Executive Summary

Recipe for change: An agenda for a climate-smart and sustainable food system for a healthy Europe

Report of the EC FOOD 2030 Independent Expert Group
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European Commission
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Europe is on the move from the present to the future. The long financial and economic crisis made us focus on immediate problems without much room to invest in our future. With improved economic growth this period is coming to an end, although I suspect that many Europeans may not yet experience this personally and may not have yet recovered from the setbacks. The economic crisis taught us that the systems that we have set up to organise the world are vulnerable.

Also our food system is far from resilient. It has too many negative effects on the environment and on our health. The system delivers more affordable food at larger quantities than ever, but this goes at the expense of future generations. This is an important insight for the direction in which we have to innovate the food system. At a global level this has been recognised by the adoption of the Sustainable Development Goals (SDGs) and the signing of the Paris’ agreement on climate change (COP21).

Especially the latter, creates a juridical obligation for member states that will make a redesign of our food systems unavoidable. Rethinking the use of soils and the role of livestock in the food system of the future is needed. But preparing the food system for the future is not only a challenge for agriculture. A sustainable world implies sustainable consumption of a healthy diet. And although individual consumers and farmers can make important contributions, it are also other players in the food system, like retailers, food processor and technology providers but also cities and financial institutions that can make a difference.

In its FOOD 2030 initiative the European Commission has recognised this challenge to make our food system future-proof. Several publications and conferences have been dedicated to the need for a food system approach with improved governance. To take further steps towards implementing FOOD 2030 DG RTD has established a group of experts to appraise the current research landscape relevant to food systems and to formulate missions that can direct the future research and innovation actions in Europe.

The report of the FOOD 2030 expert group is now either on your screen or in your hands. It was my pleasure to chair the group and I warmly thank my colleagues for their hard work and excellent collaboration. I extend my thanks to all others that contributed indirectly and to the Commission staff for their support and entrusting us with this challenging task.

In the coming year the European Union will discuss its investments for the future, in financial discussions and in allocating budgets to research and innovation programs. With this report we argue to recognise the resilience of our food system not only as a serious challenge but also as an opportunity to bring Europeans together at the table with diverse and healthy food from its many regions.

Krijn J. Poppe
Chair of the Independent FOOD 2030 Expert Group
Introduction

In 25 years, our food system will look very different from now. Technology and social practices will have changed the way we produce and process our food, as well as how we shop. Even what we eat will be different.

Our current food system is not fit for the future. Farm practices are not sustainable, we eat less healthily than we should and we are unprepared for climate change. We also think about agriculture, the wider bio-economy and managing natural resources as being separate from the food system, while in reality they are all interconnected. We need to create sustainable, diversified, inclusive and resilient processes that can cope with the complex social and ecological effects of increased urbanisation, population growth, changing demographics, climate change and resource scarcity: our whole food system needs innovation.

In this report, a group of experts recommends orientations for innovation in the years to come at the request of the European Commission’s DG RTD. The report will contribute to a Research, Innovation and Investment Strategy (RI&IS) in line with the Commission’s FOOD 2030 initiative, which is based on four priorities:

- Nutrition for sustainable and healthy diets
- Climate smart and environmentally sustainable food systems
- Circularity and resource efficiency of food systems
- Innovation and empowerment of communities

Using food systems thinking, the experts have further elaborated and integrated these four priorities to develop a mission type approach.
# The grand challenge: a climate-smart, sustainable food system for a healthy Europe

Many of the 17 sustainable development goals (SDGs) set by the United Nations are relevant to the food system. These range from ending hunger and improved nutrition (SDG2), via halting land degradation and biodiversity loss (SDG15), to forging a global partnership for sustainable development (SDG17). Nearly 10% of the EU population are not able to afford a regular quality meal every second day. Europe is the continent most severely affected by non-communicable diseases. These are the leading cause of disability and death, and they are linked to the way we eat and drink. To put it another way, without fixing the food system, the SDGs simply cannot be achieved.

