2019

Sustainable dairy in Europe

Safeguarding our resources

Denmark, The Netherlands, United Kingdom (Northern Ireland), France, Belgium, Ireland

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Foreword

Sustainability and climate impact represents some of the biggest challenges for humankind in the 21st century and taking action to address it is one of the European Union's top priorities. The EU has set ambitious targets for this challenge in 2030: at least a 40% reduction of the emission of greenhouse gases (GHGs) from 1990 levels, at least a 27% improvement in energy efficiency and at least a 27% share of renewable energy in 2030. With these targets the EU plays an active role in the achievement of the UN's Sustainable Development Goals (hereafter SDGs). The European dairy sector is focused and working hard to be part of the solution.

This Fact Book has been produced as part of a three-year campaign 'Sustainable Dairy in Europe', launched by the European Milk Forum, co-financed by the EU Commission. National Dairy Councils from Ireland, Northern Ireland, Denmark, France, Belgium and The Netherlands are participating in the programme. The purpose of the programme is to discuss the challenges of sustainability and climate change and the determination of the dairy sector to be part of the solution, along with every other business sector and citizen, across Europe and the world.

In the six countries involved, the dairy sector acknowledges that sustainable development and climate change are pressing challenges that must be acted on and is committed to continuing to contribute to solving these issues. At each stage in the entire dairy supply chain – from single farms to manufacturers and educational partners, from feed to packaging – the sector is making significant and formidable progress to reduce its environmental footprint. On a number of key balances – emission of greenhouse gases, waste, pollutants and energy efficiency – striking improvements have been made on our journey of continuing to improve our sustainability. This publication recognises many of the exceptional achievements and positive progress made by the European dairy sector in meeting the evolving environmental challenges. These stand as a testament to the hard work and commitment across the entire supply chain, government and other partners in a collective pursuit of the sustainability agenda.

However, we cannot afford to be complacent and there is always room to improve. Our journey in continuing our environmental sustainability does not have a finish line or cut off point. There will always be more to learn as we strive to meet the challenge of a changing climate and continue to provide a source of sustainable, healthy and nutritious food for generations to come. This fact book has been produced with support from the European Milk Forum (EMF) and finance assistance from the European Union.

The EMF 'Sustainable Dairy' initiative is co-ordinating a new and informed dialogue with key stakeholders on the environmental actions being taken in six EU countries. We are grateful for the EMF and EU support and proud to highlight the positive contribution that the dairy sector is making towards the sustainability agenda in Europe.

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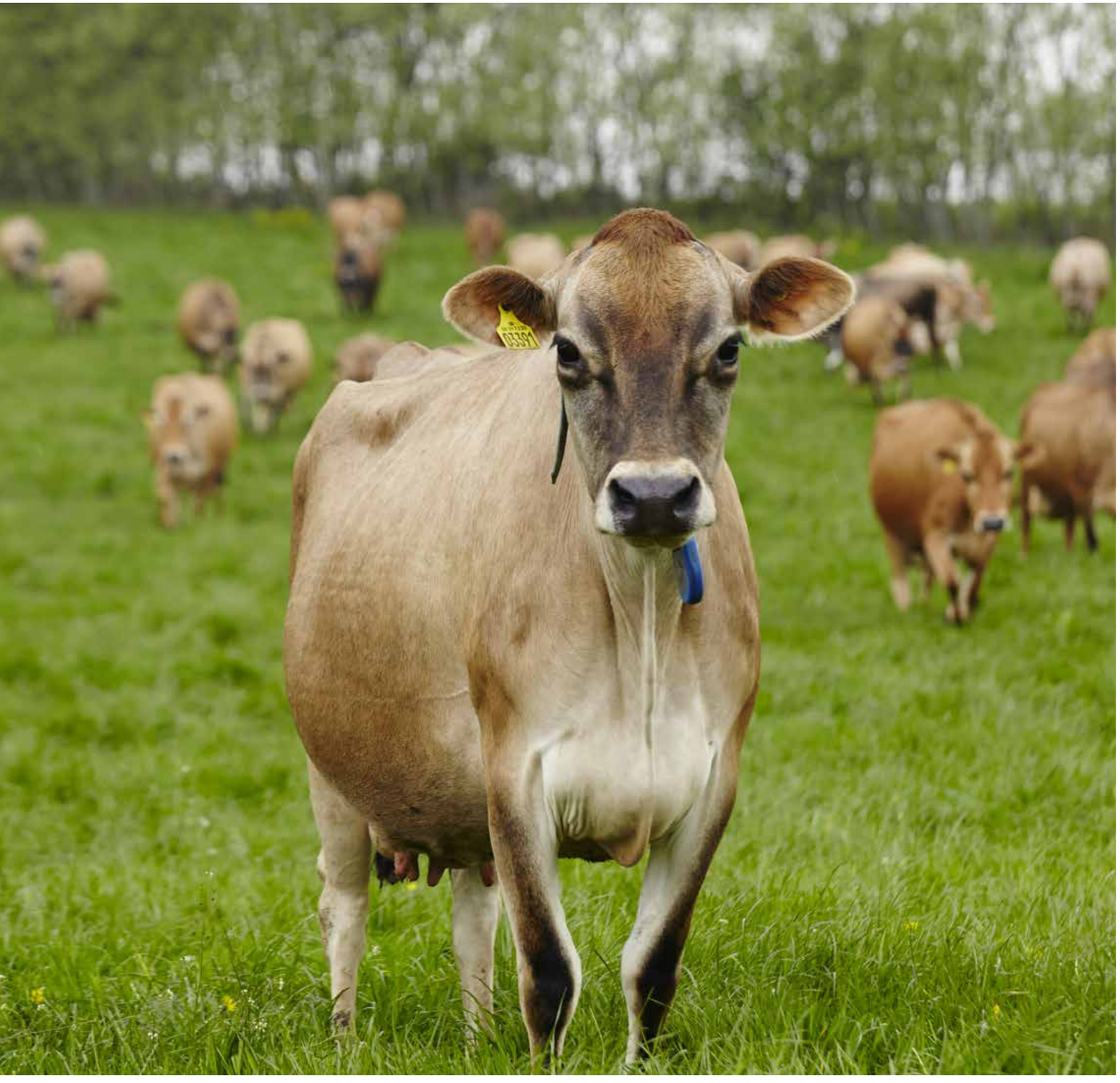


