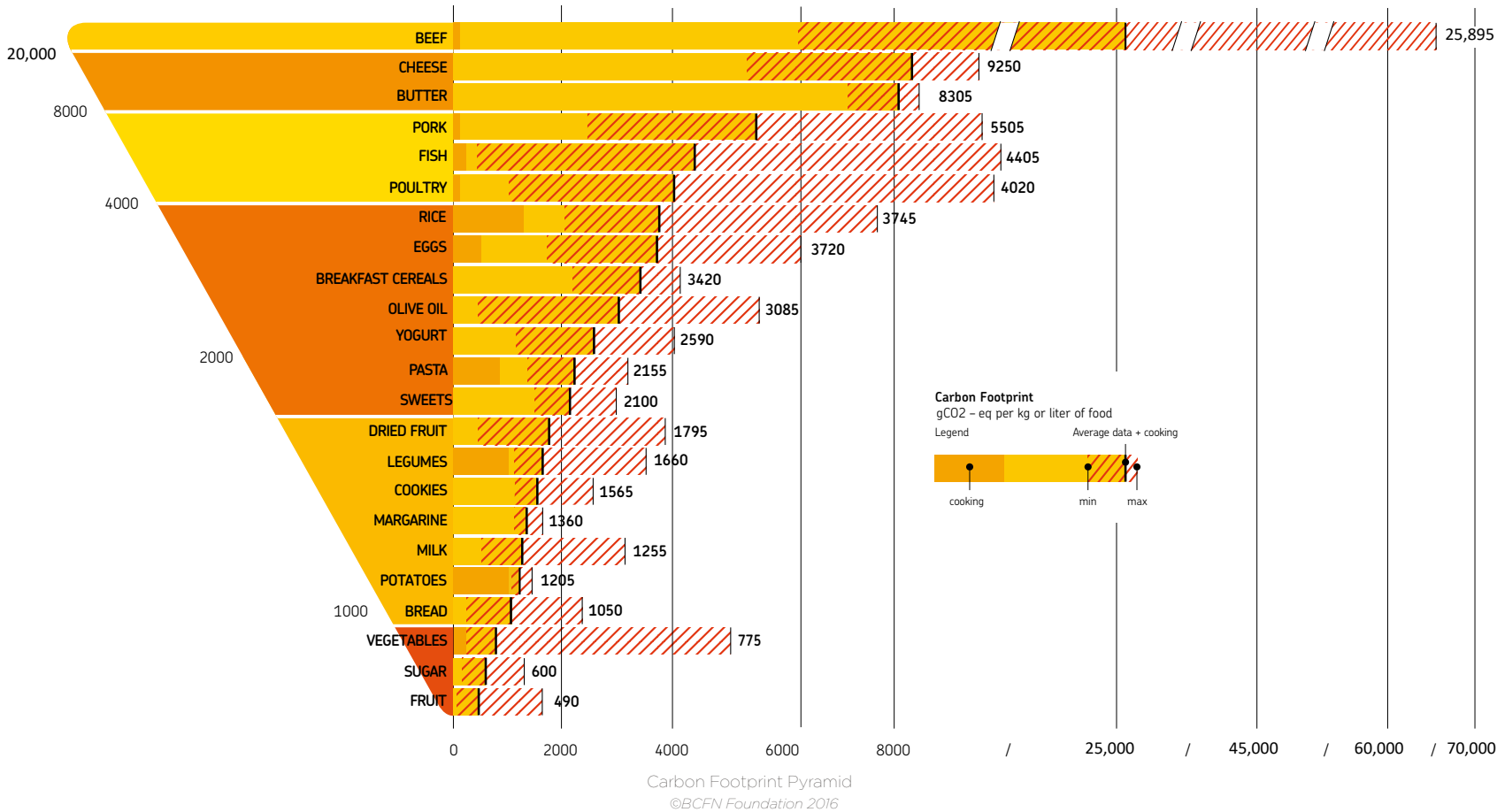


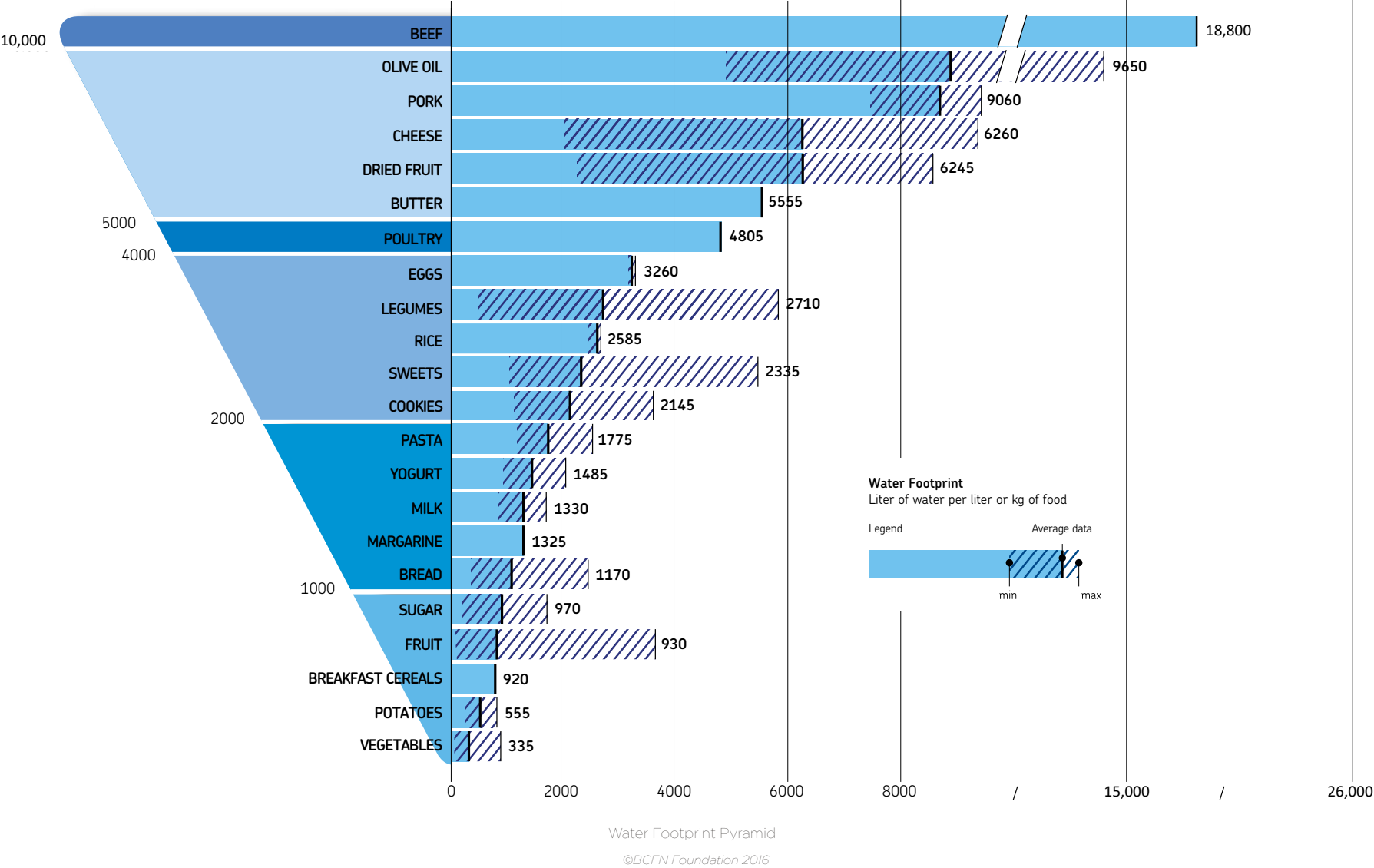
The three environmental pyramids below are quite similar to those published in past years, in that greater statistical coverage has slightly modified several numerical values while confirming the ranges at hand.  
The values<sup>1</sup> were used to determine the

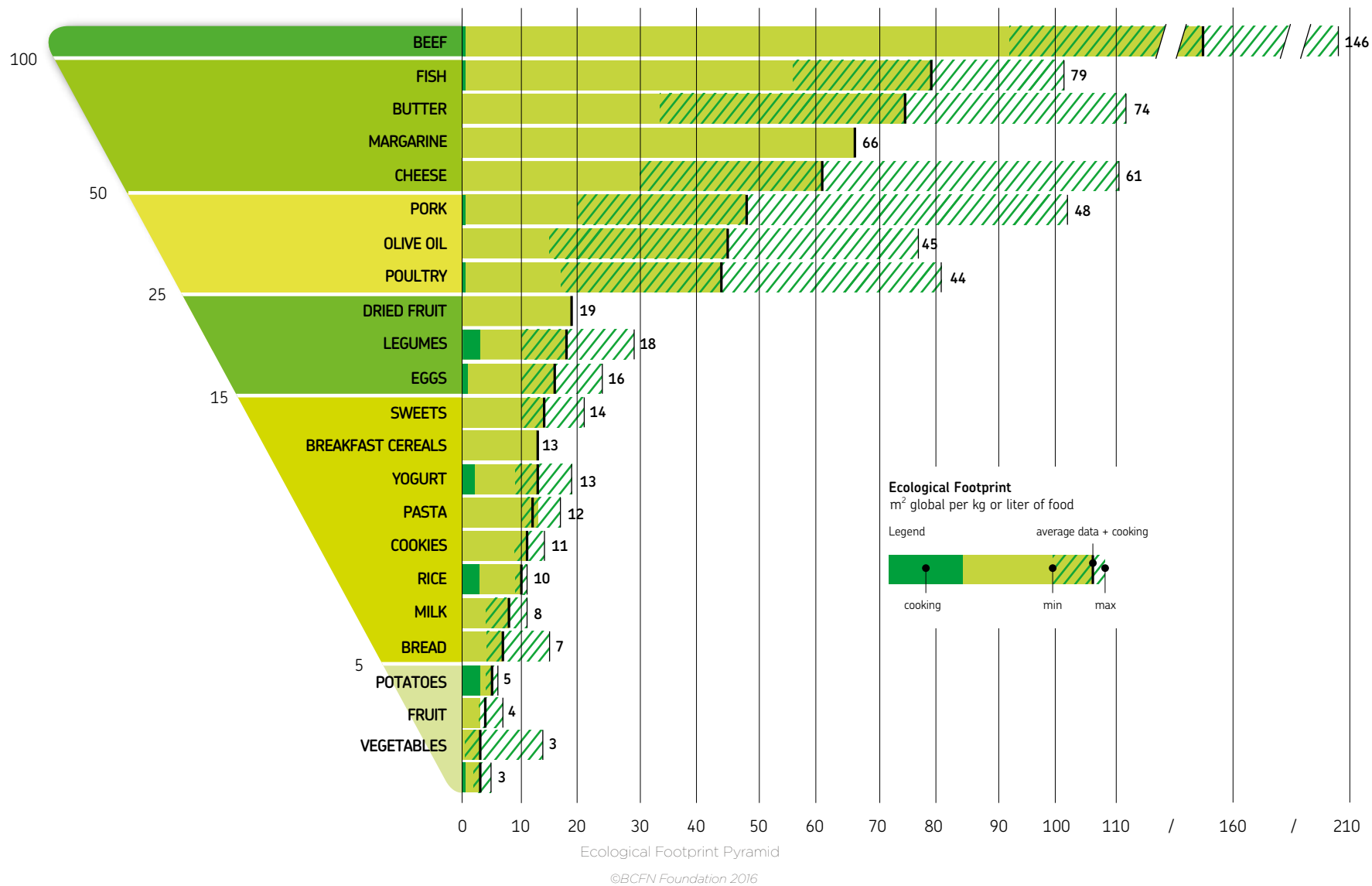
“classification” of the impacts of food while the specified impact intervals for the construction of the pyramids were partially modified for a more even distribution of food among the groups.  
In all cases, the general considerations that emerged in the previous edition of this paper are still

applicable: meat and cheese are characterized by significant impacts, while fruit and vegetables have lower environmental impact values.

<sup>1</sup>The value has been rounded for the sake of comprehension









# SUSTAINABLE DIETS AND THE BCFN DOUBLE PYRAMID



## THE BCFN DOUBLE PYRAMIDS

- 🔥 the BCFN double pyramid
- 🔥 the BCFN double pyramid for those who are growing

## THE DOUBLE PYRAMID AROUND THE WORLD

## SUSTAINABLE DIETS ACCORDING TO FAO

## BCFN MENUS

- 🔥 Daily menu
- 🔥 Weekly menu





## SUSTAINABLE DIETS AND THE BCFN DOUBLE PYRAMID

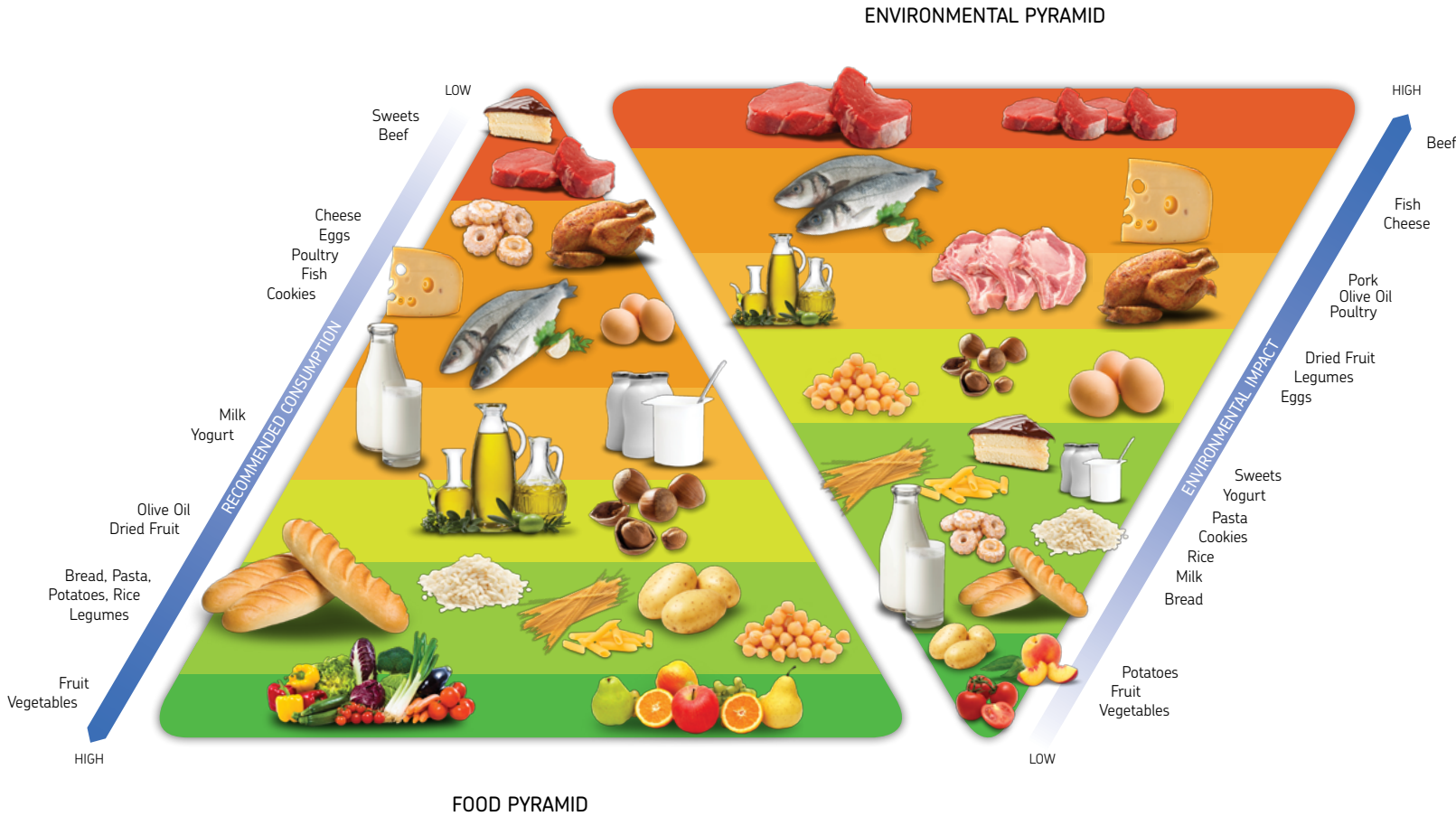
*When the BCFN Environmental Pyramid is set alongside the Food Pyramid, it creates a Food-Environmental Pyramid which the BCFN refers to as the “Double Pyramid”. It shows that foods with higher recommended consumption levels are also those with a lower environmental impact, while foods with lower recommended consumption levels are accompanied by a higher environmental impact. This newly-elaborated version illustrates, in a unified model, the connection between two*

*different but highly-relevant goals: health and environmental protection. In other words, it shows that if the diet suggested in the traditional Food Pyramid is followed, not only do people enjoy better standards of life (longer and healthier), but they also leave a lower impact – or footprint – on the environment. All of us, through eating responsibly, can most certainly reconcile our personal well-being (personal ecology) with the environment (ecological context).*

*The Double Pyramid, presented here in its seventh edition, has acquired over time the role of a useful tool in communicating the sustainability aspects of food choices. The BCFN chose to do this by evaluating the impact of different types of menus, all balanced from a nutritional point of view but with variations in the main source of protein, using different mixes between foods of plant and animal origin.*



THE BCFN DOUBLE PYRAMID

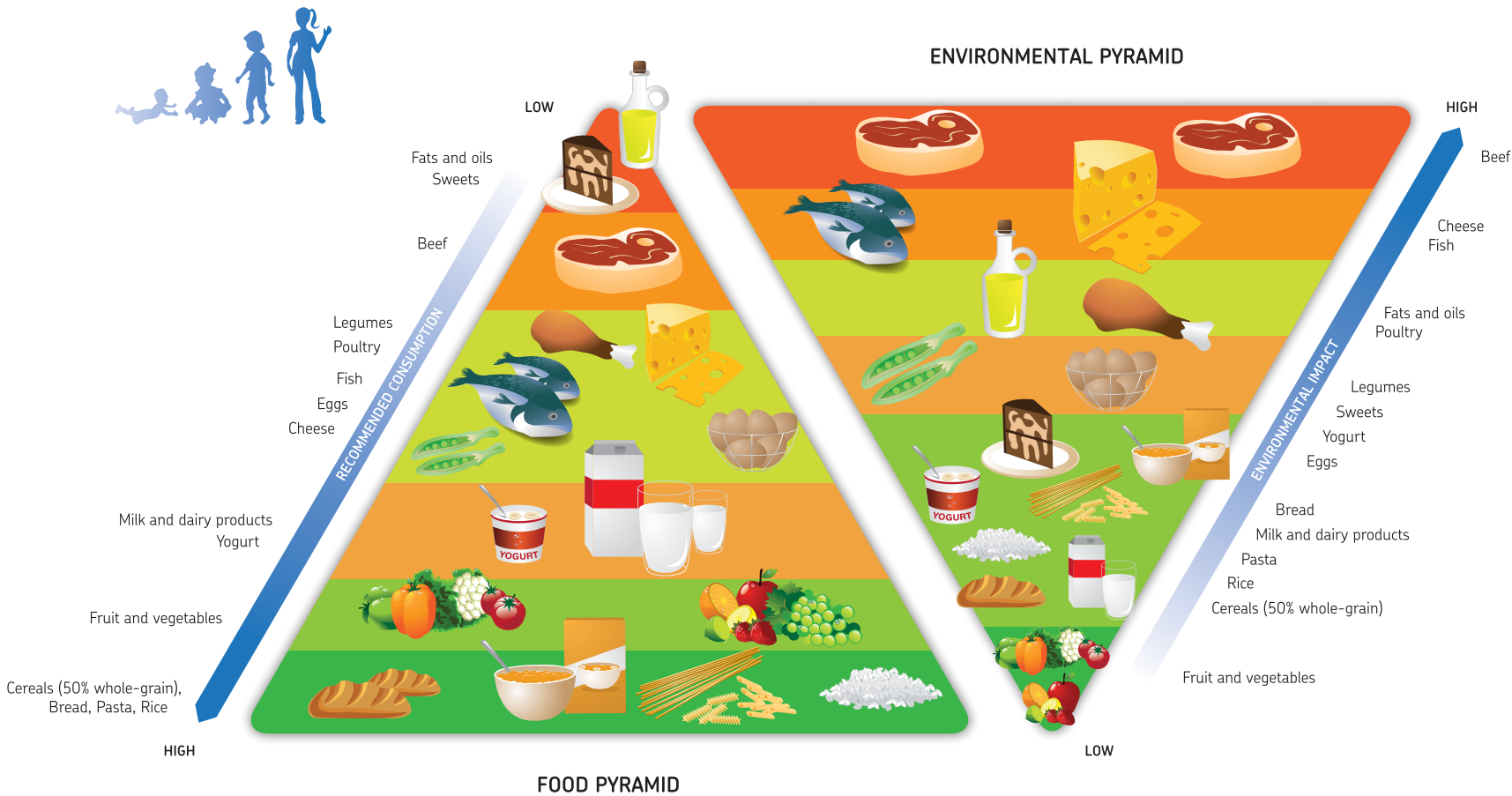


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THE BCFN DOUBLE PYRAMID FOR THOSE WHO ARE GROWING



The Double Pyramid for growing children and adolescents  
©BCFN FOUNDATION 2016



## THE DOUBLE PYRAMID AROUND THE WORLD

Since 2011, the Double Pyramid model has been used by the Barilla Company as the theoretical framework for its initiative “Si.mediterraneo”, an educational project aimed at increasing the well-being of the Group’s employees and raising their awareness of the environmental impacts of their food consumption. The project provided tangible results of the effectiveness of the Double Pyramid in promoting healthy and sustainable food consumption.

Launched in Italy in 2011, the Si.mediterraneo Project has been progressively extended to Barilla’s manufacturing plants and administrative offices in Europe, US, Canada, Brazil, Asia, and Australia.

The Double Pyramid has been translated and adapted according to the geographic areas where it has been promoted, in order to enhance the food diversity and culinary traditions of the various countries.

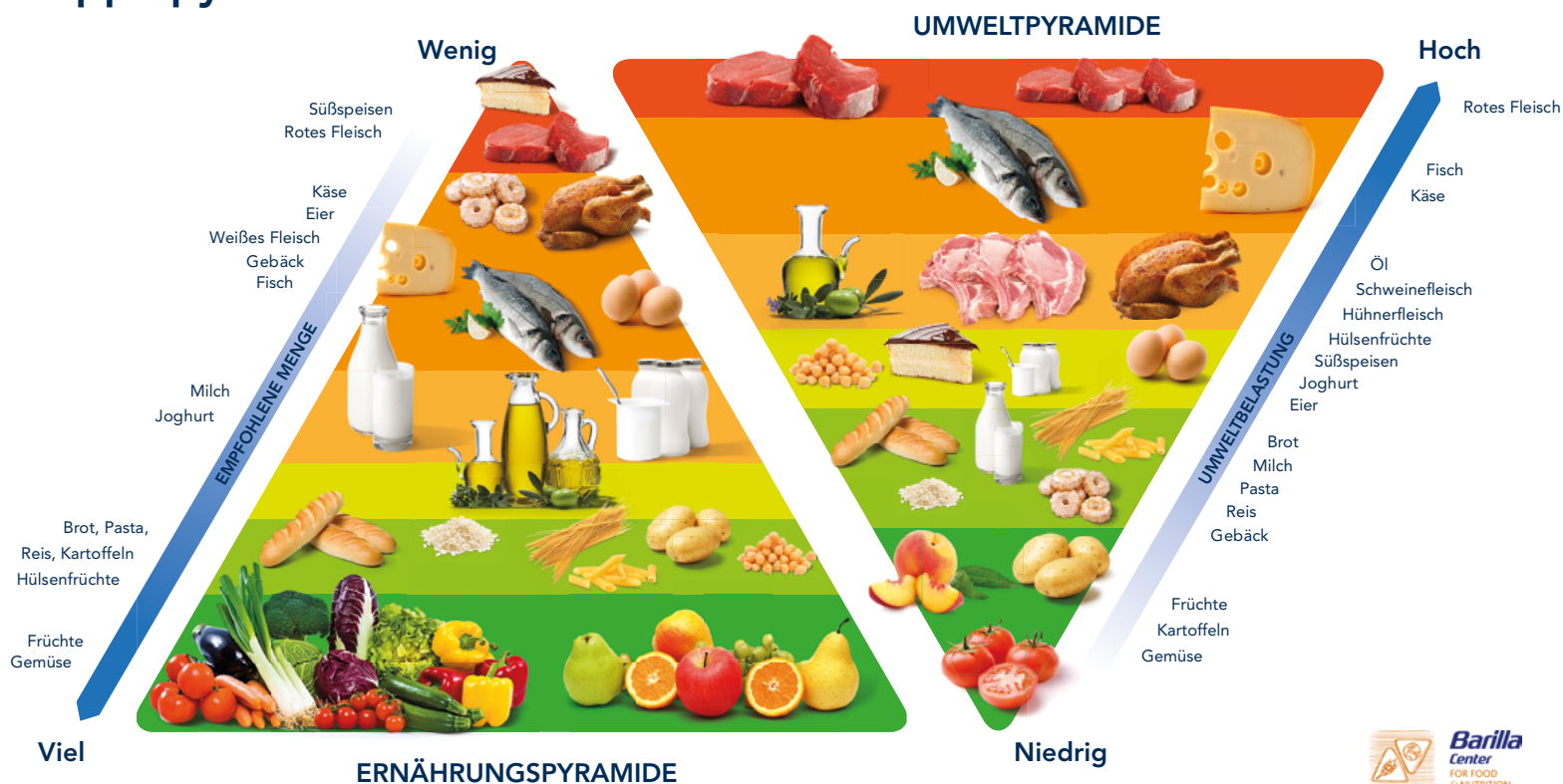
The following pages bring together the Double Pyramids that were used in France, Turkey, Germany, and Sweden during the Si.mediterraneo Project.

## THE “DOUBLE PYRAMIDE” IN FRANCE



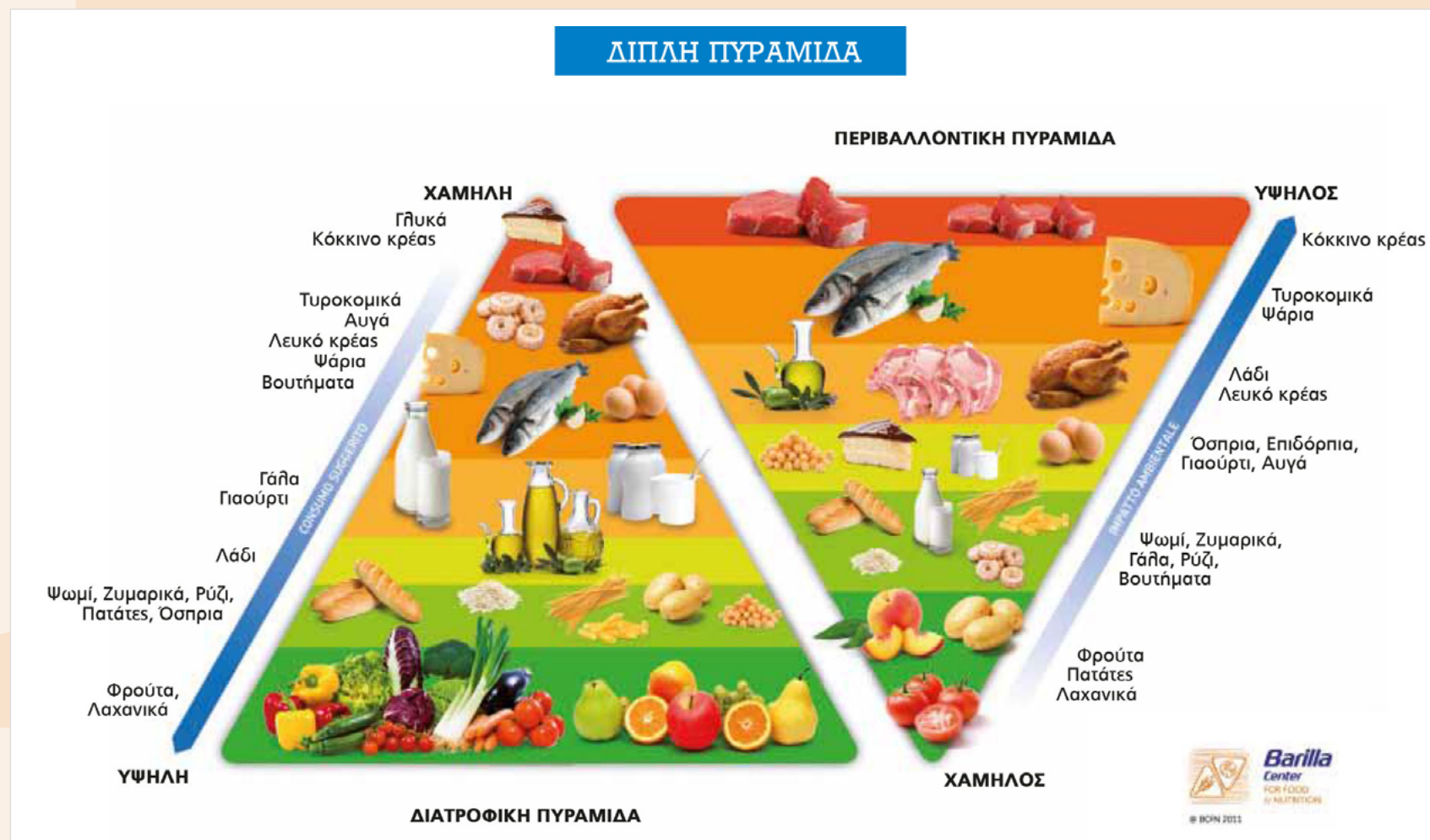
## THE "DOPPELPYRAMIDE" IN GERMANY

## Das Modell der Doppelpyramide



©BCFN FOUNDATION

## THE “DIPLÓ PYRAMÍDA” IN GREECE





## THE “DUBBEL MAT - MILJÖPYRAMID” IN SWEDEN

# Medelhavsdieten

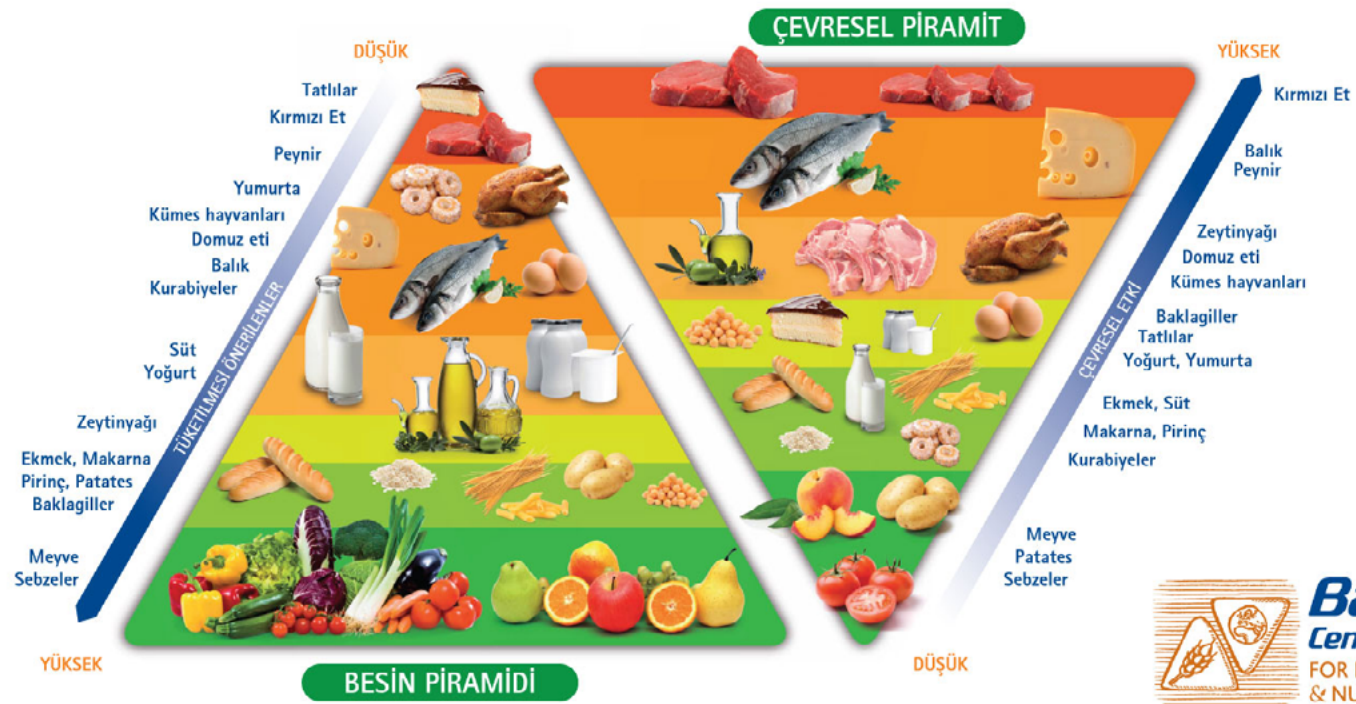
## – bra för dig, bra för miljön!

Titta på de två pyramiderna nedan. Den vänstra visar hur vi ska äta enligt medelhavsdieten för att må så bra som möjligt. Den högra visar vilken påverkan olika livsmedel har på miljön. Det visar sig att dieten som är bäst för oss också är bäst för miljön – smart va?



## THE “ÇİFT PİRAMİT” IN TURKEY

### ÇİFT PİRAMİT: SAĞLIĞIMIZ VE ÇEVREMİZİN KORUNMASI İÇİN BİR MODEL



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## SUSTAINABLE DIETS, ACCORDING TO FAO

In the early 1980s, the term sustainable diet was introduced for the first time to indicate the set of dietary recommendations able to improve the health of citizens and their environment<sup>1</sup>. In later years, the primary goal of feeding starving populations detracted attention from sustainability, and the question of sustainable diets was neglected for many years. An increasing deterioration of the environment, the progressive reduction in biodiversity, and agricultural production with an excessive impact on the ecosystem (in many areas of the world) has re-focused attention on the importance of agri-food sustainability in all its forms, including diet. In November 2010, the UN Food and Agriculture Organization and Biodiversity International organized an international scientific conference with the title “Biodiversity and ‘sustainable diets’: United against Hunger”.

The aim of the conference was to gather together leading researchers on the subject in order to define “sustainable diets” in relation to access to food and biodiversity. This definition recognizes the interdependence between food production and consumption, dietary requirements and nutritional recommendations, and the fact that human health is correlated with the health of ecosystems. In order to meet the food and nutritional demands of a richer, more urbanized world with a growing population, it is necessary for food systems to undergo radical changes and make more efficient use

of food and resources.

According to the FAO, sustainable diets can reduce water consumption and minimize CO2 emissions, promote food biodiversity and increase the value of traditional and local foods that are rich in nutrients due to their variety.

In order to promote sustainable diets, FAO believes that it is necessary to involve private individuals and communities in both supply and demand, in the fields of agriculture, nutrition, health, the environment, education, and culture.

The definition of a sustainable diet proposed by the FAO underlines its multidimensional nature, considering the correlations existing between the food, nutritional, environmental, social, political and economic variables.

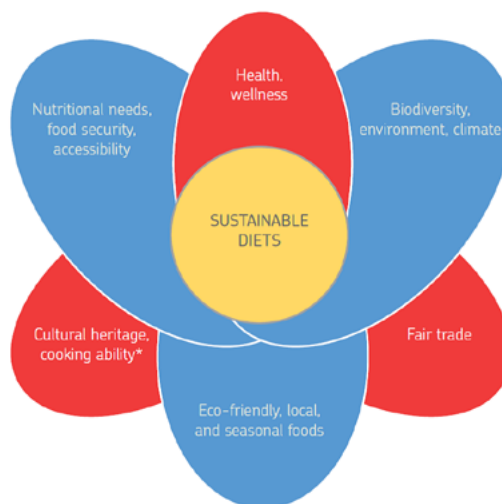


Diagram of key components of sustainable diets  
Source: FAO, 2010

Among the examples of sustainable diets, the FAO specifically cites the Mediterranean diet, whose merits go beyond nutritional aspects as it promotes social interaction through communal meals (both in the home and during collective festivities)<sup>2</sup>. There is also a relatively new concept of the Mediterranean diet: bio-cultural diversity, which originates from the many ways in which humans have interacted with their natural environment<sup>3</sup>. Their co-evolution has led to local ecological knowledge: an essential reservoir of experiences, methods, and skills that help the various local communities to manage their resources. Some researchers from the Mediterranean Agronomy Institute of Montpellier and Bari state that the traditional Mediterranean diet can be considered sustainable for various reasons. Firstly, for the large variety of foods which effectively promotes biodiversity. Secondly, for the wide range of cooking practices and techniques used for preparing food, and the numerous foods that are known to have beneficial effects on health such as olive oil, fish, fruit and vegetables, legumes, fermented milk, and spices. Lastly, due to its strong cultural heritage and tradition; its respect of human nature and seasonality; the diversity of the landscapes which contribute to well-being; and because it is an environmentally-friendly diet thanks to the reduced consumption of animal products<sup>4</sup>.

<sup>1</sup> Gussow Clancy 1986.

<sup>2</sup> Petrillo in FAO, 2010.

<sup>3</sup> Ibid.

<sup>4</sup> Padilla et al. in FAO, 2010



The definition of a sustainable diet shows its multidimensional character: agricultural, food, nutritional, environmental, social, cultural, and economic variables interact with one another. This is the result of combining environmental protection,

nutrition, and land development with economic and social aspects along the entire food chain, from the farmer to the consumer.

The last article in the book published at the end of the symposium on the Mediterranean diet is

dedicated to the BCFN's Double Pyramid<sup>5</sup>.

<sup>5</sup> Ciati & Ruini in FAO, 2010.

	ENVIRONMENTAL ASPECTS	NUTRITIONAL ASPECTS	ECONOMIC ASPECTS	SOCIO- CULTURAL ASPECTS
<b>AGRICULTURE</b>	Follow sustainable agricultural practices. Promote resilience of the systems of production.  Develop and maintain diversity.	Promote different varieties of food.  Produce food that is full of nutritional elements	Develop Appropriate cultivation techniques.  Promote self- sufficiency through local production.	Maintain traditional agricultural practices and promote local varieties.
<b>FOOD PRODUCTION</b>	Reduce the impact of production, processing and sale.	Preserve nutrients along the food chain.	Reinforce the local food systems. Produce food at affordable prices.	Produce culturally acceptable food.
<b>CONSUMPTION</b>	Reduce the environmental impact of food consumption.	Promote a diversified balanced and seasonal diet.	Promote Economic accessibility to a varied diet.	Safeguard food traditions and culture. Meet local tastes and preferences.

An example of a sustainable food system  
 Source: Padilla, M., et al. in FAO, 2010



## WHAT SCIENTIFIC LITERATURE TELLS US ABOUT THE ENVIRONMENTAL IMPACT OF DIFFERENT DIETARY CHOICES

In the last few years, a growing body of research has explored the relationship between food consumption, nutrition, and environmental impact. During 2010-2014, more than 20 studies were published in Europe and the USA.<sup>6</sup>

Generally speaking, the studies agree that a plant-based diet has a lower environmental impact than a diet based on meat and animal products.

- Some Danish authors have demonstrated that, if the Danish population were to adhere to the national dietary guidelines, greenhouse gas emissions due to food consumption would decrease by 4%. This reduction could reach up to 23%, if preference were given to those food products that have a lower carbon footprint<sup>7</sup>.
- According to a Swedish study, a balanced and varied diet would reduce the environmental impact of food consumption by 700-750 kg of CO<sub>2</sub> per capita per year<sup>8</sup>. This is the equivalent of driving for 5,600 km (in practical terms, a round trip from Milan to Moscow, Russia)<sup>9</sup>.
- Meier and Christen estimated that a vegan diet would cause about 50% of the emissions from the average diet adopted by the German population. Even a vegetarian diet, including eggs and dairy products, would have a positive impact on the environment: in this case, the reduction would be around 25%<sup>10</sup>.
- In 2011, Jennie MacDiarmid of the Rowett Institute of Nutrition applied a linear programming model to develop a model of a weekly, balanced diet that would allow reduced emissions of the current diet of the UK population. Constraint was imposed in order to reflect the current socio-economic and cultural traditions of the country of reference. The new diet, called the “2020 LiveWell diet”, would reduce the carbon footprint of food consumption by 25%, without excluding any food. In addition, the cost would remain unchanged, or be even lower than the current average diet<sup>11</sup>.
- The same approach has been applied, with similar results, in the European project “LiveWell for LIFE +” for estimating models of ideal diets that were representative of the dietary habits of the populations in France, Spain, and Sweden.<sup>12</sup> Researchers in New Zealand also conducted a similar study.<sup>13</sup>

- Finally, a study in 2014 highlighted the relationship between sustainable diets and food safety: reducing the current meat consumption by 50% would allow the feeding of two billion people, as well as reducing greenhouse gas emissions.<sup>14</sup>

<sup>6</sup> Auestad et al., 2015.

<sup>7</sup> Thorsen et al., 2014.

<sup>8</sup> Jordbruksverket, 2013.

<sup>9</sup> BCFN assessment.

<sup>10</sup> Meier & Christen, 2013.

<sup>11</sup> MacDiarmid et al., 2011.

<sup>12</sup> Thompson et al., 2013.

<sup>13</sup> Wilson et al., 2013.

<sup>14</sup> Cassidy et al., 2013.



## FOOD CONSUMPTION AND CLIMATE CHANGE

Most people are aware that the use of transport, central heating, and using electricity, all cause greenhouse gas emissions which are responsible in turn for climate change. They are factors which the individual can easily tackle with small measures: switching off the lights in empty rooms, walking or cycling to work, and so on.

On the other hand, it is not so well known that the consumption of food causes about 30% of the emissions of Western families, a higher percentage than that generated by the entire sector of transport or electricity. In fact, food represents one of the main causes of climate change.

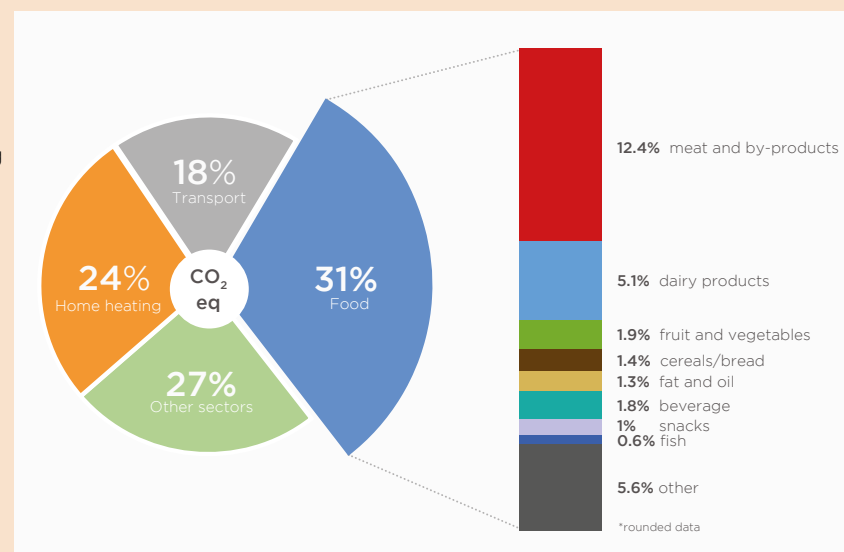
In 2006, some researchers (Tukker et al.)<sup>14</sup> conducted a study into the environmental impact of products and services commonly used in the European Union. The study, which is still quoted today as one of the most authoritative on the subject, adopted a systemic approach to measurement, taking into consideration 12 sectors of goods and services and 8 indicators of environmental pressure, including greenhouse gas emissions, eutrophication, acidification of water and reduction of the ozone layer of the atmosphere. The study showed that the sector of food and drinks is responsible for about 30% of the environmental impact on the total of all the indicators considered, a share slightly below that

represented by heating buildings (35%). The sector of transport is their third greatest contributor, responsible for 15% of the total impacts. If however, we consider greenhouse gas emissions as the only indicator, the situation is inverted: in this case, it is food that contributes most to climate change (31%), greatly exceeding heating (23.6%) and the different means of transport (18.5%) (fig. 2). A major part is played by the consumption of meat, which represents about 12% of the overall emissions. Milk and dairy products contribute for 5% of the CO<sub>2</sub> emissions, whilst fruit and vegetables, including frozen items, contribute about 2%. Lastly, the consumption of cereals and derivatives (flour products, bread, pasta, baked goods etc.) has an influence of just over 1% in the total of overall emissions.

To summarize, at an aggregate level, our food consumption has a

strong impact on the environment, even more with respect to some sectors, (such as transport) which are traditionally identified as the most “polluting”. The question remains whether, by carefully choosing what to eat, we can reduce this impact - a question that the BCFN menus, illustrated below, tried to answer.

<sup>14</sup> Tukker and Jansen, 2006



Sectors producing the greenhouse gas emissions of European families

Source: Tukker et al. 2006



## BCFN MENUS

With the aim of simplifying the sustainability concepts of the diet for easy practical use, BCFN prepared a series of similar menus from a nutritional point of view (all well balanced in proteins, carbohydrates and fats) but different in the choice of ingredients that provide the nutrients necessary, in particular proteins.

These menus, which can be daily or weekly, are regularly used in BCFN publications for estimating

the environmental impacts of the various food choices that people can make, calculated using the Double Pyramid database. Therefore, some simple elaborations were proposed to help explain how consumers' eating habits can affect food expenditure and the environment, in order to determine whether well-balanced diets are affordable and environmentally sustainable<sup>17</sup>.

It is important to note that it is better to avoid making a direct comparison between two types of

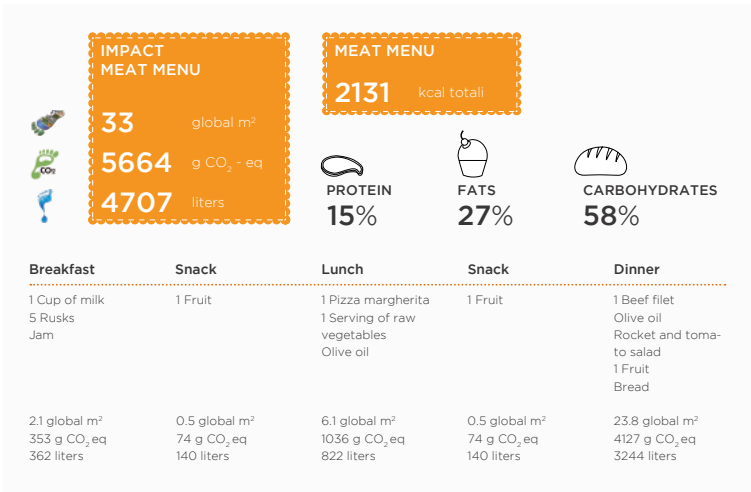
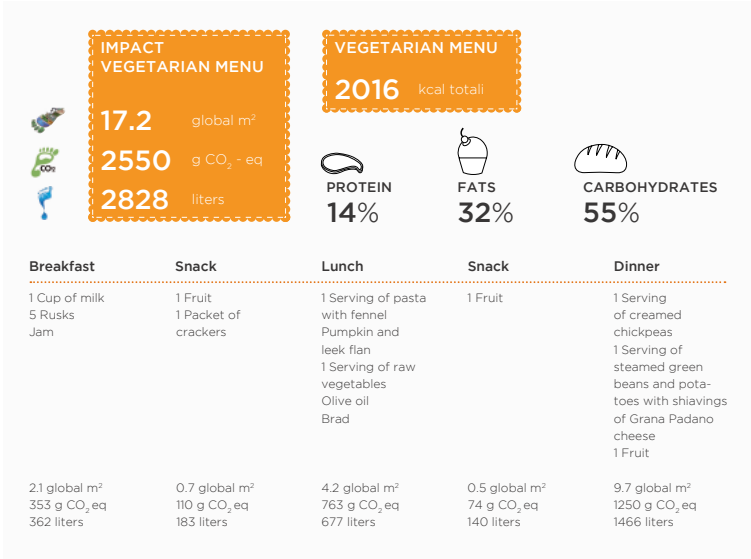
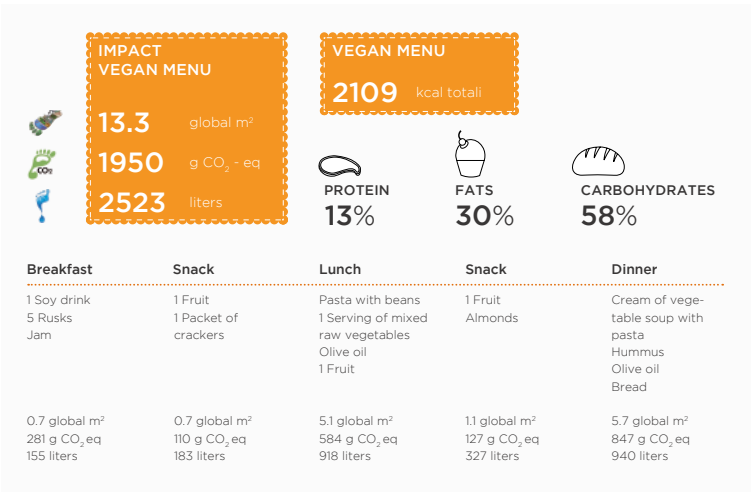
food - it is, instead, preferable to examine a mixture of products (in terms of type and quantity) eaten on a daily or weekly basis.

<sup>17</sup> This elaboration is to be deemed purely indicative and is based on some of the food choices taken as an example by the BCFN for the evaluations relative to the environmental impacts.



Daily menu

Three daily menus were analyzed in order to estimate the extent to which an individual's food choices affect the Ecological Footprint: all three are balanced in terms of calories and nutrients (proteins, fats and carbohydrates) from a nutritional point of view. The first menu (vegan menu) contains exclusively proteins of plant origin: i.e. excluding any type of meat and animal derivatives (such as dairy produce and eggs). In the second (vegetarian), meat is excluded but dairy produce and eggs are consumed. The third (meat menu) allows for everything, with proteins of mostly animal origin.<sup>18</sup> The meat menu has an environmental impact that is two times higher than the vegetarian menu: a considerable share of the daily impact of an individual. With this data it is possible to estimate how much an individual can reduce his/her environmental impact simply by changing his/her eating habits. By analyzing the food consumed in a week, we can hypothesize three different diets according to how many times a vegetarian menu is eaten and how many times a vegetarian menu is chosen instead of a meat menu: if one limits the intake of animal protein to twice a week, in line with nutritionists' recommendations, his ecological footprint decreases by up to up to 12 square meters per day.

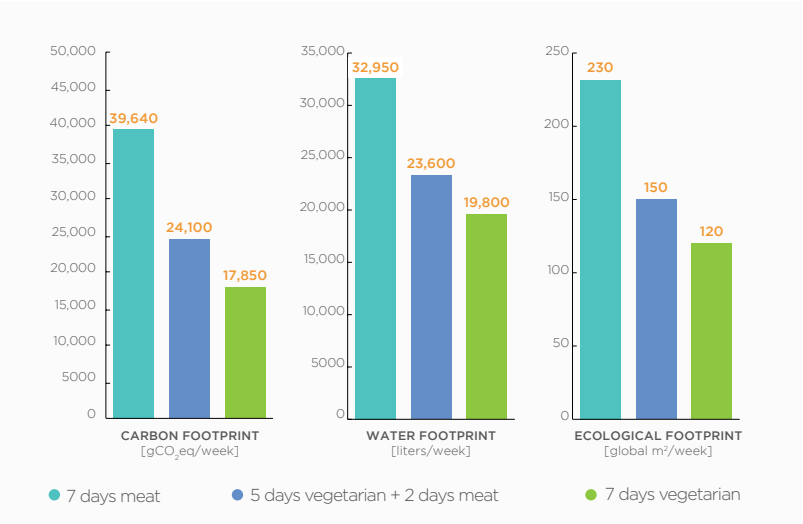


Source: BCFN Foundation, 2016





<sup>18</sup> For further information on the recipes used in the menus, see the insight







Environmental impact of the combination of different menus on a weekly base  
Source: BCFN Foundation, 2016

<div>7 TIME</div> <div>MEAT MENU</div> <div></div>	39,640	32,950	230	5660	4710	33
<div>5 TIME</div> <div>VEGETARIAN MENU</div> <div></div> <div>+</div> <div>2 TIME</div> <div>MEAT MENU</div> <div></div>	24,100	23,600	150	3440	3370	21
<div>7 TIME</div> <div>VEGETARIAN MENU</div> <div></div>	17,850	19,800	120	2550	2830	17

Variations in the environmental impact depending on three different weekly diets  
Source: BCFN Foundation, 2016



## Weekly menu

The analysis of the different daily menus, as we have seen, confirms that the environmental impact of our food may vary, even significantly, depending on what we put on our plate. Starting from this consideration, the BCFN decided to analyze the impacts of four weekly menus, all balanced from a nutritional point of view and with an equivalent calorie count. The sustainable (or BCFN) menu includes both meat and fish, with a preference for white meat, and provides a balanced consumption of vegetable or animal proteins. Meat and fish are obviously excluded from the vegetarian menu, for which protein comes from both animal (cheese, eggs, etc.) and plant (legumes) sources. The vegan menu excludes all the protein sources of animal origin (including eggs and cheese). Lastly, the meat menu is characterized by

the consumption of larger quantities of protein from animal sources.