The Paris climate change agreement (COP21) commits Europe to reducing greenhouse gases (GHG) dramatically to keep the rise in global temperatures below 2 degrees. Farming has to adapt to climate change and a world without fossil fuel. The food system (including on-farm energy use) accounts for around 26% of total EU emissions. The food system can help, for instance by partly substituting plant-based proteins for animal proteins, by reducing food losses and waste and by helping farmers to implement practices to reduce greenhouse gas emissions. Farmers only have about 10 harvests to adapt to the 2030 effort-sharing agreement. After 2030, with the easiest measures taken, the climate challenge will be much more daunting, with a clear risk of unprofitable, 'stranded' assets.

Meeting these grand challenges will have important societal benefits, ranging from major improvements in our health to safeguarding food production for future generations. These grand challenges fall under many current EU policies. We need a substantial, over-arching R&I policy to support them. Regulations and taxes can stimulate innovation and productivity, but research and innovation are crucial to achieve policy goals and integration.

The transformation of the food system should make it more sustainable, resilient, responsible, diverse, competitive and inclusive:

- Sustainable: with respect to natural resource scarcity and planetary boundaries;
- Resilient: adapting to climate and global change, including extreme events and migration;
- Responsible: being ethical, transparent and accountable;
- Diverse: being open to a wide range of technologies, practices, approaches, cultures and business models;
- Competitive: providing jobs and growth;
- Inclusive: engaging everyone involved in the food system, plus civil society, fighting food poverty, and providing healthy food for all.

In achieving these objectives, we must realise that the complexity of the food system extends to practically all bio-economic sectors. Farming depends on the natural environment, which makes the interaction of primary production with natural habitat management a crucial factor. Therefore agro-ecological knowledge approaches are very important.

## SDGs are relevant to the food system and the Paris Agreement on Climate Change

- **More beans, less beef... in 10 harvests**

## EU policies should be accompanied by an R&I policy

- **The food system cannot transform alone**

## The grand challenge: a climate-smart, sustainable food system for a healthy Europe

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Food system approach

Grand challenges cannot be met in isolation through a range of technical innovations: a more integrated approach is needed, linking food consumption and production, land and sea, farmers and consumers. We call this a **food system approach**. This kind of approach helps identify which parts of the system are interlinked and which can make the difference. Who will be the game changers?

The food system incorporates all elements and activities that relate to the production, processing, distribution, preparation and consumption of food, as well as its disposal. This includes the environment, people, processes, infrastructure, institutions and the effects of their activities on our society, economy, landscape and climate.

The food system is a complex adaptive system: complex, because there are many interrelations; adaptive, because external drivers (climate change, for example) as well as internal changes, set chains of events in motion. It is only possible to understand the effect of changes after they have been made. So, to transform the system we need a more iterative approach, using enhanced feedback loops.

Businesses that are parts of a food system are highly dependent on each other. Currently, retailers and food processors compete primarily on food prices but have few incentives to compete on quality, innovation or environmental impact. This means cost pressures on farms, with environmental consequences.

To provide affordable, high quality products and to increase the earnings of those who work in food, farming and fisheries, the food system has innovated successfully – but at the expenses of the environment, biodiversity and animal welfare. Food is now affordable and our lifestyles have changed so much that unhealthy diets contribute to obesity and non-communicable diseases. Some companies have responded and see innovations as business opportunities. But that is not sufficient and governments need to intervene.
Many small farming, fisheries, food processing and retail firms underinvest, as they are too small to reap all the benefits of risky innovations. This does not just represent classical market failure: it suggests the food system cannot become more sustainable without guidance and supportive policy frameworks.

Right now, the food system is not responding enough to meet the great challenges. It seems that everybody is locked in and kept hostage by the current system. The powerful retailers, food processors and input providers (feed, chemical and machinery firms) compete with each other but do not have enough stimulation to work together in more sustainable ways – and this affects weaker farmers and consumers. We need to look at whether they need carrots as well as sticks.