Chapter 1

Climate change

Safeguarding our resources

Sustainable **Dairy**

Over the last decades, we have witnessed the emerging of a green transition and a demand for sustainable transformation. From the Brundlandt Report defining sustainable development in 1987 to the omnipresent UN Sustainable Development Goals adopted by world leaders in 2015. Both stressing the need for cross-sectoral commitment – the economic and the ecological policies must be integrated if we are to achieve a sustainable future.

At the launch of the UN Sustainable Development Goals in 2015 all of the world was called upon to commit themselves to push the sustainable transformation further. Governments, non-governmental actors, industry and businesses are all vital in this transition.

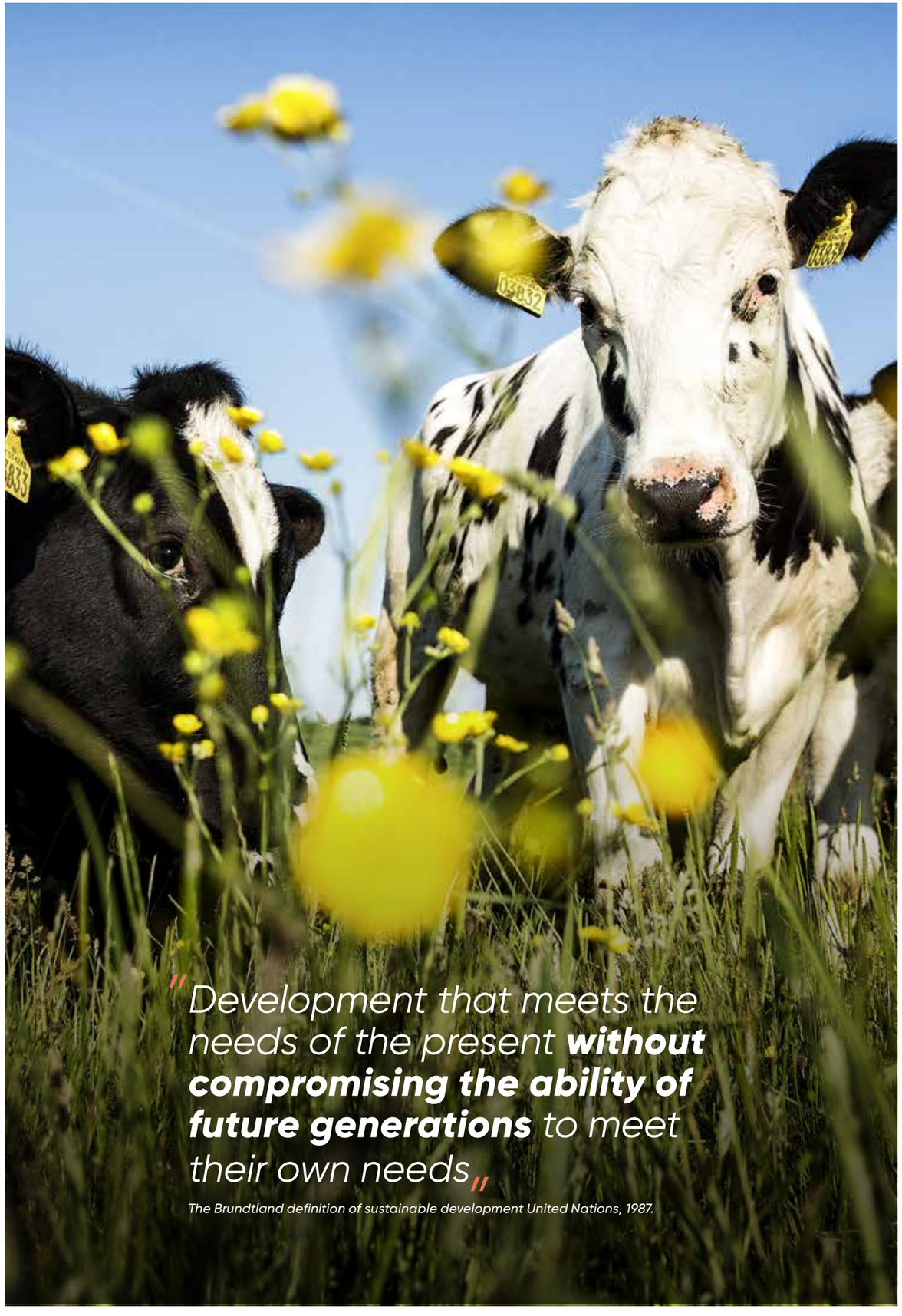
The UN 2030 Agenda and Sustainable Development Goals establishes a holistic concept of sustainability where all dimensions must be taken into account: Climate, environment, health, economic growth, circular production and consumption, clean water, biodiversity, equality and many more.