The figures below are the environmental impacts of the four menus. The differences in impact are minimal between the sustainable BCFN and the vegetarian menus, while the meat menu shows much higher values. On the contrary, the vegan menu is the one associated with the least environmental impact: this result supported many scientific studies, which have shown the environmental benefits of an exclusively vegetarian diet<sup>19 20 21 22 23</sup>. Nevertheless, some scholars have noted that a vegan diet cannot be considered “sustainable” according to the definition of the FAO<sup>24</sup>, whereby sustainability depends not only on the environmental impact but also on a series of other factors, including cultural acceptability and food security. The adoption of a vegan diet would entail a complete change of one’s diet, which is probably

too hard a change and unlikely to be accepted by the majority of the population. In addition, this diet requires great care in preparing meals, to avoid the onset of nutritional deficiencies in the long term. A Mediterranean type of diet (as defined in the sustainable BCFN menu) could be the perfect alternative for those who want to look after their own health and that of the environment, without giving up any food or excessively modifying their habits.

<sup>19</sup> Tilman and Clark, 2014

<sup>20</sup> Sáez-Almendros et al. 2014

<sup>21</sup> Westhoek et al. 2014

<sup>22</sup> Van Dooren et al. 2014

<sup>23</sup> Baroni et al., 2006

<sup>24</sup> Van Dooren et al. 2014



# 1. VEGAN MENU

	MONDAY	g	TUESDAY	g	WEDNESDAY	g	THURSDAY	g	FRIDAY	g	SATURDAY	g	SUNDAY	g
BREAKFAST	1 Cup of soy milk	200	1 Cup of soy milk	200	1 Glass of freshly squeezed citrus fruit juice	200	1 Cup of soy milk	200	1 Cup of fruit and soy milk smoothie	200	1 Cup of soy milk	125	6 Dry cookies	30
	4 Rusks	32	2 Slices of whole grain bread	50	2 Slices of whole grain bread	50	6 Dry cookies	30	2 Slices of whole grain bread	50	2 Slices of whole grain bread	50	1 Portion of Fruit	150
	1 Portion of Fruit	150	2 Teaspoons of jam	20	2 Teaspoons of jam	20			2 Teaspoons of jam	20	2 Teaspoons of jam	20		
	<b>TOTAL</b>	<b>382</b>		<b>270</b>		<b>270</b>		<b>230</b>		<b>270</b>		<b>195</b>		<b>180</b>
SNACK	1 Cup of fruit and soy milk smoothie	200	1 Cup of soy yogurt	125	1 Cup of soy yogurt	125	1 Packet of crackers	30	1 Cup of soy yogurt	125	1 Portion of Fruit	150	1 Cup of soy yogurt	125
			1 Portion of Fruit	150	2 Rusks	16	1 Portion of Fruit	150	1 Portion of Fruit	150				
	<b>TOTAL</b>	<b>200</b>		<b>275</b>		<b>141</b>		<b>180</b>		<b>275</b>		<b>150</b>		<b>125</b>
LUNCH	Whole wheat spaghetti with broccoli and pine dried fruit	262	Penne with fresh tomato and basil	220	Risotto with apples and almonds	192	Mixed salad with cucumber and tomatoes	200	Pasta with beans	303	Red bean rissoles with peas	170	Pasta with lentil sauce	280
	Mixed raw vegetables	80	Chickpeas flour omelette with aromatic herbs	78	Zucchini with parsley	80	Chickpeas	150	Spinach	200	Mixed raw vegetables	200	Fennel gratin	270
	Olive oil	10	Raw Fennel	200	Olive oil	10	2 Slices of whole grain bread	50	Olive oil	10	2 Slices of whole grain bread	50		
			Olive oil	10			Olive oil	20			Olive oil	10		
	<b>TOTAL</b>	<b>352</b>		<b>508</b>		<b>282</b>		<b>420</b>		<b>513</b>		<b>430</b>		<b>550</b>
SNACK	1 Portion of Fruit	150	1 Cup of fruit and soy milk smoothie	200	1 Portion of dried fruit	30	1 Portion of Fruit	150	1 Cup of fruit and soy milk smoothie	200	1 Portion of Fruit	150	1 Portion of Fruit	150
	1 Packet of crackers	30			1 Portion of Fruit	150	1 Packet of crackers	30	2 Rusks	16				
	<b>TOTAL</b>	<b>180</b>		<b>200</b>		<b>180</b>		<b>180</b>		<b>216</b>		<b>150</b>		<b>150</b>
DINNER	Red beans cream with grilled bread with herbs	335	Vegetable soup	250	Pasta with creamed vegetables	280	Chickpea soup with pasta	260	Chickpea flour omelette with artichokes	181	Pizza with tomatoes and mixed vegetables	520	Tomato bruschetta	243
	Grilled peppers	200	Chickpeas with tomato	215	Green salad	80	Cherry tomatoes and arugula	200	Steamed green beans and potatoes	310			Hummus	190
	2 Slices of whole grain bread	50	2 Slices of whole grain bread	50	Pinto beans	150	2 Slices of whole grain bread	50	2 Slices of whole grain bread	50			Mixed raw vegetables with oil dip	200
	Olive oil	10	1 Portion of Fruit	150	Olive oil	10	Olive oil	10					2 Slices of whole grain bread	50
	<b>TOTAL</b>	<b>595</b>		<b>665</b>		<b>520</b>		<b>520</b>		<b>541</b>		<b>520</b>		<b>683</b>



# 2. VEGETARIAN MENU

	MONDAY	g	TUESDAY	g	WEDNESDAY	g	THURSDAY	g	FRIDAY	g	SATURDAY	g	SUNDAY	g
BREAKFAST	1 Cup of milk	200	1 Cup of milk	200	1 Glass of freshly squeezed citrus fruit juice	200	1 Cup of milk	200	1 Cup of fruit and milk smoothie	200	1 Cup of skim yogurt	125	1 Croissant	50
	4 Rusks	32	2 Slices of whole grain bread	50	1 Brioches	50	6 Dry cookies	30	1 Croissant	50	2 Slices of whole grain bread	50	1 Portion of Fruit	150
	1 Portion of Fruit	150	2 Teaspoons of jam	20							2 Teaspoons of jam	20		
	<b>TOTAL</b>	<b>382</b>		<b>270</b>		<b>250</b>		<b>230</b>		<b>250</b>		<b>195</b>		<b>200</b>
SNACK	1 Cup of fruit and milk smoothie	200	1 Cup of skim yogurt	125	1 Cup of skim yogurt	125	1 Portion of Fruit	30	1 Cup of skim yogurt	125	1 Portion of Fruit	150	1 Cup of skim yogurt	125
			1 Portion of Fruit	150	2 Rusks	16	1 Portion of Fruit	150	1 Portion of Fruit	150				
	<b>TOTAL</b>	<b>200</b>		<b>275</b>		<b>141</b>		<b>180</b>		<b>275</b>		<b>150</b>		<b>125</b>
LUNCH	Whole wheat spaghetti with broccoli and pine dried fruit	112	Penne with fresh tomato and basil	220	Risotto with apples and parmesan cheese	183	Mixed salad with tomatoes and cucumber	200	Pasta with beans	303	Omelette with herbs	76	Pasta with lentil sauce	280
	Mixed raw vegetables	80	Potato and spinach pie	195	Zucchini with parsley	80	Chickpeas	150	Spinach	200	Mixed raw vegetables	200	Fennel gratin	270
	Olive oil	20	Raw fennel	200	Olive oil	10	2 Slices of whole grain bread	50	Olive oil	10	2 Slices of whole grain bread	50	Olive oil	10
			Olive oil	10		273	Olive oil	20		513	Olive oil	10		
	<b>TOTAL</b>	<b>212</b>		<b>625</b>		<b>282</b>		<b>420</b>		<b>513</b>		<b>336</b>		<b>560</b>
SNACK	1 Portion of Fruit	150	1 Cup of fruit and milk smoothie	200	1 Portion of dried fruit	30	1 Portion of Fruit	150	1 Cup of fruit and milk smoothie	200	1 Portion of Fruit	150	1 Portion of Fruit	150
	1 Packet of crackers	30			1 Portion of Fruit	150	1 Packet of crackers	30	2 Rusks	16				
	<b>TOTAL</b>	<b>180</b>		<b>200</b>		<b>180</b>		<b>180</b>		<b>216</b>		<b>150</b>		<b>150</b>
DINNER	Creamed red beans with grilled bread with herbs	335	Vegetable soup	250	Pasta with creamed vegetables	280	Pasta and pea soup	260	Asparagus with eggs	155	Pizza margherita	361	Tomato bruschetta	243
	Grilled peppers	200	Caprese salad with tomato and mozzarella	335	Green salad with mozzarella	170	Arugula and cherry tomatoes	200	Steamed green beans and potatoes	310			Hummus	190
	2 Slices of whole grain bread	50	2 Slices of whole grain bread	50	Olive oil	20	2 Slices of whole grain bread	50	2 Slices of whole grain bread	50			Mixed raw vegetables with oil dip	200
			1 Portion of Fruit	150			Olive oil	10					2 Slices of whole grain bread	50
													Olive oil	10
	<b>TOTAL</b>	<b>585</b>		<b>785</b>		<b>470</b>		<b>520</b>		<b>515</b>		<b>361</b>		<b>693</b>



# 3. BCFN SUSTAINABLE MENU

	MONDAY	g	TUESDAY	g	WEDNESDAY	g	THURSDAY	g	FRIDAY	g	SATURDAY	g	SUNDAY	g
BREAKFAST	1 Cup of milk	200	1 Cup of milk	200	1 Glass of freshly squeezed citrus fruit juice	200	1 Cup of milk	200	1 Cup of fruit and milk smoothie	200	1 Cup of skim yogurt	125	1 Croissant	50
	4 Rusks	32	2 Slices of whole grain bread	50	1 Croissant	50	6 Dry cookies	30	4 Rusks	32	2 Slices of whole grain bread	50	1 Portion of Fruit	150
	1 Portion of Fruit	150	2 Teaspoons of jam	20							2 Teaspoons of jam	20		
	<b>TOTAL</b>	<b>382</b>		<b>270</b>		<b>250</b>		<b>230</b>		<b>232</b>		<b>195</b>		<b>200</b>
SNACK	1 Cup of fruit and milk smoothie	200	1 Cup of skim yogurt	125	1 Cup of skim yogurt	125	1 Packet of crackers	30	1 Cup of skim yogurt	125	1 Portion of Fruit	150	1 Cup of skim yogurt	125
			1 Portion of Fruit	150	2 Rusks	16	1 Portion of Fruit	150	1 Portion of Fruit	150				
	<b>TOTAL</b>	<b>200</b>		<b>275</b>		<b>141</b>		<b>180</b>		<b>275</b>		<b>150</b>		<b>125</b>
LUNCH	Whole wheat spaghetti with cheese and black pepper	112	Penne with fresh tomato and basil	220	Turkey escalope with sage and lemon	115	Caprese salad: tomato and mozzarella	335	Casarecce (pasta) with sardines and fennel	183	Pasta with broccoli	200	Potato gnocchi with tomato sauce	389
	Mixed raw vegetables	80	Salmon with artichoke puree	315	Zucchini with parsley	80	2 Slices of whole grain bread	50	Pumpkin and leek flan	178	Chicken strips with mixed vegetables	370	Baked sea bass	160
	Olive oil	10			2 Slice of whole grain bread	50	Olive oil	20					Mixed raw vegetables	80
					Olive oil	10							Olive oil	10
	<b>TOTAL</b>	<b>20</b>		<b>535</b>		<b>255</b>		<b>405</b>		<b>360</b>		<b>570</b>		<b>639</b>
SNACK	1 Portion of Fruit	150	1 Cup of fruit and milk smoothie	200	1 Portion of dried fruit	30	1 Cup of skim yogurt	125	1 Portion of Fruit	150	1 Cup of fruit and milk smoothie	200	1 Portion of Fruit	150
	1 Packet of crackers	30			1 Portion of Fruit	150	1 Portion of Fruit	150	1 Packet of crackers	30	2 Rusks	16		
	<b>TOTAL</b>	<b>180</b>		<b>200</b>		<b>180</b>		<b>275</b>		<b>180</b>		<b>216</b>		<b>150</b>
DINNER	Omelette with aromatic herbs	76	Pasta with beans	303	Pasta with vegetables cream	280	Vegetable soup with rice	270	Creamed chickpea	310	Pizza margherita	361	Tomato bruschetta	243
	Steamed Swiss chard and potatoes	300	Mixed raw vegetables	80	Mixed raw vegetables	50	Beef carpaccio with shaved parmesan cherry tomatoes and arugula	265	Steamed green beans and potatoes with shaved Grana Padano cheese	310			Hummus	190
	2 Slices of whole grain bread	50	2 Slices of whole grain bread	50	Ham	50	Olive oil	10					Mixed raw vegetables with oil dip	50
	Olive oil	10	Olive oil	10	2 Slices of whole grain bread	50							2 Slices of whole grain bread	50
					Olive oil	10								10
	<b>TOTAL</b>	<b>436</b>		<b>443</b>		<b>440</b>		<b>545</b>		<b>620</b>		<b>361</b>		<b>543</b>

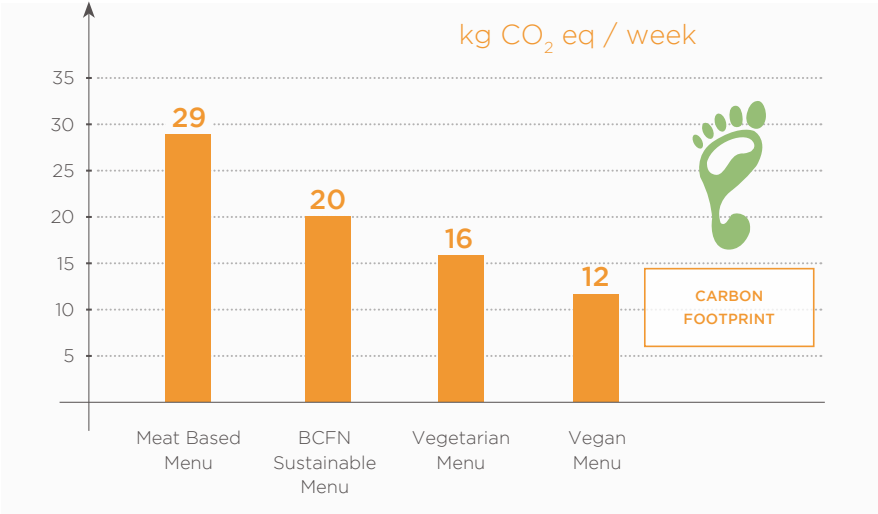


# 4. MEAT BASED MENU

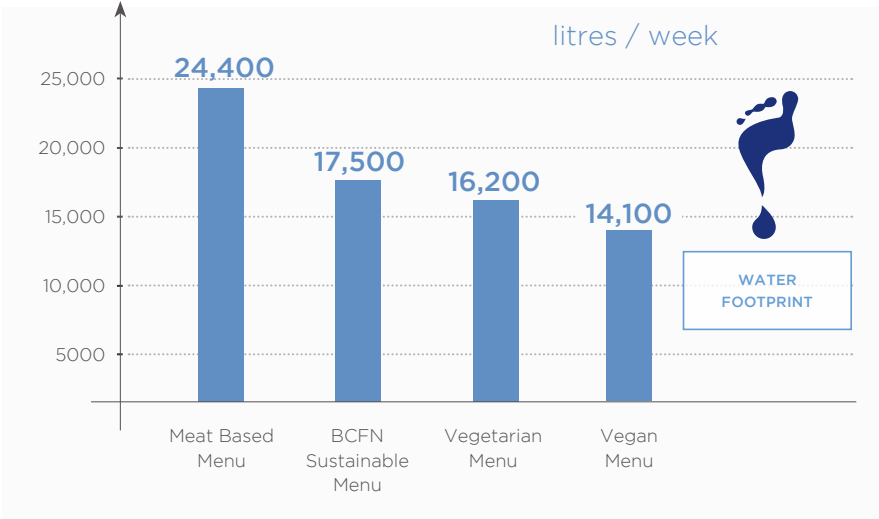
	MONDAY	g	TUESDAY	g	WEDNESDAY	g	THURSDAY	g	FRIDAY	g	SATURDAY	g	SUNDAY	g
BREAKFAST	1 Cup of milk	200	1 Cup of milk	200	1 Glass of freshly squeezed citrus fruit juice	200	1 Cup of milk	200	1 Cup of fruit and milk smoothie	200	1 Cup of yogurt	125	1 Croissant	50
	4 Rusks	32	2 Slices of whole grain bread	50	1 Brioche	50	6 Dry cookies	30	4 Rusks	32	2 Slices of whole grain bread	50	1 Portion of Fruit	150
	1 Portion of Fruit	150	2 Teaspoons of jam	20							2 Teaspoons of jam	20		
	<b>TOTAL</b>	<b>382</b>		<b>270</b>		<b>250</b>		<b>230</b>		<b>232</b>		<b>195</b>		<b>200</b>
SNACK	1 Cup of fruit and milk smoothie	200	1 Cup of skim yogurt	125	1 Cup of skim yogurt	125	1 Packet of crackers	30	1 Cup of skim yogurt	125	1 Portion of Fruit	150	1 Cup of skim yogurt	125
			1 Portion of Fruit	150	2 Rusks	16	1 Portion of Fruit	150	1 Portion of Fruit	150				
	<b>TOTAL</b>	<b>200</b>		<b>275</b>		<b>141</b>		<b>180</b>		<b>275</b>		<b>150</b>		<b>125</b>
LUNCH	Whole wheat spaghetti with cheese and black pepper	112	Penne with fresh tomato and basil	220	Bresaola (cured meat) roulades with stracchino cheese	100	Pasta with meat sauce	290	Salmon with artichoke puree	315	Pasta with broccoli	200	Potato gnocchi with tomato sauce	389
	Mixed raw vegetables	80	Rost veal	225	Carrot and fennel salad	200	Pumpkin and leek flan	178	2 Slices of whole grain bread	50	Meatballs with peas	160	Lamb chop	112
	Olive oil	10	Zucchini with parsley	80	2 Slices of whole grain bread	50					Mixed raw vegetables	50	Grilled peppers	200
			Olive oil	10	Olive oil	10					Olive oil	10	Olive oil	10
	<b>TOTAL</b>	<b>202</b>		<b>535</b>		<b>360</b>		<b>468</b>		<b>365</b>		<b>420</b>		<b>711</b>
SNACK	1 Portion of Fruit	150	1 Cup of fruit and milk smoothie	200	1 Portion of dried fruit	30	1 Cup of yogurt	125	1 Portion of Fruit	150	1 Cup of fruit and milk smoothie	200	1 Portion of Fruit	150
	1 Packet of crackers	30			1 Portion of Fruit	150			1 Packet of crackers	30	2 Rusks	16		
	<b>TOTAL</b>	<b>180</b>		<b>200</b>		<b>180</b>		<b>125</b>		<b>180</b>		<b>216</b>		<b>150</b>
DINNER	Omelette with aromatic herbs	76	Pasta with beans	303	Pasta with creamed vegetables	280	Vegetable soup with rice	270	Chickpea cream	310	Pizza Margherita	361	Tomato bruschetta	243
	Steamed Swiss chard and potatoes	300	Mixed raw vegetables	80	Beef roulades with sage	125	Beef carpaccio with cherry tomatoes and arugula	265	Steamed green beans and potatoes with shaved Grana Padano cheese	310			Hummus	190
	2 Slices of whole grain bread	50	2 Slices of whole grain bread	50	Spinach	200	Olive oil	20	Olive oil	10			Mixed raw vegetables with oil dip	200
	Olive oil	10	Olive oil	10	Olive oil	10							2 Slices of whole grain bread	50
													Olive oil	10
	<b>TOTAL</b>	<b>436</b>		<b>443</b>		<b>615</b>		<b>555</b>		<b>630</b>		<b>361</b>		<b>693</b>



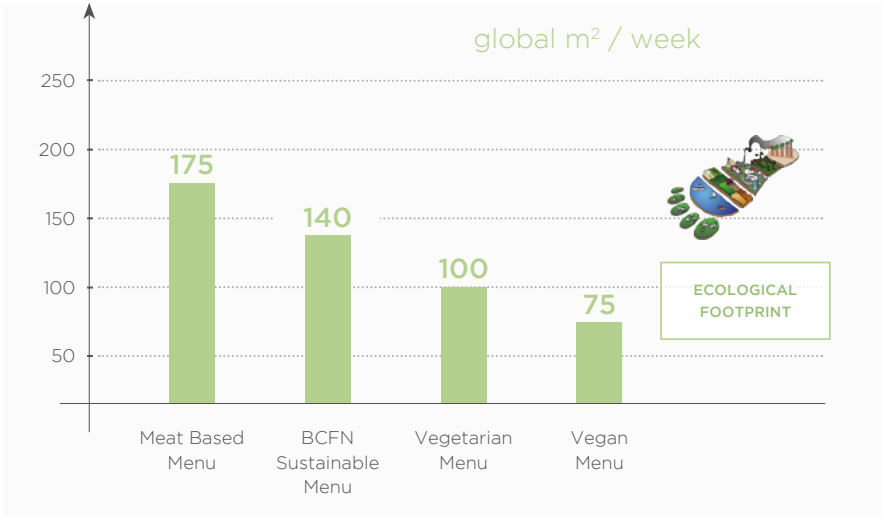




Carbon footprint of the four different menus analyzed, all nutritionally balanced  
Source: BCFN Foundation, 2016



Water footprint of the four different menus analyzed, all nutritionally balanced  
Source: BCFN Foundation, 2016



Ecological footprint of the four different menus analysed, all nutritionally balanced  
Source: BCFN Foundation, 2016



## SUSTAINABILITY IN PRACTICE

What we put on our plate influences not only our health but also the environment. In essence, what does reducing our carbon footprint by 5, 10, 15 kilos a month mean? To give an idea, it may be useful to compare the results of our elaborations with the variations of CO<sub>2</sub> which would be obtained by applying various other “eco” measures, which are perhaps more commonly known: leaving the car at home, a more frugal consumption of electricity, the installation of low consumption light bulbs, etc...

Consider, for example, that:

- If one person were to give up eating meat for two days a week for one year, there would be a saving of 323 kg of CO<sub>2</sub> a year, equal to the CO<sub>2</sub> emitted driving a car for 2485 km (equivalent to the distance between Rome and Lisbon)
- If a family of four were to adopt a moderate omnivorous diet, such as that recommended by the BCFN, there would be a saving of 1.9 tons, equal to the CO<sub>2</sub> emitted by driving 14,400 kilometres or the same family's annual consumption of gas;
- If all Italian citizens were to give up eating meat for one day a week for one year, there would be a total saving of 5.7 million tons of CO<sub>2</sub>, equal to the annual electricity consumption of almost 3 million families, or to 9.3 billion kilometres by car.

In practice, one meal a week without meat would remove more than 2 million cars from the road for one year<sup>25</sup>.

From this comparison, it is easy to understand how a simple change in our dietary habits is a powerful solution, and also amongst the easiest things to do. While giving up meat for a few days a week is an option within everyone's reach, giving up heating or the car could be more difficult. If we then consider that the change in diet does not only have positive repercussions on CO<sub>2</sub> emissions but also on the scarcity of water, the use of land and, last but not least, on our health, it is easy to understand that adopting a sustainable diet has many advantages with no cost to ourselves.

<sup>25</sup> Our own elaboration considering a car that travels on average 20,000 km a year (data: US Department of Transportation <http://www.fhwa.dot.gov/ohim/onh00/bar8.htm>)





# THE COST OF A SUSTAINABLE DIET



## THE COST OF DIFFERENT MENUS IN ITALY

- 🔥 Data sources
- 🔥 Data used
- 🔥 Cost of menus in Italy

## THE SCIENTIFIC DEBATE ON THE COST OF HEALTHY EATING

- 🔥 How to compare food prices
- 🔥 The scientific debate on the cost of diets

## THE COST OF HEALTHY EATING IN THE UNITED STATES

- 🔥 What people eat in the United States
- 🔥 Does a sustainable diet cost more in the U.S.?

## THE COST OF HEALTHY EATING IN EUROPE

- 🔥 United Kingdom
- 🔥 France
- 🔥 Other EU countries





# THE COST OF A SUSTAINABLE DIET

*It is well known that sustainability implies long-term environmental, social, and economic equilibrium. This is why the BCFN decided to analyze sustainability issues in more detail by integrating food and environmental variables (in terms of human health and, consequently, social issues) with some preliminary considerations concerning economic aspects. The BCFN thus tried to understand what effect consumers' dietary choices have on their food budget, in order to determine whether well-balanced diets which are also sustainable models for the environment are economically viable. Unlike environmental and nutritional issues, where data tends to be quite consistent, the elaboration of the numerous price variables is extremely complex. In fact, the cost of food is influenced by the type of product (e.g., meat or vegetables) and by other aspects such as quality (real or perceived), the type of store (hypermarket, supermarket, discount stores), and the geographic region where it is purchased. Therefore, the purpose of this paper is to integrate economic aspects into the overall issue of sustainability.*

*The aim of this chapter is to present the main hypotheses and sources of information used when calculating the prices of different eating habits around the world. In analyzing the situation in Italy, the assessment is based on*

*official data collected for statistical purposes by government agencies. For other European countries and the United States, a literature review was carried out.*

## THE COST OF DIFFERENT MENUS IN ITALY

### Data sources

The information used to define the prices of food is taken from the Italian Osservatorio Prezzi e Tariffe [Price and Rates Observatory] prepared by the Italian Ministry of Economic Development<sup>1</sup> [MISE], in order to establish a reference point when gathering information on the price of mass-consumed goods and services, their variability, and the dynamics of inflation.

To define the economic values of reference, a list or virtual "shopping basket" of goods and services that reflect the most common items of expenditure for Italian families was identified. Prices and rates are periodically surveyed to ensure a sufficient degree of representativeness in terms of number of observations, the items included in the basket, and territorial coverage. For each product, average prices are recorded, taking into account the different ranges of consumption in different geographical areas and,

in the interests of "consumer information", the results will be communicated nationwide.

The data included refers to prices recorded by municipal statistics agencies in the area of monthly retail price surveys, coordinated by the Italian National Statistics Office [ISTAT]. A retail price survey is performed in which, for each business, prices are recorded on a monthly basis for those products or items (defined by the combination of three characteristics: variety, brand, and package) that are most popular in the specific retail points (e.g., pasta, price of variety x of brand y, for package of grams z). The item price takes on the name "price listings". This means that – in comparisons between cities or between months in the same city – the price listings may refer to different varieties, brands, and packages. Therefore, a comparison over time can be performed properly only by using indexes issued by ISTAT and the municipal statistics agencies, while information relating to price levels may provide useful information in relation to a specific month.

For these reasons, the considerations presented in this work are purely indicative and preliminary to any future detailed evaluations.

<sup>1</sup> In collaboration with the State Administration – central and local – with ISTAT, UNIONCAMERE, the consumer associations, and the social parties.



### Field of application of available data

The available data in the Osservatorio dei Prezzi database refers to the prices of several products divided into four groups: fruit and vegetables, food, home and personal care, services. For this paper, we have chosen to use the value for fresh produce and food: the data refers to 163 products (of which 97 are different types of fruits and vegetables). The data provided by the observatory refers to the average price as recorded by ISTAT on a sample of stores representing the principal types of retail points. The information is organized in such a way as to provide monthly average data for each of the Italian provincial capitals. In this case, too, choices have been made to identify representative data useful to the objectives of this paper.

As far as the time reference is concerned, we selected the months of April and October as representing two very different seasons in terms of food production. With regard to the cities, five of the largest cities in the country were selected: **Milan, Turin, Naples, Rome, and Palermo.**

### Basic data elaboration

As mentioned, the data collected refers to some of the major food products sold in the markets of reference. To define the prices of individual food types contained in the Double Pyramid, the data available was aggregated to obtain average representative values of the various food groups represented.



Basically, the foods in the price database were grouped according to the categories used in the Food Pyramid, as shown in the diagram illustrated below.

Since the values available in the various sample cities and selected two-month periods do not always refer to exactly the same food, the aggregation procedure attempted to make groups as similar as possible in order to create comparable values. An example is fish - in some cases values are available for both open-sea and farmed products, while in others only farmed fish data is available. Therefore, to standardize the values in this group, only data relevant to the values of farmed fish was used.

Other hypotheses relative to these elaborations are:

- Data on canned tuna and frozen fish were aggregated within the “packed fish” category;
- Data on pre-packaged snacks and chocolate have been included in the “sweets” category;
- Pre-cut and ready-to-eat packaged salad was considered in its own category.

The data is usually provided in kilograms (or litres), except for a few cases where the price is the unit of sale. In the latter case, the values were reported per kilogram; in the case of eggs (where the price is for a box of six), the conversion was made considering a weight of 60 grams per egg.

### Data used

The following are the averages for all categories, while the aggregate and individual values used are presented in the following tables<sup>2</sup>.

<sup>2</sup> The figure referred to as average is not to be interpreted as the average Italian price, for which it would be proper to make a weighted average based on sales volumes in all cities, but simply as the average price of the five cities represented here.



OCTOBER 2015	TURIN	MILAN	ROMA	NAPLES	PALERMO	AVERAGE
BEEF MEAT	€ 18.64	€ 17.81	€ 18.21	€ 13.11	€ 15.48	€ 16.65
BISCUITS	€ 3.43	€ 4.56	€ 4.40	€ 3.15	€ 3.49	€ 3.81
BREAD	€ 2.68	€ 3.05	€ 2.58	€ 2.21	€ 2.63	€ 2.63
BUTTER	€ 9.33	€ 10.04	€ 10.02	€ 9.02	€ 8.91	€ 9.46
CHEESE	€ 13.87	€ 13.87	€ 14.23	€ 13.51	€ 14.59	€ 14.01
CURED MEAT	€ 20.68	€ 25.63	€ 22.94	€ 20.83	€ 18.81	€ 21.78
EGG	€ 5.83	€ 5.83	€ 6.10	€ 5.19	€ 5.28	€ 5.65
FRESH FISH	€ 14.84	€ 14.44	€ 18.69	€ 9.55	€ 11.44	€ 18.60
FRESH VEGETABLES	€ 2.66	€ 3.16	€ 2.48	€ 1.96	€ 2.41	€ 2.82
FROZEN VEGETABLES	€ 3.05	€ 3.16	€ 3.20	€ 3.71	€ 2.88	€ 3.20
FRUIT	€ 2.10	€ 2.76	€ 2.28	€ 2.08	€ 2.06	€ 2.39
MILK	€ 1.38	€ 1.37	€ 1.42	€ 1.11	€ 1.23	€ 1.30
OIL	€ 3.77	€ 4.31	€ 4.03	€ 3.55	€ 4.01	€ 3.93
PACKED FISH	€ 17.19	€ 15.58	€ 18.03	€ 16.12	€ 17.15	€ 16.81
PASTA	€ 1.67	€ 2.20	€ 1.76	€ 1.22	€ 1.10	€ 1.59
PORK MEAT	€ 7.43	€ 7.67	€ 7.44	€ 7.42	€ 7.08	€ 7.41
POTATOES	€ 1.05	€ 1.40	€ 1.09	€ 0.82	€ 0.95	€ 1.11
POULTRY MEAT	€ 11.51	€ 11.08	€ 10.31	€ 7.93	€ 9.30	€ 10.03
RICE	€ 2.91	€ 3.00	€ 2.94	€ 2.23	€ 2.35	€ 2.69
SWEETS	€ 8.95	€ 10.27	€ 10.73	€ 10.25	€ 9.49	€ 9.94
YOGURT	€ 4.72	€ 4.40	€ 4.48	€ 4.32	€ 4.00	€ 4.38

Average values for October 2015, for 1 kg or 1 litre  
 Source: BCFN elaborations on Osservatorio Prezzi e Tariffe data, 2016





APRIL 2016	TURIN	MILAN	ROMA	NAPLES	PALERMO	AVERAGE
BEEF MEAT	€ 18.36	€ 18.69	€ 18.61	€ 13.03	€ 14.15	€ 16.57
BISCUITS	€ 3.41	€ 4.64	€ 4.35	€ 3.05	€ 3.37	€ 3.76
BREAD	€ 2.65	€ 3.08	€ 2.57	€ 2.20	€ 2.62	€ 2.62
BUTTER	€ 9.14	€ 10.13	€ 9.97	€ 9.00	€ 8.60	€ 9.37
CHEESE	€ 13.69	€ 13.89	€ 14.27	€ 12.96	€ 14.54	€ 13.87
CURED MEAT	€ 20.58	€ 26.23	€ 22.87	€ 21.32	€ 18.89	€ 21.98
EGG	€ 5.82	€ 5.89	€ 6.08	€ 5.22	€ 5.13	€ 5.63
FRESH FISH	€ 10.33	€ 12.30	€ 10.57	€ 8.65	€ 11.20	€ 10.50
FRESH VEGETABLES	€ 2.36	€ 3.00	€ 2.48	€ 2.09	€ 2.37	€ 2.47
FROZEN VEGETABLES	€ 2.92	€ 3.10	€ 3.21	€ 3.79	€ 3.00	€ 3.20
FRUIT	€ 1.96	€ 2.39	€ 2.07	€ 1.94	€ 1.83	€ 2.05
MILK	€ 1.43	€ 1.53	€ 1.52	€ 1.36	€ 1.38	€ 1.46
OIL	€ 3.84	€ 4.43	€ 4.09	€ 3.62	€ 3.99	€ 3.99
PACKED FISH	€ 14.29	€ 13.75	€ 15.66	€ 14.45	€ 14.67	€ 14.57
PASTA	€ 3.38	€ 3.73	€ 3.23	€ 3.35	€ 3.04	€ 3.34
PORK MEAT	€ 7.27	€ 7.72	€ 7.46	€ 7.21	€ 7.01	€ 7.33
POTATOES	€ 1.11	€ 1.40	€ 1.17	€ 0.79	€ 0.96	€ 1.14
POULTRY MEAT	€ 11.39	€ 11.40	€ 10.43	€ 8.07	€ 9.19	€ 10.10
RICE	€ 2.98	€ 3.08	€ 3.00	€ 2.19	€ 2.36	€ 2.72
SWEETS	€ 8.76	€ 10.00	€ 10.94	€ 10.08	€ 10.57	€ 10.07
YOGURT	€ 4.48	€ 4.08	€ 4.48	€ 4.16	€ 3.84	€ 4.21

Average values for April 2016, for 1 kg or 1 litre  
 Source: BCFN elaborations on Osservatorio Prezzi e Tariffe data, 2016



The averages relating to each category have been used to define the economic values to be attributed to individual foods. Among all the possible values, it was decided to take **Milan** and **Naples** as a reference and only for the month of **April 2016**.

The decision to analyze only one month instead of two is due to the fact that there were no substantial differences between the data relating to the two months analyzed. The initial choice to consider two different months in seasonal terms was to attempt an assessment of any differences in price due to the seasonality of food. The available data, however, does not allow - at least in a preliminary analysis, which is the goal of this work - to reach this level of detail. Instead, the differences could be ascribed to changes in prices due to standard market rules.

Regarding the choice of cities, we decided to refer to one city in the North and one in the South of Italy, characterized by significant price differences (particularly for certain categories of food such as fish or meat). Milan and Naples were the two cities with the highest and lowest prices, respectively. The roundup of data that will be used in the elaborations conducted in the Double Pyramid document is shown below.

The available information confirms the fact that the prices of food types at the base of the pyramid are generally lower than those at the top. It is thus confirmed - although less marked as compared to the environmental aspects - that following nutritional advice (the Food Pyramid) can lead to generally sustainable behaviour.

APRIL 2016	MILAN	NAPLES
BEEF MEAT	€ 18.69	€ 13.03
BISCUITS	€ 4.64	€ 3.05
BREAD	€ 3.08	€ 2.20
BUTTER	€ 10.13	€ 9.00
CHEESE	€ 13.89	€ 12.96
CRACKERS	€ 3.08	€ 3.08
CURED MEAT	€ 26.23	€ 21.32
DRIED FRUIT	€ 9.18	€ 9.18
EGG	€ 5.89	€ 5.22
WHOLE WHEAT FLOUR	€ 0.69	€ 0.71
WHEAT FLOUR	€ 0.69	€ 0.71
RUSKS	€ 3.25	€ 3.25
FISH	€ 13.03	€ 11.55
FRESH VEGETABLE	€ 3.00	€ 2.09
FRUIT	€ 2.39	€ 1.94
JAM	€ 4.27	€ 4.27
LAMB MEAT	€ 12.90	€ 12.90
LEGUMES	€ 4.20	€ 4.20
MILK	€ 1.53	€ 1.36
PASTA	€ 3.73	€ 3.35
PESTO ALLA GENOVESE	€ 7.32	€ 7.32
PORK MEAT	€ 7.72	€ 7.21
POTATOES	€ 1.40	€ 0.79
POULTRY MEAT	€ 11.40	€ 8.07
RED WINE	€ 2.47	€ 2.01
RICE	€ 3.08	€ 2.19
SACCOTTINI APRICOT	€ 8.18	€ 8.18
SOY MILK	€ 2.43	€ 2.21
SUGAR	€ 1.00	€ 1.05
SWEETS	€ 10.00	€ 10.08
VEGETABLE OIL	€ 4.43	€ 3.62
YOGURT	€ 4.08	€ 4.16

Values of the price of food in Milan and Naples (April 2016) used for economic evaluations of BCFN menus, expressed per kg or litre.

Source: BCFN elaborations on Osservatorio Prezzi e Tariffe data, 2016; Prontospesa.it



# THE ECONOMIC PYRAMID

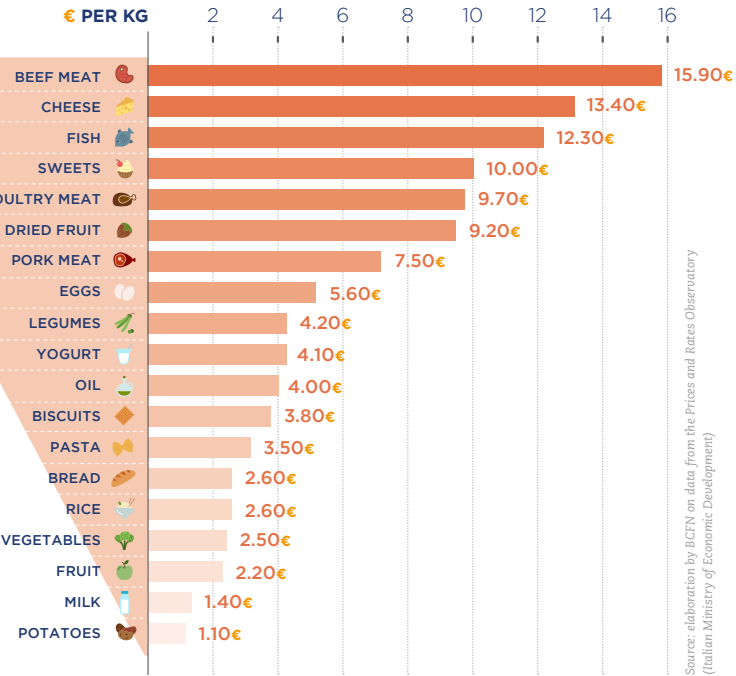
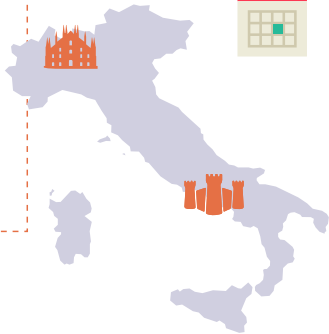
BY ORGANIZING FOODS OF THE FOOD PYRAMID ACCORDING TO THEIR PRICE PER KG, YOU GET AN **INVERTED PYRAMID**, THE ECONOMIC ONE: THE **MOST EXPENSIVE** FOODS ARE AT THE **TOP** (THE BASE OF THE PYRAMID), WHILE THE **CHEAPEST** ONES ARE AT THE **BOTTOM** (THE APEX OF THE PYRAMID).



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THE PRICES SHOWN IN THE ECONOMIC PYRAMID HAVE BEEN CALCULATED AS THE AVERAGE OF PRICES RECORDED BY THE PRICES AND RATES OBSERVATORY OF THE MINISTRY OF ECONOMIC DEVELOPMENT, IN THE CITIES OF **MILAN** AND **NAPLES** IN APRIL 2016.

APRIL 2016



## Cost of menus in Italy

On the basis of these prices, we propose some simple diagrams that might be helpful in understanding how people's dietary choices can also influence their expenditure. These diagrams are to be considered merely indicative, based on a number of food choices selected by the BFCN in order to assess their environmental impacts.

In addition, just as for environmental impacts, it is important to **avoid the direct comparison of two foods**, but to consider instead the different food pairings (in terms of quantity and categories) eaten in one day. In particular, a daily and a weekly menu will be examined, both of which are balanced from a nutritional point of view.

### *The daily menu*

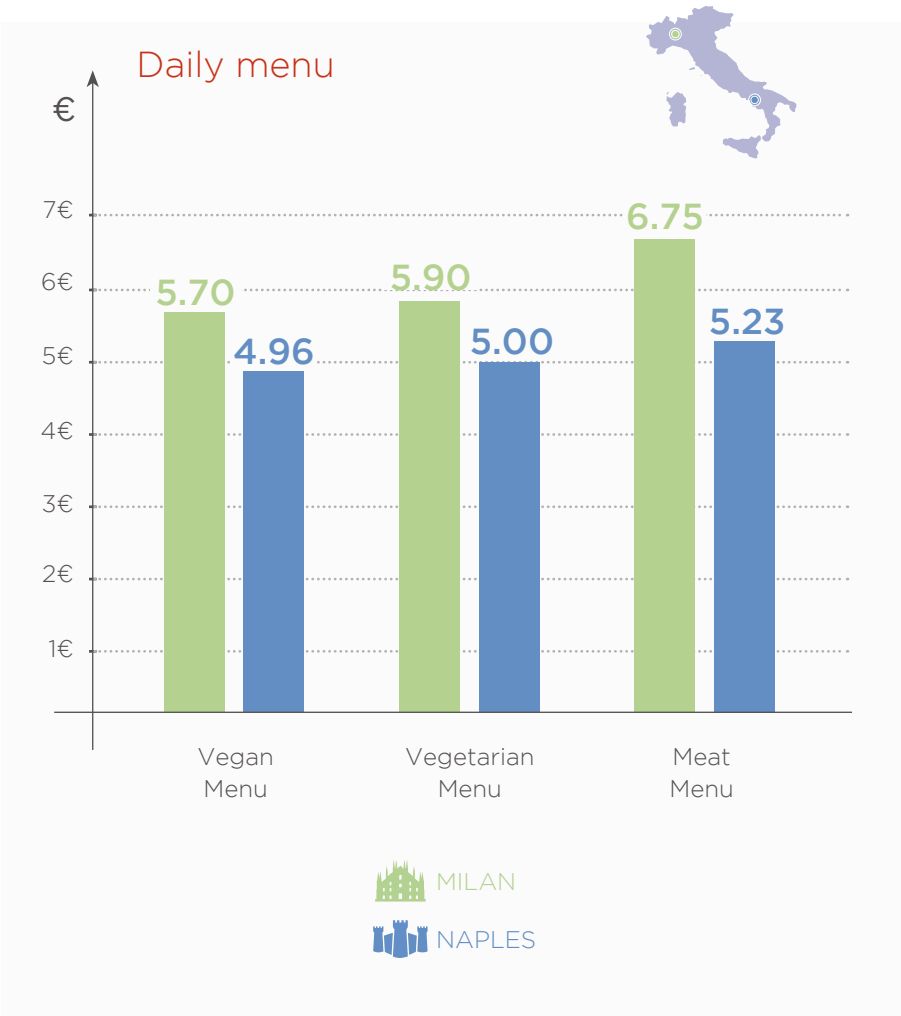
Regarding daily menus, we will consider the three alternatives already analyzed in the previous section for the BCFN menu, referring to the environmental impacts. The first (Vegan Menu) excludes any kind of meat and animal products (such as dairy products and eggs). In the second menu (Vegetarian), there are eggs and dairy products, but no meat. Finally, the third one (Meat Menu) is omnivorous and relies mainly on animal proteins. As shown, in Naples there is almost no difference in the cost of the vegan and vegetarian menu, while in Milan the vegan menu costs € 0.20 less<sup>3</sup>. The menu based on meat,

however, is more expensive: about € 0.85 more per day in Milan and € 0.23 in Naples with respect to the vegetarian menu.

To understand to what extent dietary choices can influence a person's food budget, the BCFN tried to combine the meat and vegetarian menus, assuming three kinds of weekly diets: a meat menu every day; a vegetarian menu every day; and a combination of two menus: vegetarian five days and meat twice. The results show that by reducing meat consumption to only twice a week, it is possible to save up to € 4.20 per week, which translates into a total saving of around € 220 in a year, hardly a negligible amount.

<sup>3</sup> It should be noted that the vegan menu here described does not include any kind of meat substitute, such as seitan or soy products, which can be quite expensive in Italy





Cost of a menu with a meat dish and a vegetarian menu, showing the food prices recorded in Milan and Naples

Source: BCFN elaborations, 2016



The cost of three possible weekly diets: the first diet is calculated assuming that only the menu with meat dishes will be eaten; the second diet includes two days of a menu with a meat dish and five days following the vegetarian menu. The third diet calculates only eating the vegetarian menu.

Source: BCFN elaborations, 2016



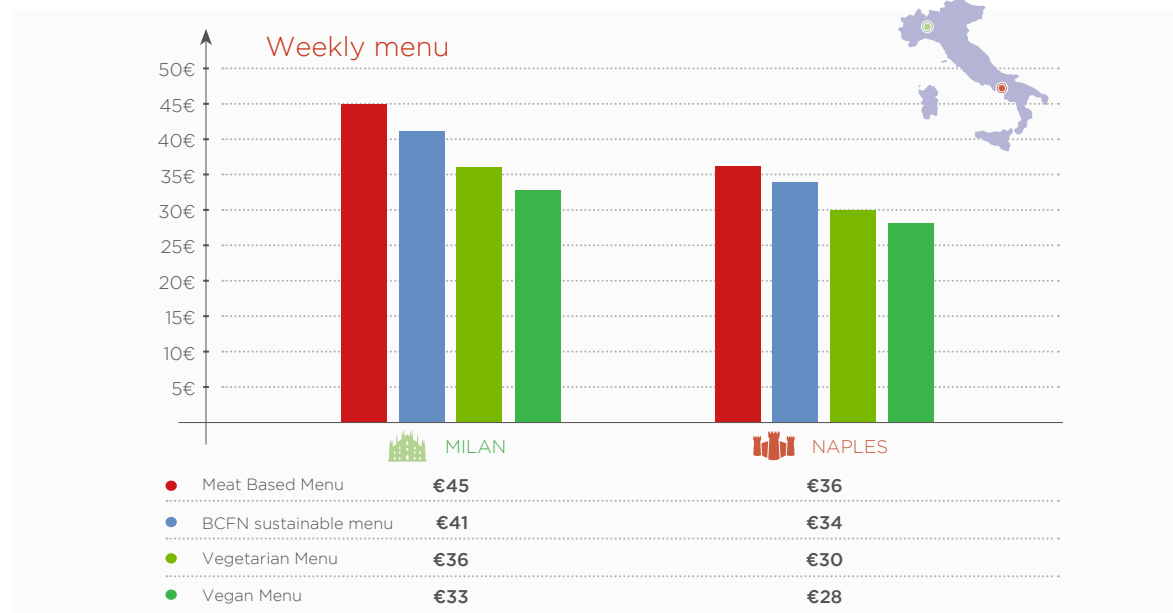
### The weekly menu

The same analysis was conducted on the weekly menus proposed in the previous section for the BCFN menu, making reference to the environmental impacts. From an economic point of view, the menus have some differences, although not as pronounced as for the environmental impact. Specifically, the two plant-based menus (vegan and vegetarian) are the cheapest, followed by the BCFN sustainable menu. The “meat menu”, richer in animal proteins, have a slightly higher cost.

From this assessment it can be stated that, in Italy, a sustainable Mediterranean diet not only has a lower environmental impact, but also enjoys a lower cost than diets richer in animal protein (meat and/or fish)<sup>4</sup>.

## THE SCIENTIFIC DEBATE ON THE COST OF HEALTHY EATING

In Italy, a country with the finest cuisine and one of the homes of the Mediterranean diet, everybody can eat well and healthily, and adopting a sustainable diet on a budget is not very complicated. In other countries, the issue is more complex. Some studies show an inverse relationship between socioeconomic status and obesity rate, highlighting a higher presence of overweight individuals among those households with a lower socio-economic status<sup>5</sup>. In the debate over the causes of obesity and cardiovascular diseases, food prices are often accused of being too high for



Economic cost of the four different menus analyzed, all nutritionally balanced  
 Source: BCFN elaborations, 2016

healthy foods (fruit, vegetables, whole grains, and low-fat dairy products) and, even worse, of being too low for soft drinks, snacks, and other types of junk food<sup>6</sup>.

On the other hand, many researchers believe that price is only one of the factors that influence people's purchasing behaviour and that other variables, such as the level of education, perceived convenience, taste, and a tendency towards a healthy lifestyle, also play important roles<sup>7</sup>. Navigating the scientific evidence is not simple because studies often lead to conflicting conclusions.

### How to compare food prices

It is essential to choose a suitable unit of measurement when comparing the prices of different foods. If we wish to analyze consumers' purchasing decisions, we must use the same unit of measurement as the store<sup>8</sup>.

<sup>4</sup> The vegan menu described here does not include any kind of meat substitute, such as seitan and soy products, the price of which can be quite high in Italy.

<sup>5</sup> Drewnowski et al. 2004; 2005; 2009

<sup>6</sup> Aggarwall et al. 2012, Drewnowski et al. 2005

<sup>7</sup> Drewnowski et al., 2012; Aggarwall, 2012

<sup>8</sup> Carlson & Frazão, 2014



In most American and European supermarkets, the price of the products is expressed with two variables: price per unit and price per kg/pound. The first is the most direct and intuitive way for comparing foods belonging to the same category but it is only applicable to products with the same type of packaging or the same weight. The second allows for comparisons to be made between different quantities, but it is of little use when we need to compare foods that differ in form: for example, when comparing the price of a fresh vegetable with its frozen equivalent. In this case, it would be more logical to use price per amount of final edible product since part of the unprocessed product is lost during preparation.

There are other units of measurement commonly used in scientific research: price per calorie of energy, price per edible gram, and price per average portion<sup>9</sup>. The main characteristics of these three metrics are briefly described below.

#### *The calorific price (price per calorie)*

This is the metric commonly used in scientific literature. The price per calorie is the ratio between the price per 100 grams of food and the number of calories contained in the same weight. Nevertheless, the use of this unit of measurement has been subject to two main criticisms<sup>10</sup>:

- It is misleading. According to this metric, high-calorie foods (high energy density) are always less expensive simply because the ratio is divided by a larger number of calories, while low-calorie (low energy density) foods are more expensive, since

there are fewer calories in the denominator<sup>11</sup>;

- It is not a good indicator of the total cost of a diet. Since it does not take the amount actually eaten into consideration, this metric ignores the total cost associated with the total intake of calories. In 2011, Frazão demonstrated that, even if a healthier diet has a higher cost per single calorie than a less healthy diet, this does not mean that a daily meal has a higher total cost.<sup>12</sup> This is because if people generally eat foods with higher energy content, they tend to consume a higher number of calories. Most people will probably consume more than 100 Kcal from a packet of crisps (a typical packet contains about 250 kcal) and definitely less than 100 kcal of broccoli (a medium portion contains about 27 kcal).

#### *Price per edible gram*

Price per edible gram measures the cost of a given food as it is presented on the plate. It is based on the fact that most unprocessed food undergoes some kind of preparation that changes its weight and quantity. There are several advantages to using this metric, for both researchers and consumers. The advantage from a scientific perspective is that it can be used to compare the price of diets that comply with the official guidelines for proper nutrition, while analyzing different foods in type and quantity.

The advantage for consumers is that it is particularly useful for comparing the price of foods that differ in form and degree of transformation.

#### *Price per average portion*

This metric has recently been proposed in the USDA report entitled: “Are healthy foods really more expensive? It depends on how you measure the price”<sup>13</sup>. Average portions were calculated on the basis of the average quantities consumed by adults of various ages. This metric has the advantage of being easy to communicate and understand: for this reason, it is already used on some specialized websites and in grocery stores. However, due to its sensitivity to quantity and the inflexibility of the standard portions, it is not always suitable for making comparisons. Moreover, this metric only reflects people’s eating habits and does not take into account the costs of a well-balanced diet that meets the standards required by the guidelines.

The USDA commented on the possible distortion arising from the use of different units of measurement and definitions, and carried out a study in 2012 in order to determine if, and to what extent, the estimated cost of a “healthy” diet is influenced by the unit of measurement<sup>14</sup>.

Price per calorie, price per 100 edible grams, and price per average portion were calculated for the same basket of 4,439 foods. The foods belonging to one of the main food groups (vegetables, fruit, grain

<sup>9</sup> Carlson & Frazão, 2014

<sup>10</sup> Carlson & Frazão, 2014

<sup>11</sup> Lipski, 2009; Rao, 2013

<sup>12</sup> Frazão et al. 2011

<sup>13</sup> Carlson & Frazão 2012

<sup>14</sup> Carlson & Frazão, 2012



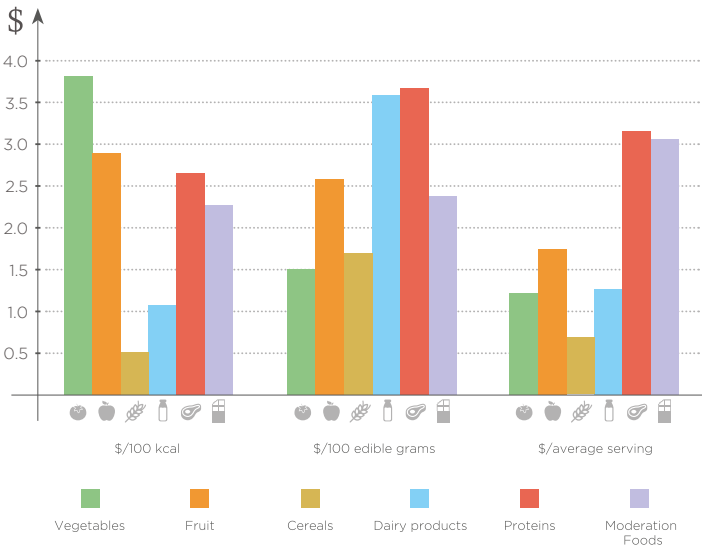
cereals, dairy and protein foods) and which contain moderate amounts of saturated fat, added sugars, and sodium according to the Dietary Guidelines for Americans 2010 were then included in the category of “healthy foods”. Meanwhile, all the foods containing large amounts of fat, added sugars, or sodium at levels higher than those recommended by the Dietary Guidelines or containing food from other food groups than those listed above were classified as “moderation foods”. The results show a wide variation in price depending on the metric used, as can be seen in the Figure below.