**Missions**

Successful innovations tend to have a clear direction. Governments can tell businesses to change, but they could also create a market for innovative products or (public) services, or a label explaining a certain type of sustainable farming. A mission type approach (in short: missions) is a powerful tool for this, as it promotes solutions from people on the ground. Missions are political in nature and require broad stakeholder engagement. We propose breaking down the grand challenge of "A climate-smart, sustainable food system for a healthy Europe" into three missions, using the frame proposed by Mazzucato (2018). These three missions, which further build on and integrate the four FOOD 2030 priorities, contain 17 focus areas.
A. Improve dietary patterns and lifestyles for a 50% reduction in the incidence of non-communicable diseases (NCD) in 2030, while reducing the environmental impact of food consumption

Changing dietary habits and increasing physical activity could address major risk factors and reduce rates of obesity and Non-Communicable Diseases (NCDs) in Europe by 50%. Successful nutrition and lifestyle strategies will enable European citizens to live longer, healthier and more independent lives in a more sustainable environment, decreasing the costs of health systems. Changing dietary habits, for example, by switching to more plant-based proteins also has a large potential to reduce the environmental impact of food consumption. This mission builds on the FOOD 2030 priority of Nutrition for sustainable and healthy diets.

Direction: eat more diverse and healthier foods

Innovation: cities, insurance companies and ICT as new players

Currently seven of eight major risk factors for premature death are linked to the way we eat, drink and exercise; we need to prevent diseases rather than just treating them. A quarter of greenhouse gas emissions come from the food system, where food choice and waste are critical. Scientists understand better than ever how our body functions, thanks to ongoing progress in areas such as neuro-science, genetics, omics-technologies and understanding the intestinal microbiome. In this context food safety will be improved to an even higher level.

Businesses that offer food to consumers can play an important role in promoting healthy and sustainable choices. Cities are important as regulators and spaces – do they, for instance, encourage fast-food outlets or cycling lanes and urban farms? The health sector (from dietitians/nutritionists and doctors to health insurance companies) can also play a key role in facilitating sustainable food choices. The European industry could build up suitable, personalised nutrition technology (apps, food printing, food delivery) based on scientific and socio-economic evidence.

An example

Innovative food products with taste attributes for the elderly are developed that target malnutrition and are environmentally sustainable. Strategies are developed to deliver nutrition advice tailored to the individuals’ biological readouts (dna, microbiome, neuro-science) that will also promote sustainable dietary patterns. These might be delivered in new ways (with personalised nutrition advice and food printing in smart kitchens). It will give European companies a competitive advantage.
### Five focus areas

1. **Halt Obesity**: halt the rise in obesity levels in school-aged children, adolescents and adults by tackling complex causes via a food systems approach.

2. **Healthy Aging**: add healthy and independent years to the ageing population, halving the number of dependent adults.

3. **Healthy and Sustainable Food**: help more people eat a healthy and sustainable diet by making twice as many affordable energy and protein food sources available. Collaboration with Africa is useful.

4. **Improve Food Processing**: improve food processing for more nutritional and tastier products that are also safer and better for the environment.

5. **Personalised Nutrition**: use personalised nutrition strategies to improve dietary patterns and lifestyles, reduce the incidence of non-communicable diseases in Europe by 50% and decrease the environmental footprint of the consumption by 20%.
B. Create a resource-smart food system with 50% lower greenhouse-gas emissions by 2030

We need to redesign the food system to help solve Europe’s climate challenge, respecting environmental limits on water quality and irrigation levels, air quality (ammonia, odour, fine particles), biodiversity (pesticides, natural habitats) and soil quality (no soil degradation and more carbon storage).

The food system must not pose unnecessary risks for public health (fine particles, zoonosis, use of antibiotics and pesticides) and should respect ethical demands (e.g., animal welfare). Aquatic production should double and the use of feed from insects and algae should increase. Plant production should be strongly based on agro-ecological principles supported by reductions of fossil-based energy and pesticides. Integrated water resources management is needed. We must also reduce the negative impacts of packaging, particularly of plastics.