Clearly, the dairy sector plays an important part in this green transition. With securing a nutritious and healthy diet for the growing populations all over the world and as a major contributor to economies, employment and livelihood globally. Moreover the dairy sector is a key element in the management of terrestrial ecosystems, supporting biodiversity and addressing environmental degradation and climate change, e.g. by sequestrating carbon in the soil.

Therefore, in October 2016 the global dairy sector, represented by the International Dairy Federation (IDF), and the UN Food and Agriculture Organization (FAO) formally committed itself to push this sustainable transformation by signing a declaration that the global dairy sector is working with the UN Sustainable Development Framework. Moreover the Declaration also acknowledges the dairy sector's key role in feeding a growing population. The declaration was signed in Rotterdam and is referred to as the Rotterdam Declaration (FAO, 2016).

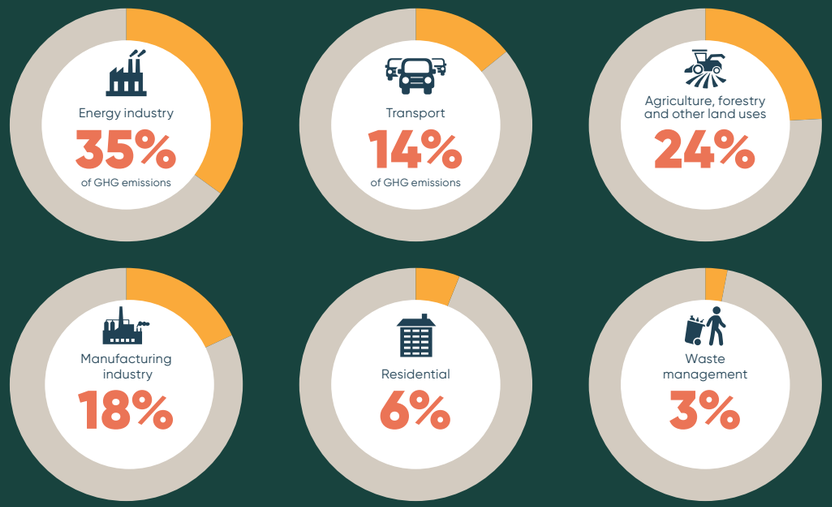
As part of this sustainable transformation, patterns of production and consumption must be transformed. Consumption in the developed world leads to an immense use of resources – and this is expected to more than double towards 2050, if we don't change this (IPCC, 2017). Such an immense use of resources leads to large emissions of greenhouse gases, a lack of biodiversity and natural eco-system imbalances. The dairy sector is committed to playing a part in solving the schism between reducing the pressure on resources while producing more, nutritious food to a growing, global population.

With this publication the European dairy sector is taking stock on the sustainable transformation up until this point. How far have we come? And what challenges still lie ahead of us?