By using the price per calorie metric, it was observed that low-calorie foods with the same weight are more expensive when the price is commensurate with the number of calories. For example, fruit can cost up to nearly \$3 for 100 calories and vegetables up to \$3.76; conversely, moderation foods tend to have a higher calorie content and a low cost per calorie. However, if food is measured on the basis of the weight in edible grams or average portions, fruit, vegetables, and dairy products are less expensive than most protein and moderation foods, which may cost more than \$3 per average serving. Cereals are always the cheapest food, regardless of the metric used.

In short, according to this study the cost of healthy food compared with less healthy food varies according to how the price is calculated. In fact, eating healthily costs more if the price is calculated in dollars per 100 calories. Conversely, eating healthily can cost less if the price is calculated in edible grams and average portions.



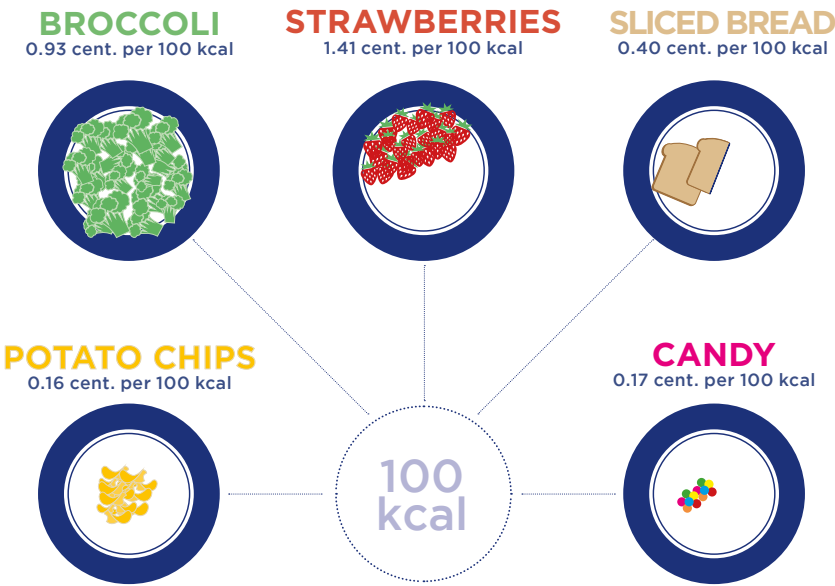
# THE COMPARISON OF PRICES BASED ON KCAL DOES NOT CONSIDER THE AMOUNT OF FOOD EATEN



Food prices vary according to the method used for measuring them. 'Moderation foods' are foods which have higher levels of fat, added sugars or sodium than those recommended by the U.S. Dietary Guidelines or that contain foods belonging to other food groups than those listed above.

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These plates contain 100 calorie servings of the following foods (broccoli, strawberries, sliced bread, potato chips and chocolate candies). As you can see, there is a larger amount of vegetable and fruit on the plates compared to the chips, while normally one eats smaller servings of broccoli and strawberries and larger servings of chips. The comparison between prices based on calories does not take into account the quantity of food which is generally eaten and is therefore misleading. (Barilla Center for Food & Nutrition, adapted from Carlson and Frazão, 2012)



Source of prices: USDA National Fruit and Vegetable Retail Report Vol VIII - No. 19 (<http://www.ams.usda.gov/mnreports/fvwretail.pdf>)  
Snacks - average retail price and cost per portion for calorie-dense snack foods; dollar price.  
([http://www.ers.usda.gov/datafiles/Fruit\\_and\\_Vegetable\\_Prices/Snack\\_Substitutions/snackprices.xls](http://www.ers.usda.gov/datafiles/Fruit_and_Vegetable_Prices/Snack_Substitutions/snackprices.xls))

## The scientific debate on the cost of diets

While the negative relationship between the energy density of food and the quality of diets containing energy-high foods is well known, there is still heated debate concerning the relationship between the energy density of the food and the expense incurred by families.

This is a controversial issue, since apart from obtaining conflicting results, many of the proposed studies use different units of measurement (such as those listed above), which are not easily comparable. One theory, counting epidemiologist Adam Drewnowski amongst its main supporters, argues that there is a positive relationship between cost and healthy foods and that this explains consumers' purchasing behaviour, which enables us to identify a link between obesity and socioeconomic status<sup>15</sup>.

A second argument claims that price is not an insurmountable obstacle to healthy eating. As we will see later, several studies show that it is possible to choose food that is in line with nutritional recommendations at a reasonable cost, or to improve the nutritional characteristics of our diets without incurring additional costs. According to this school of thought, one of the causes of diffusion of poor-quality diets is the population's lack of nutritional education. In other words, people lack the information necessary for purchasing the right products and practising healthy eating habits<sup>16</sup>. To what extent does income affect our choice of food? Drewnowski et al.<sup>17</sup> proved that there is an inverse

relationship between the energy density of a food, its cost per calorie and its micronutrient content. Since that study, the academic world has suggested that the association between poverty and high-calorie diets can be attributed to the lower cost of unhealthy food. In another study carried out on the French population, Drewnowski demonstrated that people with a higher income and level of education have a healthier diet which is rich in nutrients - especially those contained in fruits and vegetables: vitamin C, beta-carotene, potassium, and magnesium. The same association was found in a study carried out on a sample of low-income females in California<sup>18</sup>.

In this respect, the pursuit of a well-balanced diet becomes essentially a question of money: the high costs of healthier foods makes the poorer population more inclined to consume refined, calorific, and relatively inexpensive products. This relationship would explain why the poorest segments of the population are usually found to have a poor quality diet and are more prone to contracting diet-related diseases<sup>19</sup>.

## THE COST OF HEALTHY EATING IN THE UNITED STATES

### What people eat in the United States

Most Americans do not follow the Dietary Guidelines, the guidelines for a healthy diet established by the

United States Department of Agriculture (USDA) and the Department of Health and Human Service (HHS). The daily calorie intake of adults and children is much higher than the values recommended; Americans particularly tend to prefer foods that are high in saturated fat, salt, and added sugars<sup>20</sup>.

A recent study<sup>21</sup> clearly shows that the actual amount of the family food budget is far from the amount established in the Dietary Guidelines. The figure below shows the percentages of individual expenditure for each food category according to income bracket. As can be seen, the amount of money spent on the various food groups does not vary according to income. On average, American households only spend 17% of their budget on fruit and vegetables, while they spend much more on meat (28%) and "other products" (35%). This term mainly refers to packaged foods, snacks, frozen convenience meals, chips, and candy. These products usually contain a large amount of calories and are high in salt, fat, or added sugar<sup>22</sup>.

<sup>15</sup> Drewnowski et al., 2009; Aggarwal et al., 2012

<sup>16</sup> Kats, 2011; Carlson & Frazão 2014; Flynn et al., 2013

<sup>17</sup> Drewnowski et al., 2004, 2005; Aggarwal et al., 2012

<sup>18</sup> Townsend et al., 2009

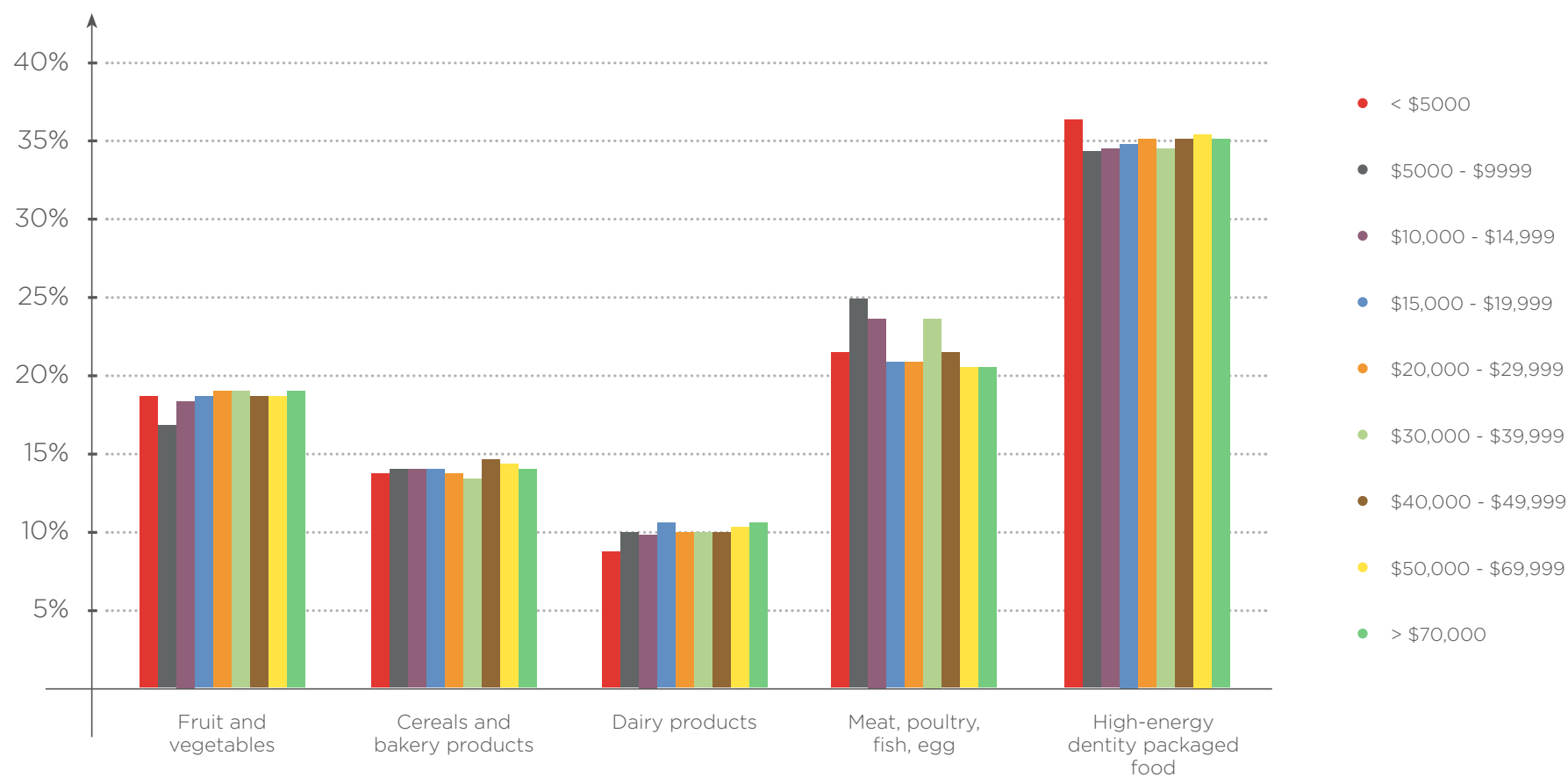
<sup>19</sup> Drewnowski, 2004

<sup>20</sup> USDA, 2010

<sup>21</sup> Carlson & Frazão, 2014

<sup>22</sup> Carlson & Frazão, 2014





The percentages of individual expenditure for each food category according to income bracket

Source: Frazão et al. 2014



A previous study<sup>23</sup> showed that the poorer members of the population are more inclined to substitute fruit and vegetables with more calorific foods. In general, an inverse relationship was observed between the socio-economic status of the population and the obesity rate<sup>24</sup>. The relationship between poverty and obesity in the United States is also confirmed by some recent studies<sup>25</sup>, which show that customers of hard discount stores belong to a lower socio-economic level and have a higher obesity rate (27%) than those who purchase their food in high-end supermarkets (9%). Moreover, the diet of the latter group is also of a better quality in terms of nutritional intake.

### Does a sustainable diet cost more in the U.S.?

A recent study carried out by the Department of Public Health at Harvard University confirmed the hypothesis that healthy food costs slightly more<sup>26</sup>. The authors carried out a thorough meta-analysis of 27 studies published between 2000 and 2011, all concerning the price of food. The aim of the analysis was to compare the cost of “healthy” choices compared to less healthy tendencies, both in terms of individual foods and diets in general. The foods were divided into six groups: meat, grain cereals, dairy products, sweets, fats, and drinks or fruit juices. In order to minimize the risk of distorting the results, two different metrics were used for comparing the prices of individual foods. Particular reference was made to the price per average portion and price per

200 kcal. A daily intake of 2000 kcal divided into three meals was used as a reference for the diets. The results showed that the healthier options are also the most expensive, except for soft drinks and dairy products. The greatest differences were observed for meat: the healthier options cost on average \$ 0.29 more per serving and \$ 0.47 per 200 calories. Chicken shows a greater variability: for the same amount of calories, buying thighs instead of breasts can cost up to \$ 0.72 more. There is a smaller, yet still quite significant, difference between various kinds of candy (\$ 0.12/serving), rice (\$ 0.03/serving) and fat (a difference of \$ 0.02, for example, between margarine which is high in trans fats and the healthier fats). This price gap also affects the price of the whole diet: a healthy diet based on vegetables, fruits, grain cereals, and fish can cost up to \$ 1.54 more per day compared to a diet based on processed foods, meat, and refined cereals. This is a relatively small amount, but it increases the grocery expenditure by up to \$ 550 a year, thus representing a difficult option for low-income households.

Therefore, eating well may appear to be an exclusive privilege of the upper classes of the population. A 2015 study on families with diabetic children reached similar conclusions: maintaining a healthy diet with 30% less fat content than their usual dietary habits, led to an increase of about \$56 a week for a family of four<sup>27</sup>.

However, the authors specify that the results of the comparisons may vary significantly depending on three factors: the “intensity” of the comparison, i.e., similarity in terms of type and quality of the food

to be compared; the definition of the variables (in particular the arbitrary choice of the criteria with which to define the “healthiness” of a food or a diet) and, as discussed above, the units of measurement used.

### *Education for promoting a healthy low-cost diet*

Several studies show that it is possible to eat a healthy diet in line with nutritional recommendations without exceeding our food budget.

For example, for several years the USDA has been promoting four Food Plans based on the Dietary Guidelines in order to demonstrate that it is possible to maintain a healthy diet at every income level.

The cheapest of these, the Thrifty Food Plan, shows how to feed a family of four with less than \$ 600 per month<sup>28</sup>, although there are limitations in terms of palatability and cultural acceptability, as well as a tendency for lengthy preparation times.

There is a section of the USDA's website dedicated to dietary guidelines, *ChooseMyPlate.com*, which has tips on how to eat well and cheaply. The site provides an example of a bi-weekly menu, some practical advice on how to optimize your grocery shopping budget, a list of foods for each season of the year, an online collection of recipes, and more<sup>29</sup>.

<sup>23</sup> Jetter & Cassady, 2006

<sup>24</sup> Drewnowski et al., 2009

<sup>25</sup> Drewnowski et al., 2012; Aggarwall et al., 2012

<sup>26</sup> Rao et al., 2013

<sup>27</sup> Patton, 2015.

<sup>28</sup> Data updated in January 2015

<sup>29</sup> <http://www.choosemyplate.gov/budget/>





Another study<sup>30</sup> shows that there is no direct correlation between the price and dietary value for various categories of packaged foods; indeed, for some products the “healthiest” version can cost less than those that are high in fat. Therefore, even if it is believed that higher quality diets cost more, it is possible to improve one’s diet at no extra cost simply by choosing the option with the “healthiest” nutrients of commonly purchased foods.

Similar results emerge from case studies in which families work alongside a nutritionist with the aim of improving the quality of their diet while maintaining their food budget.

Mitchell<sup>31</sup> and Raynor<sup>32</sup> have shown that, when treating children suffering from obesity, the transition from a high calorie diet to a diet that is rich in fruit, vegetables, and legumes does not have a negative effect on food expenditure; on the contrary, it is possible to save money by choosing nutrient-dense vegetables and low-fat dairy products<sup>33</sup>, or by following ethnic diets, such as the Latin American diet, which are healthier and enjoy a lower cost than the US alternative<sup>34</sup>. This is also confirmed by two studies concerning the consumption of the Mediterranean diet by American and Canadian people<sup>35</sup>: if cheaper foods are chosen for the same amount of nutrients, a dietary regime based on the Mediterranean diet is no more expensive than its highly energetic alternative.

In some cases, an improvement in the nutritional quality of the diet may even lead to saving money. Flynn<sup>36</sup> showed that by introducing three meals per week based on vegetables, whole grain cereals, and

olive oil into the diet of a low-income population in Rhode Island, a significant reduction in the weekly budget for food was observed, as well as a general improvement in the nutritional status and in body weight control. A group of 63 people of low socioeconomic status participating in food assistance programs attended a six-week educational program, which consisted of a series of cooking classes. The aim was to improve the quality of the diet of the participants without negatively affecting their food budget. The cooking classes involved preparing dishes based on vegetables, whole grain cereals, and a small amount of olive oil. During each lesson, a specific nutritional topic was discussed, such as: the benefits of using olive oil in cooking, the protein content of legumes and vegetables, and the fact that it is not essential to eat animal protein at every meal. Since olive oil was perceived as being a particularly expensive food, the cost per portion (two tablespoons) was emphasized. The participants were encouraged to prepare the recipes again at home and to add at least two vegetarian meals to their weekly diet. The experiment had a very positive outcome: the weekly number of vegetable-based dishes increased significantly following the cooking program. About 60% of the participants declared that they eat at least three vegetarian meals per week, compared to 5% at the beginning of the program. This change in eating habits was accompanied by a different way of allocating their food budget: although they had not been given explicit instructions in this regard, the participants significantly reduced their consumption of meat,

snacks, sodas, and candy. In particular, their meat expenditure decreased by 54% from \$ 16.45 to \$ 7.54 per week. In total, the cost of the weekly food expenditure decreased by 45%, from \$ 67.68 to \$ 37.12 per week, i.e., a monthly saving of about \$ 122. Similar results were obtained from the pilot survey carried out by Cortés et al.<sup>37</sup> on the dietary habits of the Latin American population, which involved 20 low-income Latin American families who took part in an intensive nutritional education program. The families were given advice on healthy eating on a budget. At the end of the educational program, the participants were able to make healthier choices, follow a lower calorie diet, and reduce their food expenditure.

All the above-mentioned studies show that nutritional education plays a key role in consumers’ wellbeing, especially if they belong to the low-income bracket.

Therefore, it would appear to be possible to eat healthily regardless of income level. However, public authorities should intervene in order to break down all of the physical and educational barriers which may hinder the access of less privileged members of the population to healthy food.

<sup>30</sup> Kats, 2011.

<sup>31</sup> Mitchell et al., 2000

<sup>32</sup> Raynor et al., 2002

<sup>33</sup> Darmon et al., 2015; Drewnowski et al., 2009

<sup>34</sup> Rehm et al., 2011; Maillot et al., 2008; Drewnowski et al., 2010

<sup>35</sup> Goulet et al., 2008

<sup>36</sup> Flynn et al., 2013

<sup>37</sup> Cortés et al., 2013



## TEN TIPS FOR SPENDING LITTLE AND EATING WELL

The website Choosemyplate.com offers household tips for maintaining a healthy diet without spending too much: here are the top ten.



### 1. Plan in advance, to prevent impulse buying

Before you go shopping, decide what you will eat during the week and make a list of what you need.

### 2. Take advantage of discounts

Check flyers and ads for in-store offers.

### 3. Compare prices carefully

Packaging can be misleading: check the food cost based on the price per kg.

### 4. Family-size packs are best

These are cheaper than single servings: prepare and freeze excess food for future use.

### 5. Seasons still exist!

Fruit and vegetables that are in season cost less, and they are fresh and tasty! Try new recipes for tasty dishes with different vegetables.

### 6. Convenience comes at a price...

Ready-made products cost more: buy simple foods instead of ready-made meals, and cook them at home. Both your budget and your taste buds will benefit!

### 7. Choose value

Certain products are cheap all year round: legumes are an excellent source of cheap protein. And for fruit and vegetables, the green light goes to carrots, potatoes, leafy green vegetables, apples, and bananas.

### 8. Cook once.... and eat all week!

Prepare several portions of your favourite dishes: you can freeze them individually, ready to take out during the week as necessary.

### 9. Be creative

There are many solutions to avoid throwing food away! These range from different flavouring to using leftovers with a variety of different recipes. Remember that wasting food is wasting money.

### 10. And when you eat out...

Eating at a restaurant can be very expensive. Hunt for offers and keep an eye on the beverages: these can easily add up on the final bill, for an unpleasant surprise.





## DOES A HEALTHY DIET COST MORE IN THE U.S.?

It depends on how the price is measured

PER AVERAGE PORTION IT COSTS **LESS**

### COST PER AVERAGE PORTION

- \$ 3.1 Moderation foods
- \$ 1.7 Fruit
- \$ 1.4 Vegetables
- \$ 0.7 Wholegrain cereals

PER EDIBLE GRAM IT COSTS **LESS**

### COST PER EDIBLE GRAM

- \$ 2.6 per 100 g Fruit
- \$ 2.4 per 100 g Moderation foods
- \$ 1.7 per 100 g Wholegrain cereals
- \$ 1.6 per 100 g Vegetables

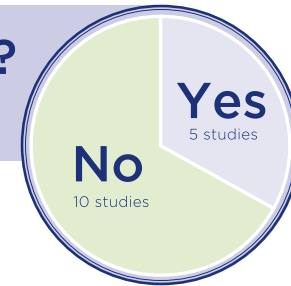
PER CALORIE IT COSTS **MORE**

### COST PER KCAL

- \$ 3.7 per 100 Kcal Vegetables
- \$ 2.9 per 100 Kcal Fruit
- \$ 2.3 per 100 Kcal Moderation foods
- \$ 0.5 per 100 Kcal Wholegrain cereals

## Does it cost more?

Results from a metanalysis of **15 studies** carried out on the cost of food in the US

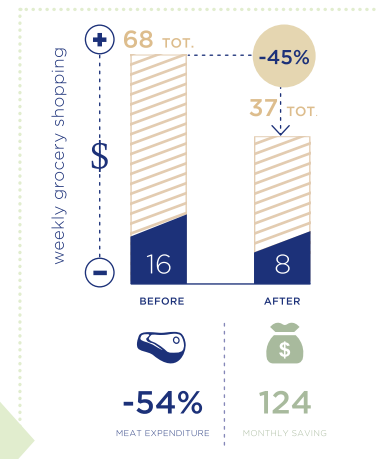


**No**, not if you choose cheaper foods which are high in nutrients

"Following a Mediterranean diet in America does not mean spending more on daily food shopping" (Goulet *et al.*, 2008).

**No**, after attending an adequate nutrition education program

As shown by the graph on the right, "after attending the program, meat shopping decreased by 54% as you can see in the graph on the right. Overall, weekly grocery shopping expenditure decreased by 45% from 68 to 37 dollars a week which is equal to a monthly saving of approximately 122 dollars" (Flynn, 2013).



10 STUDIES show EDUCATION plays an important role

5 STUDIES

**Yes**, it does cost more but only \$1.50 per day

A healthy diet is only a little more expensive: "it costs 1.54 dollars more per day which amounts to approximately 550 dollars a year" (Rao *et al.*, 2013).

"There is an inverse relationship between socio-economic status and obesity rate"  
 "Some studies show that the obesity rate in the male population rises in accordance with the increase in income, while an opposite trend was observed for the female population"

**Male and female obesity rates**

**CONTROVERSIAL**

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## THE COST OF HEALTHY EATING IN EUROPE

### United Kingdom

According to a recent study by the University of Cambridge<sup>38</sup>, in the United Kingdom the healthiest diets are allegedly associated with the highest prices. The variations in price between healthy and less healthy food in the decade 2002-2012 were analyzed, taking into consideration 94 food products, classified according to healthiness. The healthiest foods include milk, yogurt, fruit and vegetables, fish and lean meat; whilst the other category includes bacon, beef burgers, sweetened drinks, donuts and ice cream.

The results show that not only do healthier products cost more, but their price also tends to increase more over time than the price of less healthy foods. Suffice it to say that in 2012, the foods with the most calories (and thus less healthy) cost an average of £2.5 per 1000 kilocalories, while the healthier foods cost £7.49: about three times more. From 2002 to 2012, the average price of healthy foods increased by £0.17 per year per 1000 calories, compared with £0.07 of the less healthy foods. Some special offers to lower the price of fruit and vegetables could be enough to increase their weekly consumption by 20%<sup>39</sup>. Those who perceive healthy foods as too expensive are generally the more vulnerable sections of the population, who devote a very large proportion of their income to food purchases<sup>40</sup>. In fact, in this

context, it is easier to yield to a tendency to replace a food (perceived as too expensive, but usually also more nutritious) with another one that is cheaper, even if of lower quality.

Other studies, on the other hand, suggest that a healthy diet is not necessarily more expensive.

For example, the report by WWF UK on the food education project LiveWell<sup>41</sup> analyzes the cost of a sustainable diet (characterized by a low carbon footprint) compared with the average food expenditure outlined by the British Department for Environment, Food and Rural Affairs (DEFRA). The results show that the cost of the 2020 LiveWell diet is less than the average expenditure for food of families in the United Kingdom: this proves that, in England too, it is possible to make healthier food choices with a low environmental impact, whilst spending less.

The same position is supported by the British Health Ministry, which in 2014 launched the project “Eat4Cheap Challenge” to show that people can eat well for very little money. The project began with a very powerful call to action: to evaluate how much money could be saved in a week by eating in a healthy and tasty way, and share the results with the specially-created community. By following a few simple tips and reducing food waste, a family can save up to £2650 a year: the equivalent of a holiday for four to Disneyland in Paris<sup>42</sup>. The project's website includes many fun and useful resources for maintaining a healthy, low-cost diet: there is an online cookbook, practical advice, a self-evaluation

questionnaire on nutritional knowledge, interactive graphics, and a forum where users can exchange tips and opinions on how to maintain a healthy diet.

### France

Studies have also been carried out in France<sup>43</sup>, aimed at showing that healthy diets cost more. From a study carried out by Professor Drewnowski and his team<sup>44</sup>, 100 additional grams of fruit and vegetables are associated with a daily increase of costs for food, which can vary from \$0.23 to \$0.38. Again, it has been shown that diets with a high energy density (calculated in kilocalories per gram of food) are poor in nutrients and cost less (in terms of dollars per kilocalorie). On the other hand, diets with a lower energy density and a greater quantity of micronutrients are associated with higher costs. If a man who follows a diet with a high energy density, consuming on average 18,798 kcal a week (about 2700 kcal a day), decides to reduce the number of calories to about 16,730 per week, he has to sustain an additional financial cost (measured in dollars per 2000 kcal) of about 25%. Therefore, if 2390 kcal are consumed per day, the additional price to

<sup>38</sup> Jones, Conklin, et al., 2014

<sup>39</sup> Ball et al., 2015.

<sup>40</sup> Darmon et al., 2015.

<sup>41</sup> WWF, 2001

<sup>42</sup> <http://www.nhs.uk/Livewell/eat4cheap/Pages/save-money-and-eat-a-healthy-diet.aspx>.

<sup>43</sup> Schröder, Marrugat et al., 2006

<sup>44</sup> Drewnowski, Darmon et al., 2004





pay against the lesser energy density option will be equivalent to \$764 a year<sup>45</sup>.

Other studies have shown a less drastic situation. A study conducted in 2013<sup>46</sup> on food prices in France that year showed that it was possible to maintain a healthy, tasty, and varied diet with just €3.5 per person per day. However, the conditions imposed that the individual not eat out, not waste food, and drink only tap water. According to the study conducted by the WWF as part of the European Project “LiveWell For LIFE” (LiveWell for low-impact food in Europe)<sup>47</sup>, implementing a sustainable diet would not only reduce greenhouse gas emissions compared with current levels, but would mean savings for families as well.

### Other EU countries

Contrary to results in the UK, Sweden does not perceive a clear gap between the prices of healthy and less healthy foods, a situation which has remained essentially constant over the years<sup>48</sup>. A Dutch study has shown that it is possible to follow a nutritious, culturally acceptable diet (i.e. based on the typical food of the local cultural tradition), which is varied, cheaper, and with less impact in terms of its carbon footprint<sup>49</sup>.

One can also eat well while spending little in Spain: the Livewell for LIFE results show that it is possible to adopt a sustainable diet without varying the cost of the weekly shopping<sup>50</sup> (for more details, see the separate box on the project).

### Sustainable diets can also be less expensive in Europe.

Ultimately, despite some contrasting data, the case studies analyzed show that it is possible to eat healthily regardless of the level of income; the “healthiest” and most sustainable diets do not necessarily have the highest costs. However, it is necessary to modify one’s dietary habits, carefully choosing the most nourishing, cheapest and environmentally-friendly food: a step in which education plays a key role.

<sup>45</sup> Drewnowski, Monsivais et al., 2007

<sup>46</sup> Maillot et al., 2013.

<sup>47</sup> WWF, 2012b.

<sup>48</sup> Hakasson, 2015.

<sup>49</sup> Van Doreen, 2015.

<sup>50</sup> WWF, 2012b.



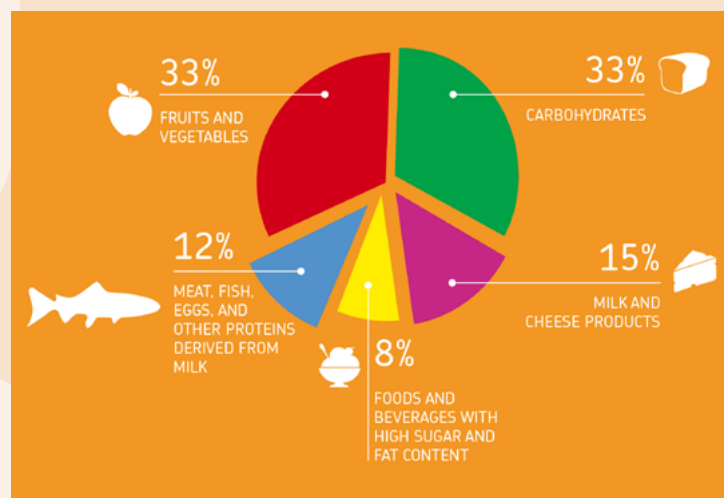
## LIVEWELL FOR LIFE: SUSTAINABLE DIETS FOR THE UNITED KINGDOM, FRANCE, SPAIN AND SWEDEN

As part of the food education campaigns, WWF-UK started a program called LiveWell 2020 in 2011. The principle on which this initiative is based is that the food we eat has a significant impact, not only on our health, but also on the health of the planet. The initiative, developed by the WWF in collaboration with the Rowett Institute of Nutrition and Health of the University of Aberdeen and taking into account the nutritional guidelines of the British government, sets out to modify the food habits of the British by directing them towards a more sustainable diet that could potentially lead to

a reduction of 255 of the greenhouse gas emissions by 2020, as well as reducing the per capita consumption of meat from 9 to 10 kilos a year. Starting from the EatWell plate, a tool to visually communicate the proportions for a correct diet developed by the Food Standard Agency of the United Kingdom, in its "plate", (LiveWell 2020), LiveWell suggests a division of the food groups which differs by a maximum of 10% from the original. This slight difference is enough to substantially reduce the greenhouse gas emissions and thus make the diets more sustainable from

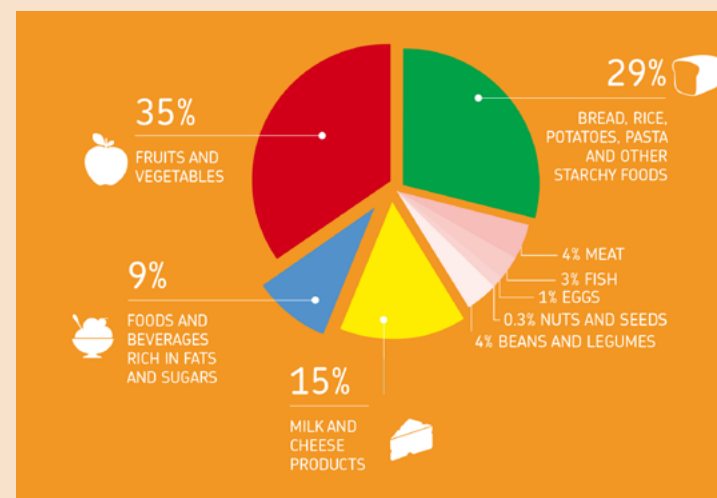
an environmental point of view, limiting the consumption of animal proteins and increasing those derived from other foods such as pulses and dried fruit. The initiative has been extended with the LiveWell for LIFE+ (Plate for low-impact food in Europe) project, funded by the European Union and launched in February 2022 by WWF UK, WWF European Policy Office and the think tank Friends of Europe<sup>51</sup>.

<sup>51</sup> WWF, 2012



EatWell

Source: BCFN elaboration on WWF, 2012



LiveWell 2020

Source: BCFN elaboration on WWF, 2012



The program, based on a proposal to introduce the concept of a healthy and sustainable diet at European level, involved three countries: France, Spain and Sweden. Here, the researchers identified local food trends and, from real consumption, created a local LiveWell plate. All the plates were calculated so that the daily cost for food was the same, or less, than the original one.

The results are encouraging:

- In France, the LiveWell diet could reduce

greenhouse gas emissions by 25% and reduce the average daily costs for food expenditure of one person, from the present €4.90 to €4.36. The French should increase their consumption of pulses and cereals and reduce that of meat and derivatives.

- The LiveWell diet for Spain could reduce greenhouse gas emissions by about 27% at a cost that is almost identical to the present one (on average, €3.48 per day per person), reducing the consumption of meat, dairy

produce, sugar, sweets and fruit-based products, and increasing vegetables, cereals and nuts;

- In Sweden, the LiveWell diet would allow a reduction of emissions by 25%, with a cost slightly lower than that of the current diet (from 44.64 krona to 44.07 krona per day): the proposed diet reduces the consumption of meat and increases that of fruit and vegetables.



**REDUCED  
GHG EMISSION**  
CO<sub>2</sub> **25%**

**DAILY FOOD EXPENDITURE**  
**REDUCED ↓**



**REDUCED  
GHG EMISSION**  
CO<sub>2</sub> **27%**

**DAILY FOOD EXPENDITURE**  
**UNCHANGED =**



**REDUCED  
GHG EMISSION**  
CO<sub>2</sub> **25%**

**DAILY FOOD EXPENDITURE**  
**REDUCED ↓**





# CONTEXTS AND INCENTIVES FOR PROMOTING SUSTAINABLE FOOD CHOICES



THE SOCIAL CONTEXT

MARKETING BY FOOD COMPANIES

CAMPAIGNS AND SOCIAL COMMUNICATION

CATERING

BOOKS AND EDITORIALS

THE ROLE OF TECHNOLOGY AND APPS

ANALYSIS OF YOUNG ITALIANS' CHOICES

CONCLUSIONS



## CONTEXTS AND INCENTIVES FOR PROMOTING SUSTAINABLE FOOD CHOICES

According to data provided by the World Health Organization in 2014, more than 1.9 billion adults aged 18 years and older were overweight. Of these, over 600 million (approximately 13% of the world's adult population) were obese, while 42 million children under the age of 5 were overweight or obese in 2013<sup>1</sup>. The United States appears to be one of the nations with the highest percentage of obese (38%) and overweight (70%) people, with more than 26% of children under the age of eleven resulting as overweight or obese<sup>2</sup>.

A survey by the Organization for Economic Cooperation and Development (OECD) found that in most European countries the number of overweight or obese people has doubled over the last two decades<sup>3</sup>.

In Italy, in particular, there is a high rate of overweight and obese children and adolescents. According to a study conducted by the Ministry of Health in 2014, overweight children represent 21% of the population and 10% are obese. In other words, one in three children weighs more than he/she should weigh for his/her age<sup>4</sup>. The unprecedented and rapid spread of this phenomenon, which is mainly due to incorrect eating habits, has led the World Health Organization (WHO) to sound the "Globesity" alarm<sup>5</sup>.

As well as being the main cause of obesity, bad eating habits are often believed to trigger many other diseases. A recent study by the University of Newcastle, carried out by the Institute for Food Research (IFR)<sup>6</sup>, shows that food affects the likelihood of developing certain tumours due to epigenetic modification: what we eat affects the functionality and activity of genes by

"activating" or "deactivating" them, thus causing a change in cell activity.

<sup>1</sup> WHO, 2016

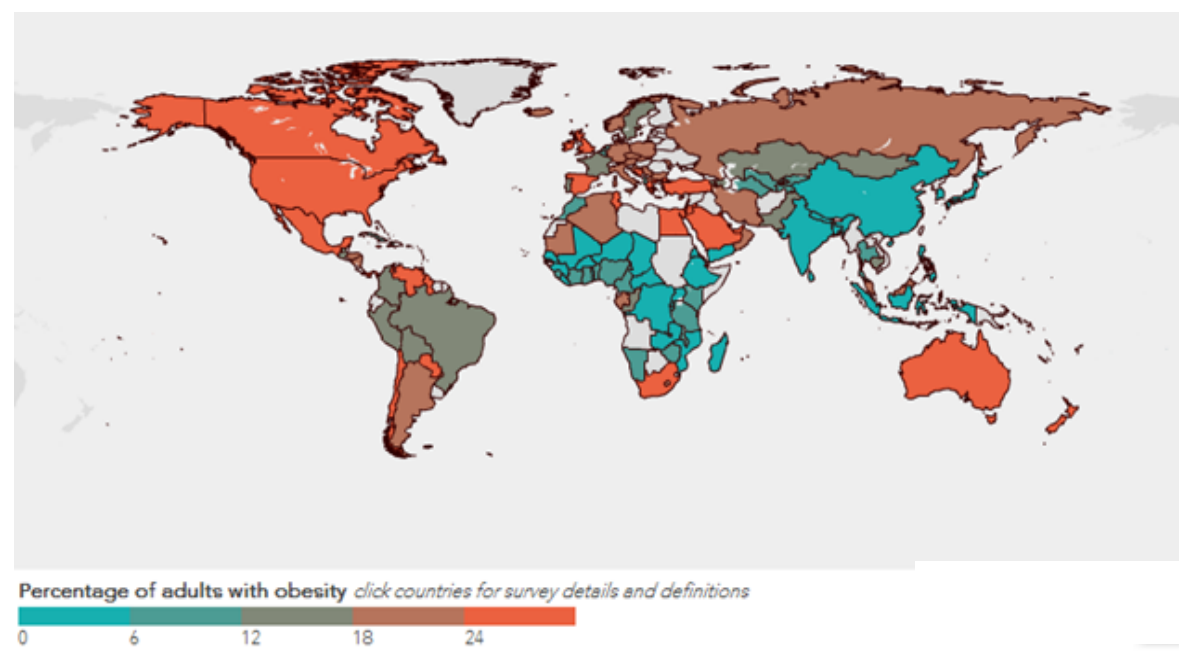
<sup>2</sup> CDC, 2015.

<sup>3</sup> OECD, 2012

<sup>4</sup> Ist. Superiore Di Sanità, 2014;<sup>4</sup> World Obesity Federation, 2012

<sup>5</sup> World Obesity Federation, 2012

<sup>6</sup> OECD, 2012



Worldwide percentages of obese adults

Source: World Obesity Federation (2012) World map of obesity. Data (2000-2013).



Through specific initiatives, world governments are advising people to follow the guidelines of the World Health Organization<sup>7</sup>, which recommends an intake of 400 grams of fruit and vegetables per day (equal to about five servings). A British study conducted in 2014 by University College of London and published in the *Journal of Epidemiology and Community Health*<sup>8</sup> goes even further, by recommending seven servings of fruit and vegetables per day. The study, carried out by Oyebo Oyinola and his colleagues between 2001 and 2008 on a sample of 65,226 adults aged at least 35, shows a positive relationship between an increase in the number of servings of fruit and vegetables consumed and the reduction of heart disease and cancer rates. Statistically, data regarding the risk of death showed a reduction of 42%, a 31% reduction in the risk of strokes and cardiovascular diseases, and a 25% reduction in the risk of cancer.

There are many good reasons for healthy eating, yet people's eating habits continue to be unbalanced, often through simple ignorance. Contrary to popular belief, junk food is not even good for your mood; in fact, researchers at Penn State University<sup>9</sup> kept 131 students under observation and asked them to keep a daily diary. It was observed that their mood worsened considerably after eating cakes and snacks.

In order to better understand the psychological causes of unhealthy eating, the researchers

Sobal and Needs<sup>10</sup> conducted a study on people's food preferences and demonstrated how frequent, multifaceted, situational, dynamic, and complex these choices actually are. The multidisciplinary study, which involved psychologists, economists, philosophers, and scientists, produced a model with a wide range of factors involved in the process of choosing food.

There are three main components that, together, influence the decision-making

process.

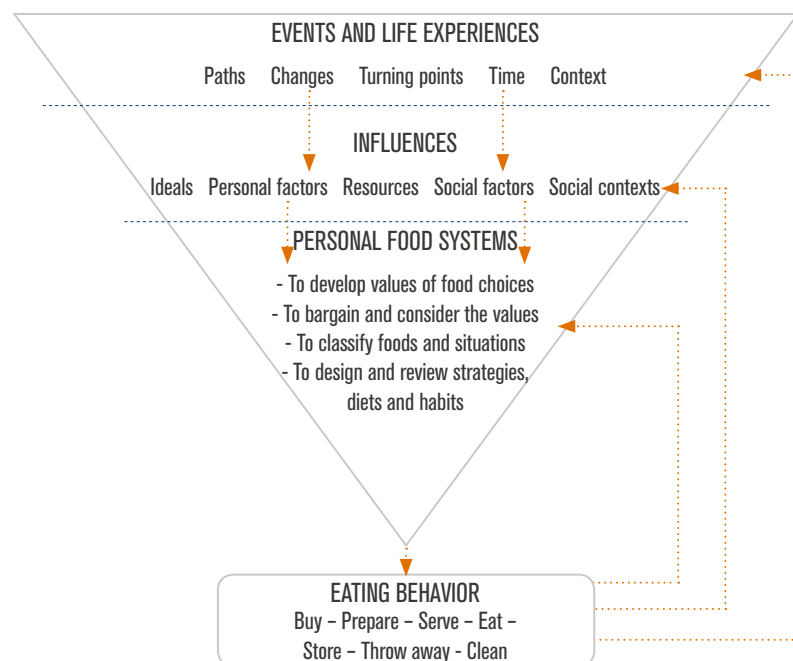
The first is represented by a person's *life* and includes events that individuals have experienced before deciding what to eat. The second aspect is linked to the wide

<sup>7</sup> WHO, 2006

<sup>8</sup> Oyebo Oye et al, 2014

<sup>9</sup> Swayne, 2013

<sup>10</sup> Sobal & Bisogni



The process of choosing food

Source: Sobal and Bisogni 2009





range of contextual factors that **influence** our decisions, such as cultural ideals, personal and social factors, economic resources, and the environment. Finally, individuals develop **food systems** and **personal** cognitive processes which influence their eating behaviour in particular ways; these include values, how to classify foods, strategies, and eating habits.



The model also features a relationship of correlation and influence between the variables; therefore, the individual's life experience affects this influence, which in turn leads to the formation of food systems and personal cognitive processes.

Choosing what to eat is consequently a complex and dynamic process that changes according to the individual's own life experiences and situation

In this chapter, we will examine the various stimuli and contexts that lead people to adopt a dietary regime consistent with a sustainable diet. Firstly, we will discuss the social context: family, friends, and the work environment all significantly influence an individual's food choices. Secondly, we will analyze the role that food companies and their initiatives play in promoting a well-balanced diet, before moving on to examine institutions and their social campaigns for promoting sustainable diets in various countries. We will describe some interesting initiatives by catering services (not only fast-food restaurants but also school and workplace canteens) and discuss interesting papers and articles. We will then conclude by illustrating the main apps on nutritional education and healthy lifestyles developed for smartphones and tablets.

## THE IMPORTANCE OF THE SUSTAINABILITY OF THE AMERICAN POPULATION'S FOOD CHOICES

From a survey carried out by Cone Communications<sup>11</sup>, it was observed that food sustainability is a priority for three-quarters of the American population. They are willing to limit their variety of food and spend money in order to achieve a well-balanced and healthy lifestyle. Besides family satisfaction (97%) and health and dietary values (93%), sustainability (77%) is one of the main factors that affect their shopping trends. Food choices are also influenced by the so-called zero kilometre products (74%), sustainable packaging (69%), the well-being of livestock (69%), the absence of GMOs (67%), and the safeguarding and renewal of natural resources (65%).

<sup>11</sup> Cone Communications, 2014



## THE SOCIAL CONTEXT

### *The family*

The family has always been the first point of reference for dietary education, thanks to parents and close relatives who explain the basic principles of healthy eating to children (e.g., to eat more fruit and vegetables and avoid eating too many sweets and fats, etc.). According to an American study by Videon and Manning,<sup>12</sup> adolescents eat more fruit, vegetables, and dairy products if their parents are present at the evening meal, and they are also less inclined to skip breakfast (one of the worst eating habits). Children can be more easily persuaded to adopt balanced diets and healthy lifestyle when their parents explicitly show pleasure in eating healthy foods and encourage their children to follow their example.<sup>13</sup>

It has been proven that in adulthood we are inclined to maintain the same food habits and preferences we adopted in childhood and adolescence. For this reason, it is essential to train children and adolescents to follow a healthy dietary regime.<sup>14</sup>

In Australia, the Sydney Medical School, in collaboration with the University of Sydney, demonstrated the influence of parents' "food culture" on their children's eating habits. The study<sup>15</sup> was carried out on a sample of 667 mothers with children aged between 0 and 2; the aim of the researchers was to determine to what extent the dietary education provided by the children's mothers influenced the development of their children's eating behavior. The percentage of obese children was 11.2% following two

years of training sessions, compared with 14.1% of obese children whose mothers had not attended the meetings.

Another study<sup>16</sup> shows that the presence of parents during meals, where they eat the same food as their children, has a positive effect on the health of young people, who are also more likely to follow a healthy diet in the future than those who usually eat alone. Moreover, the eating habits of children belonging to extended families are even healthier: according to researchers at Monash University,<sup>17</sup> grandparents can influence the eating habits of children even more than parents.

Unfortunately, several global trends indicate how the eating habits of families and the important role they play in the dietary education of children are changing. The data shows a sharp increase in the consumption of snacks and convenience foods and in the flexibility of mealtimes, as well as a general decrease in the time spent eating meals and an increase in their 'on-the-go' consumption, as observed in a study by Euromonitor International.<sup>18</sup>

One of the main factors responsible for the dangerous deterioration of meals is the evolution of new lifestyles, which have become more and more hectic as we juggle numerous tasks. We often eat while performing other activities (in front of the computer or the television, for example). People also tend to work longer hours and travel more, if only to accompany children to and from various activities (language lessons, sports, etc.). There is also an increase in "unconventional" working hours (evenings, weekends) due to more flexible jobs. Finally, there is the effect of

the increase of employed single people and women, who cannot dedicate much time to preparing meals. Although less time is today spent cooking, according to a study by Datamonitor<sup>19</sup> the global economic crisis has made people more inclined to eat at home: in fact, 39% of respondents claimed to do so more often than before, which explains the increase in demand for faster and more convenient meals. Globally, there was a 27% increase in the sale of convenience foods between 2006 and 2011, with 31% of households buying them regularly, according to the study conducted by Euromonitor International.<sup>20</sup> Considering that only 16% declared they never purchased convenience foods, it appears that more than one third of the population eats them on busy days.<sup>21</sup> The reasons given for justifying this behaviour were: lack of time for cooking (45%), convenience (31%), not knowing how to cook well (21%), and finally 5% of the respondents said they thought it was healthier to buy convenience food. Less time at the table, less time spent eating with parents, less time for cooking: these are all trends that trivialize the ritual of meals, leading to a lack of knowledge about nutrition, which is necessary for a healthy and well-balanced diet, especially among the younger generations.

<sup>12</sup> Videon & Manning, 2003

<sup>13</sup> Barthomeuf et al., 2012

<sup>14</sup> Mikkilä et al., 2004

<sup>15</sup> Wen et al., 2012

<sup>16</sup> Skafida, 2013

<sup>17</sup> Science Daily, 18 December 2013

<sup>18</sup> Euromonitor International, 2012

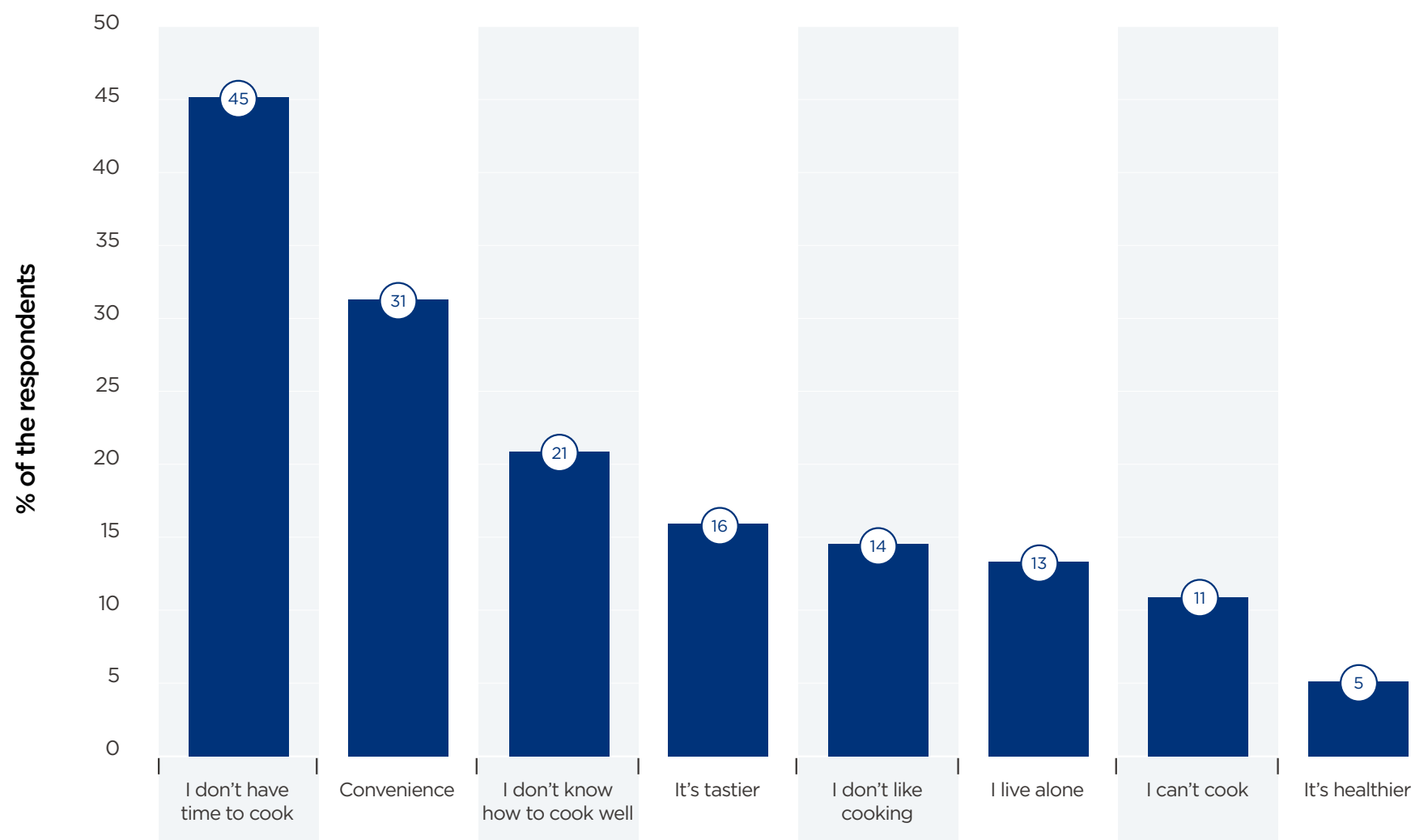
<sup>19</sup> Datamonitor, 2011

<sup>20</sup> Euromonitor International, 2012

<sup>21</sup> Euromonitor International, 2012







The reasons that make people buy convenience food

Source: Euromonitor international, 2012.



## Friends

What we eat is greatly influenced by the tablemates with whom we share our meals. In fact, when eating with our friends, we tend to lose control of the situation and let others decide about the duration of meals, the number of courses, and the size of servings. The social connotations of food were observed in a recent study carried out in England<sup>22</sup>, according to which our eating habits are influenced by what our peers eat, whether we are eating in their company or alone at home. We subconsciously

imitate the behaviour of the group to which we belong; so, for example, whenever we are surrounded by people with a sweet tooth, we are more likely to choose a dessert than a serving of fruit.