This entire redesign should result in a food system built on sustainable diets and minimal waste, which is recycled in a safe way in accordance with circular economy principles. This diet should be affordable for all Europeans. Farmers and fishermen should also have a fair income that is not based on subsidies, but where needed on public contracts for public services. This mission builds on and integrates the FOOD 2030 priorities to make food systems climate-smart and environmentally sustainable as well as circular and resource efficient.

More ecological understanding of agro-ecosystems is now available to redesign food production. Innovative changes in the organisation of primary production and agro-ecosystems have been developed by groups of farmers and need support for upscaling. New technologies speed up breeding processes, while self-driving robots can farm with great precision, requiring fewer chemicals. Just as tractors and pesticides revolutionised production in the 1950s, modern techniques could completely redesign the food system and avoid negative environmental impacts. But such technologies do have negative aspects too, such as the impact on employment, or ethical and data ownership implications. We need a societal debate from the start to ensure responsible innovation in this area.

Input industries and food processors are important, but innovation systems must also work closely with farmers, as many solutions are linked to local conditions. This is the case in the EU but also holds for joint innovation programmes with Africa and the Middle East, where demographic developments, climate change, war and migration often lead to food insecurity.
On a territorial scale the farming system is redesigned with an integrated approach to animal and plant production, to reduce the diversion of biomass for animal feed, drive down GHG emissions and turn waste flows into fertility. Ecological principles are further developed and knowledge on proper soil management is enhanced, alongside advances in ict-driven precision farming. This makes a reduction of virgin minerals and chemical inputs possible – and affordable for smaller farmers. Such food is marketed on the basis of reducing waste and increasing sustainability, contributing to a shift in consumer preferences – just as consumers opt for the electric self-driving cars of the future over current diesel cars.

### Seven focus areas

6. **Territorial systems**: develop sustainable and climate-resilient food systems on a territorial scale.

7. **Diversified systems**: diversify fields, farms, landscapes and diets to use resources in a climate-proof, sustainable way.

8. **Low impact animal systems**: redesign, integrate and encourage low-impact animal production systems.

9. **Smart soil and virgin mineral use**: arrive at a fully sustainable and smart use of natural resources: zero land degradation by 2030, healthy soils, reducing the yearly input of virgin minerals (such as phosphate) by 50%.

10. **Reduce impact packaging**: Reduce the environmental impact of food packaging by 2030 by 75%.

11. **Halve food waste and losses**: Halve food waste and losses from the EU food and farming system by 2030.

12. **Double food from aquatic systems**: Double the sustainable production of high-quality food from EU aquatic systems by 2030.
C. Realise trust and inclusive governance for a resilient and safe food system

A resilient food system that copes with new challenges through responsible innovation needs fast feedback loops. Challenges should quickly provoke action. Current food systems are failing because they do not factor in negatives such as health and environmental impacts. Instead, food producers need to be empowered to take action. Vulnerable farmers, fishermen, consumers and small food companies as well as innovators benefit from open data and open innovation; this openness also helps people to accept new technologies. Remote rural and coastal areas also need links to cities and innovation centres in Europe’s major food regions. This mission builds on the FOOD 2030 priority on Innovation and empowerment of communities.

Direction: empower small producers and foster open innovation

Innovation: a shopping list, from sharing food data to keeping isolated places liveable

To make the food system more inclusive, we need to look at certain pressing issues. These include stimulating social innovation, including and empowering small food businesses, combining the modern and old, and creating new business and governance models. We also need to look at ways to engender a sense of community that keeps isolated locations feeling “liveable” in emptying rural/coastal areas with an ageing population. In this context food safety will be improved to an even higher level.