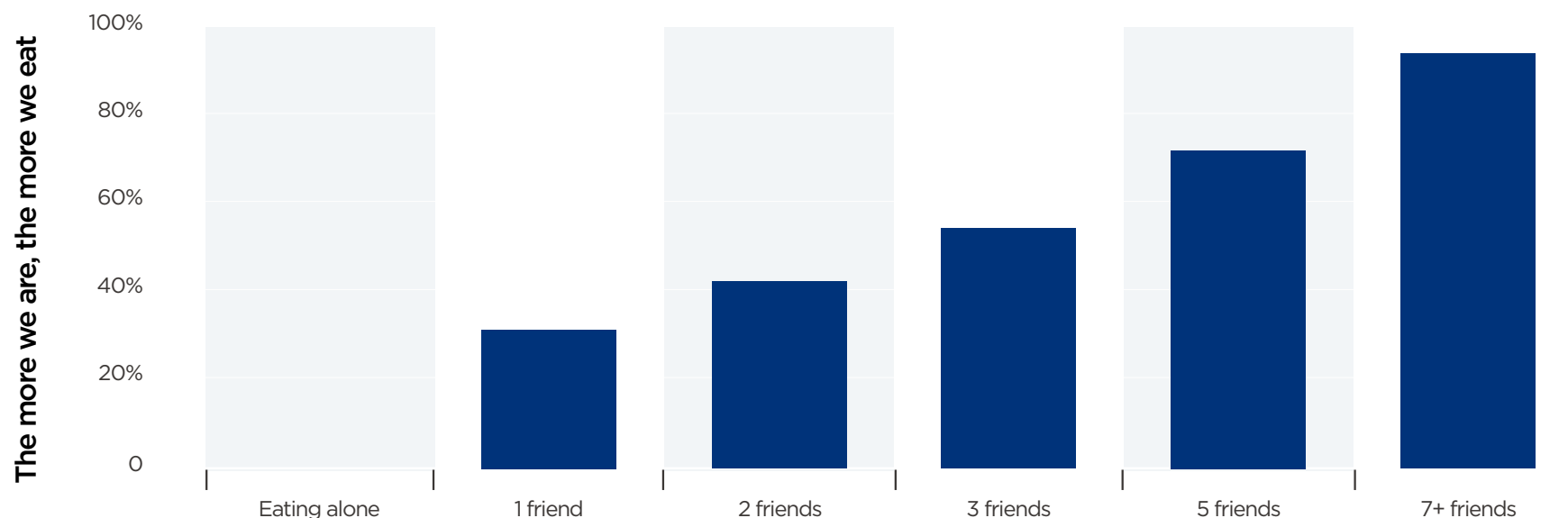
The psychologist John De Castro<sup>23</sup> demonstrated how the presence of other people at the table increases both the time we spend at the table and our food intake. We tend to eat 35% more when dining with someone else than we would alone. People who eat with a group of seven or more friends tend to eat almost double (96%).

This was confirmed by the University of Birmingham<sup>24</sup>, where it was shown that eating with friends is often responsible for weight gain and unwise dietary choices. Eating with friends, relatives, or colleagues leads us into unconsciously eating larger quantities of food and to a higher consumption of fatty foods or sweets.

<sup>22</sup> Robinson et al., 2014

<sup>23</sup> De Castro, 1994

<sup>24</sup> Robinson E. & Higgs S., 2014



Percentages of the increase in food intake when eating in company

Source: J. De Castro



### At work

Our workplace can also encourage us to pursue a healthier lifestyle. A report published by the International Labor Organization (ILO)<sup>25</sup> analyzed eating habits in different parts of the world and showed that a diet which is either too rich or too poor could reduce productivity by almost 20%. As already mentioned, one of the most frequent and serious consequences of incorrect nutrition is obesity, which increases the likelihood of taking sick leave and causes difficulty in movement at the workplace and premature fatigue. According to a report by the UK National Audit Office<sup>26</sup>, in 2001 in England, obesity alone was responsible for 18 million days of sick leave and 30,000 premature deaths. In Italy, the social cost of obesity amounts to €8.3 billion per year. Promoting healthier lifestyles should therefore be a key part of company strategies, since it can positively affect the welfare of the workers, as well as improve performance and productivity<sup>27</sup>. John and Norton<sup>28</sup> conducted a study in a large factory in order to observe the lifestyles of employees. The participants were offered the opportunity to improve their sedentary lifestyles by equipping the workstations with treadmills. The researchers programmed the information access settings so that some workers were only aware of data relating to their own personal use of the machines, while other employees were aware of the data concerning one colleague's use, and others of the data regarding four colleagues' use of the treadmill. The study showed that being aware of their

colleagues' performance had the negative effect of reducing its use. According to the experts, the comparison with other colleagues tends to decrease the total performance of the group (convergence towards the so-called lowest common denominator). Stephenie C. Lemon<sup>29</sup> conducted a study on the prevention of obesity in the workplace among hospital workers. 806 workers employed in six hospitals in Massachusetts were included in the study, which aimed at preventing them from gaining weight. The study led to a decrease in their body weight index with positive effects, according to the level of the employees' participation.

## MARKETING BY FOOD COMPANIES

What is the role of food companies in promoting healthy diets? Over the last few years, the most far-seeing companies, producers, and retailers have committed themselves to actively implementing campaigns for promoting healthy diets.

### Food products

The Global Alliance for Improved Nutrition (GAIN) has created the Access To Nutrition Index (ATNI), a worldwide initiative which classifies the leading twenty-five food and soft drink producers according to their policies and performance concerning obesity and unhealthy diets. The general ATNI ranking takes into account the companies' performance in each of

the following categories: business strategies, suitable form of the product, accessibility to the product, responsible marketing policies, the promotion of healthy diets and active lifestyles, product labeling, and participating companies' commitment. The total score is obtained by calculating the average of the scores for each category.

Here are some interesting examples.

- **Danone** has changed some of the ingredients in its drinks in order to reduce sugar levels and has implemented a number of programs aimed at nutritional education of the younger generations. In 2011, the project Bon appétit, bouge ta santé! was launched in Belgium and involved primary school pupils in an educational program focused on the importance of physical activity and a well-balanced diet.
- **Unilever** launched its strategy of sustainable business The Sustainable Living Plan in 2010 and it focuses on three important topics: improving people's health by promoting healthy products and lifestyles, safeguarding the environment, and improving the living conditions of the communities in which it operates. Furthermore, it is committed to reducing the calorie content of ice cream and the amount of added sugar in its beverages. It

<sup>25</sup> Wanjek, 2005

<sup>26</sup> National Audit Office, 2001

<sup>27</sup> Baccolo et al., 2010

<sup>28</sup> John & Norton, 2012

<sup>29</sup> Lemon et al., 2010



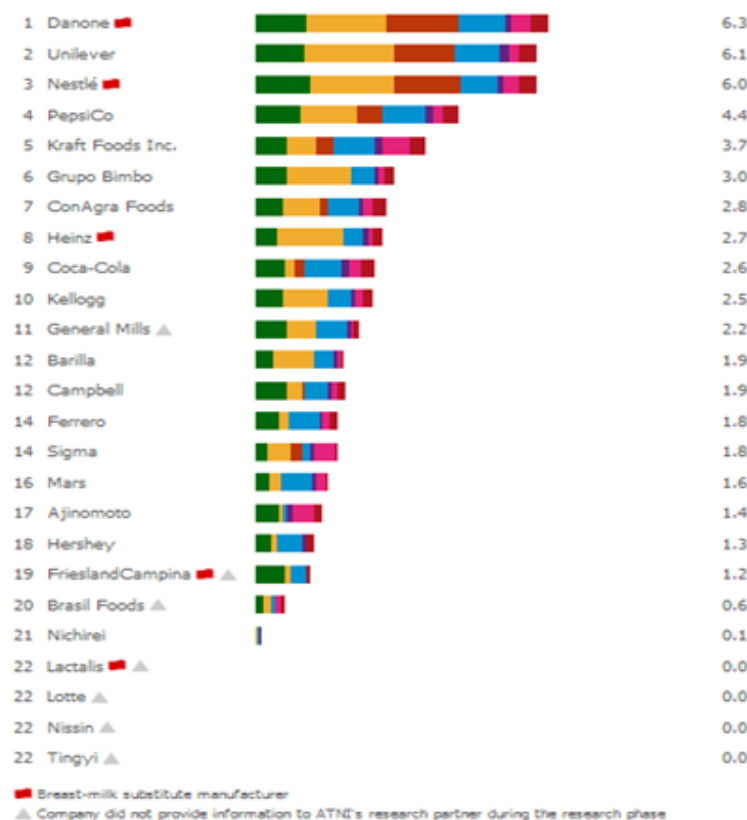
does not stage advertising campaigns directly targeted at children under the age of 12.

- **Nestlé** is committed to fighting diseases caused by overeating or bad eating habits, by providing the foundations of a correct nutritional education through scientific research programs (to improve the nutritional quality of products), and educational programs (to promote proper nutrition). These include the international Nestlé Healthy Kids Global Programme, a project aimed at children and implemented in collaboration with the EPODE International Network.
- **Kellogg's** has made nutritional education its strong point by carrying out educational campaigns on the Internet, supplying voluntary nutritional labels, and organizing initiatives in schools. Its website kelloggnutrition.com was established in 2012 for nutritionists and contains useful scientific information on nutrition and wellness. With the initiative Breakfast for Better Days (2012-2013), Kellogg's funded 98 school projects in order to ensure a complete breakfast for students.
- **General Mills** makes the safeguarding of its consumers' health one of the main objectives of its Nourishing Lives mission. Since 2005, it has reformulated the recipes of over 750 products in order to improve their nutritional profiles. It is known for its advertising campaign aimed at promoting reasonably-sized portions of food and discouraging overeating. It is committed to not implementing advertising campaigns aimed at primary school children.

- **Coca Cola** has launched Live Positively, an integrated sustainability strategy including Balanced Living, which explains how to fight obesity and promote a healthy lifestyle. In this context, it has sponsored over 290 programs with strategies that vary from country to country. It

also founded "Coming Together", a website where people can share their ideas for fighting obesity. It does not stage advertising campaigns aimed at children under 12 years old.

- **Ferrero** promotes sport activity to combat childhood obesity and physical inactivity. It also



Access to Nutrition Index overall ranking.  
 Source: Source ATNI

supports Media Smart, an educational program for children aimed at creating a critical approach to television programs and the content of commercials. Barilla has implemented a sustainable business strategy based on respect for people and the environment: Good for you, Good for the Planet. To this end, the company has adopted the Double Nutritional and Environmental Pyramid model as a reference point in its business methods. In this context, it is continually trying to improve the nutritional profile of its products. In 2011, Barilla launched the Si.Mediterraneo project, aimed at increasing its staff's nutritional knowledge and promoting a sustainable diet in its staff canteens.

COMPANY	COMMITMENT/INITIATIVE
	Beverage sugar reduction program
	Sustainable Living Plan Unilever
	Food Coaching Etichet-ti-amo (Nestlè Italia)
	Member of the Healthy Weight Commitment Foundation financing (share your breakfast) in the USA
	Program for the diffusion of more nutritional information on Big G cereal packets
	Coming together
	Kinder + Sport supports Media Smart

The main initiatives by the leading food companies  
*Source: BCFN elaboration*



## THE ROLE OF FOOD LABELS CONCERNING HEALTHIER FOOD CHOICES

Not all studies agree on the positive effect that nutritional information on food labels may have on people's food choices. A study carried out at the University of Minnesota<sup>30</sup> shows that 91% of consumers do not pay attention to the amount of calories declared on food labels.

It has been observed<sup>31</sup> that in supermarkets only one shopper in four reads the nutritional information on products, and that many consumers do not understand the meaning or know the ideal amount of calories, fat, and sodium levels to be consumed per meal.<sup>32</sup>

A considerable amount of time and effort is required to understand this kind of information; much more than most people are generally willing to spend on a decision as apparently trivial as food shopping. In this regard, it has been shown<sup>33</sup> that customers take less than one minute to decide which product to buy in supermarkets.

Many studies have found that emphasizing the healthiness of a certain food may also be counterproductive. Wansink and Chandon<sup>34</sup> underlined that the information concerning low-fat food products may lead the consumer to eat more than they should because these foods are perceived to be healthier.

Similarly, when healthy eating is recommended by authorities, people who eat "healthy" food feel hungrier and eat larger quantities than those

who eat the same food classified as being "tasty" or those who do not eat anything. These effects depend on the perception of consumers that it is compulsory to follow a healthy diet<sup>35</sup>. This means that declaring a food "healthy" reduces individual satisfaction in the post-consumer phase and makes people eat more than required and more than they would have eaten if the product had been perceived instead as "tasty".

On the same topic, Raghunathan<sup>36</sup> confirmed that eating a food perceived as "healthy" reduces one's level of pleasure and individual satisfaction, and negatively affects the post-consumption experience.

Another study<sup>37</sup> shows that the labels attached in a central position are looked at more often and for a longer time than those placed on the right or left side of the packet. In fact, the time spent observing a centrally-placed label is 30% more than the time spent observing labels affixed laterally. It was also observed that most consumers pay more attention to the labels attached higher up on the packet, compared to the information on labels placed lower down.

A study carried out in France in 2009<sup>38</sup> showed how the nutritional information on food labels ranks tenth in the classification of elements influencing the purchase of food products. One

of the few symbols used on food labels which appears to increase the awareness of healthy food and its subsequent purchase, is the so-called "traffic light"<sup>39</sup>. The traffic light is a simple symbol which indicates foods to be eaten less often in red, foods to be eaten in moderation in yellow, and foods to be eaten on a daily basis in green. However, in this case it is difficult to correctly establish which foods should be classified with a red light and which with a yellow light, as well as the criteria used for the classification.

<sup>30</sup> Borgmeier & Westenhoefer, 2009

<sup>31</sup> Borgmeier & Westenhoefer, 2009

<sup>32</sup> Burton et al., 2009

<sup>33</sup> Borgmeier & Westenhoefer, 2009

<sup>34</sup> Wansink & Chandon, 2006

<sup>35</sup> Finkelstein & Fishbach, 2010

<sup>36</sup> Rajagopal et al., 2006

<sup>37</sup> Graham & Jeffery, 2011

<sup>38</sup> Agence Française de Sécurité Sanitaire des Aliments, 2009

<sup>39</sup> Thorndike et al., 2012 ; Roberto et al., 2012





### Retailers - Stores, Mass retail

Stores play an important role as “supra-educators” concerning sustainable diets. In fact, unlike food companies, stores have no conflict of interest regarding individual products. According to a report commissioned by the National Heart Foundation of Australia<sup>40</sup>, most consumers think that supermarkets should implement initiatives to promote healthy diets and that they are (partly) responsible for the future state of consumers’ health. Recently, several retail chains have implemented Corporate Social Responsibility programs in order to improve their brand image: the managers of some Swedish supermarkets observed that when the stores promote well-balanced diets, people form better

opinions of the store, and also improve their eating habits<sup>41</sup>. A report published by the Centre for Food Policies at the City University of London examined the corporate social responsibility commitments undertaken by 25 of the leading worldwide food manufacturers and retailers, ten of which are large supermarket chains: Ahold (Netherlands), Aldi (Germany), Carrefour (France), Ito-Yokado (Japan), Kroger (United States), Metro (Germany), Rewe (Germany), Schwarz (Germany), Tesco (UK), and Walmart (United States). Most chains implement nutrition programs as part of their company strategy, and some, in particular Tesco, have measurable performance indicators and are committed to stocking a “healthy” range of products. With the aim of promoting healthier foods in the so-called

“impulse purchase” phase, the large British Tesco chain announced that by the end of 2014, snacks and chocolates would disappear from the shelves beside the cash registers and would be replaced by healthier foods.

The results of this study and others regarding consumers’ expectations from mass distribution chains convinced distributors to assume a key role in informing and educating people to follow a well-balanced diet which is sustainable for the environment<sup>42</sup>.

<sup>40</sup> National Heart Foundation of Australia, 2012

<sup>41</sup> Steenhuis et al., 2004

<sup>42</sup> Lang et al., 2006



## THE ROLE OF RETAILER IN CONSUMERS' FOOD CHOICES

A study carried out by SCS Consulting<sup>43</sup>, commissioned by the BCFN (among others), shows how the educational commitment of large-scale distributors affects customers. The aim of the study, carried out for the first time in 2009 and repeated in 2011, was to assess the knowledge, interest, and tendency of Italian consumers concerning the purchase of products, and to determine if, and to what extent, they actually purchase them. The study was conducted by evaluating (with the respondents) the products they purchased.

In 2011, the sample was made up of 1200 customers of eight different supermarket chains, each with its own approach and its own activities regarding sustainability, in order to determine how the retailer affects customer awareness and sustainable food choices.

Firstly, the results show that consumers are becoming more and more aware of sustainability issues: in 2009, 65% of consumers were "aware of sustainability", while in 2011 the percentage had risen to 78%. The figure shows that statements of interest and purchase of sustainable products before actually opening the envelope were very positive (only 6.2% were "declared skeptics", as opposed to 15.1% in 2009). The right side of the diagram

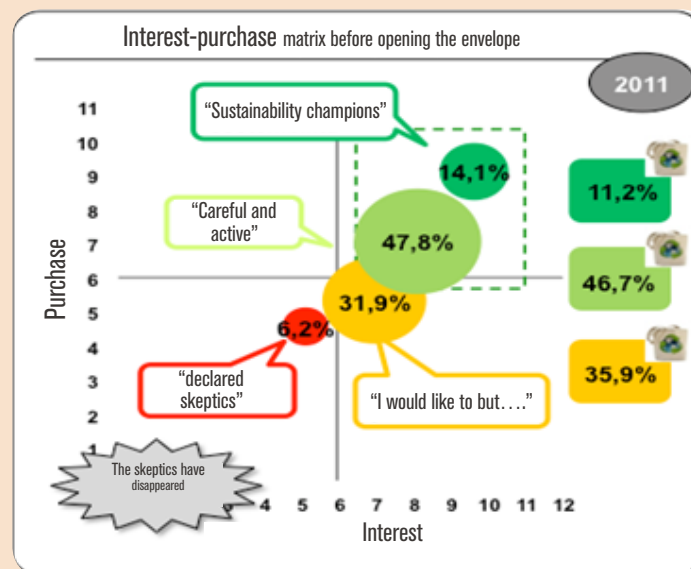
shows the purchasing results for each group of consumers: there is no overall consistency, even though the statements generally coincide with what was actually purchased. The results show that more sustainable products are sold in supermarkets when they have a specific approach to sustainability in some way: a special label and a large assortment of eco-friendly products; websites and corporate newsletters with sections dedicated to the environment; and/or "green" sales outlets (thanks to photovoltaic

systems, water and energy-saving practices, etc.). This shows that the arrangement of the store and the introduction of ad hoc lines make consumers more inclined to buy sustainable products. On the other hand, a lack of knowledge and communication represent the main obstacles to sales: 31.9% of consumers ("I'd love to but...") who do not buy sustainable products claimed that it is because they do not know which products are sustainable and 26.1% do not know where to find them.

50% of sustainable purchases are made for fresh produce (milk and dairy products, fruit and vegetables, etc.): these categories have the largest range of sustainable products (in particular, organic and zero kilometre products). This suggests that they are produced and adequately advertised, and that there is good sales potential for sustainable products belonging to other categories.

Another aim of the study was to analyze how consumers perceive, and to what extent they are aware of, the environmental impact of food in relation to the Double Pyramid.

90.3% of consumers are aware of the fact that their food choices affect the environment, but they do not know the actual impact of each type



Interest-purchase matrix  
Source: SCS Consulting, 2012

<sup>43</sup> SCS Consulting, 2011

of food or perceive the small differences in the impact of various foods.

It is interesting to note that the ability to reconstruct the BCFN Double Pyramid is directly proportional to the level of education, proving that a person's level of education is positively correlated with a higher level of awareness and concern for the environment.

Another aspect that is positively connected to the educational level is that people who are aware of

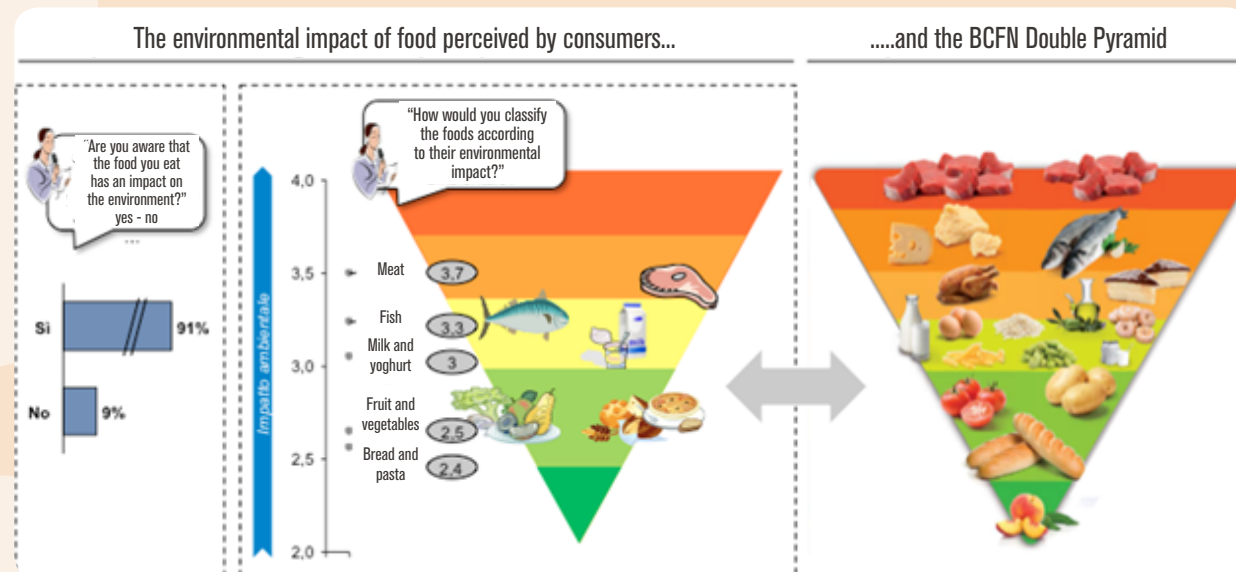
the concept of sustainability in the food industry do not focus their purchasing on foods positioned at the lower levels of the BCFN Pyramid: in other words, differences in purchase and consumption behaviour do not appear to be related to the consumer's degree of familiarity with the Double Pyramid.

This may be partly explained by the fact that you can buy eco-friendly products without necessarily taking into account the nutritional information

provided.

It appears that people are quite willing to follow the suggestions of shopkeepers regarding sustainability, a good sign for the companies concerned. By analyzing initiatives carried out in the various countries, an interesting case was observed in the United States in February 2012, when Walmart announced its intention of donating \$9.5 million to a number of non-profit organizations, to be used for promoting

healthy eating habits through nutritional education programs, cooking classes, and by teaching consumers how to shop healthily without exceeding their food budget. The associations involved in this project are: Action for Healthy Kids, the American Medical Association Foundation, the Children's Health Fund, the League of United Latin American Citizens, the National Black Child Development Institute, the National 4-H Council, the National Latino Children's Institute, Oldways, and Share Our Strength.



The environmental impact of food perceived by consumers and the BCFN Double Pyramid

Source: BCFN elaboration

has been committed to sustainable business practices for years. In 1992, it launched several “Quality Lines”, i.e. ranges comprising foods produced in accordance with environmental and social criteria; in 1996, it began producing own-label foods without GMOs; in 1997, it launched its own line of organic products; in 2000, it developed its own corporate bylaws for suppliers, in collaboration with the International Federation for Human Rights (FIDH); and the following year, it joined the UN Global Compact and signed an international protocol with the UNI Network International trade union.





- The leading Dutch retailer **Royal Ahold** developed an awareness campaign for nutritional education: in 2011, it launched Passport to Nutrition, a program created on the web for educating





children, their parents, and teachers to follow healthy lifestyles. This includes lessons concerning the food pyramid and physical activity, how to read the information on food labels, and what to eat in order to follow a healthy diet in the right proportions.

- The UK **Marks & Spencer Company** launched an initiative in 2005 to eliminate all hydrogenated fats from its products, achieving this goal in 2006. It periodically carries out checks on all of its food products with the aim of eliminating excess saturated fats.
- In 2012 **Coop Switzerland** promoted its brand of organic products, Naturaplan, by using a bus that crossed the entire country and stopped at 59

locations. In each place, adults and children were able to go onboard and learn about organic and sustainable consumption by playing various types of games.

- Since 2011, the Norwegian group **NorgesGruppen** has had a nutritionist in order to attract more attention to healthy eating and has implemented a company strategy. The consumption of fruit and vegetables is promoted in every supermarket by acting on prices, as well as on assortment. Numerous branches are selling freshly-caught fish, already cleaned and packaged, with the aim of increasing the consumption of fresh fish rather than frozen fish. The company also promotes lower levels of salt among its products and it has already reduced the amount of salt contained in

RETAILER	COMMITMENT/INITIATIVE
	Use of measurable performance indicators; committed to selling a healthy range of products
	An investment of \$9.5 million/billion to no-profit organizations for promoting healthy eating habits
	Production of organic products and those without OGM
	Passport to Nutrition

RETAILER	COMMITMENT/INITIATIVE
	Elimination of hydrogenated fats and checks on food products to reduce excess fats
	Nutritional education program by means of a bus
	Promotion of fruit and vegetables by acting on price and assortment – promotion of fresh fish e reduction of salt content in food
	Nutrition and Health

The most interesting initiatives implemented by large-scale retailers

Source: BCFN elaboration





its own-label products. The group has set itself the goal of eliminating palm oil from its own-label products.

- In 2012, **Auchan Italy** continued the Nutrition and Health project which was developed to promote healthy and correct eating habits. Products requiring action plans were identified, with the aim of eliminating “critical” ingredients and creating new recipes with lower levels of salt.
- **Coop Italy** has distinguished itself by paying particular attention to the childhood obesity alarm. In 2009, it started developing a nutritional education project for children, under the supervision and with the help of a scientific committee made up of members of the European Childhood Obesity Group (ECOG) and the Italian Society of Obesity (SIO); this resulted in the creation of the Club 4-10 campaign and the drafting of “Guidelines for the correct nutrition of children”. This initiative led to the creation of an ad hoc line of products (Club 4-10 Coop) with balanced nutritional levels, and various interventions were carried out on approximately 1500 Coop brand products by attaching “critical” stickers to the labels on potato crisp packets and carbonated drinks to indicate that they should be consumed in moderation.



## CAMPAIGNS AND SOCIAL COMMUNICATION

The purpose of social communication initiatives, such as those carried out in Italy by the non-profit organization **Pubblicità Progresso**, is to solve the moral, civic and educational issues involving the entire community, by implementing campaigns (advertising or other) aimed at positively modifying people's behaviour.

Due to its nature, social communication has a low success rate for various reasons:

- Low level of investment (compared to typical commercial communication);
- Extreme difficulty in identifying the right message capable of changing collective behaviour; these messages should generally be more natural and pleasant.

Regarding this last point, it is important to note that, unlike the promotion of food and other types of products which are designed to appeal to an individual's taste, in the case of social communication the desired result is to discourage the consumption of certain products, in favour of others which are often less attractive.

This makes the process of designing the message much less intuitive, requiring an in-depth study of the reasons for (incorrect) consumption, in order to tackle the problem.

Moreover, social communication does not necessarily (or exclusively) imply advertising, although in reality any media-based strategy – which has a strong effect on consumers' opinions and can help determine

major changes in the population's consumption and purchasing trends - falls within this field. The main initiatives of social campaigns in favour of healthy diets promoted in Italy and abroad are listed below.

### Italy

*Salute al piacere* is a nutritional education campaign launched in 2012 and promoted by the Italian Association of Dietetics and Clinical Nutrition, the Medical Association of Diabetes doctors, and Slow Food Italy. The aim of the program is to study issues related to diabetes and obesity through a series of meetings. It provides useful tips for living with these diseases, and for preventing them as far as possible, and promotes healthy lifestyles alongside enjoyable, healthy diets that are also environmentally friendly. At the end of the meetings, the participants are given a copy of the guidebook *Benessere con gusto per noi e per il pianeta* (Tasty well-being for us and sustainability for the planet) so that they can rediscover the role of food as a source of both pleasure and health. The guide provides useful tips without demonizing food types and underlines the importance of following a comprehensive and varied diet. *Salute al piacere* recommends taking the time to shop for food and prepare meals with care, as well as providing information on the nutritional values and functions of foods, and offering advice for choosing tasty and healthy foods.

Since 2011, Slow Food has published six guides on: "meat", "fish and aquaculture", "legumes", "food and health", "food choices and climate

change", and "sustainable spending". The guides (which are available for free download from the association's website) are a simple and effective way to educate people and promote the purchase of high-quality seasonal foods which are healthy and environmentally friendly.

As we have seen, children and young people are easily influenced by advertisements for unhealthy foods and they should be educated in correct nutrition from an early age, especially now that families have less time to pass on this message. The Mangia Bene, Cresci Meglio (Eat Well, Grow Better) food awareness campaign, carried out from 2007 to 2011 by the Ministry of Agriculture and Forestry, was specifically addressed to teenagers. It consisted of a competition for junior high school pupils and teachers who, working in teams, were asked to create an advertisement on the importance of healthy eating and the variety and quality of Italy's food heritage. The authors of the best advertisement won a vacation at an Italian resort that is famous for its agricultural heritage. The aim of this social campaign was to help students reflect on their own nutritional choices and make them more aware of food, whilst helping them to understand and critically evaluate the complex language of advertising.

### France

France is renowned for its healthy eating habits and with the Programme National Nutrition Santé (PNNS), launched in 2001 and continued until 2006, it set out to improve the health of the population by





acting on a principle element, nutrition. Since then, it has launched PNNS 2011-2015 Manger Bouger, which has four main objectives:

1. to reduce the population's overweight and obesity issues;
2. to increase physical activity and reduce sedentary lifestyles at all ages;
3. to improve eating habits and nutritional intake;
4. to reduce the occurrence of food-related diseases.

Information, communication, and education are useful tools for promoting better eating habits and can be used strategically to achieve this goal. Certain measures, such as the restriction of advertisements targeting children regarding the consumption of fatty, sweet, or very salty foods, can also be adopted. The national food program *Bien manger c'est l'affaire de tous!* (Healthy eating is everyone's business!), implemented by the Ministry of Agriculture, Food and Forestry, is aimed at achieving various objectives:

1. to make diverse, high-quality and sustainable food more easily available;
2. to make informative food labels specifying the country of origin compulsory for all food products;
3. to preserve and promote French culinary heritage;
4. to improve people's knowledge about food.

The communication channels have been designed to better convey positive values by avoiding conflicting and anxiety-inducing messages, and by trying to meet consumers' expectations.

#### Great Britain

*Change4Life* is the first national social campaign

## THE EPODE PROJECT

In 2003, the Ensemble Prévenons l' Obésité Des Enfants (EPODE) project was launched in eight French cities, with the collaboration of the Ministries of Family, Youth, Education, Agriculture and Food, and called for the implementation of various initiatives to fight and prevent childhood obesity. In particular, the EPODE project aimed to:

1. Integrate school curricula with nutritional education programs;
2. Promote an active and dynamic lifestyle;
3. Modify the food served in school canteens in order to accustom children to following a healthy, well-balanced, and varied diet;
4. Involve parents in the healthy growth of their children.

The project consisted of implementing two programs, one at the national level and one at the local level. Three different bodies established the guidelines (a group of independent expert nutritionists, the relevant ministries, and a few multinational food companies), while the implementation and coordination of the policies at the local level were assigned to a project manager assisted by the local authorities and the main stakeholders.

The peculiarity/uniqueness of the project was the involvement of all the local stakeholders (schools, media, associations, shops, supermarkets, etc.)

with the aim of creating a long-term strategy capable of modifying the local environment in order to promote healthy lifestyles and eating habits for families and children.

Among the various initiatives, considerable importance was given to using advertising channels for making parents and children aware of the importance of a healthy diet through social communication messages that draw attention to the importance of eating fruit and vegetables, following a varied diet, and practicing sports.. This initiative was a great success, considering the large number of local stakeholders who took part in the eight pilot cities in France: between 2003 and 2008, there was an encouraging reduction in the average BMI (body mass index) of children.

Between 2008 and 2011, DG Health, in collaboration with the Consumers of the European Community, launched the EPODE European Network (EEN) with the aim of including other countries in the EPODE project or implementing similar programs. Today, the EEN project involves about 4 million people in 226 cities in France, 38 cities in Spain, 16 cities in Belgium, and 13 cities in Greece.



aimed at reducing obesity; it has been active since 2009 and is run by the UK Department of Health. The program consists of marketing via television commercials designed by the world's top agencies, newspaper and web advertisements, and an up-to-date and visually appealing website.

*Change4Life's* slogan is "eat well, move more, live longer" and it aims to give helpful advice to children and adults on how and where to do sport and eat better. The site offers suggestions for healthy recipes and tips for a better understanding of food labels and of the nutritional and caloric values of food.

#### Canada

In Canada, the Union des consommateurs, following a research study<sup>44</sup>, made an appeal to WHO urging all Member States to implement nutritional policies that limit access to foods high in salt, sugar, or fat, and to take appropriate measures against advertising that negatively influences children's eating habits. In March 2011, the Canadian Ministry of Health launched the Our Health, Our Future – A National Dialogue on Healthy Weights program, an essential step for identifying ways of curbing childhood obesity and promoting healthy weights. An important element of this initiative is the active participation of Canada's local governments, which have the task of mobilizing young people, adults, schools, and all sectors of civil society to take part in debates and educational activities on physical activity and healthy eating.

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<sup>44</sup> Union Des Consommateurs, 2006



### *The United States*

In the United States, Michelle Obama is actively engaged in the fight against childhood obesity. In 2010, she promoted the Let's Move! program, a nationwide initiative aimed at improving children's eating habits while encouraging them to exercise more.

The main goals of the program are:

- to provide access to healthy food for everyone;
- to encourage physical activity;
- to provide healthier food at school.

The purpose of the campaign promoted by Michelle Obama is to provide useful information to parents regarding healthy lifestyles, promote environments that support healthier food choices, and encourage children to do more physical activity. The goal is to counteract the dramatic forecast that, for the first time in history, today's children may have lower life expectancies than their parents due to unhealthy lifestyles. The program offers a number of recommendations and suggests the best ways of encouraging children to play "actively" every day for at least an hour, as recommended by the U.S. Centers for Disease Control and Prevention (CDC). In order to increase and encourage physical activity, the First Lady supports the construction of playgrounds and pedestrian and bicycle paths between homes and schools.

Moreover, the initiative gives advice on how to prepare healthy recipes and the best food to put on the table. The most important recommendations of

Let's Move! are:

- to eat fruit and vegetables at every meal;
- to drink water or skimmed milk instead of sugary drinks;
- to eat meals with the family.

Among other things, the program suggests that every member of the family should undergo a periodic monitoring of their body mass index (BMI) and that community gardens should be created at schools or in parishes in order to teach children to eat produce they grow themselves. In addition to Let's Move!, there is another important initiative called The President's Challenge, which urges children and adults to actively engage in regular physical activity, such as going to school by bike or climbing stairs instead of using elevators, five days a week for six weeks. The participants who are able to complete the challenge and pass a "fitness test" can earn the President's Active Lifestyle Award (PALA). Moreover, in order to obtain a concrete and comprehensive result, in addition to the government's efforts, local communities should also be involved in the First Lady's project. By activating Let's Move! Cities and Towns, Michelle Obama has drawn attention to the fight against childhood obesity and encouraged them to promote healthier lifestyles. Inaugurating the fourth consecutive year of Let's Move!, in 2014 the First Lady produced the video "Show Me How You Move", in which she personally does a number of physical exercises, from pushups to skipping, and encourages Americans to do the same, to move and have fun and to publish videos of their performances on the web.

## THE RESULTS OF THE LET'S MOVE! CAMPAIGN

Thanks to the numerous campaigns and initiatives implemented in recent years and the First Lady's frontline involvement, a comparative analysis carried out in recent years has shown that the number of overweight children aged between 2 and 5 has dropped by 43% and that there was a decrease in the obesity rate from 14% in 2003-2004 to just over 8% in 2011-2012. This result was achieved thanks to a lower overall consumption of sugary drinks, a general increase in breastfeeding, and the effect of various initiatives (governmental and otherwise) which promote the purchase of healthier foods such as fruit and vegetables. However, the initiative also succeeded in drawing criticism. In particular, the replacement of "ordinary" school meals with more balanced and healthy menus has led to a decline in the number of children eating in school canteens. The main reason for the criticism seems to be the low appeal of the proposed menus which are designed to be low in calories and fat.



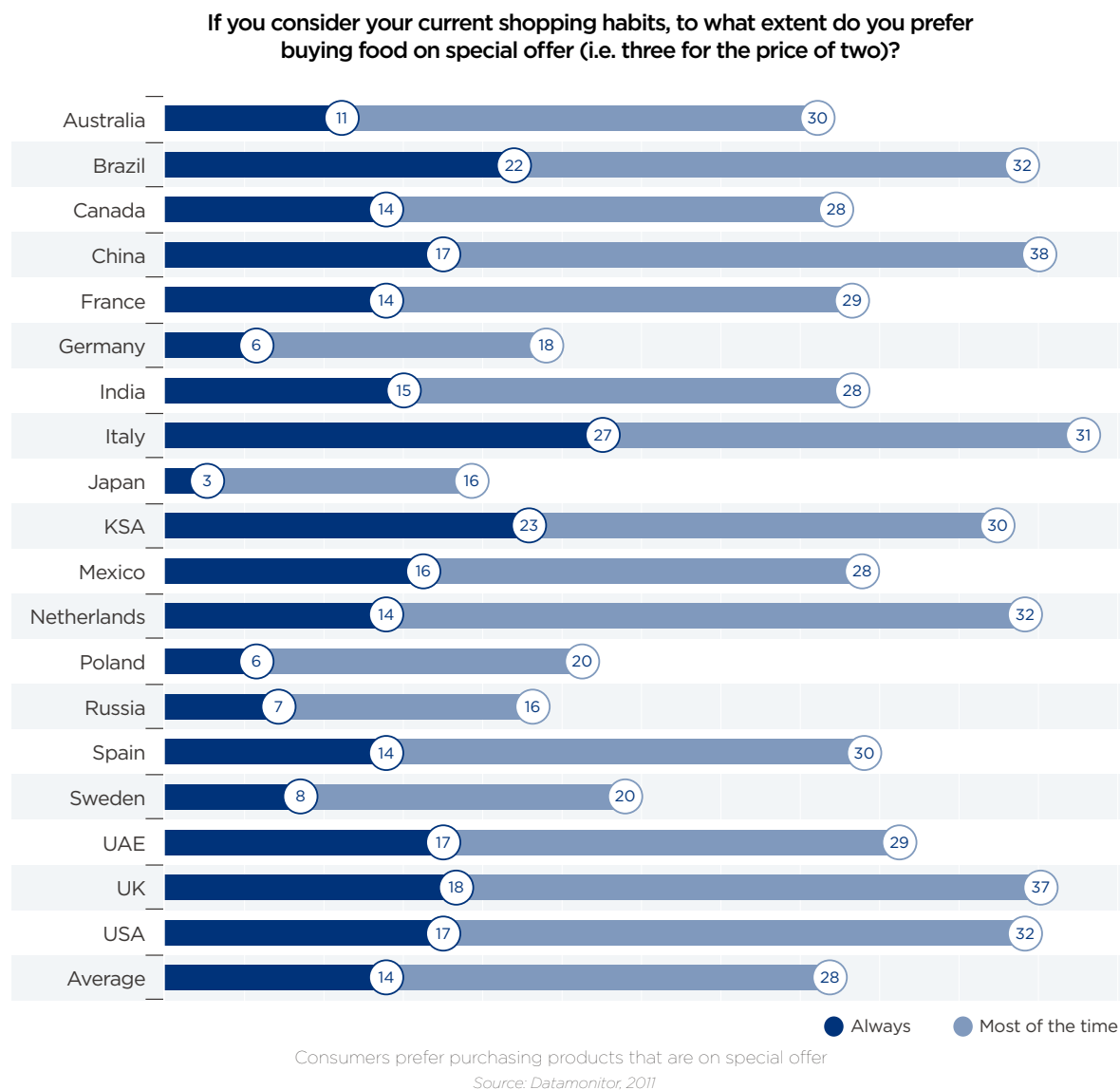
## CATERING

Another context that allows acquiring nutritional skills and habits is the “out-of-home” context. In relation to catering services (restaurants, fast food chains), data shows that consumers have recently been more careful about their choice of menu, preferring less expensive dishes and reducing their consumption of appetizers and desserts (probably to save money).

A study carried out by Datamonitor<sup>45</sup> shows an increase in demand for products on special offer in restaurants, thus popularizing fast food restaurants which often promote meals at discounted prices.

The fact that people want to spend less at restaurants and opt for meals on special offer could lead them to eat less healthy food and/or consume more than they actually need. It is also clear that, especially in the case of adolescents, the marketing of some typical fast food encourages unhealthy eating habits that can no longer be corrected if maintained over time.

<sup>45</sup> Datamonitor, 2011



A study carried out in 2006 by Brian Wansink<sup>46</sup> shows how lighting and menus should not be underestimated as factors that influence the choice of food in restaurants. The arrangement of furniture and lighting are always relative to the type of restaurant and the foods it offers. In snack bars and fast-food restaurants, there are bright lights, bright colours, and strong contrasts: the objective is for customers to enter, eat quickly, and then leave to make room for others. The crowd that gathers is a mark of social approval, which attracts other customers. The possibility of taking advantage of large amounts of food at low prices makes customers inclined to eat more in less time. In restaurants where the food is served on porcelain plates laid on white tablecloths with dim lights and soft music

in the background, the relaxed atmosphere leads customers to take more time to slowly savor their food. This induces us to order more food and drink than planned, but certainly with greater satisfaction. As for the menu, dishes can be named more attractively in order to increase the customer’s curiosity and his/her expectations of eating something tasty.

As already mentioned, school canteens and catering businesses play an important educational role, since they can influence people’s eating habits and promote healthy and environmentally-friendly meals by transmitting educational messages (of varying degrees of force) .

As people become more and more inclined to eat

outside the home, canteens that serve millions of meals a day have an enormous potential to guide consumers and the market towards healthy behaviour and products. They can become a true educational model, as demonstrated by various examples around the world. The FAO, when listing the three cornerstones of developing countries (nutrition, health, and education), admits that well-organized nutritional education activities provided by schools can persuade everyone to follow a well-balanced diet, in Italy and abroad<sup>47</sup>.

<sup>46</sup> Wansink, 2006  
<sup>47</sup> FAO, 2007

MENU A	MENU B
Rice with red beans	Rice with Cajun red beans
Fish fillets	Succulent Italian fish fillets
Chicken on the spit	Tender chicken on the spit
Chicken with Parmesan cheese	Homemade chicken with parmesan cheese
Chocolate pudding	Satin chocolate pudding
Squash biscuits	Grandma’s squash biscuits

Which menu presents the best food? The description of identical menus, yet the dishes are more tempting in menu B  
Source: Wansink, 2006





## Europe

In Europe, there are several initiatives which combat childhood obesity. Two programs have recently been launched, the School Fruit Scheme, aimed at stimulating the consumption of fruit and vegetables among youngsters, and the School Milk Scheme, aimed at promoting milk and dairy products as sources of important nutritional components. Many Italian schools are taking part in the School Fruit program, and schools in Italy and 40 other countries are members of the European Network of Health Promoting Schools.

## Italy

In Italy, there are various programs created by Slow Food which promote healthy and high-quality food produced by companies that respect the environment, safeguard biodiversity, and ensure a fair profit for producers. Slow Food's concept is that effective nutritional education revolves around the idea of food as representative of pleasure, culture, and conviviality, and that the act of eating can influence people's attitudes and emotions. Slow Food a mensa (Slow Food in the canteen) is a program designed to achieve these values by working in direct contact with catering businesses, service operators, and consumers. One of the goals of this program is to raise the general public's awareness of proposals made by the Common Agricultural Policy (CAP) for fighting childhood obesity, and the two European programs mentioned above (the School Fruit

Scheme and the School Milk Scheme) are explained and promoted. For this purpose, Slow Food provides European schools, parents, and local institutions with the tools to take advantage of the opportunities offered by the CAP, and suggests integrating them with the holistic approach to food proposed in Slow Food's educational projects. Another initiative organized by Slow Food Italy, in collaboration with the CTO Maria Adelaide of Turin, is the Gusti Giusti project: launched in 2008, this pilot project provided a nutritional education program to the Intesa Sanpaolo bank employees who eat in the company canteens in its Milan Lorenteggio and Turin Moncalieri branches, with the aim of promoting a healthy diet starting with the meals served in the canteens. The project has two objectives: first, to spread the culture of correct nutrition among its employees in order to promote good health and preserve taste, notions which the employees can also pass on to their families; and second, to integrate elements of sustainability in the management of canteen supplies in the medium term, with the aim of reducing transportation costs and the relative CO<sub>2</sub> emissions and promoting the so-called "short distribution channel". Thanks to the very positive results, in mid-2012 the project was extended to all the canteens of the Intesa Sanpaolo Group. Finally, "International Health" (a blog run by doctors and experts) proposed introducing a meatless day in public canteens, an initiative already experimented in Belgium, during which meat and fish dishes are replaced by vegetarian dishes made with vegetables and legumes.

## France

Another interesting initiative implemented in France is Bien manger à la cantine, financed by the Ministry of Agriculture, Food and Forestry, which aims at improving the quality of meals served in school canteens. It also encourages canteens to develop seasonal menus and to try to renew the bond between the eater and the food, in order to encourage everyone to take the time to sit down at the table at mealtimes. The on-line newspaper "Cantine scolaire" is published in France and contains information on well-balanced diets in school canteens. Moreover, it is interesting to note Mary Brighton's blog "Brighton Your Health", which offers advice on how to live well and eat healthy, well-balanced meals. In her blog Mary Brighton relates her experiment in which she compared an American student's diet to a French student's diet by describing the meals eaten by both students over the course of a month. The conclusion of this experiment was that people know more about nutrition in France than in America.

## United States

In 2007, by order of Mayor Bloomberg, New York was the first American city to introduce strict rules regarding the food served in restaurants, which cannot exceed 0.5 grams of trans fat per serving<sup>48</sup>.

<sup>48</sup> BCFN, 2012





Furthermore, it was made compulsory for certain categories of fast food restaurants to indicate the amount of calories contained in a product on the menu, which prompted all the leading fast food chains to adapt their recipes in order to meet the new regulations. A few years later, researchers from the New York City Department of Health verified how the dishes offered to New Yorkers had changed, considering that they, like all Americans, receive more than a third of their daily calorie intake from food purchased and prepared outside the home. As reported in the "Annals of Internal Medicine"<sup>49</sup>, the analysis of more than 15,000 meals, carried out in 2007 and then in 2009 (i.e., immediately before and two years after the new limits came into effect), showed significant differences in the composition of the dishes. Trans fatty acids decreased by an average of 2.4 grams per serving, achieving an

average reduction of 3.8 grams in some hamburger, Mexican food, and fried chicken chains. According to the study, since it was made compulsory to indicate the amount of calories on menus, 15% of customers in New York have been ordering healthier foods, consuming an average of 100 calories less than before Regulation 18 came into effect. Regarding school canteens, the Choose My Plate for Kids: Make Half Your Plate Fruit and Vegetables project is still under way. It was proposed by the Center for Nutrition Policy and Promotion, a USDA organization established in 1994 with the aim of improving the diet and health of Americans. The poster features an iconic image of the project, showing how the tray or plate of a student or individual should be half full of fruit and vegetables, both at home and at school. This initiative is part of the larger My Plate project, which, as already mentioned, provides good nutritional

education by using the familiar image of a plate to represent a meal. The American Center for Disease Control and Prevention drafted four informative documents for four different target audiences: parents, teachers and school staff; school councils, school districts and other school administrators; staff responsible for nutritional education in schools; and students. For this purpose, it used data collected by the Institute of Medicine (IOM), a non-profit organization which provides decision-makers and the public with specific information and data concerning medicine and nutrition. These explanatory booklets are used to support and develop high nutritional standards which may have a positive impact on schools and on students' health.

<sup>49</sup>BCFN, 2012

## THE FLEXITARIAN DIET

Drastically reducing meat consumption in favour of fruit, vegetables, and proteins of plant origin is the key point of the Flexitarian or semi-vegetarian diet. It was developed by the American nutritionist Dawn Jackson Blatner<sup>50</sup> and is similar to the vegetarian diet but does not totally exclude animal proteins, reducing them instead to a minimum.

The British NGO Friends of the Earth promotes the Flexitarian diet with its Eat Smart Action Pack 2014<sup>51</sup>. The guide contains information on diets,

recipes, advice, techniques for reducing food waste, and ways of making the entire community more environmentally friendly. In addition to reducing greenhouse gas emissions, eating less meat could prevent the death of 45,000 people per year in the United Kingdom alone.

On the same topic, another international campaign that promotes the health of the planet and its inhabitants is Meatless Monday, which was launched in America in 2003. It involves eliminating

meat from the diet one day per week, with the aim of reducing meat consumption by 15%. This has now become a global initiative and involves 28 countries, providing information and advice to anyone who is interested in starting off the week in a healthy and eco-friendly way.

<sup>50</sup>Blatner, 2010

<sup>51</sup>Athanasias, 2014



## WHERE AND HOW TO PROMOTE SUSTAINABLE FOOD CHOICES



THE INCREASE IN OBESITY IS A CAUSE OF CONCERN FOR MANY GOVERNMENTS. IN FACT, MALNUTRITION IS ONE OF THE MAIN THREATS TO PEOPLE'S HEALTH AND THEREFORE NEGATIVELY AFFECTS ECONOMY.

BCFN, 2014

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### Cooking at home and eating with the family

A positive relationship has been found between the presence of parents during the evening meal and a higher consumption of fruit, vegetables, and dairy products by adolescents  
Videon e Manning, 2003.



### The importance of friends

Our eating patterns are influenced by what our peers eat.  
Robinson et al., 2014.



### The workplace

A diet which is either too rich or too poor can lead to a decrease in productivity of almost 20%.  
ILO, 2005.



### School

In Italy the "School Fruit Scheme" has involved 870,000 children in 5,000 schools.



### Marketing of food companies

FOOD COMPANIES - 7 producers analyzed

DISTRIBUTION - 8 retail chains analyzed

COLLECTIVE CATERING - 11 initiatives analyzed



### Institutional campaigns and social communication

Positive results of social communication campaigns: in the U.S., the number of overweight children between the age of 2 and 5 has dropped by 43% also thanks to Michelle Obama's "Let's Move" campaign.

The obesity rate has decreased from 14% (2003-2004) to just over 8% (2011-2012).



## BOOKS AND EDITORIALS

In the last few years, several academics have published books on how to promote well-balanced diets effectively. The most interesting articles can be seen below.

### *Nudging: a small “push” towards better eating habits*

*Nudging* is the term we use to express a collection of approaches and techniques aimed at incentivizing people to improve their habits. The method was developed by two American researchers, Thaler and Sunstein<sup>52</sup>, and is based on the “libertarian” or “soft” concept of paternalism. The idea is that people should be guided through the decisional process without demanding that they obey rules. This technique can also be used concerning food choices. Good examples can be found in the studies carried out by Brian Wansink<sup>53</sup> on American school canteens, which are often accused of serving fatty foods and cakes leading to childhood obesity. Some schools have abolished junk food and only serve vegetable proteins, fruit, and vegetables. Yet this is a double-edged sword which can backfire when kids skip lunch or bring snacks from home. Following the “nudging” theory, Wansink proposes a “smart canteen” in which students are persuaded to change their eating behaviour simply by a different arrangement or display of the food.

The expert demonstrated that:

1. if broccoli is in the middle of the self-service counter, there is a 10% to 15% increase in its

consumption;

2. renaming healthy food in order to make it sound more appetizing increases its consumption by 27%;
3. hiding ice cream in freezers under dark lids significantly reduces sales;
4. promoting the use of trays increases the consumption of vegetables: kids without trays eat 21% fewer vegetables;
5. reducing the size of bowls from 500 to 400 grams reduces the amount of breakfast cereals by 24%;
6. arranging fruit in baskets instead of on plates increases its consumption by almost 50%;
7. serving a plate of salad spontaneously increases its consumption by 33%;
8. placing salad near cash desks triples its sales;
9. applying the “only cash for cookies policy”, i.e. prohibiting the payment of cookies with meal tickets, led students to buy 75% more fruit and 55% less candy or cookies.

Another study<sup>54</sup> confirms the importance of offering a variety of fruits and vegetables in school canteens in order to drive consumer choices. The authors have carried out an analysis of the number of fruit and vegetable products and children’s consumption of them to see if there is a relationship between variety and consumption. It was observed that each additional item of fruit or vegetables increases by 12% the probability that each child will eat at least one serving.

### *Be careful of Mindless Eating*

Brian Wansink, in his famous book *Mindless Eating*<sup>55</sup>,

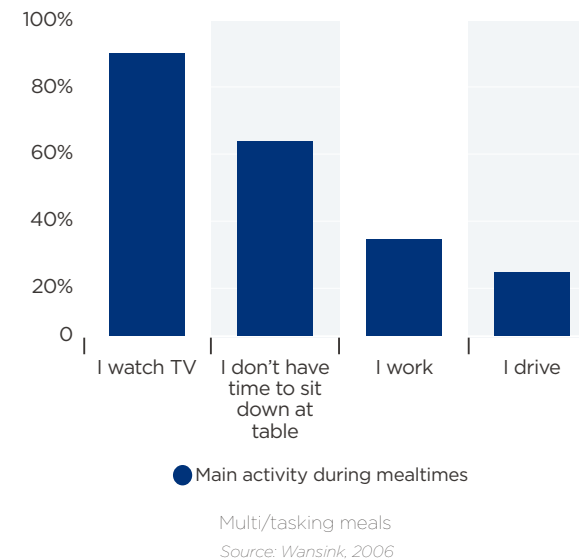
draws attention to the fact that we often eat while carrying out other activities and we are not always completely aware of the amount and quality of the food we eat. A study carried out in the United States produced some rather disturbing results: Americans do many other activities while eating, which leads them to eat more, and in a worse manner. As can be seen in the figure below, 91% of the respondents generally watch TV while eating meals, 62% are too busy to sit down at a table, 35% eat while they work, and 22% eat while driving.

<sup>52</sup> Thaler & Sunstein, 2009

<sup>53</sup> Wansink et al., 2010

<sup>54</sup> Just et al., 2012

<sup>55</sup> Wansink, 2006



In order to make people follow well-balanced diets, Wansink's book suggests interesting strategies such as:

1. cooking or serving 20% less food: when serving a dish or preparing food, in most cases it is possible to reduce the amount by 20% which makes the serving the right size;
2. eating 20% more fruit and vegetables;
3. reducing the size of plates and bowls: intake is reduced by 20% to 30%;
4. using large, tall glasses instead of small, short ones;
5. hiding so called "see-food" (i.e. sweets placed in bowls on tables): out of sight, out of mind;
6. making access to tempting foods difficult.

#### Michael Pollan's point of view

Michael Pollan, a journalist and professor at the University of Berkley, is a defender and supporter of healthy eating in the United States. The author of many bestsellers such as *In Defense of Food*<sup>56</sup>, he says that, from generation to generation, mankind is moving towards a type of consumption that is related to science rather than nature. He criticizes the way nutritionists are constantly dividing food into individual nutrients and forgetting what food actually is. His work resulted in what he calls the "American paradox": the more a person is preoccupied with nutrition and concerned about his or her health, the less healthy his or her lifestyle and state of health appear to be. Professor Pollan thus suggests that we return to our origins, which means eating "real food", preferably of plant origin, in moderation and a varied

diet featuring a little of everything.

In his last book, entitled *Food Rules*<sup>57</sup>, Pollan draws our attention to some simple dietary rules for "de-complicating" our daily decisions about our diet. When drafting the 64 rules, Pollan consulted with doctors, anthropologists, nurses, nutritionists, and dietitians, as well as mothers and grandmothers. Here are some of the main rules:

The rules a five-year-old can understand:

- "Stop eating when you are full";
- "Buy smaller plates and glasses";
- "if you aren't hungry enough to eat an apple, you aren't hungry".

The no-logo rules:

- "It's not food if it is served through a car window";
- "It's not food if it called with the same name in every language";
- "Never eat anything that pretends to be something else";
- "Eat all the junk food you like as long as you prepare it";
- "Avoid food advertised on TV".

Popular pearls of wisdom:

- "It is better to pay a grocer than a doctor";
- "Sit down at the table to eat";
- "The true pleasure of food is in the first two bites";
- "Prepare your own lunch at home and take it to work";
- "Try not to eat alone".

The rules of dieticians and environmentalists:

- "No matter how good it is, don't have seconds";
- "If the food comes from a plant, eat it";

The anti-Pollan rules:

- "Every once in a while, don't follow rules".

<sup>56</sup> Pollan, 2009

<sup>57</sup> Pollan & Kalman, 2011



PUBLISHING HOUSES		DESCRIPTION
	Thaler e Sunstein: Nudge: Improving Decisions About Health, Wealth, and Happiness	A collection of approaches and techniques aimed at giving people a little “nudge” towards better habits. People should be guided in the decisional process without imposing specific behavior.
	Wansink, Just e Mckendry: Lunch Line Redesign	The author suggests creating “smart canteens” where students are led to modify their eating habits simply by serving food in different ways.
	Wansink: Mindless eating: Why We Eat More Than We Think	Draws attention to the fact that we often eat without thinking. During most meals people carry out other activities so that they lose track of the amount or quality of the food they eat
	Pollan: In defense of Food: An Eater's Manifesto	He criticizes nutritionists and the way they divide food into single nutrients and forget the true value of food. He calls us back to our origins, to eating natural produce and well-balanced diet by eating a little of everything
	Pollan e Kalman: Food Rules: An Eater's Manual	64 rules for guiding and “de-complicating” daily food choices

Editorials on how to promote a well-balanced diet effectively.

Source: BCFN elaboration



## THE ROLE OF TECHNOLOGY AND APPS

Initiatives promoting healthy lifestyles and well-balanced diets have been developed for smartphones and other technological devices.

Still in the pilot phase but already on the launch pad is *Pegaso*: Fit for the Future, an innovative project financed by the European Union to promote a healthy diet and regular physical activity among young people. The initiative is aimed mainly at teenagers and adopts the most suitable approach for this target market: using video games and new technology. The program - managed by the Milan Polytechnic Foundation and coordinated by the Department of Design of Milan Polytechnic - uses smartphones, social networks, video games, and other technology to encourage young people (through an educational platform) to eat well and do physical exercise. At the technological level, *Pegaso* is a system based on ICT, which, by using sophisticated and interesting video games, motivates adolescents to adopt healthy lifestyles, thus fighting overweight and obesity among young people. The main features of this initiative are: the creation of a virtual community, an educational computer game, a special app for smartphones, and specific wearable devices for monitoring the youngsters' physical parameters. In addition, through these channels, the kids are asked to compete with each other in both real and virtual games, individually or in teams, with an underlying teamwork logic in which one

participant influences the other. The three-and-a-half-year program targets mainly teenagers but it is also suitable for families, schools, and doctors, and aims at spreading the culture of healthy living as widely as possible. Some of the most interesting proposals of apps for smartphones and tablets can be seen below.

*The Nutrino* application recently launched in the UK offers you a virtual nutritionist at your fingertips. By filling in an initial questionnaire, the system stores the medical and physical profile, dietary habits, and goals and preferences of the user in order to create an ad hoc food program. It helps people make healthier food choices by providing a daily diet. Users are given the option of adding the dishes to the "shopping list" section so that they can buy the scheduled meals or weekly plans from large British supermarket chains, including Tesco, with the app.

Vito Bellini has developed *iFood Pro*, an application that enables you to keep track of the amount of calories consumed and burned. Using data such as age, height, and amount of physical activity, the app calculates the user's ideal weight and constantly shows the intake of protein, fats, and carbohydrates required daily, according to the personal settings of the user. The application has a large database containing approximately 1700 foods and 150 sports for calculating exactly how many kcal are burnt per hour of physical activity.

Another interesting app has recently been developed that focuses on the consumption of fresher, local

food products: *Fresh & Local*. By entering the type of food and place or country of origin in the special section of the app called green-O-meter, it is possible to establish how far the food has travelled and a detailed table shows all the seasonal products. You can also visit an interactive, virtual farm where the fresh products are tastier and healthier, more controlled and less expensive than products grown or bred in traditional systems.

With the goal of conveying good and healthy eating habits, Massimiliano Allegretti has created *My Coach*. Using "News Of The Day" and "Video Of The Day", the user can learn the basic concepts of a healthy lifestyle. Using the Tools section, a person can calculate his or her BMI (Body Mass Index) and obtain other information such as protein factors, calorie needs, basal metabolic rate, lean body mass, and fat body mass. There is also a special section that puts a Personal Wellness Coach at the user's disposal.

*Fresh Fruit* is the app developed by Alessandro Barile, and is entirely dedicated to fruit. Month by month, it provides information about the most and least common fruits in order to raise people's awareness about which fruit is in season and the benefits the body obtains from each individual fruit. A table is shown for each type of fruit, providing essential information concerning its country of origin and beneficial properties.

*GreenApes* is a virtual community for those who are





interested in living sustainable lives. The platform, which was created by Gregory Eve in collaboration with the co-founders of GreenApes, enables you to create a profile and share your eco-friendly actions with others. The app is divided into four categories: food, mobility, home, and shopping, and puts users in competition with one another. Each recorded action corresponds to a score. The app's logo is a chimpanzee since they live in packs and are therefore influenced by one another. Similarly with GreenApes, every "green" action shared by a user is an incentive and stimulus for someone else to do something equally beneficial.

Another interesting app is the *Restaurant food game*, created by Infinite Dream Factory Inc. to make healthy eating a game. The Restaurant food game app aims at educating children of all ages to avoid eating junk food and to opt instead for healthy products. If they eat too much junk food during the game, they must go back to the beginning. In this way, children can learn what is right to eat and what they should avoid.

*Attivo!* is an app that targets toddlers; it consists of a drawing book, created by Johannes Metzler, where they can colour in fruit and vegetables and learn how to distinguish seasonal foods while having fun.

APPS FOR SMARTPHONES AND TABLETS	DESCRIPTION
 <b>Nutrino</b> <a href="http://www.nutrino.co/app.php">www.nutrino.co/app.php</a>	A virtual nutritionist that, according to the user's medical and physical profile, objectives and preferences, creates an ad hoc diet.
 <b>iFood Pro</b> <a href="http://www.vitobellini.com/ifoodpro/it">www.vitobellini.com/ifoodpro/it</a>	it counts calorie intake and the number of calories burnt. It calculates the daily requirements of protein, fats and carbohydrates according to the user's personal settings.
 <b>Fresh &amp; Local</b> <a href="http://cloudintouch.it/portfolio/fresh-local">cloudintouch.it/portfolio/fresh-local</a>	it gives advice on the consumption of local, seasonal food. By entering the type of food and place or country of origin, one can know how far it travelled and whether it is in season or not.
 <b>Mio Coach</b> <a href="http://miocoach.altervista.org">miocoach.altervista.org</a>	It explains the basic concepts of a healthy lifestyle and calculates BMI, protein factors, calorie needs, basal metabolic rate, lean body mass and fat body mass. It also puts a Personal Wellness Coach at the user's disposal.
 <b>Fresh Fruit</b> <a href="https://itunes.apple.com/it/app/fresh-fruit/id323895540?mt=8">itunes.apple.com/it/app/fresh-fruit/id323895540?mt=8</a>	It provides information on and type of fruit. For each product there is a table providing essential information, country of origin and beneficial properties.
 <b>GreenApes</b> <a href="http://www.greenapes.com/en">www.greenapes.com/en</a>	It is a community which promotes eco-friendly lifestyles. The App is divided into four categories; food, mobility, home and shopping. The users compete with one another and their every action corresponds to a score.
 <b>Restaurant Food Game</b> <a href="https://itunes.apple.com/us/app/restaurant-food-game-eat-well/id604394664?mt=8">itunes.apple.com/us/app/restaurant-food-game-eat-well/id604394664?mt=8</a>	it is a game for educating children to avoid eating junk food: if they eat too much junk food they must go back to start.
 <b>Attivo!</b> <a href="https://itunes.apple.com/it/app/attivo!-libro-da-colorare/id863014235?mt=8">itunes.apple.com/it/app/attivo!-libro-da-colorare/id863014235?mt=8</a>	it is a virtual drawing book for toddlers where they can learn about fruit and vegetables by coloring the pictures.

The main nutritional education Apps

Source: BCFN elaboration



## EATING HABITS, AWARENESS OF THE ENVIRONMENTAL IMPACT OF FOOD AND LIFESTYLE: EXPLORATORY ANALYSIS OF YOUNG ITALIANS' CHOICES<sup>58</sup>

Almost 30% of students do not eat breakfast every day. In contrast, they consume a fair amount of fruit and vegetables, especially those who practice sports regularly, yet they tend to eat too much meat and few legumes.

They are aware of the environmental impact of food yet few act accordingly, even though they

consider the Earth's "state of health" to be important. Consequently, the Environmental Pyramid Food was correctly identified by two thirds of the students, even though one third had never heard of it. As we have seen, it is essential to promote sustainable eating habits from an early age. A preliminary level, exploratory analysis was conducted on adolescents in two secondary schools in Northern Italy (Modena) and Central Italy (Viterbo), with the aim of analyzing their eating habits and lifestyles, as well as their awareness of the environmental impact of food and, in particular, of the BCFN Double Pyramid. The analysis launched in spring 2014 involved a questionnaire with closed-end questions

to be filled out by 291 students (69% female and 31% male) between 14 and 20 years of age.

Regarding their eating habits, about 90% of the respondents claimed to eat 3 to 5 meals a day, including snacks. 61% eat breakfast every day, while about 12% of the respondents stated that they never have breakfast.

Concerning their eating habits at home, each student was asked to indicate the number of times per day/week they eat certain types of food.

<sup>58</sup> By Principato L., Secondi L., Ruini L., Pratesi C.A.

	MORE THAN TWICE A DAY	TWICE A DAY	ONCE A DAY	A FEW TIMES A WEEK	LESS THAN ONCE A WEEK	NEVER	TOTAL
Fruit	18.21%	26.81%	24.74%	21.99%	5.84%	2.41%	100%
Vegetables	12.03%	36.08%	22.34%	20.27%	6.19%	3.09%	100%
Legumes	0.69%	0.35%	7.61%	58.13%	22.49%	10.73%	100%
Pasta	2.06%	12.72%	56.70%	24.40%	2.75%	1.37%	100%
Yogurt and/ or Milk	5.16%	11.00%	40.55%	28.52%	9.62%	5.15%	100%
Dairy products and/or cheese	3.45%	10.00%	26.21%	46.20%	10.00%	4.14%	100%
Meat	4.15%	14.19%	39.10%	37.37%	3.11%	2.08%	100%

Dietary habits at home: frequency of consumption of various foods (frequency percentages)

Source: Principato L., Secondi L., Ruini L. and Pratesi C.A. 2015



The students claimed to eat a good amount of fruit and vegetables. As we can see from the table, about 45% of the students eat fruit at least twice a day and 48% eat vegetables at home with the same frequency.

Distinguishing the consumption of fruits and vegetables according to the gender of the respondents, 22% of female students consumed fruit “more than twice a day”, compared to 10% of their male schoolmates. However, approximately 32% of the male students stated that they eat fruit “twice a day” (vs. 24% of females). There is an even clearer distinction between males and females if we analyze the frequency of their vegetable consumption: approximately half of the female respondents stated that they eat vegetables at least twice a day, compared to 42% of their male school mates. 4.4% of the boys said that they never eat fruit and vegetables, compared to approximately 2% of the girls.

The students eat large quantities of meat: 39% of the students eat it daily and 14% even twice a day, while they eat few legumes: about one third of the respondents said they eat legumes “less than once a week” or “never”, while more than half of them (58.13%) eat them a few times a week. Pasta is eaten “at least once a day” by 56.70% of the respondents, while 13% of the respondents eat pasta “twice a day”, presumably for both lunch and dinner.

Regarding “eating habits at school”, the students were asked to indicate what they usually eat during breaks at school. 34.71% of the respondents eat salty

snacks, 26.80% eat sweet snacks, and only 12.71% eat fruit. More than half of the students (52.42%) stated that they generally buy their snacks at school.

More than a quarter (26.12%) of the students stated that they never have snacks at school.

Well over half (67.01%) of the students said they practice sports, with 7 out of 10 saying that they do physical activities “a few times a week”. By analyzing the data concerning physical activity and the consumption of certain types of food, it was observed that 25% of those who declared they do physical activity “every day” also eat fruit “more than twice a day”, 17.27% declared doing physical activity “a few times a week”, while 12.50% of the students do physical activity “once a week” or “a few times a month”. A similar trend is reported concerning their consumption of vegetables: more than 30% of those who do physical activity on a daily basis eat vegetables more than twice a day.

Concerning leisure time, it was observed that mobile phones and the Internet have surpassed television. The students were asked how long they usually spend watching television: 44.60% said they watch television less than an hour per day, 40.77% between one and three hours a day, and only 5.57% responded that they watch television for more than three hours a day. 9.06% of the students replied that they do not watch television.

The students were then asked how long they spend on their mobile phones sending text messages, chatting, making phone calls, web browsing, and on

applications. 46.71% of the respondents said that they spend more than three hours a day on their phones, 41.18% between one and three hours a day, and 10.73% less than an hour.

Concerning the amount of time spent studying at home in the afternoons, 41.11% of the students said that they studied from one to three hours per day, 43.34% more than three hours, while 10.80% study less than an hour per day at home.

Regarding the environmental impact of food, 84% of the students declared: “I am aware of the fact that what we eat has various impacts on the environment”. When asked how they knew this, the most common sources of information were the family (54.64%), school (57.59%), and television (56.55%)<sup>59</sup>. The students’ awareness of the specific impact of certain types of food on the environment was then analyzed in more detail.

<sup>59</sup> Each student could choose a maximum of three options concerning the channels through which he/she became aware of the environmental impact of food. For this reason, the percentages do not amount to 100.



	EXTREMELY LOW	FAIRLY LOW	NEITHER HIGH NOR LOW	FAIRLY HIGH	EXTREMELY HIGH
Fruit and vegetables	36.46	32.99	19.44	10.07	1.04
Pasta and cereals	11.81	38.19	36.46	11.81	1.73
Dairy products and cheese	9.34	22.15	42.91	23.18	2.42
Meat	4.21	5.27	21.75	47.02	21.75

I think that eating the following foods has an effect on the environment.. (Percentages for each type of food)

Source: Principato L., Secondi L., Ruini L. and Pratesi C.A.2015

69.45% correctly stated that eating fruit and vegetables has an extremely low or fairly low environmental impact. Almost 7 out of 10 students think that eating meat generates a high impact on the environment, while 1 in 10 is convinced that eating meat has an “extremely” or “fairly” low environmental impact.

Fruits and vegetables, followed by fish, are perceived as being the healthiest foods, according to the students who participated in the survey. Foods

perceived to be unhealthy and therefore to be eaten in moderation are French fries (indicated by 90% of respondents), snacks, candies, and carbonated drinks.

74.57% of the teenagers stated that they eat a well-balanced diet because they “care about their health”. Despite this, 35% of the respondents also said that they would probably eat “unhealthy” food in the 4 weeks following the interview.

It is interesting to note the distribution of the responses to the same type of statement, in reference to following a well-balanced diet to safeguard the environment (they were specifically asked “I try to follow a healthy diet because I care about the environment I live in”): approximately half of the respondents said they “neither agree nor disagree” and about 20% claimed to “strongly disagree” or “disagree” with the statement.

	I STRONGLY DISAGREE	I DISAGREE	I NEITHER AGREE NOR DISAGREE	I AGREE	I STRONGLY AGREE
... I care about my health	2.07	4.14	18.97	42.75	32.07
... I care about the environment in which I live	6.21	14.14	45.86	26.55	7.24

I try to follow a well-balanced diet because.. (distribution of percentages)

Source: Principato L., Secondi L., Ruini L. and Pratesi C.A.2015



They were then asked to express their interest in the environment and the environmental impact of food,

in order to determine their general attitude towards these issues.

	I EXTREMELY AGREE	I DISAGREE	I NEITHER AGREE NOR DISAGREE	I AGREE	I EXTREMELY DISAGREE
I consider myself a person who is interested in safeguarding the environment	6.87	8.59	28.18	39.52	16.84
I consider myself a person who is aware of the environmental impact of what I eat	11.34	14.09	37.11	28.52	8.94

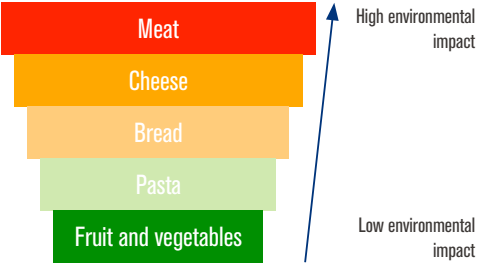
Attitude towards the environment and the environmental impact of food (distribution of percentages)  
Source: Principato L., Secondi L., Ruini L. and Pratesi C.A. 2015

Over half of the respondents expressed “agreement” when they were asked if they considered themselves people who care about the environment. Moreover, more than a third of the students also agreed with the statement concerning the environmental impact of food and being aware of the consequences of our diets. However, when the same statement was expressed in a more explicit way concerning eating habits (specifically: “My diet is affected by the impact

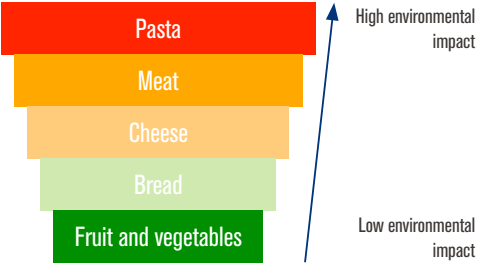
that the foods I eat may have on the environment”), approximately 53% of the respondents said they disagree with this statement, while 26% stated they “neither agree nor disagree”. By combining the “environmental” and “food” aspects, 33% of the respondents knew about the Double Pyramid model and had heard about it at school, at home, or on television. Finally, regardless of their knowledge of the Double

Pyramid model, all students were asked which of the pyramids illustrated below reported the correct scale of the environmental impact of food. 69% of respondents answered correctly by indicating Pyramid 1 as the pyramid showing the correct order of the environmental impact of food. Approximately 16% stated Pyramid 2 as being correct, while approximately 15% believed that it was Pyramid 3.

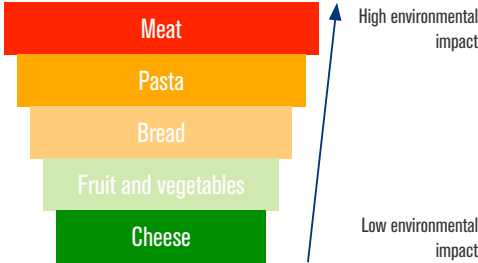
Pyramid 1



Pyramid 2



Pyramid 3



Pyramid showing the environmental impact of food  
Source: Principato L., Secondi L., Ruini L. and Pratesi C.A. 2015



## CONCLUSIONS

Many governments are concerned about the growth of obesity. An unhealthy diet is one of the main threats to people's health and this has a negative effect on the economy.

Obesity is nearly always the result of incorrect diets and lifestyles which combine a lack of physical activity with an unbalanced diet characterized by large amounts of unhealthy food.

1. Although there is accurate information that raises people's awareness of "what you should do", various reasons lead people to adopt "obesogenous" lifestyles and eating habits: their physical environments; their communities (family,

friends, schoolmates, colleagues, etc.); type of work (more or less sedentary), or what they do in their free time (amount of physical activity); their age or time of life (young, middle-aged, elderly); their state of health; and their external stimuli.

2. In light of this, convincing people to actually modify their behavior in opposition to current trends requires systemic actions that, in accordance with shared guidelines, involve various players and influencers. Families and schools, whose task is to form children's characters; companies, where adults spend most of their time; and the media, which often convey patterns of good or bad behaviour very effectively.
3. The commitment of those who report on food issues on a daily basis and through considerable

investment is also essential (and not only through advertising). This regards manufacturers, distributors and catering firms that, in addition to providing the "raw material" for our diets, can lead us, explicitly (by means of awareness-raising campaigns) or implicitly (by making healthy foods more attractive and accessible to us), to modify our behaviour.

4. Finally, it is important to underline that individual countries must recognize their population requirements in terms of health status, dominant culture and budgets, and access to food, in order to implement appropriate "country-specific" dietary guidelines and enact laws and regulations with the aim of solving all of the related issues, as soon as possible.







## FURTHER INSIGHTS



### FOOD POLICIES FOR HEALTH AND THE ENVIRONMENT

- 🔥 The importance of ensuring adequate nutrition for the most vulnerable sections of the population
- 🔥 Access to food and climate change
- 🔥 Guidelines for a healthy and sustainable diet
- 🔥 Environmental labeling

### THE CLIMATE ON OUR PLATES: MUSINGS IN THE LIGHT OF THE COP21

- 🔥 International agreements on climate change
- 🔥 Climate and food: musings in the light of the international commitments of the COP21
- 🔥 Feeding the cities

### THE RITUALS OF FOOD: THE SACRED NATURE OF DIETS

- 🔥 Food and social rituals
- 🔥 Identity and the culture of food
- 🔥 The symbolic value of food in religious faiths
- 🔥 The sacralization of food consumption
- 🔥 Today's food trends
- 🔥 Food phobias and the “demonization” of food



# FOOD POLICIES FOR HEALTH AND THE ENVIRONMENT

*Eating is one of the primary needs of mankind, so food has always been at the center of legislators' attention.*

*Food policies are the rules, incentives, taxes, and information and education or information campaigns undertaken by the institutions on the various economic, social, and environmental activities in the agrifood sector. The objective is to govern and, if possible, improve the way food is produced, processed, distributed, and consumed, while ensuring the health of people, society, and the environment, and the legitimate interests of citizens represented by pressure groups<sup>1</sup>. Essentially, food policies have an effect on what, when, and how you eat, and on the related economic, social, and environmental consequences. Food policies directly or indirectly involve different actors (from the farms to the workers, from society*

*in the broadest sense to the individual end consumers, and finally, the environment) and require an interdisciplinary approach for their preparation and implementation that covers several aspects: nutrition, health, the environment, psychology, and economics. In this chapter, we will try to analyze the main food policies adopted to protect people's health and, at the same time, to reduce the impact of food on the planet. In particular, we will explain a few emblematic cases of institutional activities aimed at ensuring adequate nutrition for the most vulnerable sections of the population; policies to reduce obesity and overweight conditions; regulation of food marketing addressed to children; policies that guarantee access to food in the face of climate change; the new guidelines for a sustainable diet; and, finally, the environmental labels used in the food*

*sector. Along the way, we will be highlighting some controversial topics involving actors with potentially divergent interests or complex issues on which it is often difficult to legislate. According to Professor Tim Lang<sup>2</sup>, there are three distinct avenues of research in nutrition that lawmakers should take into account. The first focuses on the biochemical interactions of nutrients and their health implications; the second highlights how social factors influence food choices; the third one examines the links between nutrition issues and environmental protection. The most important challenge for policy makers, which the Barilla Foundation has promoted since 2009 with the Double Pyramid model, is to promote sustainable lifestyles that, along with public health objectives, take into account the impact different foods have on the environment.*



## The importance of ensuring adequate nutrition for the most vulnerable sections of the population

If the first policies came into being to try to ensure that everyone would have adequate access to food, in recent years, their objective has also extended to include the opposite extreme, namely the excessive consumption of food.

In general, the institutions today are trying to ensure appropriate nutrition for the vulnerable sectors of society: alongside children and populations still suffering from hunger, there are also obese people and people on low incomes. Below we will see the policies that have been developed at an international level.

### *Reducing obesity and overweight conditions*

The obesity epidemic is a serious problem for public health, not only in developed countries but also in developing ones. According to the latest estimates by the World Health Organization (WHO)<sup>1</sup>, the number of overweight or obese people in the world continues to increase and has exceeded two billion<sup>2</sup>. The United States, followed by China and India, is the country with the highest number of obese people (with almost 13% of the world's obese people).

Policies for reducing the rates of obesity and overweight conditions of the population can be divided into soft and hard approaches. The former include education campaigns to raise people's

awareness on the gravity of the phenomenon and its impacts, and the rules on information to be included on food labels. The latter are more complex and require a systemic approach to be implemented, and include: the prohibition of the consumption of certain foods, fiscal measures (for example, the taxation of certain types of foods or ingredients), and the request to reformulate product classes to bring them into line with specific guidelines.

International organizations generally propose optional guidelines and recommendations for national governments which in practice are soft policies, whereas it is up to the individual states to legislate on matters of hard policy.

Hard policies, however, are often opposed for being too coercive, especially in the US, where the right to choose was one of the four consumer rights proclaimed by President Kennedy in his 1962 speech. Food choices of individuals have always been part of the private sphere in America, and it is only recently that the social and economic consequences of the obesity epidemic on its national health system has been analyzed (estimated at \$147 billion<sup>3</sup>).

Until the twenty-first century, the focus of international policies towards food focused primarily on issues related to food security and under-nutrition, rather than the over-consumption of food. The first time anyone officially spoke of obesity and the diseases related to it was in 2003, in a joint report by the FAO and WHO<sup>4</sup>, following a UN declaration stating the importance of proper nutrition and physical activity to prevent being overweight. The

following year, the World Health Assembly (the legislative body of the WHO) passed a resolution calling on governments, international partners, the private sector, and civil society to take action at global, regional, and local levels to support healthy diets and physical activity.

One of the latest international policy proposals was the one put forward in 2013 by the WHO, in which, the nine targets suggested for improving the conditions of global public health, included stopping the growth of diabetes and obesity and reducing the consumption of salt by 30%<sup>5</sup>. In addition, this year the WHO recommended<sup>6</sup> adults and children reduce their daily consumption of sugar to less than 10% of their total energy intake, underlining that if it were to remain below 5% (equal to about 25 grams, the equivalent of 6 teaspoons) per day, even greater health benefits would be obtained.

<sup>1</sup> WHO (2015), Obesity and Overweight, Fact sheet N°311, updated January 2015.

<sup>2</sup> Ng M., et al. (2014), Global, Regional, and National Prevalence of Overweight and Obesity in Children and Adults During 1980–2013: A Systematic Analysis for the Global Burden of Disease Study 2013, "The Lancet", vol. 384, Issue 9945.

<sup>3</sup> Finkelstein E. A., et al. (2009), Annual Medical Spending Attributable To Obesity: Payer-And Service-Specific Estimates, "Health Affairs", 28, no.5.

<sup>4</sup> WHO/FAO. (2003). Diet, Nutrition and the Prevention of Chronic Diseases, Report of the joint WHO/FAO expert consultation. WHO Technical Report Series, No. 916 (TRS 916)

<sup>5</sup> WHO, (2013), Global Action Plan for the Prevention and Control of Ncds 2013-2020.

<sup>6</sup> WHO, (2015), Guideline: Sugars Intake for Adult and Children.





At the European level, in 2005 a round table was set up on obesity involving large companies, healthcare professionals, and several other stakeholders. In 2007, the European Commission, with the adoption of the White Paper A Strategy for Europe on Nutrition, Overweight, and Obesity,<sup>7</sup> indicated the actions that can be taken at the local, regional, national, and European levels to reduce the risks associated with a poor diet and reduced physical activity. However, as required by the Maastricht Treaty, the European Commission's role in stemming the phenomenon is solely to suggest policies, educate people (through social campaigns, etc.), and allocate resources for scientific research.

At the national level, it is worth mentioning the case of the United Kingdom, where a study lasting two years produced the best governmental analysis on obesity<sup>8</sup>. The report proposes a map of factors that affect obesity, including the social context, the production and consumption of food, and individual behavior<sup>9</sup>.

In the United States, one of the most important national laws against obesity is the "Healthy, Hunger Free Kids Act", passed in 2010, which reformed school food programs, influencing the eating habits of 31 million children. The law increased the subsidies for access to school lunchrooms, making portions of fruit, vegetables, and whole grains larger, and reducing the total calories, sugar, and salt. Unfortunately, its impact was partly reduced by the action of some lobby groups (an example is that of pizza, where tomato sauce is considered a vegetable

and then calculated in the daily percentage). Although international organizations have long been committed to bringing obesity to the attention of governments, and some countries are struggling to fight it with regulations and laws, the results are not encouraging<sup>10</sup>. According to a study recently published in "The Lancet", since the 1980s, no country in the world has managed to achieve significant progress in reducing rates of overweight conditions and obesity<sup>11</sup>. When he was interviewed by Bloomberg, Christopher Murray, one of the authors of the study and Professor of Global Health at the University of Washington, declared that food policies promoted by the different nations have not been effective, nor have the social campaigns, developed to promote proper nutrition<sup>12</sup>.

<sup>7</sup> CE. (2007), White Paper: A Strategy for Europe on Nutrition, Overweight, and Obesity.

<sup>8</sup> According to T. Lang, Ibid., p.1

<sup>9</sup> Foresight, (2007). Tackling Obesity Future Choices, London: Government office of science.

<sup>10</sup> Lang, Ibid.p.1.

<sup>11</sup> Ng M., et al. (2014), Global, Regional, and National Prevalence of Overweight and Obesity in Children and Adults During 1980–2013: A Systematic Analysis for The Global Burden of Disease Study 2013, "The Lancet", vol 384, Issue 9945.

<sup>12</sup> Walls, H., et al. (2011). Public Health Campaigns and Obesity – A Critique, "BMC Public Health", 11-136.



## TAXING JUNK FOOD AND SUGARY DRINKS

Kelly Brownell, Professor of Public Policy at Duke University, proposed introducing taxes on sugary drinks in 1994. Assuming that eating behavior is influenced by the price variable, this proposal argued that adopting fiscal measures could have a role in reducing the consumption of some foods classified as “junk food”, just as in the campaign against smoking, where the rise in prices seems to have been an effective deterrent to consumption. In this regard, however, there have been conflicting opinions. For some, imposing taxes on unhealthy and unsustainable products is a severe measure that demonizes certain foods and forces consumers to pay additional costs. Others see it as an effective weapon for guiding people towards better choices, seeing as so far the recommendations have essentially failed. In addition, some<sup>13</sup>, point out that fats, as well as salt and sugar, are present in almost all foods, and so it is hard to understand the threshold designating that one food is classified as unhealthy instead of another.

The scientific evidence on the effectiveness of these measures is controversial. According to a recent study by Ecorys for the European Union<sup>14</sup>, taxing foods with a high content of salt, sugar, and fat leads to an effective reduction in consumption. At the same time, however, care

must be taken, because the poorest people, who are also those that are most likely to become obese or overweight, could move their choices towards foods that are cheaper but whose nutritional value is even worse than the taxed foods, or to foods that are equally unhealthy but not taxed. Such as in France, where the taxation of sugary drinks appears to have led to an increase in the consumption of potato chips.

In Europe, there are not many countries that have enacted this type of economic governance as a tool to change peoples' diets, but those that have done so appear to have achieved the desired result. The countries that have successfully applied taxes on food and drinks are: Denmark (saturated fat), Finland (sweets, ice cream, sugary drinks, and some alcoholic beverages), Hungary (sweets and condiments, sugary and energy drinks, chocolate) and France (sugary drinks). The Hungarian government, supported by the WHO, has persuaded 30% of citizens to change their consumption habits; of these, 80% have reacted to the higher prices, while in other countries, there are also other factors that have had an effect, such as increased awareness of the phenomenon which has formed thanks to the discussions preceding the adoption of legislation. The United States has debated at length on such

actions and in April 2015, the first experiment in such tax measures was selected: the Navajo Indian Reservation (which covers some areas of Arizona, Mexico and Utah). Here the population suffers from obesity rates above the American average and, in some areas, nearly 60% of the population have type 2 diabetes. The regulation enacted calls for a 2% tax on so-called junk foods, balanced by the elimination of the 5% tax on fresh fruit and vegetables. The revenue from this “sin tax” will be allocated to projects to promote the health and well-being of the community, including the provision of incentives to increase the number of fresh fruit and vegetable markets. Seeing as obesity rates continue to grow and, consequently, so does spending in health services for the treatment of related diseases, taxation is bound to become actual leverage for action by policy makers. The challenge for governments will be in determining where and how to impose taxation and how to measure its effectiveness.

<sup>13</sup> Including Prof. Tim Lang.

<sup>14</sup> Ecorys, (2014), Food Taxes and Their Impact on Competitiveness in the Agri-Food Sector, A Study.



## SUBSIDIES AND FOOD ASSISTANCE PROGRAMS FOR LOW-INCOME PEOPLE

An alternative to taxing junk foods is the subsidies for food that is low in calories and has a high nutritional level. Starting from the same premise, namely that the price has a significant influence on people's purchasing decisions, a financial incentive can influence behavior towards healthier products, especially for people with low incomes. There has been plenty of criticism concerning this measure, too. The first criticism is that the people who benefit from a subsidy can still use the money to buy unhealthy foods. One study found that people use the money saved thanks to subsidies to buy more food in general, including

products that contain high levels of sugar, salt, and fat<sup>15</sup>. In addition, subsidies represent a significant expense for the State and it is not easy to find the necessary funds.

Other than subsidies, there are also food assistance programs that provide economic aid for purchasing food to the most needy families. A typical example in the United States is SNAP (Supplemental Nutrition Assistance Program), a federal program that annually assists about 47 million Americans. Conversely, however, with the checks from this kind of food subsidy project, people can buy any kind of food, with the

obvious risk of encouraging the consumption of unhealthy food as well. There have been several law proposals on excluding the possibility of junk food purchases with SNAP, but none of them have ever passed because they were considered as limiting individual freedom.

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<sup>15</sup> Epstein, L.H. et al. (2010), The Influence of Taxes and Subsidies on Energy Purchased in an Experimental Purchasing Study, "Psychological Science", vol 21, issue 3, pp. 406-414.





### Regulation of food marketing aimed at children

Children have always been a vulnerable and impressionable target, and need to be protected by strict policies. If this does not happen it is because the economic interests at stake are very high. It has been shown that, if not integrated with parental control, exposure to the advertising and promotion of food products can encourage the adoption of unbalanced eating habits, with possible effects on health<sup>16</sup>.

Internationally, in 2010 the WHO approved a series of recommendations on the marketing of foods and non-alcoholic beverages for children. These guidelines should assist countries in designing policies to reduce the impact the marketing of foods deemed unhealthy has on children. Interestingly, consumption of snacks for children has declined in countries where there are regulations: Australia has prohibited any advertising of foods to children under 14 years of age, Holland banned any advertising of sweets for children under 12, Sweden banned the use of cartoon characters for advertising, and Norway has prohibited any form of advertising aimed at children.

Walt Disney America, which also advocates more control of food advertising in children's programs, has gotten rid of junk food commercials on its own television channels, website, and radio stations, and is promoting healthy foods, such as fruit and vegetables, and other foods with fewer calories, and less saturated fat, salt, and sugar.

### Access to food and climate change

According to the FAO, worldwide there are 805 million people suffering from hunger, about 11% of the world population, the vast majority of whom live in poor or developing countries<sup>17</sup>. Although the numbers are still high, the results of the food policies of recent decades are encouraging, with 209 million fewer starving people than in 1990-92, so we are not so far from achieving the Millennium Development Goal: to halve the proportion of undernourished people by 2015.

However, according to a new UN report<sup>18</sup>, risks due to climate change could actually reverse years of progress against poverty and hunger. The scenarios of climate change in the medium to long term are catastrophic: food shortages, refugee crises, the flooding of major cities and entire island nations, the extinction of plants and animals, and a climate so drastically altered that could make it dangerous for people working outdoors (including in fields) during the hottest periods of the year.

According to the International Food Policy Research Institute (IFPRI)<sup>19</sup>, in 2050, 25 million children under the age of five will be malnourished due to the effects of climate change, equal to the number of all the children of the same age in the United States and Canada.

According to Oxfam<sup>20</sup>, there are several factors that influence access to food in a world affected by climate change. First of all, 80% of world agriculture (and 90% in Africa) uses rainwater for irrigation, a

factor which subjects it to changes in the quantity and intensity of rainfall. Then we have to consider that the diversity of seeds has decreased by 75% over the last 100 years, thus depriving farmers of those species that could better adapt to climate change. In unstable weather conditions, crop insurance can make a big difference in stabilizing a farmer's income: although 90% of US farmers benefit from it, whereas only 15% of Indian farmers, 10% of Chinese farmers, and around 1% of those in developing countries are able to have access to insurance. Out of 20 African countries that have pledged to spend 10% of their budgets on agriculture, only four have achieved this goal. The world grain reserves are at historically low levels, which could drive up prices in case of extreme weather events, leading to a severe food crisis. Finally, again according to Oxfam, technology is very useful in dealing with climate change. In particular, access to weather data can be crucial in helping farmers plan their irrigation and crops. Again, the differences between the developing and developed countries are relevant: in California, for example, there is a weather station per 2000 km<sup>2</sup>, whereas in Chad, there is one every 80,000 km<sup>2</sup>.

<sup>16</sup> J.C.G., Halford et al., 2004, Effect of Television Advertisements for Foods on Food Consumption in Children, 'Appetite' 42, pp. 221-225.

<sup>17</sup> FAO, (2014), The State of Food Insecurity in the World.

<sup>18</sup> IPCC, (2014), Climate Change 2014.

<sup>19</sup> IFPRI, (2014), Climate Change: Impact on Agriculture and Costs of Adaptation.

<sup>20</sup> Oxfam, (2014), Hot and Hungry – How to Stop Climate Change Derailing the Fight Against Hunger.



Considering all these factors, there is considerable work to be done at the political level (both global and local). The Chicago Council on Global Affairs, in a recent report on this matter<sup>21</sup>, urges the US government to integrate climate change into its strategy on food security. One of the recommendations is to create long-term rules on food security and increase funding for agricultural research linked to climate change, in particular focusing on some species' adaptation to extreme weather events.

### Guidelines for a healthy and sustainable diet

The first attempts to introduce environmental considerations into the field of nutrition date back to the mid-eighties, when Gussow and Glancy<sup>22</sup> conducted a study on the environmental effects related to the adoption of the US dietary guidelines. Recently, a growing number of international organizations and governments have recognized that in the future, food policies should aim to integrate the dual objective of improving health for people and the environment. Some countries have actually begun to incorporate the concept of environmental sustainability in their traditional food guidelines<sup>23</sup>. But putting them into practice is not easy, because interpretations of the definitions of sustainability vary widely depending on the different sensibilities and cultures; and the analysis of environmental, social, and economic impacts does not always result in concurring indications.

Many countries in Europe have developed guidelines for a healthy and sustainable diet including France, Sweden, the United Kingdom, Belgium, Germany, the Netherlands and the Nordic countries. In the first four, government agencies drew up the guidelines, whereas non-governmental agencies<sup>24</sup> did so in the others.

The guidelines mentioned share a qualitative nature and are based on the theory that a mainly vegetable diet, with limited consumption of animal protein, is preferable from the environmental and nutritional standpoint. In most of the cases there is no information on the precise amount and frequency with which various foods should be eaten, or for which ones consumption should be encouraged or discouraged, but only a recommendation on buying behavior<sup>25</sup>.

In April 2015, the UK government published *The principles of healthy and sustainable eating patterns* as part of the Global Food Security Program. The guidelines, described in eight principles, are intended as the natural complement to the much better known Eat Well Plate and provide information on the measures to adopt to reconcile the objective of a healthy diet with the protection of the environment. The principles are the point of arrival of a journey taken with the Green Food project, aimed at identifying margins of action and the opportunities to improve the sustainability of the British food system. The principles are based on advices previously elaborated by the Sustainable Development Commission<sup>26</sup> and by the WWF in the Livewell for LIFE project<sup>27</sup>.

The French<sup>28</sup>, Belgian<sup>29</sup>, and German<sup>30</sup> guidelines were proposed respectively by the French Agency for the Environment and Energy (ADEME), by the Department for the Environment of the Brussels region (Bruxelles Environment) and by the German Council for Sustainable Development. In all the cases, recommendations and advice of a qualitative nature are given, part of broader programs aimed at promoting responsible purchasing and consumption in the different product sectors.

The *Nordic Nutrition Recommendations 2014*, produced by the Nordic Council of Ministers<sup>31</sup> has a whole chapter dedicated to the concept of sustainable diet which stresses the interrelationships between food, health, and environmental protection, and highlighting the benefits of a sustainable diet and the possible trade-offs between environmental and nutritional goals. In addition, it lists the eating

<sup>21</sup> Bereuter D. et al. (2014), Advancing Global Food Security in the Face of a Changing Climate.

<sup>22</sup> Gussow J., Clancy K. (1986) Dietary guidelines for sustainability, "J Nutr Educ" 18, 1-5.

<sup>23</sup> T. Garnett. (2014), What Is a Sustainable Healthy Diet?

<sup>24</sup> Respectively the UK Sustainable Development Commission and the WWF-UK for the United Kingdom, the Health Council of the Netherlands for Holland, the Barilla Center for Food & Nutrition for Italy.

<sup>25</sup> Westland et al., 2012.

<sup>26</sup> Sustainable Development Commission, 2009

<sup>27</sup> WWF-UK, 2014

<sup>28</sup> ADEME, 2012

<sup>29</sup> Bruxelles Environment, 2014

<sup>30</sup> German Council for Sustainable Development, 2008

<sup>31</sup> The Nordic Council is a forum of cooperation between the governments of the Nordic countries (Denmark, Sweden, Finland, Norway, Iceland, and Greenland) which defines the nutritional requirements and values on which the individual member States work out their food guidelines.



choices required in order to switch from the current diet to a more sustainable one, and for each one, highlights the implications (positive and negative) that such actions would have on the environment and health<sup>32</sup>.

The report by the Health Council of the Netherlands is addressed to the government and provides a detailed overview of the interconnections between health and the environmental effects of different foods. The report examines the 2006 Dutch dietary guidelines, which are then classified according to their potential synergies or conflicts in terms of environmental sustainability. The study identifies recommendations with a positive impact both on health and for the environment as “total winners”, the cases in which the benefit in terms of nutrition is achieved at the expense of the environment as “winners-losers”, and as “winners from an environmental perspective,” those recommendations having a positive impact on the environment, but neutral from the point of view of health (for example, those relating to the reduction of food waste). The report identifies the recommendation on the transition to a predominantly vegetable diet as totally winning, while a strong point of contention is the consumption of fish, considered healthy but not always sustainable from an environmental point of view<sup>33</sup>.

The Swedish guidelines, published in 2013 by the National Food Agency together with the Agency for Environmental Protection, reach similar recommendations: eat less meat, eat only fish that is not at risk and from certified sources, store

vegetables appropriately, reduce the consumption of sweets, and reduce food waste. The Swedish guidelines stand out by their accuracy in analyzing the different environmental impacts of individual foods<sup>34</sup>.

The following table lists the indications given by the various sustainable dietary guidelines with reference to the various food groups.

Like the report by the Advisory Committee which recognized the fact that the production and consumption of food have impacts on the environment, the US nutritional guidelines to be published in fall 2015 will include aspects of sustainability for the first time<sup>35</sup>. We should remember that the Mediterranean diet is cited in this report as a positive example of a sustainable diet. A similar approach has already been adopted by the Brazilian guidelines, published at the end of 2014, where it is acknowledged that “healthy” food comes from “healthy” ecosystems, recognizing that preserving the biodiversity, health and equilibrium of the ecosystems, and people’s health is interconnected. The Brazilian guidelines stress in particular the importance of eating vegetables and whole cereals, and of reducing the consumption of transformed foods and food rich in fats, salt and added sugars<sup>36</sup>.

The WWF’s project, LiveWell, launched in the UK and then extended to Sweden, France, and Spain, is the only one that provides not only qualitative, but also quantitative recommendations on how to follow a sustainable diet. The study involved

devising weekly menus that are adapted to the food and cultural needs of the population, balanced in terms of nutrition, and can reduce greenhouse gas emissions compared to the current diet. The results showed that a significant reduction in CO<sub>2</sub> emissions is possible without “upsetting” the eating habits of the population. LiveWell has been instrumental in introducing the issue of sustainable diets in the European political agenda. In particular, the project has developed a series of recommendations for institutions, including: the revision of national food guidelines with the integration of the concept of environmental sustainability and reduction of greenhouse gas emissions, the need to update agricultural and food policies taking into account sustainability, the need to support education in healthy and sustainable eating habits, strengthening preventive measures on diseases related to nutrition, and promoting local-global synergies.

<sup>32</sup> Nordic Nutrition Recommendations 2014.









<sup>33</sup> Health Council of the Netherlands, 2011, Guidelines for a Healthy Diet: The Ecological Perspective, The Hague, 2011

<sup>34</sup> National Food Agency, 2013

<sup>35</sup> Dietary Guidelines Advisory Committee, Scientific Report of the 2015 Dietary Guidelines Advisory Committee <http://www.health.gov/dietaryguidelines/2015-scientific-report/PDFs/Scientific-Report-of-the-2015-Dietary-Guidelines-Advisory-Committee.pdf>

<sup>36</sup> Ministry of Health of Brazil, 2014.



COUNTRY FOOD	FRANCE Mes Achats	GERMANY The Sustainable Shopping Basket	SWEDEN Towards Environmentally Sound Dietary Guidelines	NETHERLAND Guidelines for a Healthy Diet: The Ecological Perspective	UNITED KINGDOM The principles of healthy and sustainable eating patterns	NORDIC COUNTRIES Nordic Nutrition Recommendation 2014	BELGIUM Nutrition and the environment
 <b>FRUIT, VEGETABLES, LEGUMES, CEREALS, POTATOES</b>	Buy local, varied, seasonal, and when possible, organic food. Avoid fruit and vegetables with bulky packaging	Consume at least 5 portions of fruit and vegetables a day. Choose local and seasonal products.	Increase your consumption of cereals, fruit and vegetables. Choose local and organic products in season. Prefer vegetables that stay fresh longer, such as cruciferous ones. Eat more legumes.	"Follow more of a vegetarian than an animal-based diet: less meat and dairy products, more whole-grain cereals and legumes, vegetables and vegetable-based protein substitution. (win-win situation)"	Eat at least 5 portions of fruit and vegetables a day. Eat more peas, beans, dried fruit and other sources of vegetable proteins.	Eat more cereals, fruit, and vegetables, especially potatoes and fibrous vegetables. Reduce consumption of vegetables grown in heated greenhouses. Eat more legumes. Choose local and organic produce.	Eat more cereals, fruit, and vegetables. Choose local and organic food in season. Eat more legumes. If you buy exotic product, choose the Fair Trade brand.
 <b>MEAT</b>	Reduce consumption to the level indicated by nutritionists. Alternate meat-based menu with vegetarian meals.	-	Moderate your consumption. Buy meat from local free-range farms.		Eat in moderate quantities	Reduce your consumption	Reduce your consumption of meat. Try different types of meat. Alternate animal and vegetable proteins.
 <b>DAIRY PRODUCTS, EGGS</b>	Reduce consumption to the levels indicated by nutritionists	-	-		Include milk and dairy products in your diet, or try plant based alternatives fortified with calcium and vitamins.	"Reduce your consumption of dairy products. Eat more eggs."	-
 <b>FISH, SEAFOOD</b>	Eat fish from sustainable stocks	Reduce you consumption. Eat fish from sustainable stocks.		"Eat 2 portions of fish per week, 1 of which only fish. This recommendation could have negative repercussions on the environment. The consumption of less exploited species needs to be encouraged. (win-lose situation)"	Eat only fish that is certified and from sustainable stocks /and or fish farms	-	Avoid buying fish species in danger of extinction. Eat only fish that is certified and from sustainable stocks and/or fish farms.
 <b>FAT AND OIL</b>	-	-	Increase you consumption of locally produced rapeseed oil. Reduce your consumption of palm oil.	-	-	Use vegetable oils. Reduce your consumption of butter and palm oil.	Avoid palm oil.
 <b>WATER, BEVERAGES</b>	Drink tap water. If you buy bottles water, choose water in 5-liter recyclable PET containers	Choose recyclable packaging	-	-	Drink tap water	-	Drink tap water. If you buy bottled water, choose recyclable bottles.
 <b>SNACK HIGH IN SUGAR AND SALT</b>	-	Eat healthily. Try Fair Trade products. Avoid producing waste.	-	"Moderate your calorie intake by eating less food with nutritional value. (win-win situation)"	Eat fewed foods high in saturated fat, sugar and salt.	"Reduce your consumption of foods with little nutritional value."	Eat fewer foods high in salt, sugar and fat.
 <b>OTHER GENERAL ADVICES</b>	Eat a balance diet. Try Fair Trade products. Reduce your waste. Try not to do the shopping by car.	-	-	"Reduce your food waste. (environmental win - health neutral)"	Eat a balanced diet. Reduce your food waste. Value what you buy and what you eat, Ask about where it comes from and how it is produced.	-	Eat a varied and balanced diet. Store food properly and avoid wasting food. Make a shopping list. Avoid products with very bulky packaging.



## Environmental labeling

Over the past three decades, different labels or special logos have been created, driven by public and private initiatives, to be placed on food packaging to communicate information to consumers on sustainability. Some of the best known are those of Fair Trade groups, the logo of the Rainforest Alliance (which promotes sustainable agriculture in favor of the farmers and the environment in developing countries), and those related to environmental impacts and welfare in animal breeding. A study by the European Commission found that there are 129 nutritional information schemes related to sustainability in Europe<sup>37</sup>. The goal of these

programs is to increase transparency in the food chain and inform consumers to promote responsible consumption.

In general, consumer awareness about the sustainability labels and their influence on consumption is low<sup>38</sup>, even though some studies reveal consumers' readiness to pay a slightly higher price for certified food products<sup>39</sup>. The most appreciated labels, aside from those of organic products, are those indicating a product comes from free range farming and certifying animal welfare. The environmental labels, such as the Carbon Label, are considered less attractive and associated with less willingness to pay a higher price. This is due to the fact that, while recognizing the label, consumers

often do not fully understand the concept expressed (for example, what the "carbon footprint of food" actually means)<sup>40</sup>.

<sup>37</sup> European Commission. (2012). Food Information Schemes, Labelling and Logos, Internal Document DG SANCO.

<sup>38</sup> Eufic Forum. (2014). Sustainability and Social Awareness Labelling – A Pan-European Study on Consumer Attitudes, Understanding and Food Choice.

<sup>39</sup> McCluskey, J., Loureiro, M., Consumer Preferences and Willingness to Pay for Food Labeling: A Discussion of Empirical Studies, "Journal of Food Distribution Research", Vol. 34, 03, 2003.

<sup>40</sup> Grunert K., Sophie Hieke S., Wills J., Sustainability Labels on Food Products: Consumer Motivation, Understanding and Use, "Food Policy" 44 (2014) 177-189.





## THE CLIMATE ON OUR PLATES: MUSINGS IN THE LIGHT OF THE COP21

*Today we know what the causes of global warming are. And we also know that it is time to act quickly to prevent the situation from deteriorating even further. Agriculture and food account for a very substantial share of climate-altering emissions: reducing them is the responsibility of all the actors in the supply chain, from farm to fork. From the households, called upon to have balanced diets, to the farmers, who can combine ancient traditions and technological innovation in order to reduce the impact of farming; from the manufacturers, who have to invest to develop a truly sustainable food offer, to the institutions and policy makers, now aware that the protection of natural resources and environmental protection are at the top of their priorities.*





## International agreements on climate change

Climate change is one of the greatest problems that humanity has ever faced: rising temperatures, melting ice, the increased frequency of extreme weather events (such as hurricanes, floods, droughts, and heatwaves) are some of the signs that the climate of our planet is changing faster than ever recorded before. Scientists agree that, at the origin of these changes, are the greenhouse gas emissions produced by human activity, the constant increase of which is causing a rise in the global temperature.