Connecting communities of small businesses to innovation hubs (with ICT tools or otherwise) can improve knowledge flows. Engaging citizens through educational and social programmes can strengthen their role in the system, as can short supply chains. Urban food policy networks can play an important role in fostering knowledge exchange, civil society participation and the dissemination of good practice. New technologies and organisational arrangements (like e-platforms) make it possible to share data along the food chain, thereby promoting safety, transparency and trust. Methods to assess sustainability and to support true cost accounting can improve the governance of the global food system. We must also pay special attention to institutional development frameworks to upgrade local food systems in an urbanising Africa and the Middle East.
Cities that aim to be carbon-neutral will adopt a food policy that promotes a healthy living environment and source their food from carbon-neutral food systems. Food outlets are spatially planned to nudge consumers into sustainable healthy products. Vulnerable (consumer) groups are empowered to take the lead in developing effective ways to gain control over their food intake. Such cities are innovation hubs to which farmers and small food businesses are linked, also through new technologies that efficiently deliver the food and provide farmers and fishermen with options to innovate. New technologies bridge the geographical distance between those cities and remote areas to connect distant populations and allow equal access to social advancements.

**An example**

**Five focus areas**

13. **Increase food safety and consumer trust**: increase consumer trust by 50% by improving the authenticity, transparency and safety along the food system by 2030.
14. **Upgrade innovation capability**: upgrade innovation capabilities of small firms in food systems.
15. **Strengthen the citizen’s role**: strengthen the different roles of citizens in a healthy, diverse and sustainable food system.
16. **Link cities and remote areas**: link cities, remote rural and coastal areas to help them develop innovative food systems.
17. **Improve international cooperation**: improve international cooperation in trade and development, especially with Africa and the Middle East.
Conclusions

Like a Michelin-starred menu, the food system has a lot of ingredients – individual farmers, multinational vendors, international governments and, of course, consumers, who may not equate what is healthy with what is tasty. There is no one switch for a sustainable system.

Interventions at the point where the problem occurs do not solve it: the taxpayer will continue to subsidize farmers and pay for the increasing costs of the health system. Meanwhile, small food companies, farmers and fishermen continue to lack incentives to provide sustainable and healthy food. So, we need a multi-objective and multi-actor drive for responsible innovation across the food system, with new partners like cities and health insurers. New technologies in genetics and preventive health (e.g., the microbiome, neuroscience) and ICT (artificial intelligence, precision farming, personalised nutrition) could also help to bring change, if applied in the right way. Social innovation and organizational changes are required to realize a climate-smart, sustainable food system for a healthy Europe.

In the age of the bioeconomy, Europe is well positioned to take the lead and guide the world towards a food system that is future proof. We have a sense of urgency plus state-of-the-art food production systems, high levels of food safety and environmental quality standards and a first-class knowledge infrastructure. Europe has the capacity to lead the world in creating a sustainable food system and benefit from the business it will generate. In this way the European industry (food, health, ict) will improve its competitive position vis-à-vis other continents.

Tackling this grand challenge by completing the three missions will need major investment, way above the currently allocated framework funding. We, as experts, therefore call for substantial investment within the framework of the next EU budget in partnership with Members States, industry, foundations, civil society, and others. This investment should be deployed via a dedicated Research, Innovation and Investment Strategy (RI&IS) which engages all possible instruments and partnerships necessary to get the job done. Past investments in agricultural research have resulted in a large societal return: US data suggest that $1 invested was worth ten times as much, over time. Even greater results have been shown with non-communicable diseases: reducing salt intake by 30% in the high-burden population of sick people reportedly gave US society $19 of benefit for every $1 spent. In Europe, greenhouse gas emissions from the food system are currently around 1.180 Mtonnes CO2-equivalents. Reducing that by 50% would save the equivalent of €20 billion a year.

Innovations make farm subsidies avoidable and reduce rising health costs

Europe is well positioned

An investment of €10 billion ... has a high return on investment
Recommendations

**European Union (Commission, Parliament, Council)** Adopt the main conclusion of this advice to develop a unified, health-centric, climate-smart, sustainable and resilient food system for Europe based on a system approach to R&I and of a substantial investment way above the current allocation from the EU budget and beyond.