According to the Intergovernmental Panel on Climate Change (IPCC)<sup>1</sup>, the effects on our ecosystem will be irreversible unless there is a global commitment to implement concrete measures of lowering the temperature. The temperature could increase to a level between 3.2 and 5.4°C by 2100 whereas, to avoid disaster scenarios (such as the melting of ice, rising water levels, the extinction of some plant and animal species, etc.), the increase in average temperatures has to be kept to a maximum of +2°C.

<sup>1</sup> WMO, UNEP, 2007

## THE EVOLUTION OF THE INTERNATIONAL AGREEMENTS ON CLIMATE CHANGE



- 1992: the UNFCCC (United Nations Framework Convention on Climate Change) is signed. Since then, the signatory nations meet annually at the Conference of the Parties (COP) in order to deal with climate change and to propose solutions.
- 1997: the Kyoto Protocol (COP3) was drafted, which requires the developed countries (37 countries, including the EU, Japan, Russia) to reduce greenhouse gas emissions by an average of 5.2% by 2012, as compared to the levels in 1990. Almost 60% of the countries involved (including France, Britain, and Germany) have met or exceeded the target. Italy has recorded a reduction of 4.6%<sup>2</sup>.
- The COP13 (held in Bali in 2007), the COP15 (in Copenhagen in 2009), the COP16 (in Cancún in 2010), the COP17 (in Durban in 2011), and the COP20 (in Lima in 2014) were the first important steps towards a shared agreement on greenhouse gas emissions management, without any concrete actions being foreseen.
- The COP21, held in Paris from November 30 to December 11, 2015, became the first conference to establish a concrete, long-term plan to reduce greenhouse gas emissions and to involve not only the most advanced countries, but also the developing countries. For the first time in 20 years of negotiations in the United Nations, a legally binding, universal agreement on the climate was signed, with the ambitious goal of keeping global warming below 2° C and, in the longer term, to below 1.5°<sup>3</sup>. The agreement was ratified in New York on April 22, 2016, International Earth Day, by 175 countries (174 countries and the European Union), which is considered a record number of participants for an international agreement signed on a single day.

<sup>2</sup> ISPRA, 2007

<sup>3</sup> <http://www.cop21paris.org/about/cop21>



### COP21: the commitment to reduce greenhouse gases

The Paris Agreement was reached thanks to demanding diplomacy beforehand. The UNFCCC asked the individual participating States to present a proposal for a national climate plan, called the INDC (Intended Nationally Determined Contribution), to reduce their greenhouse gas emissions. There were 162 INDC plans, representing 189 countries, covering almost 99% of global greenhouse gas emissions<sup>4</sup>, and the reductions that have been achieved.

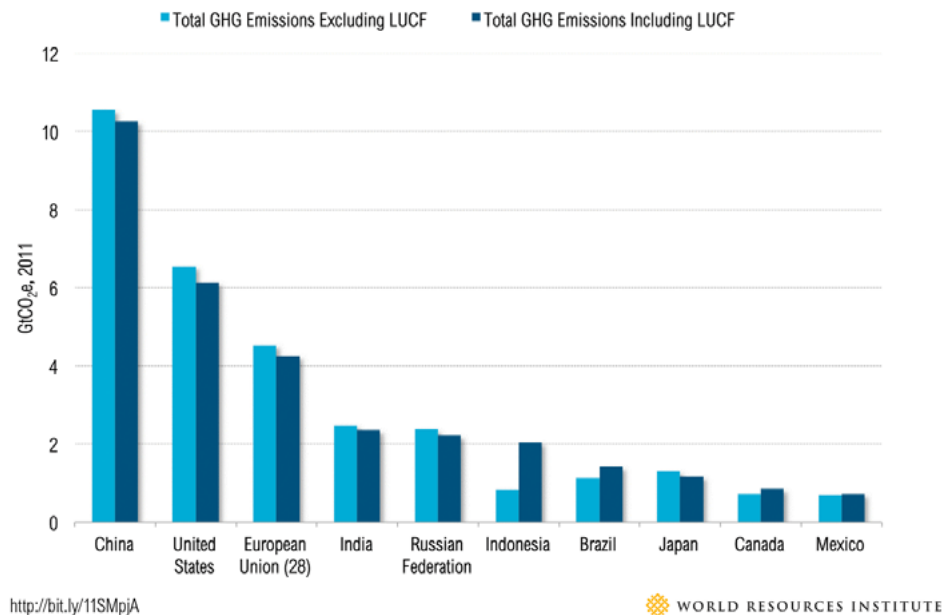
Several countries have proposed an ambitious long-term reduction of greenhouse gas emissions. Europe

will strive to reduce them by 40% below the 1990 levels by 2030; the United States by 17% by 2020 and 26-28% by 2025 (compared to 2005); Canada plans a reduction of 30% by 2030 (compared to 2005), and Australia is committed to a 26-28% reduction by 2030 (compared to 2005). Russia has a goal of 70-75% by 2030 (compared to 1990). Other countries have set targets that will have indirect positive impacts on emissions, such as China, whose INDC includes the commitment to a 20% increase in the use of energy from zero-emission sources by 2030. Argentina has also proposed a use of renewable

energy equal to 8% by 2017, and 20% by 2020.

The COP21 agreement will not enter into force before 2020, 30 days after the rectification of at least 55 countries responsible for at least 55% of greenhouse gas emissions. Every five years, the goals will be reviewed and modified according to the evolution of the global scenario.

<sup>4</sup> World Resource Institute, Climate Data Explorer, 2016



The ten largest producers of CO<sub>2</sub>  
 Source: World Resources Institute 2014

### WHAT DO PEOPLE THINK OF THE COP 21?

According to research carried out by the UNFCCC on a sample of 10,000 people belonging to 79 developed and developing countries, 78% of respondents want their country to implement policies to reduce greenhouse gas emissions, and 70% are not satisfied with the results of the climate agreements prior to the COP21. And there is more: nearly 90% are in favor of a carbon tax (tax on energy sources that emit carbon dioxide into the atmosphere), 56% are in favor of the use of renewable energy, and 46% would support the development of environmentally friendly technologies.



## Climate and food: musings in the light of the international commitments of the COP21

With a total of 76%, production of energy, industry, and transport are the biggest emitters of greenhouse emissions. But agriculture, which was included in AFOLU (Agriculture, Forestry, and Other Land Use, i.e. in the agricultural and forestry sector), also plays a crucial role and is responsible for about a quarter of the total emissions. In Europe<sup>5</sup>, food production is actually the human activity that contributes the most to climate change (31%), surpassing the heating of buildings (23.6%) and means of transport (18.5%). Reforestation, sustainable forest management,

and reduced deforestation are essential for mitigating emissions from the forestry sector, whereas in agriculture, what counts above all are the management of cropland and pastures, and the restoration of soil fertility.

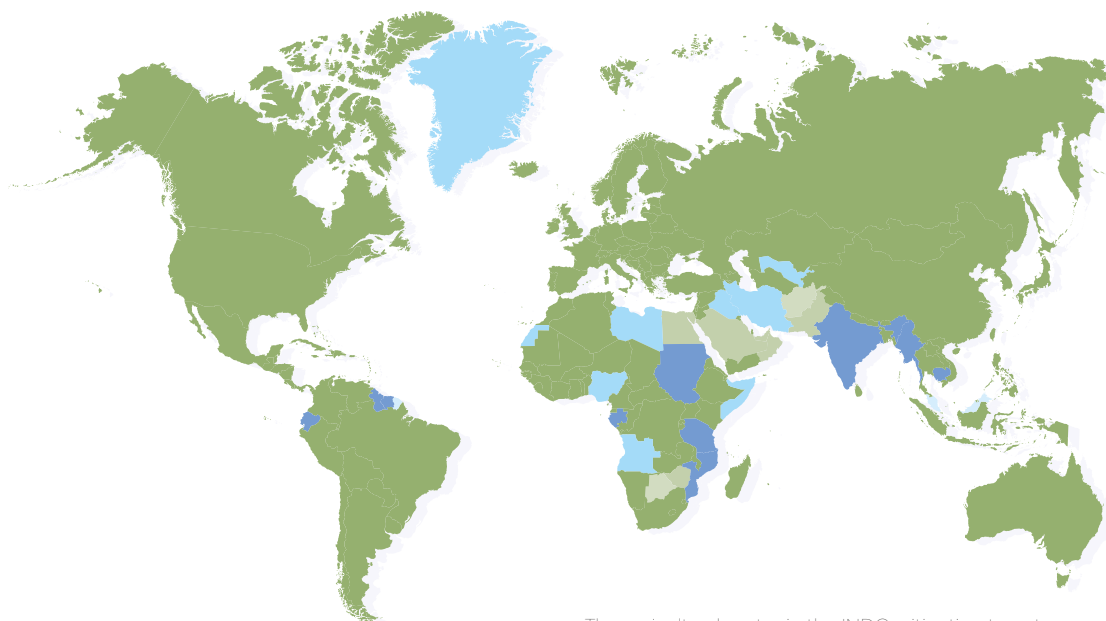
The COP21 underlined just how vulnerable the food production systems are and how affected they are by the negative effects of climate change<sup>6</sup>, which in turn is a major cause of undernourishment and malnutrition in developing countries. Therefore, it is crucial that resilient agricultural systems are adopted, which can also give the least developed countries access to an adequate supply of food. To comply with the limits imposed by the COP21, substantial

action on mitigation and adaptation in the agricultural sector will be necessary. There are 103 countries that have included the issue of agriculture in their INDC, developing medium and long term strategies to improve the sustainability and efficiency in the agri-food sector (see details in the table below). For example, IRRI (Rice Science for a Better World) has developed a method of rice production in Asia that would reduce water usage by 30% and methane emissions by 48%, with no impact on the yields.

<sup>5</sup> Tukker, 2006

<sup>6</sup> UN, 2016

<sup>7</sup> Climate Change, Agriculture, and Food Security



The agricultural sector in the INDC mitigation targets.  
Source: CCAFS<sup>7</sup>, 2015

## THE ROLE OF AGRICULTURE IN INDC MITIGATION CONTRIBUTIONS

- Agriculture and other land use
- No agriculture or land use
- Agriculture only
- Other land use only
- No INDC



Mitigation Measures	No. of Parties
Livestock	54
Croplands	50
Grasslands	48
Rice	48
Manure Managemet	46
Agricultural residue management	41
Fertilizer	17
Agroforestry	15
Climate-smart agricultire	11
Agricultural intensification	6
<b>Total Parties including agricultural mitigation</b>	<b>103</b>
<b>Total Parties specifying at least one measure</b>	<b>84</b>

Main Adaptation Measures	No. of Parties
Livestock management	54
Crop management	51
Fisheries and aquaculture management	48
Irrigation management	46
Water management	45
Knowledge transfer (e.g.extension)	35
Agricultural diversification	32
Soil and land management	31
Climate-smart agriculture	29
Early waarming systems (e.g. seasonal forecast)	28
Agroforestry	22
Agroecology	20
Idigenous knowledge	19
Financial mechanism (e.g. crop insurance)	18
<b>Total Parties including agricultural adaptation</b>	<b>102</b>
<b>Total Parties including at least one measure</b>	<b>94</b>

INDC agricultural mitigation and adaptation measures.  
Source: CCAFS, 2015

A careful examination of the individual national INDC plans prepared in Paris<sup>8</sup> reveals different approaches. The most advanced agricultural economies – such as the United States<sup>9</sup>, Australia and Canada – do not explicitly mention interventions to reduce greenhouse gas emissions in the agricultural sector, but they do state that the sector will be considered. Instead, in the developing countries, where agriculture has the greatest impact in terms of greenhouse gas emissions, most of them propose

specific action plans. For example, in Ethiopia, where the agricultural sector (inserted in the AFOLU) accounts for 85% of total emissions, very ambitious plans have been prepared: a total reduction of 64% of greenhouse gas emissions by 2030, with 86% of inventions regarding precisely the agricultural sector<sup>10</sup>.

Even India, which employs over half of its labor force in agriculture and which is the second country

in the world in terms of greenhouse gas emissions from this sector, has included different mitigation and adaptation projects in its INDC plans that will affect the AFOLU, such as the development

<sup>8</sup> Brookings, 2015

<sup>9</sup> UNFCCC, 2015. US INDC. The target set by the United States is to reduce greenhouse gas emissions by 26% -28% by 2025, compared to 2005

<sup>10</sup> UNFCCC, 2015. Ethiopian INDC



of new technologies with a lower impact on the climate, more sustainable cultivation practices, or reforestation<sup>11</sup>.

The country mainly responsible for greenhouse gas emissions globally is China, which has set different goals and actions for 2020 and 2030, including the promotion of low carbon agriculture, to maintain the same degree of utilization of fertilizers and pesticides until 2020 and prevent their increase, and the development of agriculture which allows the reuse of discarded materials from the agricultural sector<sup>12</sup>. In its INDC plan, the European Union set a target to reduce greenhouse gas emissions by the Member States by 40% (compared with 1990) by 2030, and by 80% by 2050.

All the aspects relating to the agricultural sector and the plans of each country were analyzed by the UFCC-SBSTA (Subsidiary Body for Scientific and Technological Advice)<sup>13</sup>, which will present a separate study in November 2016 to be used as the basis for a concrete program of intervention in the agricultural sector.

<sup>11</sup> UNFCC, 2015. Indian INDC

<sup>12</sup> UNFCC, 2015. Chinese INDC

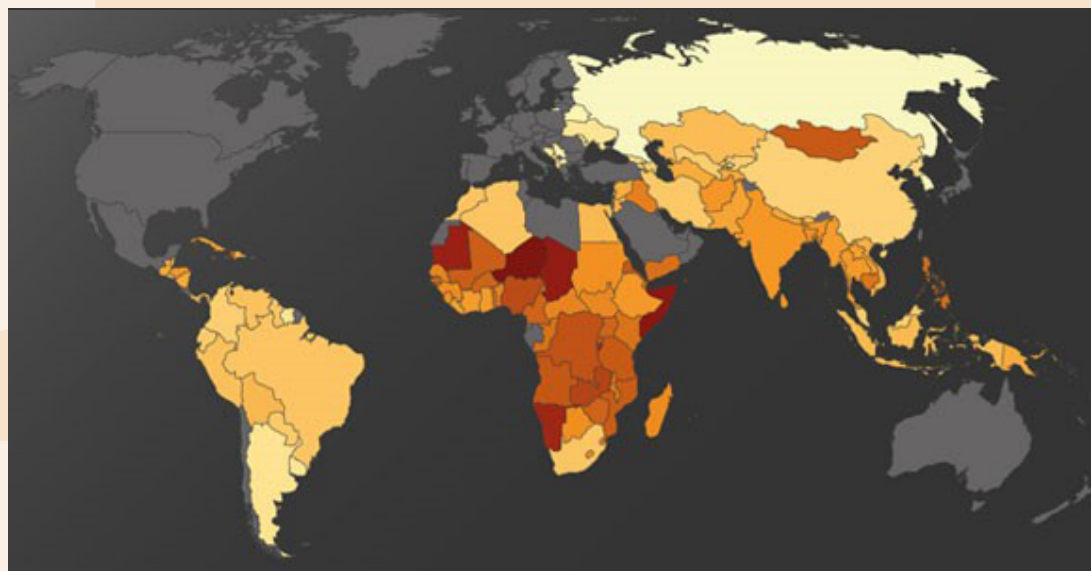
<sup>13</sup> Technical-scientific body of the UNFCC

## ACCESS TO FOOD AND VULNERABILITY TO CLIMATE CHANGE

An interactive online map (launched during the COP21 conference and produced by the UN World Food Program (WFP) and the Met Office Hadley Center<sup>14</sup>), allows visualizing some possible global scenarios between now and 2080. In particular, it relates the levels of greenhouse gas emissions (high, medium, low); the degree of adaptation, understood as the level of interventions implemented in agriculture (high, low, nil); and food vulnerability and

vulnerability to food insecurity of the planet. The map clearly shows that intense efforts are needed for adaptation and mitigation in order to avoid climate change endangering the survival of millions of people.

<sup>14</sup> Met Office, WFP (World Food Program), 2015. <http://www.metoffice.gov.uk/food-insecurity-index/>



Vulnerability to food insecurity.  
Source: WFP, 2015



### *Sustainable diets to combat climate change*

Reducing emissions of agricultural production alone will not be enough. We must also change people's eating habits, by trying to reduce the consumption of products throughout their life cycle – from their cultivation to preparation and subsequent disposal – that have major impacts on the environment<sup>15</sup>. In fact, the more complex the supply chain is, the more the raw materials must be processed before reaching the consumer, thus increasing their impact.

The Intergovernmental Panel on Climate Change (IPCC) pointed out that families' behavior plays a key role in reducing greenhouse gas emissions<sup>16</sup>. If by 2050 the global population were to adjust their food consumption to a diet based on a calorie intake of 2,100 calories a day<sup>17</sup> (of which only 160 are from the consumption of meat, as advised by the World Health Organization<sup>18</sup>), it would be possible to save around 15 gigatonnes of CO<sub>2</sub> equivalent, a third of the global emissions of greenhouse gases in 2011.

### *Are we willing to change our eating habits in favor of the environment?*

In terms of eating habits, it should be noted that, in the face of global population growth, the demand for meat is expected to increase by up to 70% by 2050<sup>19</sup>. This consumption is high in developed countries and increasing in many developing countries, especially in Asia and South America<sup>20</sup>. While it is now known

that reducing the consumption of meat and adopting a sustainable diet can decrease greenhouse gas emissions generated by the food industry by about a quarter<sup>21</sup>, in the near future, the challenge will be to contain the consumption of animal products. This is especially important for developing countries where these foods are considered an aspirational food<sup>22</sup>, that is to say, a symbol of economic well-being. On the other hand, there has been a reduction in meat consumption in some developed countries<sup>23</sup>, such as the United States, where people are increasingly aware of the impact that meat consumption has on their health and the environment; or in France, where a positive relationship between the level of education of the household head and a lower consumption of meat has been shown<sup>24</sup>. However, despite these and other encouraging signs, the road to the adoption of sustainable diets in developed countries is still long: in the United States and the United Kingdom meat consumption per capita, respectively, is triple and double the worldwide average<sup>25</sup>.

However, a recent study pointed out a certain moral disengagement of individuals on the topic: despite awareness of their responsibility towards personal health, the surrounding environment, and animal welfare, they do not really seem to want to change their eating habits<sup>26</sup>. As MacDiarmid has shown<sup>27</sup>, meat is still associated with cultural and social values, and there is still little awareness of the link between diet and climate change<sup>28</sup>. A survey carried out among university students in the United States showed that less than 10% of respondents associated

meat with the issue of climate change<sup>29</sup>. In Australia, too, only 22% of the people believe that eating less meat can reduce environmental impacts, compared to 90% who see the reduction of food packaging as the road to sustainability<sup>30</sup>. A recent study showed that eliminating packaging from the products, air cargo, and the wastage of food by the food system, greenhouse gas emissions would be reduced by only 12%, 5%, and 3% respectively. But by eliminating meat from our diet, emissions would be reduced by a good 35%<sup>31</sup>.

<sup>15</sup> European Commission, 2012

<sup>16</sup> IPCC, 2014, chapter 11: Agriculture, Forestry, and other land use (AFOLU)

<sup>17</sup> UNHCR, UNICEF, WFP, WHO, 2011

<sup>18</sup> WHO

<sup>19</sup> FAO, 2012

<sup>20</sup> Allievi et al., 2015

<sup>21</sup> Macdiarmid et al., 2012; Chun Yip et al., 2013; Soret et al., 2014; Biesbroek et al., 2014; Wellesley et al., 2015.

<sup>22</sup> Popkin, 2006; Smil, 2002

<sup>23</sup> Vranken et al., 2014

<sup>24</sup> Allais et al., 2012

<sup>25</sup> FAOSTAT, 2014

<sup>26</sup> Graça et al., 2014

<sup>27</sup> Macdiarmid, 2016

<sup>28</sup> Vanhonacker et al., 2013; Lea & Worsley, 2003; Tobler et al., 2011; Truelove & Pardi, 2012; Bailey, 2014

<sup>29</sup> Truelove & Pardi, 2012

<sup>30</sup> Lea & Worsley, 2008

<sup>31</sup> Hoolohan, 2013





## Feeding the cities

There is no place where the problems of the global food system are more obvious than in cities<sup>32</sup>. In an era when more than half the world's population lives in cities and the urbanization rate is the highest in history<sup>33</sup>, enormous challenges related to food security must be dealt with in both the industrialized and the developing countries. In the latter, more than half of the household income is for the purchase of food<sup>34</sup>, and even in the industrialized countries, the most vulnerable sectors of the urban population cannot meet their food needs: the number of undernourished people has reached 15 million, an increase of 54% between 2007 and 2010<sup>35</sup>. Testifying to this is the proliferation of food banks, soup kitchens, and charitable meals on wheels services set up in cities around the world.

Taking care of the cities is a priority, in that they play a key role in the transition to a more sustainable food system. In fact, cities are where there is a concentration of unsustainable food practices and challenges such as food insecurity and malnutrition, overweight conditions, and obesity<sup>36</sup>. A city is also the ideal environment for inducing changes in daily practices, namely purchase, preparation, and consumption<sup>37</sup>.

For some time now, there has been talk about smart cities, urban areas where economic activities, mobility, environmental resources, inter-personal relationships, and housing policies are conducted in a "smart" way. Today we also speak of a *food smart city*, the city that, through food, tries to

combine public health, environmental sustainability, social justice, respect for the land, knowledge, and innovation. In other words, in urban contexts, food can facilitate the integration of economic, social, and environmental sustainability<sup>38</sup>.

### Urban food strategies

The initiatives promoted in different cities around the world can be classified on the basis of the goals pursued: 1) ensuring food security and the availability of healthy food; 2) strengthening the local economy; 3) reducing environmental impacts; 4) improving public health<sup>39</sup>. (Table 1)

These objectives can be achieved through an "*urban food strategy*", i.e. a process in which the city changes its approach to food (from procurement to distribution in different urban areas, from the management of urban markets to the redistribution of food waste), by creating synergies between the various stakeholders (local institutions, civil society, and the private sector)<sup>40</sup>. A food strategy is innovative when it redefines the community's knowledge of food, intervenes through legal and regulatory frameworks, and prepares tangible or intangible infrastructures to facilitate food management<sup>41</sup>. However, the elaboration of a food strategy is a complex process, because directly or indirectly, food involves all of the major policies of local municipalities. Not only that, the initiatives related to food and diet have to ensure the achievement of long-term objectives that affect all of

society; for example, they can aim for the reduction of overweight conditions and obesity through the promotion of a balanced diet or taxing certain types of foods (such as those high in sugar)<sup>42</sup>. Therefore, public health, the environment, and society are the three components that a food policy must integrate<sup>43</sup>.

### 1. Ensuring food security and access to food

Among these initiatives to we can mention the creation of the Food Policy Councils, or more simply, Food Boards, responsible for coordinating the efforts of different stakeholders in the urban context and accompanying the development of food policies. The activities of the Food Policy Councils in many cities have played an important role in the evolution of the citizens' food strategy. For example, the strategy of Toronto was drawn up on the basis of its Board's history and experience with food policies<sup>44</sup>. In Vancouver as well, the Council played a key role in defining its food strategy, based on the principles of

<sup>32</sup> Sonnino 2009

<sup>33</sup> UNFPA 2015

<sup>34</sup> FAO 2011

<sup>35</sup> FAOSTAT 2015

<sup>36</sup> Morgan and Sonnino 2010

<sup>37</sup> Cohen and Ilieva 2015

<sup>38</sup> Moragues 2013

<sup>39</sup> Antonelli et al., 2015

<sup>40</sup> Moragues et al., 2013

<sup>41</sup> Di Iacovo 2013

<sup>42</sup> Mah and Thang 2013

<sup>43</sup> Lang 2009

<sup>44</sup> Mah and Thang 2013



health, accessibility, and the sustainability of the local food system<sup>45</sup>. The initiatives to improve the logistics have specific targets, depending on the context, that range from the approach of bringing the countryside closer to the city, to projects for solving the typical supply problems of the so-called food deserts in cities such as Belo Horizonte, New York, and Dar es Salaam<sup>46</sup>. Among these initiatives, there are also some social projects such as “Do Good” in the city of Turin, which recovers unsold surplus food and spontaneous donations from buyers in the local markets, and manages the redistribution to families in economic difficulty, who will then “return” the support received through time, effort, and skills donated to the community. Urban farming is included in this category because, in some cities of the world, its role has been recognized as increasingly important in ensuring the regular and sufficient supply of food in cases of market failure.

## 2. Strengthening the local economy

These are projects that promote the supply of local food by public bodies in contexts such as canteens and schools, and initiatives to strengthen the alternative food networks, such as farmers’ markets, joint purchasing groups, etc. For example, the city of Beijing has incorporated urban farming in its long-term plan, with the objective of making an area of three million cubic meters on the roofs of buildings available in order to create spaces for urban farming<sup>47</sup>. In the city of Dar es Salaam, 74% of the population own cattle and 60% of all milk sold is produced in the city<sup>48</sup>.

## 3. Reducing environmental impacts and waste

These are actions that include social campaigns, food education, and initiatives for food waste prevention. For example, many cities in the UK give support to the WRAP campaign “Love Food, Hate Waste” and host events like “Feeding the 5000” to turn waste into a resource and feed the more vulnerable sections of society (Feedback 2015)<sup>49</sup>.

## 4. Improving public health

Initiatives in this category include nutrition education and conducting campaigns to raise citizens’ awareness of the benefits of a balanced diet and an active lifestyle, and the health risks associated with an excessive consumption of fats, sugar, and alcoholic beverages. “Pouring the pounds”, a campaign, aimed at discouraging excessive consumption of sugar, promoted by the Health Department of the City of New York and nutritional education imparted to the students of 26 high schools in Daegu, South Korea, are examples of this type<sup>50</sup>.

An essential step in accelerating the process of transition to a more sustainable food system is the possibility of using the experiences of different countries and cities that have already implemented change processes locally as a common factor. The Urban Food Policy Pact, promoted by the city of Milan and signed by over 100 municipalities around the world in October 2015, was a great opportunity for knowledge, exchange, and sharing experiences.



<sup>45</sup> EVancouver Food Strategy 2015

<sup>46</sup> Halweil and Nieremberg 2007


<sup>47</sup> Halweil and Nieremberg 2007

<sup>48</sup> Lee Smith and Prain 2006; Halweil and Nieremberg 2007

<sup>49</sup> It is interesting to note that the initiatives of food recovery perform a dual function. On the one hand, they contribute to the reduction of waste (goal 3), and on the other, they carry out a redistribution of food to the most vulnerable groups of society, achieving the goal of “ensuring food security” (goal 1).

<sup>50</sup> Forster et al., 2015



GOAL	TYPES OF INITIATIVES	PROMOTERS	<b>URBAN FOOD STRATEGY</b> 
<b>ENSURE FOOD SECURITY AND THE AVAILABILITY OF HEALTHY FOOD</b>	Formation of Food Policy Boards	Public sector	
	Improvement of Logistics	Public and Private sectors	
	Promotion of urban farming	Public sector NGOs and social movements	
	Development of initiatives to combat urban poverty	Public sector NGOs and social movements	
<b>STRENGTHEN THE LOCAL ECONOMY</b>	Public procurement of local products	Public sector	
	Strengthening of alternative food networks	Public and Private sectors NGOs and social movements	
<b>REDUCE ENVIRONMENTAL IMPACTS</b>	Social campaigns	Public sector NGOs and social movements	
	Environmental education	Public sector NGOs and social movements	
	Food recovery and waste prevention	Public sector NGOs and social movements	
<b>IMPROVE PUBLIC HEALTH</b>	Social campaigns	Public sector NGOs and social movements	
	Education in healthy eating	Public sector NGOs and social movements	

. Initiatives to promote a sustainable diet.  
 Source: BCFN elaboration on Antonelli et al. 2015





# FEEDING CITIES

*Cities have changed their approach to food and this is changing them*

*Cities have changed their approach to food and this is changing them. The initiatives being promoted range from the production phase to that of the disposal of food waste.*

**Source:** Forster et al. (2015), Milan Urban Food Policy Pact. Selected Good Practices from Cities. Utopias/29 Globalization, Giangiacomo Feltrinelli Foundation. Available online: [www.fondazionefeltrinelli.it/article/ebook-utopie-milan-urban-food-policy-pact](http://www.fondazionefeltrinelli.it/article/ebook-utopie-milan-urban-food-policy-pact)

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# THE RITUALS OF FOOD: THE SACRED NATURE OF DIETS

*Food has been, and still is, an instrument that creates identity and borders. There are many cultural and symbolic-religious aspects of food, and even in multi-cultural contexts such as those of today, it is still a vehicle to preserve identities and, at the same time, of influence and encounter: when all is said and done, we still are what we eat.*

*In this chapter we will investigate what food has meant in the past for people and the “religious” values that it still holds today.*



## Food and social rituals

All the fathers of the social sciences (from Marcel Mauss to George Simmel and Emile Durkheim) stressed that food is first and foremost a social fact: eating is an act that is almost never done individually, not only because it is done mostly in the company of others, but because even when dining alone, the way we act always refers to culturally and socially shared habits and choices.

Every meal is the result of behavior that has been layered over time, of sedimented habits passed from generation to generation. Commensality is one of the most typical manifestations of human sociality.

There are different ways, times, and places to dine, but each society has established shared rules and the table has become a social space that governs the relationship between the people seated around it: think of the link between the distribution of the chairs around a table (round or rectangular) and the social role of the occupants, or the order of the dishes or even the diversity of foods consumed by the diners.

The table becomes a small representation of the order that regulates society and the ritual of the meal takes on a strong symbolic value. The dining table is the physical and metaphorical place of belonging or foreignness, membership or exclusion, and all sorts of relationships that exist between the members of a community, within them, or among different communities on the outside.

Food sharing does not just have a ritual importance. According to Pollan<sup>1</sup>, the food preferences of each individual community actually represent one of the strongest social bonds we have. “Historically, national cuisines have been remarkably stable and resistant to change, and this is the reason why an immigrant’s refrigerator is definitely the last place to look to identify signs of integration.”

## Identity and the culture of food

Cuisine is the symbol of civilization and culture; food is configured as a decisive element of human identity and as one of the most effective instruments to communicate it. The reason why there is specific eating behavior in every culture and religion is that

<sup>1</sup> Pollan, 2006

## THE VALUE OF “MEDITERRANEITY”

One of the geographical areas that has produced sharing at the table is precisely the Mediterranean: not only is its diet a balanced mix of foods but it is also, and above all, the result of cultural and participatory social choices. The Mediterranean is thus presented as a macro-table, a cultural dining table, where the same ingredients appear in similar and different dishes and for plural cultures and religions.

The Mediterranean diet promotes social interaction, seeing as the basis of its social customs and holidays is the sharing of a meal; it also gave rise to a considerable body of knowledge, songs, maxims, tales, and legends, and is based on respect for the territory and biodiversity. It guarantees the preservation and development of traditional activities and

crafts linked to fishing and farming in the Mediterranean communities, from Spain to Italy, Morocco, and Greece; Catholics, Sephardic and Ashkenazi Jews, Muslims, the Orthodox, and many others have produced and continue to produce dishes that are considered cultural and religious symbols. From the transmission of skills and knowledge of rituals, traditional gestures and celebrations to safeguarding techniques that nevertheless are simultaneously open to other influences and innovation, the Mediterranean diet is crucial for the development of sustainable and “culturally compatible” practices<sup>2</sup>.

<sup>2</sup> UNESCO, 2010





this allows us to maintain our status: foods take on symbolic, metaphysical, moral, and social values, and are capable of functioning as containers or carriers of identity.

History teaches us that it is the differences and the meeting of different cultures that generate an identity, precisely because it is not static or already written but changeable and constantly evolving. This is evident in the European Middle Ages when, compared to the past, a substantially innovative food and gastronomy identity was shaped due to the influence of different cultures: that of the Roman tradition and the “barbaric” influence. The taste that one looks for on social occasions is a synthesis of historical and cultural forms that led the populations’ food traditions to evolve in parallel with historical events.

The complex symbolic universe that links foods to the effects they have on the body (hot and cold, wet and dry), or to the way in which they are consumed (cooked or raw), and eventually to their being good and “pure” or bad and “impure”, is related to the fact that food is a link between nature and culture. It is humanly universal because it is necessary, yet it is deeply variable, diverse, and arbitrary. Every kind of cuisine, from simple to more complex, from the north to the south and from east to west, subtracts the foodstuff from its natural destiny to integrate it into a system of cultural combinations. For the anthropologist Claude Lévi-Strauss, the relationship humans have with food is similar to their relationship with language. The human tongue makes sounds because it is naturally

predisposed to do so, but the language, grammar rules, syllables, phonemes, words, abstract speeches, poetry, song, and the expression of a particular vision of the world are the result of some of the countless cultural combinations in which the sounds can be articulated. The same thing happens in cooking: nutrition is the natural source of life, but the way in which people eat is entirely cultural.

Food culture is also formed and continues to be formed on the basis of environmental and climatic influences; it changes according to historical events and people, who with their migration bring new elements to it. It is these influences that change the taste of individuals through two-way influences, but which nevertheless do not erase the differences. In Europe there is still a complex geography of food habits which, even though constantly intermingled, continues to have a strong identity: an example of this is the consumption of beer and wine that, despite various influences, continue to be distributed in Europe around the center-north (beer) and the center-south (the wine). Although influenced by the standardization of consumption, local specificities therefore remain rooted in habits, perhaps especially at the popular level. It can be said that globalization has infused the discovery, or rather the rediscovery, of food identity with new meanings, and that, in this context, the differences seem bound to increase rather than to disappear. Today we have a new model of consumption based on an identity that is not only changing but also multiple: global and local, ethnic and fusion cuisine can now coexist. Food models and practices are the meeting points of different cultures,

the result of the circulation of people, goods, techniques, and tastes from one part of the world to another. The livelier and more frequent the meetings and exchanges are – for example, in border areas –, the richer and more interesting the food cultures (as well as cultures in general) are.

### The symbolic value of food in religious faiths

Many rituals, ceremonies, and religious celebrations inevitably include the relationship with food. Precisely because it is a basic and universal element, food “is central to religion – as a symbol, the subject of prayer, as a sign of sharing and not sharing, and as an element of communion”<sup>3</sup>. The symbolic value of food in the great religions cannot be underestimated. In Judaism a significant number of the 613 mitzvot (precepts) that guide the life of an observant Jew regards the food sphere and stems from important passages in the Old Testament. Most of these rules govern the consumption of meat, also because the prevailing interpretation of certain passages in the Bible leads us to believe that humanity was vegetarian at first, and became carnivorous only later, and by divine authority<sup>4</sup>. Many Jewish and Muslim scholars and experts worked during the seventeenth and eighteenth centuries to prove the existence of scientific

<sup>3</sup> Anderson, 2005.

<sup>4</sup> Di Segni, 1986.



foundations as to why pork was forbidden in Islam and Judaism. It was thought that the reason for this taboo was that pork, which could not be suitably preserved in certain climatic zones, was the vehicle of diseases or that the animal's omnivorous diet made its meat difficult to digest. However, none of these reasons can really explain a prohibition that did not stem from "scientific" reasons, but rather, from historical and cultural ones.

Besides the more famous case of pigs, there is no shortage of examples and they touch on the many various taboos concerning the meat of animals (from horses to cats, from dogs to snakes, and to cows, considered by Hindus as sacred, but not unclean), on fish without fins and without scales, on mollusks and crustaceans for the Jews, and certain foods at certain times of year, such as milk, eggs, and their derivatives for Orthodox Christians when they are preparing for Christmas and Easter. According to Jewish tradition, the act of eating teaches how to make continuous choices and verification, thus defining man's relationship with nature, and complies profoundly with sacredness. In this vision, "diet becomes a ritual, a way of being and acting sacredly, an instrument of perfection; it is not just a way to survive and a biological necessity, but also a system of cultural affirmation"<sup>5</sup>.

In religious traditions, the rule is the separation between pure and impure. The idea of purity and impurity is deeply linked to that of contamination, and therefore the rites that each of us enact to avoid it: examples of these are the habit of washing one's hands, maintaining a certain distance from strangers,

changing dishes between one course and another, and emptying the garbage, as Italo Calvino wrote in *La poubelle agréée* (The Agreeable Trash Can) when he lived in Paris, between 1974 and 1976.

### The sacralization of food consumption

The sacred nature of consumption is a real aspect in the field of consumer behavior studies, which investigates how goods, services, places, stores, brands, etc., possessing entirely profane and earthly characteristics can become something sacred for consumers, taking on characteristics that are typical of the sphere of the divine and the supernatural (Belk et al., 1989). So it is not really surprising that one of the most successful books on gluten-free nutrition that came out recently – *The Gluten Lie and Other Myths about What You Eat* (2015) – was written by a professor of religion at the James Madison University, Alan Levinovitz.

In recent years, diets seem to have undergone a progressive process of "sanctification". Not only have they lost a merely functional value linked to food and the livelihood of individuals, charged with meaning, value, and symbolic aspects related to culture, ethnicity, individual identity, but they have become actual "manifestations of the sacred".

The rituals related to food, from the choice of food (what and why) to how and when to eat them, have become veritable *hierophanies*<sup>6</sup>. Thus, for most people dietary regimes are a totally earthly thing, and, in most cases, more than having to follow real

requirements, typical of a regime, they are limited to observing dietary habits. For others, however, especially those who have embraced a diet that could be called non-mainstream (low-carb, grain-free, gluten-free, vegan, vegetarian, Paleo, Dukan, Atkins, etc.), the experience of their diet definitely connotes religious elements.

People who adopt a certain diet embark on a journey that has many of the characteristics of a real *pilgrimage*<sup>7</sup> (Turner and Turner, 1978). In consumers' stories (Nosi and Rugnone, 2015), the path of their diet is often described as a road they have travelled down with sacrifice and effort, leading to a situation where they feel impure and unworthy of a progressive state of well-being and happiness. The process of going from fat to thin, from sickness to health, or from ugly to beautiful, brings with it many of the values that are related to the processes of transformation, real rites of passage, from a profane

<sup>5</sup> Di Segni, 1986.

<sup>6</sup> From the ancient Greek *hierós*, "sacred", and *phainein*, "to appear", the term *hierophany* was introduced by the historian of religions Eliade (1959) to precisely indicate the act by which the sacred manifests itself, something which recognizes a completely different order than the earthly one, a reality that does not belong to our world (Deane e Doty, 1965). Implicit in Eliade's thought is the idea that the sacred does not manifest itself at all. A sacred stone continues to look like all other stones except for those willing to see a revelation of the sacred in it (Belk et al., 1989). The fact that the stone retains its physical and earthly characteristics does not mean that it is not a manifestation of the supernatural, but that its sacred nature appears to only a few ... the privileged, favored, and chosen.

<sup>7</sup> It is not uncommon to come across postings like this on the Internet: "My Pilgrimage Through a Fad Diet", available on <http://www.fringesport.com/blogs/news/77713348-my-pilgrimage-through-a-fad-diet> [latest access on 22/03/2016].



and earthly dimension to a higher, transcendental one where physical, as well as spiritual, well-being is reached. And therefore in the liminal processes, sacredness does not manifest itself in an exclusively individual dimension, but is expressed in terms of sharing, fellowship, and support among many individuals who are simultaneously traveling along the same path (Turner, 1974). Diets are a kind of glue: they are a source of aggregation that brings together those who not only eat in the same way, but who

also share the same ideals and the same beliefs which are manifested in a shared lifestyle and philosophy of life.

#### *Diet Gurus: the creators of charismatic diets*

A further element that suggests a process of the sacralization of diets regards the people who popularize them. In 2005, "Forbes" published a ranking of the most important American Diet Gurus

(Lacey, 2005) which included, among others, Berry Sears (Zone diet), Arthur Agatston (South Beach diet), and Robert Atkins. The creators of these diets are often referred to as geniuses, magicians, or saviors, and the sentiments expressed towards them are of profound gratitude, devotion, and love.

Just as in religion, where there are individuals who are considered sacred - such as the deities, saints, prophets, and church ministers -, in the world of food, the creators of the most popular diets also achieve this status. They become charismatic leaders able to exert an influence over their followers, those who marry their "belief" in addition to their diet, often turning them into real evangelists.

People who are so involved and devoted to a food style from which they draw miraculous benefits can feel compelled to proselytize and convince as many people as possible to abandon their eating habits and to "convert" (Miotto, 2016; Nosi and Rugnone, 2015). It is no coincidence that now, in the case of the Paleolithic diet, there are many blogs that offer tips on how to defend oneself from a Paleo evangelist or make a quick getaway from a Paleo conversation.





## Today's food trends

Some of the contemporary food trends have already been mentioned: the relentless individualization of the meal, which leads to lunches and dinners increasingly being eaten alone, and at the same time, doing other activities (eating in front of the computer screen, sending e-mails, etc.); the dynamics of food integration whereby other people's sets of rules and habits are acquired, while simultaneously maintaining the system of values belonging to their cultural background (eating a pizza topped with kebab meat ). More generally, there is an ongoing process of hybridization, of a pluralism that is conducive to the connection between elements of the original culture and the host culture and the emergence of new and more complex cultural configurations. The third trend is fasting, the lack of food not only for a physical purpose. Among the various circumstances of the absence of food for religious reasons (from prohibition to negation), fasting is found in many traditions; here we are interested in emphasizing that in the third millennium, the most complete form of the absence of substance-food is, paradoxically, a condition of aggregation, which can lead to commensality practices. Thus in different cultures and societies, fasting is experienced together and not alone: people share, help and motivate one another, and together they wait for the time when their renunciation comes to an end.

The latest trend is paradoxically the reversal of the relationship between food and religion: religion not

only influences and is embodied in food, but food itself becomes religion, taking on its sacred character and the set of rules and taboos which, however, is self-based and free from religious reasons.

Adherence to dietary rules as if they were religious requirements, the social and cultural sanctions levied on some consumption that is considered improper or

unethical, the sense of belonging of those who share a certain food life-style ("all those who" ... feel, above all, they are vegetarians or vegans, "those who" ... do not eat red meat, "those who ... drink water with lemon every morning) are the consequences of a society where the weakened traditional religious sense is expressed in new forms of practices and beliefs that create other social and cultural ties.



## DIETS AND FOOD TRENDS<sup>9</sup>

Balanced and healthy; “miraculous”; ethical, “trendy”: there are so many kinds of diets. Beyond the motivations for adopting them, not all of them are advisable from a nutritional point of view, and in fact in some cases, the excessive imbalance may even be harmful. Let’s take a look at them together.

### Lacto-Ovo Vegetarian Diet

The lacto-ovo vegetarian diet is based on grains, vegetables, fruit, legumes, seeds, nuts, dairy products, and eggs. This model can reduce the risk of chronic diseases due to a low consumption of saturated fat and cholesterol and higher intakes of phytochemicals found in foods of plant origin.

### Flexitarian Diet

The flexitarian, or reducetarian, diet is a vegetarian diet that occasionally includes meat and/or fish. More than a diet, it’s an identity, a community, a movement, in which one tends to eat fewer animal derivatives in general. The commonest reasons behind the choice of a vegetarian and flexitarian diet are health effects, concern for the environment, and the welfare of farm animals. The reasons vegetarians give for their choice include economic and ethical motivations, religious beliefs, and the inequitable distribution of food among the world’s population.

### Vegan Diet

The vegan model prescribes the exclusion of eggs, dairy products, and sometimes honey, as well as other animal products. According to the Academy of Nutrition and Dietetics, appropriately planned vegetarian diets, including vegan diets, are healthful, nutritionally adequate, and may provide health benefits in the prevention and treatment of certain diseases.

### Raw food diet

This diet consists mainly or exclusively of raw foods and food processed at temperatures below approximately 40°C. In most cases it is a vegan diet based on fruit, vegetables, nuts, and sprouted seeds, grains, and beans. In rare cases, unpasteurized dairy products and raw meat and fish are consumed. The theory at the basis of this diet is that heat degrades most of the vitamins, phytonutrients, and enzymes found in food. The elimination of high-calorie processed foods can result in weight loss; however, there is a risk of nutritional deficiencies and microbial contamination of uncooked foods.

### Macrobiotic Diet

The macrobiotic diet is based largely on grains, legumes, and vegetables, whereas fruit, nuts, and seeds are used to a lesser extent. This is not

really a purely vegetarian diet since it allows a limited amount of fish. Those who follow this dietary model attempt to balance the elements of yin and yang in food in order to improve the welfare of the person and to treat certain diseases. There is no scientific evidence to support these recommendations.

<sup>9</sup> American Academy of Nutrition and Dietetics Position Papers <http://www.eatrightpro.org/resources/practice/position-and-practice-papers/position-papers>  
 Mayo Clinic Website <http://www.mayoclinic.org/healthy-lifestyle/nutrition-and-healthy-eating/basics/nutrition-basics/hlv-20049477>



### Gluten-Free Diet

Gluten is a protein found in grains such as wheat, spelt, barley, rye, hulled wheat, and triticale, and in people with celiac disease and gluten sensitivity, it triggers an auto-immune reaction. For individuals suffering from these diseases, diet is an essential medical treatment. However, a growing number of people follow a gluten-free diet to lose weight or to have health benefits that are often unproven. Moreover, by choosing processed, packaged, gluten-free food, one tends to consume more sugar, fat, and salt.

### Paleo Diet

Those who follow this diet choose foods that can (or at least could) be hunted, fished, and gathered: meat, fish, shellfish, poultry, eggs, vegetables, roots, fruit, and berries. This diet excludes grains, dairy products, legumes, sugar, and salt. The elimination of high-calorie processed foods may be the explanation of any weight loss. At the same time, the exclusion of specific food groups such as grains and dairy products are not a guarantee for weight loss or improved health, and a balanced diet could lead to the same effect and would be easier to sustain.

### Detox Diet

Detox diets are varied, but they generally have

a common denominator: a period of fasting followed by a strict diet of raw vegetables, fruit and fruit juices, and water. Some detox diets include the use of herbs and other supplements for the intestine. There is little scientific evidence regarding their ability to eliminate toxins from the body, whereas the kidneys and liver consistently and effectively carry out this function.

### Dukan / Atkins / South Beach Diets

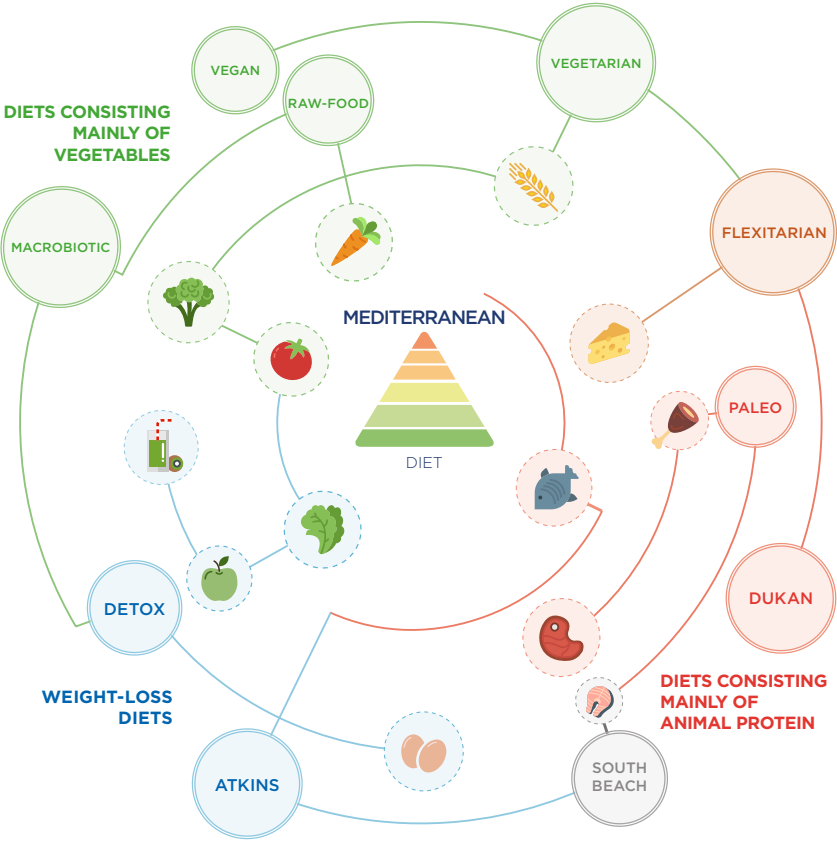
Dukan, Atkins and South Beach are diets that are high in protein and low in carbohydrates. These are strict diets that provide for an initial exclusion of entire food groups, and their gradual reintroduction. These restrictive eating patterns generally work in the short term but do not pay off in the long term, and can cause serious nutritional deficiencies.





# TRENDY DIETS

The **Mediterranean diet** includes a balanced consumption of all foods, without exceptions



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## WHAT SHOULD WE EAT?

The foods allowed in each diet

Index	meat	fish	eggs	dairy product	honey	cereals	bakery	fruit	vegetables	potatoes & tubers	legumes	dried fruit
MEDITERRANEAN												
VEGAN												
MACROBIOTIC												
RAW-FOOD												
VEGETARIAN												
FLEXITARIAN												
PALEO												
DUKAN												
SOUTH BEACH												
ATKINS												
DETOX												

The transparent foods indicate a consumption that is sporadic and/or reserved for specific variants of the diet

## REASONS FOR ADOPTING A DIET

HEALTH & WELLNESS

ETHICS

RESPECT FOR THE ENVIRONMENT

LOSING WEIGHT

## Food phobias and the “demonization” of food

Another factor that characterizes sacredness, and traces of which can be found in the current approach to diets, is the ambivalent reaction one has when dealing with divine power, which combines fascination and devotion with feelings of fear and repulsion, and this is known as kratophany<sup>10</sup>. If one believes in the supreme Good, they implicitly admit that there is also Evil with a capital “E”. While the events of Good are benevolent, pious, holy, and pure, those of Evil are bad, diabolical, and impure. Therefore, from the obvious consideration that some foods are “good” while others are “evil”, this leads to a real demonization of certain foods: for some people – even though they do not have celiac disease – it is gluten, for others, carbohydrates, and for others, only refined carbohydrates, accused not only of being the cause of obesity, but also of causing physical injury and various diseases, including brain diseases. And all this happens in a crescendo of opposition between good and evil based on beliefs that seem to have more to do with faith, superstition, and taboos than with any scientific evidence<sup>11</sup>.

The opposition between what is pure and what is impure, between what is virtuous and what is contaminated, through a process of objectification of good and bad in foods, is definitely another element that reinforces the idea of the sacralization of diets. This is why some diets are attributed with a real miraculous power, typical of the legends and mythological tales, such as the ability to heal or rejuvenate. At the same time, while recognizing the

sacred in diets, and thus their kratophanic power, one is instilled with fear. They feel guilty for straying, for giving in to the temptation to eat something that they should not have, and are ready to sacrifice themselves to recover that state of rigor and purity achieved before they had erred<sup>12</sup>.

That which is sacred has an influence on human behavior independently, and in fact often contrarily, of objective reasoning<sup>13</sup>. The sacred is something absolute that, in order to be believed, does not need rational and logical arguments: it is based on mystery and dogma. Religion is an act of faith. But

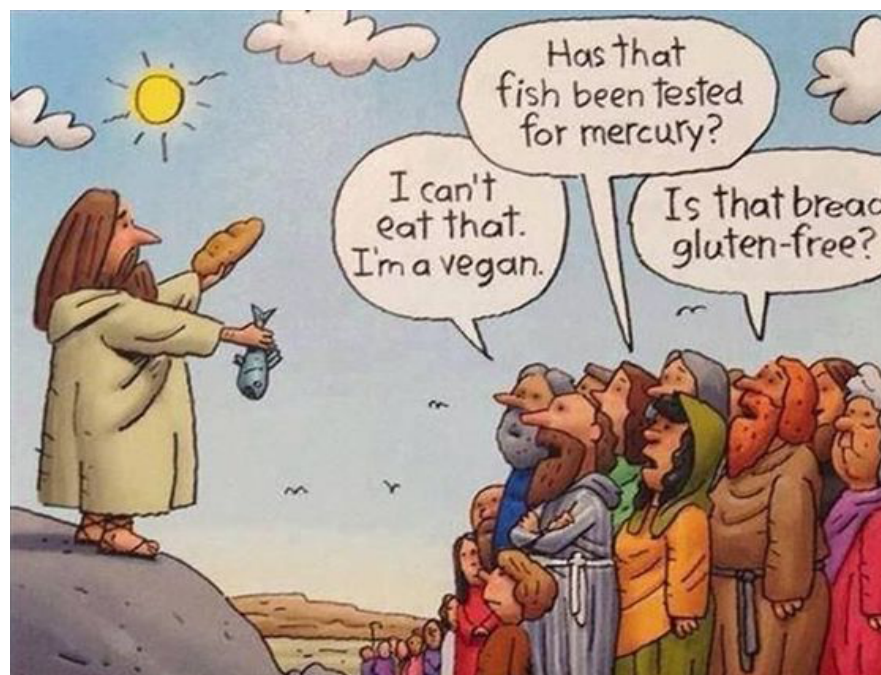
if today’s approach to a diet is similar to the way one approaches a belief and a philosophy of life, it would be appropriate to reflect on how to undertake communication in this field and what the most effective persuasive arguments are. And it is quite clear that, if this is how things really are, science has a marginal role.

<sup>10</sup> Durkheim, 1975

<sup>11</sup> Levinovitz, 2015.

<sup>12</sup> Nosi and Rungnone, 2015.

<sup>13</sup> Callois, 1959.



## CARBOPHOBIA

High-protein, low-fat, sugar-free, gluten-free diets: people are looking for the perfect foods, the eating style that will finally allow them to get into perfect shape. Most of the time, those seated at the table who choose a “reductionist” approach only enter into a vicious cycle of fasting, sacrifices, relapses, and attempting other new diets.