**Directorate General RTD** Lead by example and convene and organise the necessary critical mass within the European Commission as a first step to working together towards these common goals. Work closely with other EC services, and others, to deliver a food system that improves the social contract between agriculture and society on providing healthy, sustainable food at prices that are fair for farmers and consumers.

**Member States (and regions in federated member states)** Support the approach in the EU by making your own research and innovation programmes mission-driven, with the same grand challenge and three missions advocated here. You could choose from the 17 focus areas to represent your national priorities and specialisms. Work jointly in ministries and authorities across departments to implement a systems approach to R&I policy and governance on these missions.

**Companies (in food processing, retail, input industries, ICT, health, and finance)** Reconsider your business strategy in light of contributing to SDGs, given the challenges for the food system, scale up your innovation activities and link them to the research and innovation programmes of the EU and the member states.

**Farmers, SMEs in the food chain and start-ups in the food system** Realise that there are chances to improve your position in the food chain by pursuing innovation, stronger collaboration with different food chain actors and participation in multi-party innovation programmes.

**Citizens and consumers**: Eat in a healthy and sustainable way; contribute ideas and engage in innovative projects to support the transition of the food system.

**Cities and other local (water) authorities** Introduce a proactive and evidence-based food policy that creates healthy, sustainable urban environments to make healthy and sustainable choices appealing for consumers. Make sure that city neighbourhoods are connected with the surrounding green countryside and seaside for a healthy lifestyle. Multi-party innovation should be an important part of urban food policies.

**Fundations, civil society and non-governmental organisations** Your objectives can partly be realised by advocating for the proposed missions and aligning with or taking part in research and innovation programmes with the people you represent.

For more information and a list of references see the full report: [https://ec.europa.eu/research/bioeconomy/index.cfm?pg=policy&lib=food2030](https://ec.europa.eu/research/bioeconomy/index.cfm?pg=policy&lib=food2030)
Annex 1
Members and mandate of the Expert Group

Members
Krijn Poppe, chair
Roberta Sonnino, vice-chair and rapporteur
Lilia Ahnéd
Loraine Brennan
Nick Jacobs
Carlo Mango
Klaus Menrad
Katerina Moutou
Otto Schmid
Sébastien Treyer
Consuelo Varela Ortega
Henk Westhoek

Mandate
The group is expected to review the problems affecting the current European R&I landscape relevant to food systems and FNS, assess the main drivers and barriers to high-impact R&I, explore how best to increase public and private R&I investments and impacts, and describe who is affected and how. Furthermore, the group will develop and assess the impacts of possible R&I missions and will provide policy recommendations to increase R&I investment and R&I impact towards future-proofing our food systems so that they become environmentally sustainable, resilient, responsible, diverse, inclusive, and competitive.

In addition, the experts will examine the current and future contribution of the FOOD 2030 initiative and how it can contribute to the EU’s policy objectives (e.g., President Juncker’s 10 priorities). The expert group should also consider how FOOD 2030 interacts with other relevant policy initiatives and targets such as the Sustainable Development Goals, Modernisation of CAP, Circularity, COP21 climate commitments, etc.

The specific objectives of the group are to contribute to the preparation of a Research, Innovation and Investment Strategy (RI&IS) also exploring potential R&I missions, their impacts and targets, and R&I focused policy recommendations.
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In this report, a group of European Commission (EC) appointed experts recommend orientations for food and nutrition security research and innovation in the years to come. The report calls for a Research, Innovation and Investment Strategy (RI&IS) in line with the EC FOOD2030 initiative to deliver on four priorities: nutrition for sustainable and healthy diets; climate smart and environmentally sustainable food systems; circularity and resource efficiency of food systems; innovation and empowerment of communities. Using food systems thinking, the experts have reworked and integrated these priorities to develop a mission-type approach.

*Studies and reports*