The current enemy seems to be carbohydrates. According to a recent survey, 29% of Americans are trying to avoid their intake, and Italians are beginning to follow suit. This negative attitude towards bread and pasta has been spreading for some years, so that in 2005 the physician and author Michael Greger gave it a name: carbophobia.

The driving force behind the fear of carbohydrates is a series of trendy books and diet programs, such as Wheat Belly or No Sugar No Grains, none of which are supported by a scientific background. Moreover, none of the researchers or articles published in the most accredited scientific journals supports the underlying thesis of the carbophobic diets. Where does this strange trend come from? Probably from so-called nutritionism, a term coined by Michael Pollan in his book *The Omnivore's Dilemma*: the mania of judging the value of a diet not according to the food, but

only with respect to their nutritional composition. The author also ponders on our daily difficulties in having to choose from an endless variety of foods in a social context that leads us further and further away from our own culture and tradition. So this is why we need shortcuts to choose what to put on our dinner table: categorizing them as “good” or “bad” is the simplest way.

From a nutritional standpoint, diets that exclude carbohydrates are unbalanced, and are not sustainable in the long term. If all carbohydrates were really bad for us, then the consumption of foods such as fruit, vegetables, and whole grains would also have to be reduced. And this

would deprive the body not only of the energy it requires, but also of essential nutrients like vitamins and minerals. In conclusion: no diet that is based on the elimination of a specific nutrient works, and to obsessively select only certain types of “good” foods only makes sense if you want to lose weight quickly, with the near certainty of regaining it quickly, even with “interest”. Eating healthily and maintaining a balanced relationship with food is a long, difficult path full of compromises, where there are no easy solutions, but the rewards in terms of health, longevity, and taste will no doubt be the best reward.





## ORTHOREXIA: THE UNHEALTHY OBSESSION OF EATING HEALTHILY

Orthorexia has been described by Steve Bratman as an obsession for a healthy diet. What could be wrong with the desire to eat healthy? On the other hand, promoting a proper food life-style is the work of many professionals. But when the natural desire to improve one's diet leads to a form of obsession, the consequences can be dangerous.

Although it is not yet a clinically recognized disorder, orthorexia is spreading and gaining media attention.

Unlike anorexia or bulimia, orthorexia is not characterized by the desire to be thin. The driving force is the desire for perfect health and a state of "purity", which often finds a positive reinforcement within society.

The people who are affected by it start by choosing organic and whole foods, with specific nutritional characteristics. Then they go on to the complete exclusion of "impure" foods in an obsessive search for "cleaner and cleaner" foods until their restrictive behavior leads them to

exclude almost all foods, which interferes with their quality of life. Orthorexic people end up avoiding social situations for fear of not finding the foods allowed in their diet. With the spread of nutritionism and food trends in fashion in affluent societies, the relationship with food is becoming less serene, leading to a loss of the classic reference points and pleasure that have traditionally been associated with the dinner table.







# DISSEMINATION OF THE DOUBLE PYRAMID



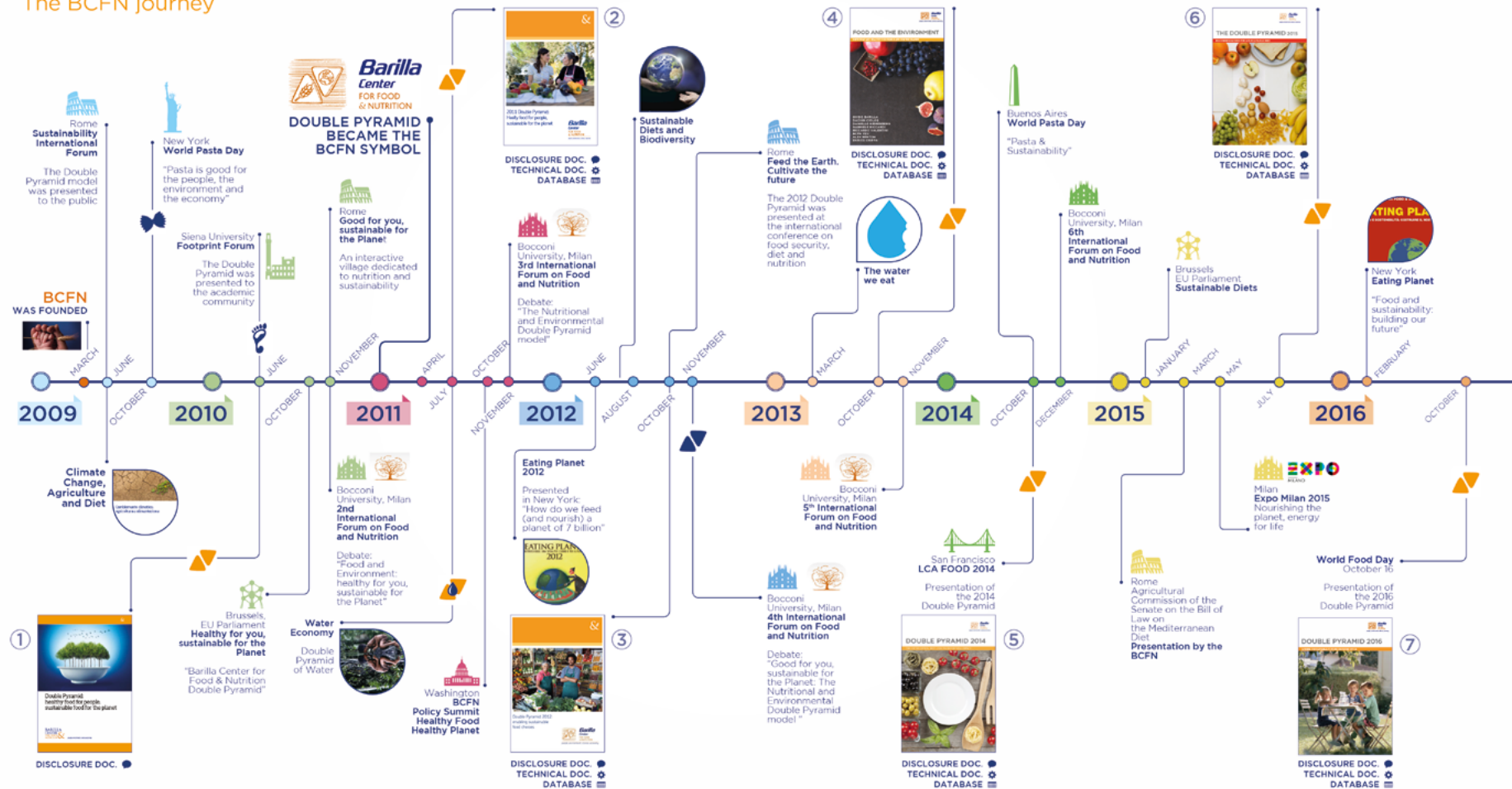
DOUBLE PYRAMID: A SEVEN-YEAR JOURNEY

DISSEMINATION ACTIVITIES



# 7 YEARS OF THE DOUBLE PYRAMID

The BCFN journey



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The following table shows the main meetings, not only those organized by BCFN, which had food in relation to environmental impact as the main theme.

	EVENT	HOSTED BY	HIGHLIGHTS	PLACE
<b>2009</b>				
<b>October 26</b>	World Pasta Day	International Pasta Organization (IPO)	"Pasta is good for the people, the environment and the economy"	New York , US
<b>2010</b>				
<b>June 7-12</b>	Footprint Forum	Uni Siena; GFN	Speech entitled "Barilla & Ecological Footprint", that introduces the concept of "Double Pyramid" to raise visibility in the academic world.	Siena, Italy
<b>June 29</b>	Food and the Environment: Healthy for you, Sustainable for the Planet	BCFN	Presentation of paper "Double Pyramid: healthy food for people, sustainable for the planet"	Milan, Italy Museum of Science
<b>October 12</b>	Healthy for you, Sustainable for the Planet	BCFN; Agriculture and Rural Development Committee of the European Parliament and development	Debate on nutrition, environment and health. Interventions: "The Double Pyramid of the Barilla Centre for Food & Nutrition" and "Food consumption and impacts on the global environment"	Brussels, Belgium European Parliament
<b>October 22</b>	I bambini ci guardano (The Children Are Watching)	Italian Society of Pediatrics	Presentation of the "Double Pyramid" concept	Rome, Italy Ergife



	EVENT	HOSTED BY	HIGHLIGHTS	PLACE
<b>November 5-7</b>	Buono per te, sostenibile per l'ambiente (Good for you, sustainable for the environment)	BCFN; Legambiente	An interactive village dedicated to food and sustainability. "Three days to discover together a great opportunity: the resources of the planet and the health of people can be defended with the same simple act of shopping in a responsible and conscious manner, simply following the principles of the Mediterranean diet"	Rome, Italy Piazza San Giovanni
<b>November 30 October 1</b>	2nd International Forum on Food and Nutrition	BCFN	Debate: "Food and the Environment: healthy for you, sustainable for the Planet"	Milan, Italy Bocconi University
<b>2011 THE DOUBLE PYRAMID BECOMES THE BCFN ICON</b>				
<b>April 6</b>	European Flour Millers Conference	The European Flour Millers	Interventions: "Sustainability, BCFN Double Pyramid and Wheat"	Brussels, Belgium
<b>April 20</b>	Water Economy: Water emergency between availability and economic interests	-	Presentation of the paper: "Water Economy". The paper presents the concept of the Water Double Pyramid in relation to the impact of food and drinks	WEBINAR on barillacfn.com
<b>July 6</b>	Alimentazione e ambiente: un Pianeta migliore per i nostri figli (Food and the environment: a better planet for our children)	BCFN	Presentation of paper "2011 Double Pyramid: healthy food for all, sustainable for the environment"	Rome, Italy Ripetta Residence



	EVENT	HOSTED BY	HIGHLIGHTS	PLACE
<b>September 5-7</b>	Greening the Economy with Agriculture	FAO; OECD Expert Meeting	Discussione sul paper GEA “Food availability and natural resource use in a green economy context”	Paris, France
<b>October 17</b>	A new approach to well-being, to integrate human health and sustainable development	BCFN	Presentation of the Double Pyramid	Paris, France Italian Embassy
<b>October 26</b>	Healthy Food   Healthy Planet	National Journal LIVE; BCFN	Debate on how to ensure production models and nutritional healthy and and sustainable for the planet, on the steps to take to protect the environment from the adverse effects of food production, on how the public and private sectors can work together to reduce these effects and, finally, on how the United States can address these issues from the point of view of policy and legislation.	Washington, U.S.
<b>November 22</b>	TGDF Food Congress '11	TGDF	Presentation of impacts classification by the Euro-Mediterranean on Climate Change Centre	Boyalik, Turkey
<b>November 30 October 1</b>	3 <sup>rd</sup> International Forum on Food and Nutrition	BCFN	Debate: “La Doppia Piramide Alimentare e Ambientale” (The Double Pyramid Food and Environment)	Milan, Italy Bocconi University



2012	EVENT	HOSTED BY	HIGHLIGHTS	PLACE
<b>March 12-17</b>	World Water Forum	France; the City of Marseille; the World Water Council	Presentation of the food and environmental Double Pyramid and food and water Pyramid, selected by the Committee of the Forum as part of the debate on water economy and the management of water resources, among the most effective ideas. In-session insights "Water conservation and sustainable diets: reduce post-harvest losses and food waste for multiple benefits" entitled "Piramide alimentare e idrica e menu sostenibili" (Food and Water Pyramids and sustainable menu)	Marseille, France
<b>March 26-29</b>	Planet under Pressure	IGBP; Diversitas; IHDP; WCRP	Interventions in the section "How much water do we eat?" entitled "The Pyramid BCFN water footprint" and "Is eating healthy is also healthy for the environment?" The BCFN Double Pyramid BCFN	London, UK
<b>May 10</b>	Supplier - Retailers collaboration on sustainable topics	ECR	Presentation of BCFN and the Double Pyramid	Brussels, Belgium
<b>June 4</b>	-	-	Presentation of the project Barilla YES! Young Earth Ideas - Food and sustainability: how to reduce our environmental impact, health and ensuring access to food for all	-
<b>June 7</b>	Summer School PureFood	University of Pisa	Presentation of BCFN	Pisa, Italy





	EVENT	HOSTED BY	HIGHLIGHTS	PLACE
June 14	Business, Health and Prosperity Leadership for the Future of Human Health	University of Cambridge; Royal Society	Intervention within the “Healthy food” entitled “Products for healthy lifestyle”	London, UK
June 26	Sustainability, sweet sustainability	CAOBISCO	Presentation of BCFN and Double Pyramid during the round table	Brussels, Belgium
June 28	Eating Planet - Nutrition Today: A Challenge for Mankind and for the Planet	BCFN; Worldwatch Institute	Presentation of the book “Eating Planet 2012”. The book explores the paradoxes of the global food system, the cultural value of the food habits of production and consumption, and the effects of individual eating habits on health and the environment. It also highlights the promising efforts to increase agricultural sustainability.	New York, US
July 5	The Agribusiness industry meets the Water Footprint	AIMS Venice Research	“The commitment of Barilla to sustainable agriculture”	Marghera, Italy
July 18	Come mangeremo (How we will eat)	Reggio Emilia Civic Museums	Interventions: “The food and environment Double Pyramid: food, health and sustainability	Reggio Emilia, Italy Civic Museums
August 8	Sustainable Diets and Biodiversity	FAO	FAO chapter in the book titled “Double Pyramid: healthy food for people and Sustainable for the planet”	-

	EVENT	HOSTED BY	HIGHLIGHTS	PLACE
<b>September 7</b>	3 <sup>rd</sup> International Conference on Degrowth, Ecological Sustainability and Social Equity	Association for degrowth	Interventions: "The environmental and nutritional model of the Double Pyramid proposed by BCFN - Common goods and food sovereignty, Double Pyramid and economic considerations on sustainable diets"	Venice, Italy
<b>September 21</b>	RIO + 20: Actions and programs of Italy for Sustainable Development	Oxfam Italia; Slow Food Italia	In the session "The world great references that connect the Italian role in national and international development: "Zero Hunger Challenge" and Target 2015 Millennium Development Goals and Universal Exposition "Feeding the Planet, Energy for Life" - how to get into action "presentation of the BCFN and Double Pyramid	Rome, Italy
<b>September 26</b>	Planetworkshop's Global Conference 2012	The Planetworkshops; Representation in France of the European Commission	Within the focus "Human Health, Healthy Territories" presentation of the position paper BCFN "Sustainable Agriculture and Climate Change", which is the sustainability of the food supply chain and its impact on climate change, with reference to the Double Pyramid model developed by BCFN.	Evian les Bains, France
<b>October 10</b>	Good for you, for the planet: the Food and Environment Double Pyramid model	BCFN	Presentation paper: "Double Pyramid 2012: promoting food choices"	WEBINAR on <a href="http://barillacfn.com">barillacfn.com</a>
<b>October 15</b>	Feed the earth. Cultivate the future	MFA: IFAD; Pam	Presentation of the Double Pyramid 2012 within the international conference on food safety, eating habits and nutrition.	Rome, Italy Ara Pacis





	EVENT	HOSTED BY	HIGHLIGHTS	PLACE
<b>October 22</b>	Food and environment: links between nutrition and environmental impacts	SINU; BCFN	Within the XXXV Congress of the Italian Society of Human Nutrition analysis, under a multidisciplinary point of view, the complex problem of the impact of the food supply chain and food consumption on the environment and the ecological consequences of human drinking behaviour	Bologna, Italy
<b>October 23</b>	RAI "MEDICINA 33"	RAI	Roberto Ciati presented the Double Pyramid Model	TV
<b>October 25</b>	Salone del Gusto e Terra Madre	Slow Food	Presentation of the book "Eating Planet 2012", within the encounter on today's paradoxes and challenges "Diamoci un taglio"	Turin, Italy
<b>November 3</b>	Science Festival	Association Festival of Science	Is eating healthy and sustainable also good for the wallet? The BCFN spoke about "Eating habits and sustainability."	Genova, Italy
<b>November 6-8</b>	The Consumer Goods Forum	The Consumer Goods Forum	Within the section "Supply Chain Excellence from Outside" speech entitled "Supply Chain Efficiency to Nourish the Planet"	Paris, France
<b>November 28-29</b>	4th International Forum on Food and Nutrition	BCFN	Debate "Good for you, for the planet: the model of the Food and Environment Double Pyramid"	Milan, Italy Bocconi University



2013

	EVENT	HOSTED BY	HIGHLIGHTS	PLACE
March	FIMP Nutrition School Workshop	Italian Federation of Paediatricians	Intervention “Good for you, sustainable for the planet: the Model of the food and environment Double Pyramid”	Parma, Italy
March 22	World Water Day	-	Presentation of the book “L’acqua che Mangiamo” (The water we eat). The book explains, with a multidisciplinary approach, the problem of water and its implications for economic, social and political, and it also contains a contribution from the Double Pyramid BCFN on the concept of food and water and some data on virtual water trading relevant to pasta.	barillacfn.com
April 12	Sustainability and social responsibility: the ingredients for competitiveness in 2020	Libera University of Bolzano	Business testimonials on corporate social responsibility	Bozen, Italy
May 28	Pane e Cioccolato (Bread and Chocolate)	Zoological Station Anton Dohrn	Speech entitled: “Good for you and sustainable for the planet: the BCFN Double Pyramid”	Naples, Italy
September 1-6	World Water Week	Stockholm International Water Institute	Speech “Water Economy: Water emergency focussing on availability and economic interests”	Stockholm, Sweden



	EVENT	HOSTED BY	HIGHLIGHTS	PLACE
2014				
October	9th International Conference on Life Cycle Assessment in the Agri-Food Sector	LCA Food	Presentation of the Double Pyramid 2014 “The fifth edition: diet and environmental impact”	San Francisco, US
2015				
January	“Good for You, Good for the Environment”	MEP, ENVI, AGRI	Presentation of a policy paper on Sustainable Diets	Brussels, Belgium European Parliament
March	A session on a bill of law on the Mediterranean Diet	-	Speech about Mediterranean Diet	Rome, Italy Italian Senate
May October	EXPO 2015	-	Different events in which the Double Pyramid has been presented	Italy, Europe, US
September 15	International conference on Agriculture in an Urbanizing Society	-	Presentation of the Double Pyramid	Roma, Università di Roma Tre
October	World Sustainability Forum	-	Presentation of the Double Pyramid 2015	Basel



	EVENT	HOSTED BY	HIGHLIGHTS	PLACE
<b>November</b>	Global Cleaner Production & Sustainable Consumption Conference	LCA Food	Presentation of the Double Pyramid	Sitges, Barcelona
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<b>2016</b>				
<b>February 23</b>	Eating Planet 2016	-	Launch of the new edition of Eating Planet: "Food and sustainability: building our future"	New York
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<b>April 21</b>	Eating Planet 2016	-	Launch of the new edition of Eating Planet: "Food and sustainability: building our future"	Rome
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# BIBLIOGRAPHY



*CHAPTER 1*

*CHAPTER 2*

*CHAPTER 3*

*CHAPTER 4*

*CHAPTER 5*

*CHAPTER 6*

*CHAPTER 7*

*CHAPTER 8*

*BCFN PUBLICATIONS*

*SITOGRAPHY*



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Last access: September 2016







## ATTACHMENTS



### ESTIMATE IMPACT OF SPECIFIC FOODS: HYPOTHESES

- 🔥 Breakfast cereals
- 🔥 Olive oil
- 🔥 Eggs

### ASSUMPTIONS FOR THE CALCULATION OF WORLD DIETS

- 🔥 Weights and units of measurement
- 🔥 Assimilations to the Double pyramid categories
- 🔥 Main foods omitted
- 🔥 Convenience food
- 🔥 Fast food
- 🔥 List of food by Country

### MENU RECIPES

- 🔥 Daily menu
- 🔥 Weekly menu

### HISTORY OF EDITIONS



# ESTIMATED IMPACT OF SPECIFIC FOODS: HYPOTHESES

The following pages provide some insights on the assumptions made the working group to estimate the environmental impact of specific foods, for which no exhaustive and detailed information were found in public databases.

Throughout the years, the value of these initial elaborations have been confirmed by new bibliographical sources.

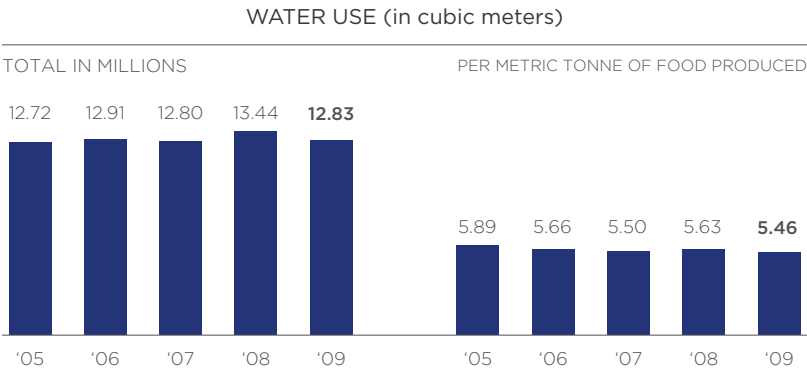
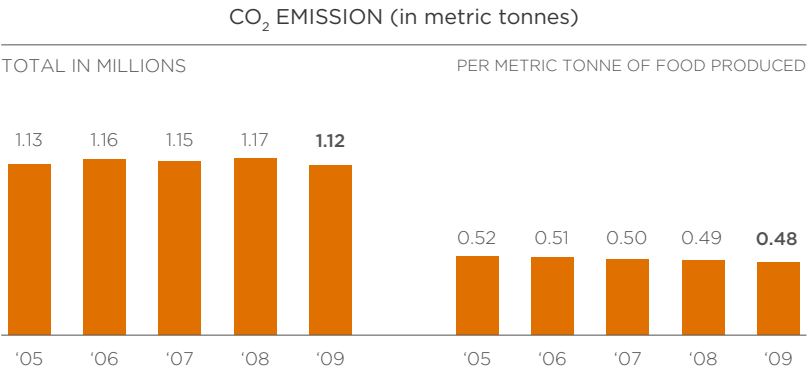
## Breakfast Cereals

To complete the details on the environmental impacts of products included in the food pyramid (particularly for the pyramid for children and adolescents), the working group proceeded with the analysis of breakfast cereal production, given that insufficient data was contained in public databases. The details of the calculations are as follows. Cornflakes were taken as the sample food, for which the data and information available allowed an estimated value for each of the three environmental indicators. The functional unit adopted is one kilogram of cornflakes ready for consumption. Starting from the reference recipe<sup>1</sup>, which requires

98% of all ingredients to be made from corn, it was assumed that the remaining 2% is sugar (added vitamins and minerals have been ignored, due to the small quantities concerned). The system boundaries comprise the following phases:

- Production of raw materials (corn and sugar);
- Cereal processing and extrusion of flakes, for which the data contained in the Sustainability Report of one of the leading manufacturers<sup>2</sup> was used (listed below for the sake of convenience).

<sup>1</sup> Kellogg's, Italian Corn Flakes Original.  
<sup>2</sup> Power and water consumption due to corn processing from: Kellogg's Corporate Responsibility Report, 2009



Power and water consumption due to corn processing  
Source: Kellogg's Corporate Responsibility Report, 2009





With regard to the agricultural phase, the carbon footprint of corn and sugar were calculated using the conversion factors published for CO<sub>2</sub> equivalence by the International Panel on Climate Changes (IPCC) in 2007. In particular, two operations were used from the EcolInvent database:

- For corn the operation “maize seed IP, at farm, CH, [kg] (# 136)” was employed;
- For sugar the operation “sugar, from sugar beet, sugar refinery at, CH, [kg] (# 6580)” was used.

The estimated emissions of CO<sub>2</sub> equivalent for the processing stage of cereal (in g CO<sub>2</sub> per kilogram of manufactured product) are those from the 2009 Kellogg’s Sustainability Report; and this contribution

was added to the environmental impact of the cultivation phase, thereby obtaining the overall value of the Carbon Footprint.

Regarding the calculation of the Water Footprint, water consumption during the crop phase for the production of corn and sugar (from the online database of the Water Footprint Network) and during processing (i.e. the consumption of water during the processing of the product, considered Blue Water) from the 2009 Kellogg’s Sustainability Report (and reported in the reference graph, above) were summed.

Lastly, the Ecological Footprint accounts for, in the first approximation, the crop land used in the

agricultural phase and the land required to absorb the CO<sub>2</sub> emissions generated during the process. The Ecological Footprint of the agricultural phase was determined by the method of “ecological footprint / total: 4” available from EcolInvent. With regard to the processing phase, the CO<sub>2</sub> emissions related to the processing of raw materials were transformed into Energy Land by means of a specific coefficient (2.77 gm<sup>2</sup>/kg CO<sub>2</sub>), as explained in the section on environmental indicators. In conclusion, the following table offers a summary of the impacts considered in assessing the three environmental indicators (Carbon Footprint, Water Footprint and Ecological Footprint) for one kilogram of breakfast cereals.



CARBON FOOTPRINT - DATA IN GRAMS OF CO <sub>2</sub> PER KG						
INGREDIENTS	DATA SOURCE	SPECIFIC IMPACTS	% IN THE RECIPE	CARBON FOOTPRINT		
				INGREDIENTS	PROCESS	TOTAL
CORN	maize seed IP, at farm, CH, [kg] (#136)	1570	98%	1550	480	2027
SUGAR	sugar, from sugar beet, at sugar refinery, CH, [kg] (#6580)	440	2%			

Carbon footprint calculation for 1 kg of breakfast cereal

WATER FOOTPRINT - DATA IN LITERS PER KG						
INGREDIENTS	DATA SOURCE	SPECIFIC IMPACTS	% IN THE RECIPE	WATER FOOTPRINT		
				INGREDIENTS	PROCESS	TOTAL
CORN	Water Footprint Network	900	98%	912	5.46	917
SUGAR	Water Footprint Network	1500	2%			

Water Footprint calculation for 1 kg of breakfast cereal

ECOLOGICAL FOOTPRINT - DATA IN GLOBAL m <sup>2</sup> PER KG						
INGREDIENTS	DATA SOURCE	SPECIFIC IMPACTS	% IN THE RECIPE	ECOLOGICAL FOOTPRINT		
				INGREDIENTS	PROCESS	TOTAL
CORN	maize seed IP, at farm, CH, [kg] (#136)	11.06	98%	11.93	1.33	13
SUGAR	sugar, from sugar beet, at sugar refinery, CH, [kg] (#6580)	2.67	2%			

Ecological footprint calculation for 1 kg of breakfast cereals





## Olive Oil

When the Double Pyramid was published for the first time, very few data items on the water and

ecological footprints of olive oil were available. For this reason, the working group proceeded to perform a complete assessment of those indicators. The evaluation was performed on the basis of the

methodology described in chapter 2 for water and ecological footprints, respectively.

WATER FOOTPRINT - DATA IN LITERS PER KG			
GREEN WATER	PARAMETER	DATA	DATA SOURCE
	EtO [mm/month]	908	UCEA Observatory <sup>3</sup>
	Kc [-]	0.65	Working group elaborations on the basis of the methodology described in (Allen et al. 1998)
	Yield [t/ha]	7	Hoepli, Agriculture Handbook
	Ete [l/kg]	843	Working group elaborations on the basis of the methodology described chapter 2
BLUE WATER [liters/kg]		4000	Avraamides, Fatta (2008)
WATER FOOTPRINT [liters/kg]		4843	Working group elaborations on the basis of the methodology described chapter 2
Data considered in the DOUBLE PYRAMID [liters/kg]		4900	

Water footprint calculation for 1 lt of olive oil

ECOLOGICAL FOOTPRINT - DATA IN GLOBAL m <sup>2</sup> PER KG						
CROP LAND			ENERGY LAND			ECOLOGICAL FOOTPRINT
Land use [m <sup>2</sup> /kg]	Equivalence factor [global m <sup>2</sup> /m <sup>2</sup> ]	Crop land [global m <sup>2</sup> /kg]	CO <sub>2</sub> emission [gCO <sub>2</sub> /kg]	Equivalence factor [gha/tCO <sub>2</sub> ]	Energy land [global m <sup>2</sup> /kg]	global m <sup>2</sup> /kg
1.43 <sup>4</sup>	2.64	3.8	3900 <sup>5</sup>	0.277	10.8	14.6

Ecological footprint calculation for 1 lt of olive oil

PRODUCT	ECOLOGICAL FOOTPRINT [global m <sup>2</sup> /kg]	DATA SOURCE
Olive Oil	14.6	Working group elaboration

Ecological footprint of 1 lt of olive oil

<sup>3</sup> UCEA

<sup>4</sup> Bianchi P.G., Castelli P.G. Agriculture Handbook, Hoepli

<sup>5</sup> Avraamides M, Fatta D. "Resource consumption and emissions from olive oil production: a life cycle inventory case study in Cyprus." J Cleaner Production 16, 809-821 (2008)



Eggs

As for olive oil, due to the scarcity of literature on the ecological footprint of eggs, the working group proceeded with a complete assessment of this indicator.

ECOLOGICAL FOOTPRINT - DATA IN GLOBAL m² PER KG						
CROP LAND			ENERGY LAND			ECOLOGICAL FOOTPRINT
Land use [m²/kg]	Equivalence factor [global m²/m²]	Crop land [global m²/kg]	CO₂ emission [gCO₂/kg]	Equivalence factor [gha/tCO₂]	Energy land [global m²/kg]	global m²/kg
2.5	6.6	3.8	800 <sup>6</sup>	0.277	2.22	8.88

Ecological footprint calculation for 1kg of eggs

PRODUCT	ECOLOGICAL FOOTPRINT [global m²/kg]	DATA SOURCE
Eggs	8.8	Working group elaboration

Ecological footprint of 1 lt of olive oil

<sup>6</sup> Data obtained considering that 2kg of corn are needed to obtain 1kg of eggs, with an average corn yield of 8t/ha



## ASSUMPTIONS FOR THE CALCULATION OF WORLD DIETS

To calculate the environmental impacts of the weekly grocery shopping of eight families described in the specific chapter (taken from the book Hungry Planet), several assumptions were made, in particular:

- Assumptions on the weight of some foods,

particularly fruit and vegetables, indicated in the book as units;

- Assimilation of certain foods with food contained in categories of the Double Pyramid, particularly dairy products and fruit and vegetables;
- Identification of foods to be omitted because of the difficulty in calculating their impact;
- Assumptions on ingredients and quantity of food

listed in the category “convenience foods”;

- Research and elaboration of the ingredients and quantities of foods in the category “fast food”;
- The assumptions made are as follows, together with the detailed list of food and impacts per country.

## Weights and units of measurement

QUANTITY	FOOD		CONVERSION	UoM
1	Avocado	=	0.25	kg
1	Cabbage, Cauliflower	=	1.3	kg
1	Head of lettuce	=	0.35	kg
1	Coconut	=	1	kg
1	Leaf (laurel, etc...)	=	0.0005	kg
1	Swivel bread	=	0.05	kg
1	Bouquet garni (parsley, etc...)	=	0.058	kg
1	Sprig of rosemary	=	0.0025	kg
1	Packet of rusks	=	0.6	kg
1	Loaf of packaged bread	=	0.5	kg
1	Corn on the cob	=	0.25	kg
1	Small cake	=	0.1	kg
1	Egg	=	0.06	kg

Assumed weight for certain foods



Assimilations to the Double Pyramid categories

FOOD		DP CATEGORY
Duck	=	Poultry
Ice cream	=	Milk
Lemon	=	Fruit
Corn	=	Vegetables
Cream	=	Milk
Herbs	=	Vegetables
Condiments	=	Ketchup
Cold cuts	=	Pork meat
Tortillas	=	Bread

Assimilations of some food to Double Pyramid categories

Main foods omitted

- Vinegar, balsamic vinegar
  - Cinnamon
  - Vegetable bullion
  - Coconut milk
  - Potato chips, and the like
  - Pepper
  - Sake
  - Sale
  - Soy sauce, and the like
  - Sunflower seeds
  - Lemon juice
- Vanilla
  - White wine kitchen
  - Wasabi
  - Soup, and the like



## Convenience food

CONVENIENCE FOOD	INGREDIENTS	%	Kg TOT	COUNTRY
DUMPLING	Flour	60%	0.25	J
	Beef	40%		
FLAN OF ONIONS AND CHEESE	Vegetables	64%	0.41	GB
	Cheese	36%		
FLAN OF CHICKEN AND MUSHROOMS	Poultry meat	64%	0.41	GB
	Vegetables	37%		
STUFFED WINE LEAVES	Rice	80%	0.41	F
			1.00	TR
FISH SALAD	Fish	100%	0.26	J
JALAPENO, MEAT & CHEESE	Vegetables	30%	0.26	USA
	Beef	50%		
	Cheese	20%		
BEEF & POTATOES	Beef	51%	0.21	J
	Potatoes	47%		
MIX OF MEAT	Beef	100%	0.40	AUS
NOODLES	Pasta	100%	0.20	J
VEGETABLE FLAVOUR	Vegetables	100%	0.21	GB
BALLS OF RICE AND FISH	Rice	67%	0.03	J
	Fish	33%		
BALLS OF RISE AND VEGETABLES FISH	Rice	53%	0.04	J
	Vegetables	27%		
	Rice	27%		
PANCAKE MIX	Flour	100%	0.36	J

Assumptions on ingredients and quantities of "convenience food"



CONVENIENCE FOOD	INGREDIENTS	%	Kg TOT	COUNTRY
SCHOOL MEALS	Pasta	50%	0.20	IT
	Tomato	50%		
PRE-COOKED MEALS	Beef	41%	0.37	F
	Vegetables	16%		
	Fruit	27%		
	Bread	16%		
PIZZA	Pizza (flour 85g, yeast beer 4g, salt 2g, oil 5g, tomato paste 4g, mozzarella 90 g, oregano)	100%	0.23	F
PEPPERS AND FIVE CHEESES TOPPING	plus: vegetables 250g, cheese 110 g	100%	0.59	GB
HAM	Ham (pork)	100%	0.23	GB
HAM AND CHEESE	Ham (pork)	50%	0.10	IT
	Cheese	50%		
RAMEN	Pasta	100%	0.44	USA
SURIMI	Fish	100%	0.21	F
SUSHI	Fish	100%	0.15	USA
TOMATO TABOULEH	Pasta	38%	0.20	F
	Vegetables	62%		
MEAT SAUCE	Sauce	83%	0.30	J
	Beef	17%		
STUFFED PASTRIES	Bread	50%	0.10	F
	Cheese	25%		
	Vegetables	25%		
SPAGHETTI CANNED	Pasta	59%	0.68	J
	Vegetables	41%		TR
SOUP WITH VEGETABLES AND CEREALS	Vegetables	51%	0.59	AUS
	Cereals	49%		GB
TOMATO SOUP	Vegetables	100%	0.41	GB
CELERY SOUP	Vegetables	100%	0.31	USA





## Fast food

FAST FOOD	FOOD	INGREDIENTS	%	Kg TOT	COUNTRY	SOURCE
BURGER KING	DOUBLE CHEESEBURGER	Beef	34%	0.20	USA	www.mcdonalds.com
		Bread	26%			
		Cheese	15%			
		Ketchup	4%			
		Vegetables	4%			
		Vegetables	18%			
	ONION RINGS	Vegetables	100%	0.12	USA	
CHINA MARKET		Rice	19%	0.37	F	www.bk.com
		Fish	27%			
		Fruit	54%			
I LOVE NY PIZZA	PIZZA SLICE	Pizza (flour 85g, yeast beer 4g, salt 2g, oil 5g, tomato paste 40g, mozzarella 90g, oregano)	100%	0.23	USA	
KFC	PC CHICKEN	Pork	100%	0.12	USA	www.kfc.com
	MASHED POTATOES	Potatoes	100%	0.15	USA	
MC DONALD'S	MC CHICKEN	Bread	36%	0.14	F	www.mcdonalds.com
		Vegetables	10%			
		Mayonnaise	10%			
		Pork	44%			
	MEDIUM FRIES	Potatoes	100%	0,12	F	
	CHICKEN MCNUGGETS (4)	Pork	100%	0,07	USA	
	LARGE FRIES	Potatoes	100%	0,15	USA	
	FILET-O-FISH	Fish	45%	0,12	USA	
		Bread	36%			
		Cheese	5%			

Assumptions on ingredients and quantities of "fast food"



FAST FOOD	FOOD	INGREDIENTS	%	Kg TOT	COUNTRY	SOURCE
MILANO'S PIZZA	LARGE SAUSAGE PIZZA	Pizza + sausage 25g	100%	0.25	USA	
	LARGE PEPPERONI PIZZA	Pizza + peppers 25g	100%	0.25	USA	
SUBWAY	WHEAT VEGGIE SUB	Vegetables	100%	0.16	USA	www.subway.com
	WHEAT SEAFOOD CRAB SUB	Fish	70%	0.16	USA	
		Cheese	30%			
TACO BELL	NACHOS BELL LARGE	Tortilla (bred)	40%	0.31	USA	www.tacobell.com
		Vegetables	20%			
		Beef	20%			
		Cheese	10%			
		Vegetables	10%			
	SOFT TACOS, TACO SUPREME, TACO PIZZA, TACO	Tortilla (bread)	40%	0.13	USA	
		Beef	30%			
		Cheese	10%			
		Vegetables	20%			
	BEAN BURRITO	Tortilla (bread)	40%	0.20	USA	
		Vegetables	20%			
		Vegetables	30%			
		Cheese	10%			



## List of food by country

## Australia (one week's food in January)

**Grains & Other Starchy Foods: \$28.79**

Coliban variety potatoes, 8.8 lb; *Home Brand* (store brand) white bread, sliced, 4 loaves; *Home Brand* whole wheat bread, sliced, 2 loaves; *Weet-Bix* breakfast cereal, 2.7 lb; *White Wings* self-raising flour, 2.7 lb; basmati rice, 2.2 lb; *Kellogg's* Sultana Bran cereal, 1.9 lb; *Nanda* spaghetti, 1.1 lb; *Nanda* spirals, 1.1 lb; white pocket bread (pita), 13 oz; *Kellogg's* corn flakes, 10.9 oz.

**Dairy: \$24.55**

*Sunshine* whole milk, 2.4 gal; *Home Brand* vanilla ice cream, 1.1 gal; *Home Brand* thickened cream, 1.3 qt; margarine, 2.2 lb; *Yoplait* yogurt, nonfat, 1.5 lb; *Yoplait* Gogurt (drinkable yogurt), 1.2 lb; *Kraft* Cheese Singles, 1.1 lb.

**Meat, Fish & Eggs: \$117.99**

*Woolworths* smoked ham, 11 lb; silverside (corned beef), 9.9 lb; minced meat, 6.6 lb; pork chops, 6.6 lb; sausages, 6.6 lb; steakettes, 6.6 lb; chicken, 4.4 lb; rissoles, 4.4 lb; *Home Brand* eggs, 24; *Home Brand* beef patties, frozen, 2.2 lb; *Home Brand* fish fingers, frozen, 2.2 lb.

**Fruits, Vegetables & Nuts: \$30.54**

Yellow bananas, 2.7 lb; white nectarines, 2.4 lb; Jarrahdale variety pumpkin, 2.4 lb; carrots, 2.2 lb; yellow onions, 2.2 lb; tomatoes, 2.1 lb; avocados, 3; cucumbers, 1.4 lb; *Master Foods* tomato sauce, 16.9 fl oz; zucchini, organic, 1.1 lb; mixed vegetables, frozen, 1.1 lb; red bell peppers, 11.2 oz; celery, 8.8 oz; green bell peppers, 8 oz; shallots, 6.4 oz.

**Condiments: \$35.44**

*Cornwell's* vinegar, 1.6 qt; *Bundaberg* white sugar, 2.2 lb; *Holbrook's* Worcestershire sauce, 25.4 fl oz; *Kraft* cheese spread, 1.1 lb; *Cornwell's* Lancashire relish, 1.1 lb; *Master Foods* BBQ sauce, 16.9 fl oz; *IXL* plum conserve (jam), 10.6 oz; *Kraft* chili & lime dressing, 10.2 fl oz; *Kraft* mayonnaise, 6.7 oz; *Kraft* smooth peanut butter, 6.6 oz; baking powder, 4.4 oz, used in *johnnycakes*; *Mitani* chicken salt, 3.5 oz; *Keen's* curry powder, 2.1 oz; mustard, 1.6 oz; *Splenda* (artificial sweetener), 1 oz; salt, 2.2 oz.

**Snacks & Desserts: \$4.59**

*Smiths* chips, variety pack, 14.1 oz; rich tea biscuits (traditional English cookies), 7.1 oz.

**Prepared Food: \$4.28**

*Maggi* instant beef noodles, 1.1 lb; *Gravox* gravy, 4.2 oz.

**Fast Food: \$28.28**

*McDonald's*: 6 Happy Meals, 3 Mc Oz (burgers), *Coca-Cola*, 6 small, 1 large.

**Beverages: \$37.92**

*Frantelle* spring water, 7.9 gal; diet *Coca-Cola*, 1.6 gal; *Mildura* fruit drink, 1.1 gal; *Just Juice* orange drink, 2.5 qt; diet *Sprite*, 2.1 qt; *Golden Circle* apple juice, 2.1 qt; *Golden Circle* lime cordial, 2.1 qt; *Golden Circle* orange & mango crush, 2.1 qt; *Kirks* club lemon soda squash, 1.3 qt; *Kirks* creaming soda, 1.3 qt; *Kirks* lemonade, 1.3 qt; *Kirks* pasito (passionfruit-flavored drink), 1.3 qt; *Solo* lemonade, 1.3 qt; *Sunkist* orange drink, 1.3 qt; *Coca-Cola*, 20.3 fl oz; *Tetley* tea, 175 teabags, *this number is not a typo*; *Bushell's* coffee, 1.8 oz.

**Miscellaneous: \$64.07**

*Longbeach* cigarettes, 10 pks; *Winfield* tobacco, 1.8 oz; *Lion* cigarette papers, 4 pks.

.....  
**Food Expenditure for One Week:**  
**481.14 Australian dollars/\$376.45 USD**  
 .....



FOOD	QUANTITY	UoM	CF gCO <sub>2</sub> eq
BISCUITS	0.13	kg	216
BUTTER	0.08	kg	669
POULTRY MEAT	2.99	kg	11,104
BEEF	1.00	kg	21,648
SHEEP MEAT	1.00	kg	13,428
PORK	0.91	kg	3865
CEREAL	1.25	kg	3720
SWEETS	0.80	kg	1918
DURUM WHEAT FLOUR	-	kg	-
SOFT WHEAT FLOUR	-	kg	-
CHEESE	0.50	kg	4597
FRUIT	8.70	kg	4172
DRIED FRUIT	0.38	kg	712
MILK	8.63	kg	11,192
VEGETABLES	1.47	kg	2024
OIL	0.13	kg	323
BREAD	1.86	kg	2049
SEMOLINA PASTA	1.27	kg	3229
POTATOES	1.99	kg	1248
FISH	2.99	kg	13,206
RICE	0.50	kg	1964
EGGS	0.36	kg	1447
SEASONAL VEGETABLES	8.69	kg	7062
YOGURT	0.50	liters	772
SUGAR	-	kg	-
KETCHUP	0.51	liters	565
SAUCE	0.03	kg	51
CRACKER	0.21	kg	315
<b>TOT</b>	<b>47.59</b>		<b>121,947</b>
<b>CONV. FOOD/FAST FOOD</b>	<b>QUANTITY</b>	<b>UoM</b>	<b>CF gCO<sub>2</sub> eq</b>
PASTA CANNED	0.68	kg	1719
MEAT MIX	0.04	kg	8733



France (one week's food in November)

### Grains & Other Starchy Foods: \$23.41

Bread, 3.9 lb; English white bread, 1.8 lb; *Barilla* spaghetti, 1.1 lb; country bread, 1.1 lb; potatoes, 1.1 lb; croissants, with chocolate, 8.8 oz; *Kellogg's* corn flakes, 7.9 oz; croissants, 3.5 oz.

### Dairy: \$24.45

*Auchan* (store brand) milk, 2.1 qt; *Danone* fruit yogurt, 2.2 lb; *Yoplait* Perle de Lait naturel (plain) yogurt, 2.2 lb; chocolate yogurt, 1.3 lb; *Yoplait* Perle de Lait coconut yogurt, 1.1 lb; butter, 8.8 oz; Saint Nectaire cheese, 8.1 oz; goat cheese, 4.9 oz; *Auchan* Swiss cheese, grated, 2.5 oz.

### Meat, Fish & Eggs: \$92.29

Beef, frozen, 2.2 lb; grenadier fish 1.7 lb; salmon, 1.3 lb; eggs, 8; beef carpaccio, 1.2 lb; shrimp, 14.5 oz; chicken, 14.3 oz; *Auchan* sausage, 14.1 oz; *Auchan* ham, 12.7 oz; lamb, 12.3 oz; duck, 10.6 oz; rib eye steak, 7.4 oz; *Auchan* ham, sliced, 7.1 oz; tuna, 4.6 oz.

### Fruits, Vegetables & Nuts: \$54.96

Pineapple, 2.9 lb; yellow bananas, 2.2 lb; persimmons, 2 lb; Royal Gala apples, 1.8 lb; pears, 1.1 lb; kiwis, 14.1 oz; oranges, 9.6 oz; prunes, 8.8 oz; green grapes, 7 oz; tangerines, 6.4 oz; mixed vegetables, fresh, 5.3 lb; mixed vegetables, frozen, 4.4 lb; tomatoes, 3.5 lb; pumpkin, 1.9 lb; hearts of palm, 1.8 lb; green beans, 15.5 oz; beetroot, 9.4 oz; cabbage, 8.8 oz; avocado, 1; artichokes, 6.9 oz; soy germ, 6.4 oz; scallions, 3.2 oz; *Auchan* chives, 1 bunch; garlic, 0.4 oz; walnuts, 1.1 lb.

### Condiments: \$32.22

*Maiile* vinegar, 1.3 qt; black currant jam, 10.6 oz; olive oil, 10.2 fl oz; sunflower oil, 10.2 fl oz; honey, 7.1 oz; *Nutella* chocolate spread, 7.1 oz; ketchup, 6.2 oz; sugar 5.3 oz; cornichons (small tart pickles), 3.5 oz; mayonnaise, 1.8 oz; mustard, 1.8 oz; parsley, 1 small bunch; basil, 1 bunch; salt, 0.7 oz; celery salt, 0.5 oz; black basil, dried, 0.4 oz; black pepper, 0.1 oz.

### Snacks & Desserts: \$17.10

Apple compote, 1.7 lb, a dessert of stewed or baked fruit; *Nestlé* chocolate mousse, 12.7 oz; *Gerblé* orange soya biscuits, 9.9 oz; *Nestlé* raisin, hazelnut, almond dark chocolate, 8.8 oz; *Balisto* cereal bars, 7.1 oz; biscuits, 5.3 oz; *Lindt* dark chocolate, 3.5 oz; *Nestlé* caramel dark chocolate, 3.5 oz.

### Prepared Food: \$85.66

Tomato tabouleh, 1.2 lb; ham and mozzarella pizza, 15.9 oz; stuffed vine leaves, 14.1 oz; *Auchan* salad, 11.5 oz; surimi (Japanese frozen minced fish mixed with sugar and other additives), 7.1 oz; cafeteria food, 10 meals, with meat, vegetables, fruit, and bread. On a scale of one to ten, the parents rate the several-course cafeteria meals as an eight or nine in both nutrition and taste.

### Fast Food: \$32.51

*Shanghai Express*: sushi, 1 order; Chinese food, 1 order; *McDonald's*: 1 McChicken sandwich, French fries, *Evian* water.

### Beverages: \$44.76

*Wattwiller* mineral water, 2 gal; *Verniere* mineral water, 2 gal; *Volvic* mineral water, 3.2 qt; orange juice, 2 1.1-qt cartons; *Sojasun* soy milk, 2 1.1-qt cartons; *Auchan* tomato juice, 1.1 qt; *Joker* carrot juice, 1.1 qt; *Tropicana* fruit juice, 1.1 qt; cider, 25.4 fl oz; red wine, 25.4 fl oz; *William Grant's* whiskey, 5 fl oz; *Auchan* coffee, 2.5 oz; *Twinnings of London* Earl Grey tea, 25 teabags.

### Miscellaneous: \$12.59

*Auchan* assorted cat food, 3.5 lb; *Friskies* cat food, 15.9 oz.

\* Homegrown; ‡ Not in Photo

**Food Expenditure for One Week:**  
**315.17 euros/\$419.95**



FOOD	QUANTITY	UoM	CF gCO <sub>2</sub> eq
BISCUITS	0.44	kg	709
BUTTER	0.26	kg	2119
POULTRY MEAT	0.72	kg	2825
BEEF	1.75	kg	45,835
SHEEP MEAT	0.36	kg	4824
PORK	0.98	kg	4931
CEREAL	0.44	kg	1489
SWEETS	2.67	kg	5979
DURUM WHEAT FLOUR	-	kg	-
SOFT WHEAT FLOUR	-	kg	-
CHEESE	0.45	kg	4159
FRUIT	6.11	kg	3028
DRIED FRUIT	0.50	kg	950
MILK	1.99	kg	2468
VEGETABLES	0.45	kg	299
OIL	0.59	kg	1843
BREAD	3.08	kg	3465
SEMOLINA PASTA	0.50	kg	510
POTATOES	0.50	kg	88
FISH	1.91	kg	7994
RICE	-	kg	-
EGGS	0.48	kg	1588
SEASONAL VEGETABLES	9.28	kg	5487
YOGURT	3.08	liters	5341
SUGAR	0.15	kg	94
KETCHUP	0.28	liters	313
SAUCE	-	kg	-
<b>TOT</b>	<b>43.08</b>		<b>117,722</b>
CONV. FOOD/FAST FOOD	QUANTITY	UoM	CF gCO <sub>2</sub> eq
TOMATO TABOULEH	0.54	kg	665
PIZZA	0.46	kg	2562
STUFFED WINE LEAVES	0.41	kg	1567
SURIMI	0.21	kg	907
CONVENIENCE MEALS	3.70	kg	3935
SUSHI	0.15	kg	587
CHINESE FOOD	0.37	kg	795
MC CHICKEN	0.14	kg	298
FRENCH FRIES	0.12	kg	70





## Great Britain (one week's food in November)

**Grains & Other Starchy Foods: \$20.41**

White potatoes, 3.9 lb; *Kingsmill Gold* soft white bread, sliced, 2 loaves; *Hovis* crusty white bread, 1.8 lb; *Weetabix* whole-grain cereal, 1.5 lb; new (young) potatoes, 1.3 lb; *McDougall's* self-raising flour, 1.1 lb; *Saxby* puff pastry, 1.1 lb; *Seeds of Change* tagliatelle, 1.1 lb; *Waitrose* (store brand) porridge oats, 1.1 lb; *Kellogg's* Coco Pops, 1.3 oz; *Waitrose* corn flakes, 12 oz; *Waitrose* garlic baguette, organic, 6 oz; *Jacob's* TUC crackers, 5.3 oz.

**Dairy: \$27.93**

Semi-skim milk, 3.5 gal; full-cream milk (whole), 2 qt; *Waitrose* strawberry yogurt, 1.5 lb; *Müller Corner* strawberry yogurt, 1.2 lb; *Waitrose* custard, 1.1 lb; mild English Cheddar, 11.5 oz; *Philadelphia* cream cheese, 8 oz; *Waitrose* rhubarb yogurt, 6 oz; *Waitrose* toffee yogurt, 6 oz; *Country Life* butter, 4.4 oz; *Cropwell* Bishop cheese, 3.5 oz.

**Meat, Fish & Eggs: \$28.34**

*Waitrose* British pork, 2.2 lb; *Waitrose* eggs, 12; *Waitrose* pork escalopes, 1.1 lb; *Waitrose* tuna, canned in brine, 1.1 lb; honey-roasted ham, 11.8 oz; *Waitrose* unsmoked British bacon, 5.5 oz; *Waitrose* large prawns, frozen, 5.3 oz.

**Beverages: \$38.51**

*Capri Sun* fruit juice, 12 6.8-fl-oz pkgs; *Somerfield Pennine Valley* water, 1.6 qt; *Wadworth* beer, 12 16.9-fl-oz cans; *Waitrose* pineapple juice 1.1 qt; *Waitrose* press apple juice, 1.1 qt; *Waitrose* pure orange juice, 1.1 qt; *Tesco* mountain spring water, 16.9 fl oz; *Cadbury* drinking chocolate, 1.1 lb; *James Herick* red wine, 12.7 fl oz; *Douwe Egberts* Continental Gold coffee, 6.2 oz; *PG Tips* tea, 40 teabags; tap water, for drinking and cooking.

**Fruits, Vegetables & Nuts: \$35.27**

Coxes variety apples, 2.8 lb; Braeburn variety apples, 1.8 lb; yellow bananas, 1.5 lb; oranges, 1.4 lb; Granny Smith variety apples, 1.3 lb; green grapes, seedless, 14.4 oz; *Del Monte* pineapple chunks, canned, 8 oz; *Heinz* baked beans, canned, 2.8 lb; *Waitrose* brussel sprouts, fresh 2.2 lb; *Birds Eye* garden peas, frozen, 2 lb; white cabbage, organic, 1 head; white mushrooms, 1.6 lb; cauliflower, 1 head; carrots, 1.5 lb; parsnips, 1.2 lb; iceberg lettuce, 1 head; tomatoes, 1 lb; broccoli, 13.9 oz; cucumber, 11.2 oz; red onion, 10.6 oz; runner beans, 10.2 oz; mange tout peas (snow peas), 5.3 oz; sugar snap peas, 5.3 oz.

**Condiments: \$20.34**

*I Can't Believe It's Not Butter* spread, 15 oz; *Heinz* ketchup, 14 oz; *Hartley's* Best raspberry jam, 12 oz; *Heinz* salad cream, 10 oz; *Heilmann's* Real mayonnaise, 10 oz; *Waitrose* smooth peanut butter, organic, 8 oz; *Waitrose* blend olive oil, 5.1 fl oz; *Tate Lyle* white sugar, 4.4 oz; *Waitrose* dark-brown muscovado sugar, 3.5 oz; waldorf salad topping, 1.8 oz; paprika, 1.7 oz; black pepper, 1.4 oz; *Maldon* sea salt, 1 oz; *Saxa* table salt, 1 oz; basil,\* 1 bunch; parsley,\* 1 bunch; *Sweetex* sweetener, 80 tablets, these are very small.

**Miscellaneous: \$27.60**

*Waitrose* variety cat food, 5.4 lb; *Bakers* dog food, rabbit & vegetable, dry 3.3 lb; *Pedigree* dog food, chicken & game, canned, 1.8 lb; *Friskies* Go-Cat cat food, dry, 13.2 oz; *Golden Virginia* hand-rolling tobacco, 3.5 oz; *Rizla* cigarette papers, 4 pks.

\* Homegrown; ‡ Not in Photo

**Food Expenditure for One Week:**  
**155.54 British pounds/\$253.15**
**Snacks & Desserts: \$28.74**

*McCain* oven chips, (French fries), frozen, 2 lb; *Mars* candy bars, multipacks, 1.7 lb; *Waitrose* savory wedges, ‡ frozen, 1.7 lb; *Waitrose* milk chocolate digestive biscuits, 14.1 oz; *Waitrose* treacle tart, 13.4 oz; *Cadbury* twirls, 8.9 oz; *Trebor* Softmints, 7.9 oz; *Hanibo* Maoam Stripes, 7.1 oz; *Waitrose* rich tea biscuits, 7.1 oz; *Golden Wonder* Nik Naks, 6.6 oz; *Walker's* BBQ crisps, 6.2 oz; *Walker's* prawn cocktail crisps, 6.2 oz; *Waitrose* caramel surprise, 5.3 oz; *Waitrose* chocolate surprise, 5.3 oz; *Onken* chocolate hazelnut mousse, 4.4 oz; strawberry laces, 3.5 oz; *Waitrose* mini jelly babies, 3.5 oz; *Dairylea* Double Dunker nachos, 1.8 oz; *Flying Saucers* candy, 1.8 oz.

**Prepared Food: \$26.01**

*New Covent Garden Food Co* vegetable and lentil soup, 1.3 lb; *Waitrose* five-cheese & pepperoni pizza, 1.3 lb; *Lloyd Grossman* four-cheese pasta sauce, 15.9 oz; *Heinz* cream of tomato soup, canned, 14.1 oz; *Waitrose* cheese & onion flan, 14.1 oz; *Waitrose* chicken & mushroom flan, 14.1 oz; *Dairylea* ham Lunchables, 7.8 oz; *Bisto* granules gravy mix, roast vegetable flavored, 7.1 oz; *Waitrose* carbonara sauce 5.3 oz.

**Homemade Food:**

Savory pancakes, made with flour, milk, and eggs, listed above.

FOOD	QUANTITY	UoM	CF gCO <sub>2</sub> eq
BISCUITS	0.61	kg	989
BUTTER	0.13	kg	1060
POULTRY MEAT	-	kg	-
BEEF	-	kg	-
SHEEP MEAT	-	kg	-
PORK	2.00	kg	10,015
CEREAL	1.90	kg	6512
SWEETS	4.12	kg	9214
DURUM WHEAT FLOUR	-	kg	-
SOFT WHEAT FLOUR	0.50	kg	519
CHEESE	0.67	kg	6171
FRUIT	4.64	kg	2297
DRIED FRUIT	-	kg	-
MILK	15.14	kg	18,808
VEGETABLES	2.78	kg	1848
OIL	0.15	kg	461
BREAD	1.99	kg	2238
SEMOLINA PASTA	0.50	kg	510
POTATOES	4.03	kg	712
FISH	0.65	kg	2725
RICE	-	kg	-
EGGS	0.72	kg	2383
SEASONAL VEGETABLES	7.59	kg	4486
YOGURT	1.57	liters	2724
SUGAR	0.23	kg	140
KETCHUP	0.99	liters	1085
SAUCE	0.61	kg	1086
CRACKER	0.15	kg	173
<b>TOT</b>	<b>54.50</b>		<b>84,689</b>
CONV. FOOD/FAST FOOD	QUANTITY	UoM	CF gCO <sub>2</sub> eq
SOUP WITH VEGETABLES AND CEREALS	0.59	kg	1620
PEPPERS AND FIVE CHEESE PIZZA	0.59	kg	2520
TOMATO SOUP	0.41	kg	335
FLAN OF ONIONS AND CHEESE	0.41	kg	1590
FLAN OF CHICKEN AND MUSHROOMS	0.41	kg	1169
HAM LUNCHABLES	0.23	kg	1135
VEGETABLES FLAVOUR	0.21	kg	168



Italy (one week's food in October)

### Grains & Other Starchy Foods: \$25.97

*Poiatti* spaghetti, rotini, orzo, margherite, macaroni, 17.6 lb; bread, 4.4 lb; bread crumbs, 2.2 lb; white potatoes, 2.2 lb; Kellogg's Frosties Chocos cereal, 1.7 lb; *Molino Bianco* fette biscottate, 1 loaf; *Molino Bianco* white bread, sliced, 1 loaf; white flour, 1.1 lb.

### Dairy: \$18.38

*Granarolo* whole milk, 1.1 gal; *Da Cucina* cooking cream, 1.8 lb; *Galbi* yogurts, 1.7 lb; *Grandi Pascoli* butter, 1.1 lb; parmesan cheese, grated, 7.1 oz.

### Meat, Fish & Eggs: \$36.64

Fish sticks, frozen, 2.2 lb, *sometimes they get a fresh fish or a fresh seafood salad from the owner of Guiseppe's business, but not often. The last fishmonger he worked for let him take one fish home almost every day*; eggs, 12; beef, 1.1 lb; beef, ground, 1.1 lb; sausage, 1.1 lb; veal involtini (meat rolls), 1.1 lb; clams, 12 oz; tuna, 11.3 oz; wurstel (German hot dog), 10.6 oz; ham & cheese, sliced, 3.5 oz; anchovies, 2.8 oz.

### Fruits, Vegetables & Nuts: \$25.12

Red grapes, 2.8 lb; yellow bananas, 2.2 lb; lemons, 2.2 lb; pears, 2.2 lb; persimmons, 2.2 lb; *Vitale* crushed tomatoes, canned, 5.3 lb; *Star* tomato sauce, bottled, 4.6 lb; broccoli-flower (hybrid of broccoli and cauliflower), 1 head; chard, 2.2 lb; peas, frozen, 2.2 lb; tomatoes, 2.2 lb; *Comal* olives, 1.1 lb; corn, canned, 11.5 oz; garlic, 8.8 oz.

### Condiments: \$18.70

*Tevere* vegetable oil, 2.1 qt; olive oil, 1.1 qt; white wine, 1.1 qt, *used only for cooking*; *Bonanno* white vinegar, 16.9 fl oz; mayonnaise, 16.9 fl oz; cherry jam, 14.1 oz; pine nuts and raisins, 10.6 oz; *Italia* white sugar, 8.8 oz; salt, 8.8 oz; tomato paste, 1 4.6-oz tube; bicarbonate of soda (baking soda), 3.5 oz; pepper, 1.8 oz.

### Snacks & Desserts: \$38.83

*Kinder* milk chocolate, 3.1 lb; biscotti, 2.2 lbs; *Nutella* chocolate spread, 1.7 lb; *Kinder paradiso* chocolate, 1 lb; *Buondi* (packaged cream cakes), 13 oz; baby biscuits, 12.7 oz; *Kinder Brioss* (packaged cream cakes), 10.6 oz; *Molino Bianco* flauti (packaged cream cakes with chocolate), 9.3 oz; *Pavesini* biscuits, 7.1 oz; candies, assorted, 3.5 oz.

### Prepared Food: \$22.33

*Star Gran* ragù sauce, 1.6 lb; *Star* vegetable bouillon cubes, 7.8 oz; school lunch, lasagna or pasta and juice, 6 days for two children.

### Beverages: \$13.47

*Pepsi*, 2 1.1-qt bottles; ginger soda, 1.6 qt; peach juice, 12 4.2-fl-oz mini bottles; *San Benedetto* iced tea, 1.6 qt; *Spuma* (light cola drink), 1.6 qt; *Top* cola, 1.6 qt; *Espresso Bar* coffee, 1.1 lb; tap water for drinking and cooking.

### Miscellaneous: \$60.67

*Diana* cigarettes, 20 pks.

Food Expenditure for One Week:  
214.36 euros/\$260.11



FOOD	QUANTITY	UoM	CF gCO <sub>2</sub> eq
BISCUITS	1.57	kg	2527
BUTTER	0.50	kg	4138
POULTRY MEAT	-	kg	-
BEEF	1.49	kg	39,046
SHEEPMET	-	kg	-
PORK	0.81	kg	4041
CEREAL	0.77	kg	2635
SWEETS	4.09	kg	9154
DURUM WHEAT FLOUR	-	kg	-
SOFT WHEAT FLOUR	0.50	kg	519
CHEESE	0.21	kg	1905
FRUIT	5.25	kg	2604
DRIED FRUIT	0.31	kg	586
MILK	4.98	kg	6185
VEGETABLES	1.00	kg	663
OIL	3.03	kg	9429
BREAD	4.09	kg	4600
SEMOLINA PASTA	7.97	kg	8155
POTATOES	1.00	kg	176
FISH	1.75	kg	7328
RICE	-	kg	-
EGGS	0.72	kg	2383
SEASONAL VEGETABLES	8.86	kg	5240
YOGURT	0.77	liters	1335
SUGAR	0.26	kg	156
KETCHUP	0.49	liters	539
SAUCE	0.86	kg	1516
<b>TOT</b>	<b>51.57</b>		<b>115,875</b>
<b>CONV. FOOD/FAST FOOD</b>	<b>QUANTITY</b>	<b>UoM</b>	<b>CF gCO<sub>2</sub> eq</b>
SLICED HAM AND CHEESE	0.10	kg	713
SCHOOL MEALS	0.20	kg	299





## Japan (one week's food in May)

**Grains & Other Starchy Foods: \$31.55**

Koshihikari rice, 5.5 lb; potatoes, 5.3 lb; Danish white bread, sliced, 1 loaf; white flour, 1.3 lb; sato imo (Japanese yam), peeled, 1.1 lb; udon noodles, 1.1 lb; sōmen noodles, 14.1 oz; white sandwich bread, 12.4 oz; *Nippn* macaroni, 10.6 oz; soba noodles, 10.6 oz; *FryStart* bread crumbs, 8.1 oz.

**Dairy: \$2.26**

Whole milk, 25.4 fl oz; *Haruna* yogurt, 12 oz; butter, 8.8 oz.

**Meat, Fish & Eggs: \$99.80**

Rainbow trout, 2.6 lb; ham, 2.2 lb; eggs, 10; sardines, large, 1.3 lb; clams, 1.1 lb; octopus, 1.1 lb; Spanish mackerel, 1.1 lb; pork loin, 1 lb; tuna, sashimi, 15.5 oz; horse mackerel, 14.8 oz; saury (fish), 13.5 oz; Japanese smelt (fish), 13.1 oz; eel, 12.7 oz; albacore, sashimi, 11.9 oz; *Hagoromo* tuna, canned, 11.3 oz; pork, cubed, 11.3 oz; beef, 10.8 oz; pork, minced, 10.6 oz; pork, sliced, 10.6 oz; pork, thin sliced, 10.3 oz; bacon, 7.8 oz; beef korokke (beef and potato patties), frozen, 7.4 oz, *used for children's lunch*; sea bream, sashimi, 3.6 oz; *Nozaki's* new corned beef (mix of horse and beef meat), canned, 3.5 oz.

**Fruits, Vegetables & Nuts: \$81.43**

Watermelon, 9.9 lb; cantaloupe, 4.4 lb; yellow bananas, 2.8 lb; red apples, 2.4 lb; white grapefruit, 2.2 lb; strawberries, 1.7 lb; cherries, canned, 7 oz; yellow onions, 4.8 lb; green peppers,

4 lb; cucumbers, 3.5 lb; daikon, 3.3 lb; bitter melon, 2.8 lb; soft tofu, 2.2 lb; tomatoes, 2 lb; carrots, 1.2 lb; green peas, in pods, 1.1 lb; broccoli, 1 lb; lettuce, 1 head; spinach, fresh, 1 lb; edamame, frozen, 14.1 oz; asparagus, 10.6 oz; green beans, frozen, 10.6 oz; mixed vegetables, frozen, 10.6 oz; bamboo shoots, 8.8 oz; white asparagus, canned, 8.8 oz; scallions, 8 oz; daikon sprouts, 6 oz; shiitake mushrooms, 6 oz; wakame (seaweed), fresh, 5.6 oz; bean curd, fried, 1.8 oz; nori (seaweed), dried, 1.8 oz; wakame, dried, 1.8 oz.

**Condiments: \$28.28**

White sugar, 15.6 oz; *Ebara* BBQ sauce, 9.9 oz; white miso, 9.9 oz; margarine, 8.8 oz; *Honen* salad oil, 8.5 fl oz; sesame oil, 7.1 oz; bean sauce, 6 fl oz; ginger, 6 oz; *Tea Time Mate* sugar, 28.2-oz pks; *Kyupi* mayonnaise, 5.6 oz; *Hinode* cooking sake 4.7 fl oz; *Hinode* mirin (low-alcohol rice wine for cooking), 4.7 fl oz; soy sauce, 4.7 fl oz; *Sudo* orange marmalade, 4.7 fl oz; *Sudo* strawberry jam, 4.7 fl oz; vinegar, 4.7 fl oz; *Fuji* oyster sauce, 4.2 oz; *Bull Dog* tonkatsu sauce, 3.4 fl oz; *Captain Cook* coffee creamers, 20.2-fl-oz pks; salt, 3.5 oz; Chinese spicy sauce, 2.9 oz, *used on tofu*; *Kagome* ketchup, 2.7 fl oz; sesame seeds, whole, 2.6 oz; honey, 2.5 oz; *Pokka Shokutaku* lemon juice, 2.4 fl oz; *Momoya* kimchi paste, 2.2 fl oz; soy sauce salad dressing, 2 fl oz; *Ajinomoto* olive oil 1.8 oz; S&B hot mustard, 1.5 oz; S&B wasabi, 1.5 oz; white sesame, ground, 1.4 oz; black pepper, 0.7 oz.

**Snacks & Desserts: \$15.33**

Small cakes, 4; coffee break cookies, 1 lb; cream buns, 10 oz; *Koikeya* potato chips, 8.8 oz; *Pasco* cream rings, 8.8 oz; chiffon chocolate cake, 5.3 oz.

**Prepared Food: \$21.78**

*Nissin* cup of noodles, instant, 1.5 lb; *Sapporo Ichiban* noodles, instant, 1.1 lb; *Showa* pancake mix, 12.4 oz; *Mama* pasta meat sauce, canned, 10.4 oz; *Oh My* pasta meat sauce, canned, 10.4 oz; seaweed salad, dehydrated, 8.8 oz, *add water to reconstitute*; S&B golden hayashi sauce mix (Japanese style beef bouillon cubes), 8.8 oz; Chinese dumplings, frozen, 8.5 oz, *used for the children's lunches*; *Ajinomoto* hondashi soup base, bonito (fish) flavor, 5.3 oz; soup, instant, 2.7 oz; yaki fu (baked rolls of wheat gluten, wheat powder, and rice powder), 2.7 oz, *eaten in soup*; vegetable and seaweed rice ball mix, 1.3 oz; *Riken* seaweed rice ball mix, 1.2 oz; *Kyowa* egg drop soup, instant, 0.9 oz.

**Beverages: \$28.40**

*Kirin* beer, 6 12-fl-oz cans; *Coca-Cola*, 2.1 qt; *Nacchan* orange soda, 2.1 qt; *Suntory* C.C. lemon joyful vitamin C soda, 2.1 qt; *Ban Shaku* sake, 1.8 qt; *Coffee Break* instant coffee, 2.5 oz; green tea, 2.1 oz; *Alpha* wheat tea, 2 oz; *Afternoon Tea* darjeeling black tea, 1.8 oz; tap water for drinking and cooking.

**Miscellaneous: \$8.42**

*Mild Seven* super-light cigarettes, 4 pks, *smoked by Kazuo*.

**Food Expenditure for One Week:**  
 37,699 yen/\$317.25



FOOD	QUANTITY	UoM	CF gCO <sub>2</sub> eq
BISCUITS	0.45	kg	729
BUTTER	0.26	kg	2119
POULTRY MEAT	-	kg	-
BEEF	0.41	kg	10,832
SHEEP MEAT	-	kg	-
PORK	2.92	kg	14,632
CEREAL	-	kg	-
SWEETS	1.19	kg	2660
DURUM WHEAT FLOUR	-	kg	-
SOFT WHEAT FLOUR	0.59	kg	614
CHEESE	-	kg	-
FRUIT	10.80	kg	5353
DRIED FRUIT	-	kg	-
MILK	0.74	kg	915
VEGETABLES	2.26	kg	1506
OIL	0.50	kg	1572
BREAD	1.09	kg	1231
SEMOLINA PASTA	1.52	kg	1557
POTATOES	2.90	kg	512
FISH	6.06	kg	25,313
RICE	2.49	kg	6307
EGGS	0.60	kg	1985
SEASONAL VEGETABLES	13.32	kg	7875
YOGURT	0.35	litres	603
SUGAR	0.61	kg	377
KETCHUP	1.34	litres	1471
SAUCE	-	kg	-
CRACKER	-	kg	-
MARGARINE	0.26		347
<b>TOT</b>	<b>53.60</b>		<b>101,777</b>
CONV. FOOD/FAST FOOD	QUANTITY	UoM	CF gCO <sub>2</sub> eq
NOODLES	0.68	kg	1292
NOODLES	0.50	kg	947
PANCAKE MIX	0.36	kg	610
MEAT SAUCE	0.30	kg	1753
FISH SALAD	0.26	kg	1124
DUMPLING	0.25	kg	2878
BALLS OF RICE, VEG. AND FISH	0.04	kg	131
BALLS OF RICE AND FISH	0.03	kg	121
BEEF & POTATOES	0.21	kg	3006





Mexico (one week's food in May)

### Grains & Other Starchy Foods: \$15.76

Corn tortillas, 22.1 lb; bread rolls, 3.1 lb; *Morelos* white rice, 2.2 lb; potatoes, 2.2 lb; *Bimbo* white bread, sliced, 1 loaf; *Kellogg's* Special K cereal, 1.1 lb; *Morelos* pasta, 1.1 lb; *La Moderna* pasta, 14.1 oz; pan dulces (sweet bread), assorted, 8.8 oz; bread sticks, 3.5 oz.

### Dairy: \$26.81

*Alpura* 2000 whole milk, 1.9 gal; *Alpura* sour cream, 2.1 qt; *Muecas* ice cream pops, 1.1 qt; *Yoplait* yogurt, 1.1 qt; cheese, handmade, 1.1 lb; *La Lechera* condensed milk, canned, 14 oz; cottage cheese, 13.6 oz; *Carnation* evaporated milk, 12 oz; *Manchego* cheese, 8.8 oz; cream cheese, 6.7 oz; butter, 3.5 oz.

### Meat, Fish & Eggs: \$42.81

Chicken, pieces, 15.4 lb; crab, 2.7 lb; eggs, 18; tilapia (fish), 2.3 lb; catfish, 2.2 lb; sausage, 6.6 oz, *one month's worth shown in photo*; *FUD* ham, 5.6 oz.

### Fruits, Vegetables & Nuts: \$44.21

Mangos, 13.2 lb; pineapples, 6.6 lb; watermelon, 6.6 lb; oranges, 5.5 lb; cantaloupe, 4.4 lb; guavas, 2.2 lb; quinces, 2.2 lb; yellow bananas, 2.2 lb; roma tomatoes, 6.6 lb; tomatillos, 6.6 lb; corn, 4 ears; avocados, 7; chayote squash, 2.2 lb; *Morelos* beans, 2.2 lb; white onions, 2.2 lb; zucchini, 2.2 lb; *La Costeña* pickled jalapeño peppers, canned, 1.6 lb; green beans, 1.1 lb; jalapeño peppers, fresh, 1.1 lb; broccoli, 12.8 oz; garlic, 8.8 oz; chipotle peppers (smoked jalapeños), 7.1 oz.

### Condiments: \$9.37

*Capullo* canola oil 2.1 qt; margarine, 15.9 oz; *McCormack* mayonnaise 13.8 oz; salt 8.8 oz; garlic salt 3.2 oz; *McCormack* black pepper 3.2 oz; cumin, 0.7 oz; bay leaves, dried, 0.5 oz.

### Snacks & Desserts: \$6.27

*Rockaleta* chili lollipops, 1.2 lb; *Ricolino* pasitas chocolate candy, 1.1 lb; *Gamesa* crackers, 15.9 oz; *Drums* marshmallows, 12 oz; *Rockaleta* chili candy, 5.7 oz.

### Prepared Food: \$4.79

*Doña Maria* mole (savory sauce made from chocolate and chili), 2.1 lb; *Knorr* chicken bouillon, 3.2 oz.

### Beverages: \$39.07

*Coca-Cola*, 12 2.1-qt bottles; water, bottled, 5 gal; *Victoria* beer, 20 11.8-fl-oz bottles; *Jumex* juice, 1.3 qt; *Gatorade* Fierce Black Hurricane drink, 1.1 qt; *Gatorade* lime drink, 1.1 qt; *Nescafe*, instant, decaf, 7.1 oz; tap water, for cooking.

Food Expenditure for One Week: 1,862.78  
 Mexican pesos/\$189.09



FOOD	QUANTITY	UoM	CF gCO <sub>2</sub> eq
BISCUITS	-	kg	-
BUTTER	0.10	kg	843
POULTRY MEAT	6.98	kg	27,292
BEEF	-	kg	-
SHEEPMEAT	-	kg	-
PORK	0.35	kg	1775
CEREAL	0.03	kg	109
SWEETS	2.51	kg	5608
DURUM WHEAT FLOUR	-	kg	-
SOFT WHEAT FLOUR	-	kg	-
CHEESE	0.88	kg	8103
FRUIT	24.17	kg	11,978
DRIED FRUIT	-	kg	-
MILK	10.97	kg	13,631
VEGETABLES	1.49	kg	994
OIL	1.99	kg	6188
BREAD	12.27	kg	13,804
SEMOLINA PASTA	0.44	kg	451
POTATOES	1.00	kg	176
FISH	3.26	kg	13,630
RICE	1.00	kg	2523
EGGS	1.08	kg	3574
SEASONAL VEGETABLES	9.16	kg	5416
YOGURT	1.04	litres	1804
SUGAR	-	kg	-
KETCHUP	0.40	litres	440
SAUCE	-	kg	-
CRACKER	0.46	kg	519
MARGARINE	0.46		627
<b>TOT</b>	<b>80.05</b>		<b>118,859</b>



*Turkey (one week's food in January)*
**Grains & Other Starchy Foods: \$10.46**

Bread, 32 loaves, 49.4 lb, 2 loaves missing—the family ate them while waiting for the photograph to be taken; potatoes, 11 lb; rice, 6.6 lb; yufka (thin pastry sheets), 2.2 lb, purchased from a street vendor; Filiz pasta, 1.1 lb.

**Dairy: \$12.16**

Yogurt, 2.1 qt; feta cheese, in water, 2.2 lb; Dost milk, 1.1 qt; drinkable yogurt (Bandirma style), 1.1 qt; Sana butter, 8.8 oz.

**Meat, Fish & Eggs: \$11.50**

Eggs, 24; hamsi (anchovy-like fish), 1.1 lb, generally eaten twice a month; beef, 13.2 oz, eaten one or two times a month only. The meat shown in the picture is enough for one month.

**Fruits, Vegetables & Nuts: \$56.53**

Oranges, 6.6 lb; tangerines, 6.6 lb; dates, 2.2 lb; yellow bananas, 2.2 lb; pomegranates, 2.1 lb; zucchini, 7.9 lb; tomatoes, 4.4 lb; black olives, 3.3 lb; chickpeas, dried, 3.3 lb; cabbage, 1 head; carrots, 2.2 lb; eggplant, 2.2 lb; leeks, 2.2 lb; lentils 2.2 lb; lettuce, 2 heads; peppers, 2.2 lb; spinach, 2.2 lb; yellow onions, 2.2 lb; cucumber, 1.7 lb; arugula, 1 lb; Avsarlar nuts, mixed, 2.2 lb.

**Condiments: \$9.60**

Sunflower oil, 1.1 qt; Bal Kıpı white sugar, cubed, 1.1 lb; jam, 10.6 oz; honey, 10.1 fl oz; mint, dried, 8.8 oz; salt, 8 oz; cinnamon, 7.1 oz; pepper, 7.1 oz.

**Snacks & Desserts: \$0.51**

Seyidoglu helva (sesame seed paste cookie), 1.1 lb.

**Prepared Food: \$1.36**

Knorr Gunun Corbasa dry soup, powdered, 11.2 oz.

**Homemade Food:**

Stuffed pastries, approx. 4.4 lb, sheets of yufka (unleavened pastry dough) formed then filled with arugula and feta, listed above; dolmas, approx. 2.2 lb, grape leaves stuffed with spices, rice, vegetables, and meat, listed above.

**Beverages: \$29.66**

Efes beer, 8 17-fl-oz bottles; Coca-Cola, 8 12-fl-oz cans; Fanta orange soda, 2.1 qt; Hediyelek tea, 3.3 lb; Pepsi, 3 12-fl-oz cans; Coca-Cola light, 12 fl oz; Nescafe VIP instant coffee, 3.5 oz; bottled water, purchased for cooking and drinking.

**Miscellaneous: \$14.10**

Tekel cigarettes, 7 pks; Simank bird food, 20 oz.

**Food Expenditure for One Week:**  
**198.48 New Turkish liras/\$145.88**



FOOD	QUANTITY	UoM	CF gCO <sub>2</sub> eq
BISCUITS	-	kg	-
BUTTER	0.26	kg	2119
POULTRY MEAT	-	kg	-
BEEF	0.10	kg	2500
SHEEP MEAT	-	kg	-
PORK	-	kg	-
CEREAL	-	kg	-
SWEETS	1.10	kg	2458
DURUM WHEAT FLOUR	-	kg	-
SOFT WHEAT FLOUR	-	kg	-
CHEESE	1.00	kg	9221
FRUIT	8.92	kg	4422
DRIED FRUIT	1.00	kg	1899
MILK	1.04	kg	1293
VEGETABLES	2.49	kg	1657
OIL	1.04	kg	3241
BREAD	23.37	kg	26,293
SEMOLINA PASTA	0.50	kg	510
POTATOES	4.98	kg	880
FISH	0.01	kg	33
RICE	2.99	kg	7569
EGGS	1.44	kg	4765
SEASONAL VEGETABLES	16.73	kg	9889
YOGURT	3.03	liters	5249
SUGAR	0.50	kg	305
KETCHUP	-	liters	-
SAUCE	-	kg	-
<b>TOT</b>	<b>73.48</b>		<b>94,148</b>
<b>CONV. FOOD/FAST FOOD</b>	<b>QUANTITY</b>	<b>UoM</b>	<b>CF gCO<sub>2</sub> eq</b>
STUFFED PASTRIES	1.99	kg	6026
STUFFED WINE LEAVES	1.00	kg	3819



USA - North Carolina (one week's food in March)

**Grains & Other Starchy Foods: \$17.92**

Red potatoes, 2.3 lb; *Natures Own* bread, sliced, 1 loaf; *Trix* cereal, 1.5 lb; *Mueller* fettuccini, 1 lb; *Mueller* spaghetti, 1 lb; *Uncle Ben's* Original white rice, 1 lb; *Flatout* flatbread wraps, 14 oz; *New York Original* Texas garlic toast, 11.3 oz; *Harris Teeter* (store brand) Flaky Brown-n-Serve dinner rolls, 11 oz.

**Dairy: \$14.51**

*Harris Teeter* milk, 1 gal; *Kraft* cheese, shredded, 8 oz; *Kraft* sharp Cheddar cheese, sliced, 8 oz; *Kraft* Swiss cheese, sliced, 8 oz; *Kraft* Cheese Singles, 6 oz; *Kraft* Parmesan cheese, grated, 3 oz; *Harris Teeter* butter, 2 oz.

**Meat, Fish & Eggs: \$54.92**

*Harris Teeter* beef, pot roast, 2.5 lb; *Harris Teeter* pork chops, 1.9 lb; *Harris Teeter* chicken drumsticks, 1.7 lb; eggs, 12; *Harris Teeter* chicken wings, 1.5 lb; *Armour* Italian-style meat balls, 1 lb; *Gwaltney* bacon, Virginia-cured with brown sugar, 1 lb; *Harris Teeter* ground turkey, 1 lb; shrimp,  $\frac{1}{2}$  1 lb; *StarKist* tuna, canned, 12 oz; honey-baked ham, sliced, 9 oz; smoked turkey, sliced, 7.8 oz.

**Fruits, Vegetables & Nuts: \$41.07**

*Dole* yellow bananas, 2.9 lb; red seedless grapes, 2.4 lb; green seedless grapes, 2.2 lb; *Birds Eye* baby broccoli, frozen, 4 lb; yellow onions, 3 lb; *Green Giant* corn, canned, 1.9 lb; *Green Giant* green beans, canned, 1.8 lb; *Bush's* vegetarian baked beans, canned, 1.8 lb; cucumbers, 1.4 lb; *Harris Teeter* tomatoes, vine-ripened, 1.2 lb; *Del Monte* whole leaf spinach, canned, 13.5 oz; garden salad, packaged, 10 oz; Italian salad mix, packaged, 8.8 oz; pickled mushrooms, 7.3 oz; *Harris Teeter* peanuts, 1 lb.

**Condiments: \$12.51**

White sugar, 1.6 lb; *Ruffles* ranch dip, 11 oz; *Crisco* vegetable oil, 6 fl oz; *Nestle Coffee-Mate*, French vanilla, nonfat, 6 fl oz; *Food Lion* garlic salt, 5.3 oz; *Hellmann's* mayonnaise, 4 oz; *Newman's Own* salad dressing, 4 oz; *Jiffy* peanut butter,  $\frac{1}{2}$  3 oz; black pepper, 2 oz; *Harris Teeter* Original yellow mustard, 2 oz; *Heinz* ketchup, 2 oz; salt, 2 oz; *Colonial Kitchen* meat tenderizer, 1 oz; *Durkee* celery seed, 1 oz; *Encore* garlic powder, 1 oz.

**Snacks & Desserts: \$21.27**

*Mott's* apple sauce, 1.5 lb; *Munchies* Classic mix, 15.5 oz; *Kellogg's* yogurt-flavored pop tarts,  $\frac{1}{2}$  14.7 oz; *Orville*

**Prepared Food: \$24.27**

*Bertolli* portobello alfredo sauce, 1 lb; *Ragu* spaghetti sauce, chunky mushroom and bell peppers, 1 lb; *Maruchan* shrimp flavored ramen, 15 oz; California sushi rolls, 14 oz; *Campbell's* cream of celery soup, 10.8 oz; *Hot Pockets*, jalapeño, steak & cheese, 9 oz; shrimp sushi rolls, 7 oz.

**Fast Food: \$71.61**

*McDonald's*: 10-pc chicken McNuggets, large fries, large *Coca-Cola*, Filet-o-Fish meal; *Taco Bell*: 4 nachos Bell Grande, 2 soft tacos, taco supreme, taco pizza, taco, bean burrito, large lemonade; *Burger King*: double cheeseburger, onion rings, large *Coca-Cola*; *KFC*: 2-pc chicken with mashed potatoes, large *Coca-Cola*; *Subway*: 6-inch wheat veggie sub, 6-inch wheat seafood crab sub; *Milano's Pizzeria*: large sausage pizza, large pepperoni pizza; *I Love NY Pizza*: 4 pizza slices.

**Restaurants: \$6.15**

*China Market*: shrimp fried rice, 2 orders; large fruit punch,

**Beverages: \$77.75**

*Budweiser*, 24 12-fl-oz cans; bottled water, 2 gal; *Harris Teeter* cranberry-apple juice cocktail, 4 2-qt bottles; diet *Coca-Cola*, 12 12-fl-oz cans; A&W cream soda, 2 2.1-qt bottles; *7UP*, 6 16.9-fl-oz bottles; *Harris Teeter* cranberry-raspberry juice cocktail, 2 2-qt bottles; *Harris Teeter* ruby grapefruit juice cocktail, 2 2-qt bottles; *Capri Sun*, 10 6.8-fl-oz pkgs; soda,  $\frac{1}{2}$  5 12-fl-oz cans, purchased daily by Brandon at school; *Arbor Mist* strawberry wine blenders, 1.1 qt; *Gatorade*,  $\frac{1}{2}$  16 fl oz; *Powerade*,  $\frac{1}{2}$  16 fl oz; *Snapple*, Go Bananas juice drink, 16 fl oz; *Maxwell House* instant coffee, 1.5 oz; *Kool-Aid*, black cherry, 0.5 oz; breakfast tea, 5 teabags; tap water for drinking and cooking.

$\frac{1}{2}$  Not in Photo

**Food Expenditure for One Week:**  
**\$341.98**

FOOD	QUANTITY	UoM	CF gCO <sub>2</sub> eq
BISCUITS	-	kg	-
BUTTER	0.06	kg	482
POULTRY MEAT	2.13	kg	8328
BEEF	1.59	kg	41413
SHEEPMET	-	kg	-
PORK	1.57	kg	7899
CEREAL	0.68	kg	2325
SWEETS	1.01	kg	2253
DURUM WHEAT FLOUR	-	kg	-
SOFT WHEAT FLOUR	-	kg	-
CHEESE	0.96	kg	8854
FRUIT	3.40	kg	1684
DRIED FRUIT	0.03	kg	55
MILK	3.79	kg	4702
VEGETABLES	1.63	kg	1085
OIL	0.17	kg	542
BREAD	1.55	kg	1747
SEMOLINA PASTA	0.91	kg	927
POTATOES	1.04	kg	184
FISH	1.41	kg	5892
RICE	0.45	kg	1147
EGGS	0.72	kg	2383
SEASONAL VEGETABLES	6.47	kg	3827
YOGURT	-	litres	-
SUGAR	0.72	kg	444
KETCHUP	0.70	litres	766
SAUCE	0.91	kg	1600
CRACKER	0.45	kg	506
<b>TOT</b>	<b>39.11</b>		<b>132,942</b>





CONV. FOOD/FAST FOOD	QUANTITY	UoM	CF gCO <sub>2</sub> eq
JALAPENO. MEAT % CHEESE	0.26	kg	3970
CHICKEN MCNUGGETS (4)	0.18	kg	704
LARGE FRIES	0.15	kg	802
FILET O'FISH	0.12	kg	410
NACHOS BELL LARGE	1.24	kg	8705
SOFT TACOS	0.26	kg	2434
TACO SUPREME	0.13	kg	1217
TACO PIZZA	0.13	kg	1217
TACO	0.13	kg	1217
BEAN BURRITO	0.20	kg	396
DOUBLE CHEESBURGER	0.20	kg	2097
ONION RING	0.12	kg	98
PD CHICKEN	0.24	kg	982
MASHED POTATOES	0.29	kg	350
WEATH VEGGIE SUB	0.98	kg	582
WHEAT SEAFOOD CRAB	0.16	kg	960
SAUSAGE PIZZA	0.25	kg	1394
PEPPERONI PIZZA	0.25	kg	1270
PIZZA SLICES	0.72	kg	4000
RAMEN	0.44	kg	836
CELERY SOUP	0.31	kg	256



## MENU RECIPES

## Daily menu

DAILY MENUS - RECIPES SUMMARY	VEGAN MENU	VEGETARIAN MENU	MEAT MENU
PASTA WITH BEANS	X		
PASTA WITH CREAMED VEGETABLES	X		
HUMMUS	X		
PASTA WITH FENNELS		X	
PUMPKIN AND LEEKS FLAN		X	
CREAMY CHICKPEAS SOUP		X	
GREEN BEANS AND POTATOES WITH PARMESAN CHEESE		X	
PIZZA MARGHERITA			X
BEEF FILLET			X



VEGAN RECIPES		
RECIPE	INGREDIENTS	HYPOTESIS
PASTA WITH BEANS	Fresh beans 150g Pasta 80g Extravirgin olive oil 10g Mirepoix 30g	Legumes Pasta Extravirgin olive oil Vegetables
PASTA WITH CREAMED VEGETABLES	Fresh vegetables 300g Pasta 30g	Legumes Pasta
HUMMUS	Chickpeas 150g Sesame 20g Extravirgin olive oil 10g Aromatic herbs 10g	Legumes Dried fruit Extravirgin olive oil Vegetables

VEGETARIAN RECIPES		
RECIPE	INGREDIENTS	HYPOTESIS
PASTA WITH FENNELS	Caserecce pasta 80g Pine nuts 1,25g Extravirgin olive oil 10g Wild fennel 10g Raisins 5g Garlic 2.50g	Pasta Nuts & Dried fruit Extravirgin olive oil Vegetables Dried fruit Vegetables
PUMPKIN AND LEEKS FLAN	Fresh pumpkin 100g 1 Egg 15g Butter 3g Leeks 50g Extravirgin olive oil 5g	Vegetables Eggs Butter Vegetables Extravirgin olive oil
CREAMY CHICKPEAS SOUP	Chickpeas 150g Potatoes 150g Extravirgin olive oil 10g	Legumes Potatoes Extravirgin olive oil
GREEN BEANS AND POTATOES WITH PARMESAN CHEESE	Potatoes 150g Green Beans 150g Parmesan 40g	Potatoes Legumes Cheese

MEAT RECIPES		
RECIPE	INGREDIENTS	HYPOTESIS
PIZZA MARGHERITA	Flour 250g Extravirgin olive oil 10g Mozzarella 50g Origan 1g Tomatoes 50g	Soft wheat flour Extravirgin olive oil Cheese Vegetables Vegetables
BEEF FILLET	Beef 150 g	Beef



## Weekly menu

WEEKLY MENUS - RECIPES SUMMARY	VEGAN MENU	VEGETARIAN MENU	BCFN MENU	MEAT MENU
TOMATO BRUSCHETTA	X	X	X	X
PASTA WITH CREAMED VEGETABLES	X	X	X	X
HUMMUS	X	X	X	X
PASTA WITH BEANS	X	X	X	X
PENNE WITH FRESH TOMATOES AND BASIL	X	X	X	X
RED BEANS CREAM WITH GRILLED BREAD WITH HERBS	X	X		
FENNELS GRATIN	X	X		
VEGETABLE SOUP	X	X		
PASTA WITH LENTILS SAUCE	X	X		
STEAMED GREEN BEANS AND POTATOES	X	X		
PASTA AND PEA SOUP	X	X		
CHICKPEAS WITH TOMATOES	X			
CHICKPEAS FLOUR OMELETTE WITH ARTICHOKE	X			
CHICKPEAS FLOUR OMELETTE WITH AROMATIC HERBS	X			
PIZZA WITH TOMATOES AND MIXED VEGETABLES	X			
RED BEANS RISsoles WITH PEAS	X			
RISOTTO WITH APPLES AND ALMONDS	X			
WHOLE WHEAT SPAGHETTI WITH BROCCOLI AND PINE DRIED FRUIT	X			
OMELETTE WITH HERBS		X	X	X
PIZZA MARGHERITA		X	X	X
WHOLE WHEAT SPAGHETTI WITH CHEESE AND BLACK PEPPER		X	X	X



WEEKLY MENUS - RECIPES SUMMARY	VEGAN MENU	VEGETARIAN MENU	BCFN MENU	MEAT MENU
CAPRESE SALAD WITH TOMATO AND MOZZARELLA		X	X	
ASPARAGUS WITH EGGS		X		
GREEN SALAD WITH MOZZARELLA		X		
RISOTTO WITH APPLES AND PARMESAN CHEESE		X		
POTATO AND SPINACH PIE		X		
STEAMED SWISS CHARD AND POTATOES			X	X
BEEF CARPACCIO WITH SHAVED PARMESAN CHERRY TOMATOES AND ARUGOLA			X	X
CREAMED CHICKPEA			X	X
STEAMED GREEN BEANS AND POTATOES WITH SHAVED GRANA PADANO CHEESE			X	X
POTATO GNOCCHI WITH TOMATO SAUCE			X	X
PASTA WITH BROCCOLI			X	X
SALMON WITH ARTICHOKE PUREE			X	X
PUMPKIN AND LEEK FLAN			X	X
VEGETABLE SOUP WITH RICE			X	X
CASERECCIE (PASTA) WITH SARDINES AND FENNEL			X	
TURKEY ESCALOPE WITH SAGE AND LEMON			X	
CHICKEN STRIPS WITH MIXED VEGETABLES			X	
ROAST VEAL				X
LAMB CHOP				X
BRESAOLA (CURED MEAT) ROULADES WITH STRACCHINO CHEESE				X
BEEF ROULADES WITH SAGE				X
PASTA WITH MEAT SAUCE				X
MEATBALLS WITH PEAS				X



RECIPE	INGREDIENTS	HYPOTESIS
TOMATO BRUSCHETTA	Bread 100g Tomatoes 125g Extravirgin olive oil 10g Basil 5g Garlic 2.5g	Bread Vegetables Extravirgin olive oil Vegetables Vegetables
PASTA WITH CREAMED VEGETABLES	Fresh vegetables 300g Pasta 30g	Vegetables Pasta
HUMMUS	Chickpeas 150g Sesame 20g Extravirgin olive oil 10g Aromatic herbs 10g	Legumes Dried fruit Extravirgin olive oil Vegetables
PASTA WITH BEANS	Fresh beans 150g Pasta 80g Extravirgin olive oil 10g Mirepoix 30g	Legumes Pasta Extravirgin olive oil Vegetables
PENNE WITH FRESH TOMATOES AND BASIL	Pasta 80g Peeled Tomatoes 125g Extravirgin olive oil 10g Onion 5g	Pasta Vegetables Extravirgin olive oil Vegetables
RED BEANS CREAM WITH GRILLED BREAD WITH HERBS	Red beans 150g Potatoes 150g Extravirgin olive oil 10g Bread 20g Herbs 5g	Legumes Potato Extravirgin olive oil Bread Vegetables
FENNELS GRATIN	Fennels 200g Soy milk 50g Extravirgin olive oil 10g Breadcrumbs 10g	Vegetables Soy milk Extravirgin olive oil Vegetables
VEGETABLE SOUP	Carrot 50g Zucchini 50g Onion 5g Beans 40g Potatoes 100g Extravirgin olive oil 5g	Vegetables Vegetables Vegetables Legumes Potato Extravirgin olive oil
PASTA WITH LENTILS SAUCE	Pasta 80g Onion, carrot, celery 20g Extravirgin olive oil 10g Lentils 70g Tomatoes 100g	Pasta Vegetables Extravirgin olive oil Legumes Vegetables

RECIPE	INGREDIENTS	HYPOTESIS
STEAMED GREEN BEANS AND POTATOES	Potatoes 150g Green beans 150g Extravirgin olive oil 10g	Potato Legumes Extravirgin olive oil
PASTA AND PEA SOUP	Peas 200g Onion 20g Pasta 30g Extravirgin olive oil 10g	Legumes Vegetables Pasta Extravirgin olive oil
CHICKPEAS WITH TOMATOES	Chickpeas 150g Tomato sauce 50g Extravirgin olive oil 10g Garlic 5g	Legumes Vegetables Extravirgin olive oil Vegetables
CHICKPEAS FLOUR OMELETTE WITH ARTICHOKE	Chickpeas Flour 70g Herbs 1g Artichokes 100g Extravirgin olive oil 10g	Soft wheat flour Vegetables Vegetables Extravirgin olive oil
CHICKPEAS FLOUR OMELETTE WITH AROMATIC HERBS	Chickpeas Flour 70g Herbs 1g Basil 2g Extravirgin olive oil 5g	Soft wheat flour Vegetables Vegetables Extravirgin olive oil
PIZZA WITH TOMATOES AND MIXED VEGETABLES	Flour 250g Mixed vegetables 200g Tomatoes 50g Extravirgin olive oil 20g	Soft wheat flour Vegetables Vegetables Extravirgin olive oil
RED BEANS RISSOLES WITH PEAS	Red beans 100g Bread 30g Peas 30g Extravirgin olive oil 10g	Legumes Bread Legumes Extravirgin olive oil
RISOTTO WITH APPLES AND ALMONDS	Rice 80g Apples 75g Extravirgin olive oil 10g Almonds 20g Onion 7g	Rice Fruit Extravirgin olive oil Dried fruit Vegetables
WHOLE WHEAT SPAGHETTI WITH BROCCOLI AND PINE NUTS	Pasta 80g Broccoli 150g Extravirgin olive oil 10g Garlic 2g Pine nuts 20g	Pasta Vegetables Extravirgin olive oil Vegetables Dried fruit





RECIPE	INGREDIENTS	HYPOTESIS
OMELETTE WITH HERBS	Egg 60g Parmesan cheese 10g Mixed aromatic herbs 4g Extravirgin olive oil 3g	Egg Cheese Vegetables Extravirgin olive oil
PIZZA MARGHERITA	Flour 250g Extravirgin olive oil 10g Mozzarella 50g Origan 1g Tomatoes 50g	Soft wheat flour Extravirgin olive oil Cheese Vegetables Vegetables
WHOLE WHEAT SPAGHETTI WITH CHEESE AND BLACK PEPPER	Pasta 85g Extravirgin olive oil 5g Pecorino cheese 15g	Pasta Extravirgin olive oil Cheese
CAPRESE SALAD WITH TOMATO AND MOZZARELLA	Mozzarella 125g Tomatoes 200g Extravirgin olive oil 10g	Cheese Vegetables Extravirgin olive oil
ASPARAGUS WITH EGGS	Asparagus 100g Egg 50g Extravirgin olive oil 5g	Vegetables Egg Extravirgin olive oil
GREEN SALAD WITH MOZZARELLA	Lettuce 30g Carrot 30g Tomatoes 50g Mozzarella 50g Extravirgin olive oil 10g	Vegetables Vegetables Vegetables Cheese Extravirgin olive oil
RISOTTO WITH APPLES AND PARMESAN CHEESE	Rice 80g Apples 75g Extravirgin olive oil 10g Parmesan cheese 10g Onion 8g	Rice Fruit Extravirgin olive oil Cheese Vegetables
POTATO AND SPINACH PIE	Potatoes 120g Spinach 20g Chickpeas Flour 50g Extravirgin olive oil 5g	Potato Vegetables Soft wheat flour Extravirgin olive oil

RECIPE	INGREDIENTS	HYPOTESIS
STEAMED SWISS CHARD AND POTATOES	Potatoes 150g Swiss chard 150g	Potato Vegetables
BEEF CARPACCIO WITH SHAVED PARMESAN CHERRY TOMATOES AND ARUGOLA	Beef meat 100g Parmesan cheese 20g Arugola 10g Cherry Tomatoes 125g Extravirgin olive oil 10g	Beef meat Cheese Vegetables Vegetables Extravirgin olive oil
CREAMED CHICKPEAS	Chickpea 150g Potatoes 150g Extravirgin olive oil 10g	Legumes Potato Extravirgin olive oil
STEAMED GREEN BEANS AND POTATOES WITH SHAVED PARMESAN CHEESE	Potatoes 150g Green beans 150g Parmesan cheese 10g	Potato Legumes Cheese
POTATO GNOCCHI WITH TOMATO SAUCE	Flour 50g Potatoes 250g Tomatoes 89g	Soft wheat flour Potato Vegetables
PASTA WITH BROCCOLI	Pasta 80g Broccoli 100g Extravirgin olive oil 7,5g Garlic 2,5g Parmesan cheese 10g	Pasta Vegetables Extravirgin olive oil Vegetables Cheese
SALMON WITH ARTICHOKE PUREE	Salmon 100g Artichoke 200g Onion 10g Extravirgin olive oil 5g	Fish Vegetables Vegetables Extravirgin olive oil
PUMPKIN AND LEEK FLAN	Pumpkin 100g Fresh cream 5g Egg 15g Butter 2,5g Leek 50g Extravirgin olive oil 5g	Vegetables Milk Egg Butter Vegetables Extravirgin olive oil
VEGETABLE SOUP WITH RICE	Rice 30g Carrot 50g Zucchini 50g Onion 5g Beans 30g Potatoes 100g Extravirgin olive oil 5g	Rice Vegetables Vegetables Vegetables Legumes Potato Extravirgin olive oil


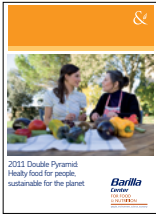




RECIPE	INGREDIENTS	HYPOTESIS
CASERECCE (PASTA) WITH SARDINES AND FENNEL	Caserecce 80g Atlantic bonito 60g Pine nuts 1g Wild fennel 10g Extravirgin olive oil 10g Anchovy fillet 6g Raisins 5g Garlic 3g Onion 8g	Pasta Fish Dried fruit Vegetables Extravirgin olive oil Fish Dried fruit Vegetables Vegetables
TURKEY ESCALOPE WITH SAGE AND LEMON	Turkey meat 100g Extravirgin olive oil 5g Flour 5g Lemon juice 5g	Poultry meat Extravirgin olive oil Soft wheat flour Fruit
CHICKEN STRIPS WITH MIXED VEGETABLES	Poultry meat 100g Carrot 50g Celery 50g Onion 10g Zucchini 50g Eggplants 50g Tomatoes 50g Extravirgin olive oil 10g	Poultry meat Vegetables Vegetables Vegetables Vegetables Vegetables Vegetables Extravirgin olive oil
ROAST VEAL	Veal meat 100g Mixed vegetables 115g Extravirgin olive oil 5g Flour 5g	Beef meat Vegetables Extravirgin olive oil Soft wheat flour
LAMB CHOP	Lamb meat 100g Extravirgin olive oil 10g Herbs 2g	Lamb meat Extravirgin olive oil Vegetables
BRESAOLA (CURED MEAT) ROULADES WITH STRACCHINO CHEESE	Bresaola 50g Stracchino cheese 50g	Cured meat Cheese
BEEF ROULADES WITH SAGE	Beef meat 80g Baked ham 20g Flour 10g Extravirgin olive oil 5g Edamer cheese 10g	Beef meat Cured meat Soft wheat flour Extravirgin olive oil Cheese





RECIPE	INGREDIENTS	HYPOTESIS
PASTA WITH MEAT SAUCE	Pasta 80g Onio, carrot, celery 20g Extravirgin olive oil 10g Beef meat 80g Tomatoes 100g	Pasta Vegetables Extravirgin olive oil Beef meat Vegetables
MEATBALLS WITH PEAS	Veal meat 100g Bread 10g Egg 10g Peas 30g Extravirgin olive oil 5g Cheese 5g	Beef meat Bread Egg Legumes Extravirgin olive oil Cheese







HISTORY OF EDITIONS

PUBLICATION DATE	TITLE	
29 <sup>TH</sup> JUNE 2010	DOUBLE PYRAMID: HEALTHY FOOD FOR PEOPLE, SUSTAINABLE FOOD FOR THE PLANET	
6 <sup>TH</sup> JULY 2011	DOUBLE PYRAMID 2011: HEALTHY FOOD FOR PEOPLE, SUSTAINABLE FOOD FOR THE PLANET	
	TECHNICAL SUPPORT DOCUMENT TO THE SECOND EDITION OF THE DOUBLE PYRAMID	
	TECHNICAL SUPPORT DOCUMENT TO THE SECOND EDITION OF THE DOUBLE PYRAMID Graphic overhaul	





PUBLICATION DATE	TITLE	
10 <sup>TH</sup> OCTOBER 2012	DOUBLE PYRAMID 2012: ENABLING SUSTAINABLE FOOD CHOICES	
	TECHNICAL SUPPORT DOCUMENT TO THE THIRD EDITION OF THE DOUBLE PYRAMID Data and bibliography updating. Introduction of the chapter “Food prices” and “Italian habits”.	
16 <sup>TH</sup> OCTOBER 2013	FOOD AND THE ENVIRONMENT: DIETS THAT ARE HEALTHY FOR THE PEOPLE AND FOR THE PLANET	
	2013 DOUBLE PYRAMID: HEALTHY FOOD FOR ALL, SUSTAINABLE FOOD FOR THE ENVIRONMENT Data and bibliography updating. Overall restructuring of document with the addition of numerous parts aimed at communication.	



PUBLICATION DATE	TITLE	
9 <sup>TH</sup> OCTOBER 2014	DOUBLE PYRAMID 2014 FIFTH EDITION: DIET AND ENVIRONMENTAL IMPACT	
	DOUBLE PYRAMID 2014 TECH DOCUMENT DATA AND BIBLIOGRAPHY UPDATING. Update of the paragraph “The price of eating healthy in the United States” and of the chapter “Contexts and incentives for promoting sustainable food choices”	
10 <sup>TH</sup> JULY 2015	DOUBLE PYRAMID 2015 RECOMMENDATIONS FOR A SUSTAINABLE DIET	
	DOUBLE PYRAMID 2015 TECH DOCUMENT DATA AND BIBLIOGRAPHY UPDATING.  Version 2 of 06/08/2015 Version 3 of 04/09/2015	



PUBLICATION DATE	TITLE	
OCTOBER 2016	DOUBLE PYRAMID 2016 SEVENTH EDITION: A MORE SUSTAINABLE FUTURE DEPENDS ON US	
	DOUBLE PYRAMID 2016 TECH DOCUMENT DATA AND BIBLIOGRAPHY UPDATING.	





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