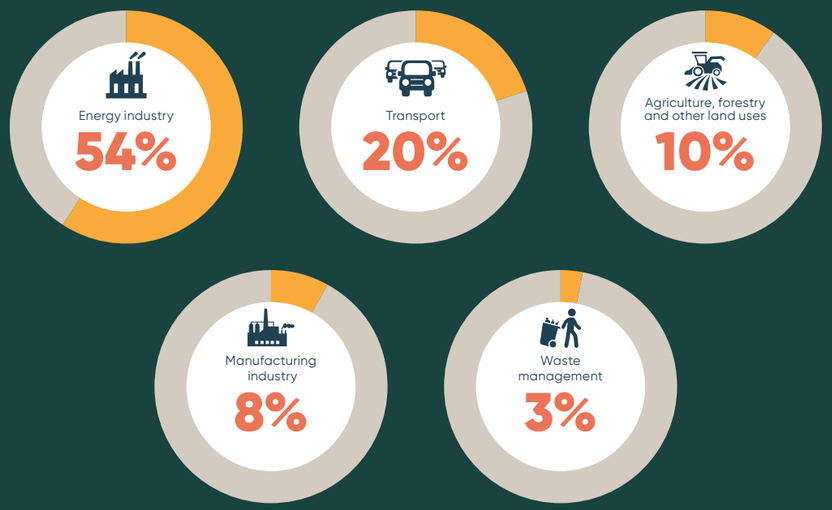
World level

– emissions from sectors



European level

– emissions from sectors



Source: IPCC 2014, UNFCC 2015, European Commission 2018.

The climate changes are costly

Tackling the challenge of **climate change**

When talking about sustainable development, tackling the effects of climate change is the first issue that comes to mind. Climate change is costly for nations, communities and people every day. Especially changing weather conditions, rising sea levels and imbalances to natural eco-systems are challenging the communities and economies all over the planet. All these changes are mostly caused by the excess emission of greenhouse gases (GHGs) from human activity such as the production of energy, transportation, manufacturing, household emissions and agriculture. This overproduction of greenhouse gases started roughly in 1900 with the industrial revolution and has risen since then.

Where does the greenhouse gas emissions come from?

When looking at the world level, the largest emitter of greenhouse gases is the energy sector. Producing and transporting energy and electricity for factories, production sites and households all over the world have a huge impact on the climate with 35% of all of the GHG emissions in 2014 (IPCC, 2014). Next to the energy sector, agriculture is the second largest contributor to greenhouse gases globally. Agriculture, forestry and other land use causes close to a fourth (24%) of all greenhouse gas emissions on a world level. Agriculture alone accounts for 10 to 12% of all GHG emission at the world level. Livestock and manure are responsible directly for 7% of all GHG emission at the world level and the rest of the emission of greenhouse gases come from forest and changed land use (UNFCC, 2015).

When looking at the European level, the energy sector's share is even bigger. In Europe, the energy sector emits 54% of all greenhouse gases in 2016 (European Commission, 2018).

At a European level, the agricultural sector emits just 10% of all greenhouse gases in 2016 (European Commission, 2018). Being highly productive and efficient, the European agriculture's emissions of GHG are relatively small, according to the IPCC (IPCC, 2006, p. 823).

In Europe, transportation is the second largest emitter of greenhouse gases, next to the energy sector emitting 24% of all GHGs in 2016 (European Commission, 2018). In Europe agriculture is thus only the third largest emitter of GHGs.

"The European agricultural sector has reduced its emissions by 23% over the last 30 years"

European Commission, 2015.

Different **methodologies**

There are two different methodologies for assessing the greenhouse gas emissions from the different sectors: The IPCC methodology and the Life Cycle Assessment methodology (European Commission, 2018).

IPCC **methodology**

The national inventories of greenhouse gas emissions from the economic sectors is the methodology used by the IPCC. These numbers are solely based on the emissions of GHGs from each sector. This methodology is different than the Life Cycle Assessment (LCA) methodology, which is used in many scientific publications (IPCC, 2014).

Life Cycle **Assessment**

The Life Cycle Assessment (LCA) considers the entire life cycle of a product, from raw material extraction and acquisition, through energy and material production and manufacturing, to use and end of life treatment and final disposal. Through such a systematic overview and perspective, the shifting of a potential environmental burden between life cycle stages or individual processes can be identified and possibly avoided (ISO 1404).

Europe has reduced emissions by 18% since 1990

Since 1990 the total emissions of greenhouse gases have been reduced by 18% in Europe, when looking at the national inventories (European Commission, 2015). This overall reduction of emissions stems mainly from a reduction of emissions from waste management and industrial processes. But also, the energy and agricultural sector have reduced its emissions of greenhouse gases markedly since 1990. The European agricultural sector has reduced its emissions by 23% over the last 30 years (European Commission, 2015).

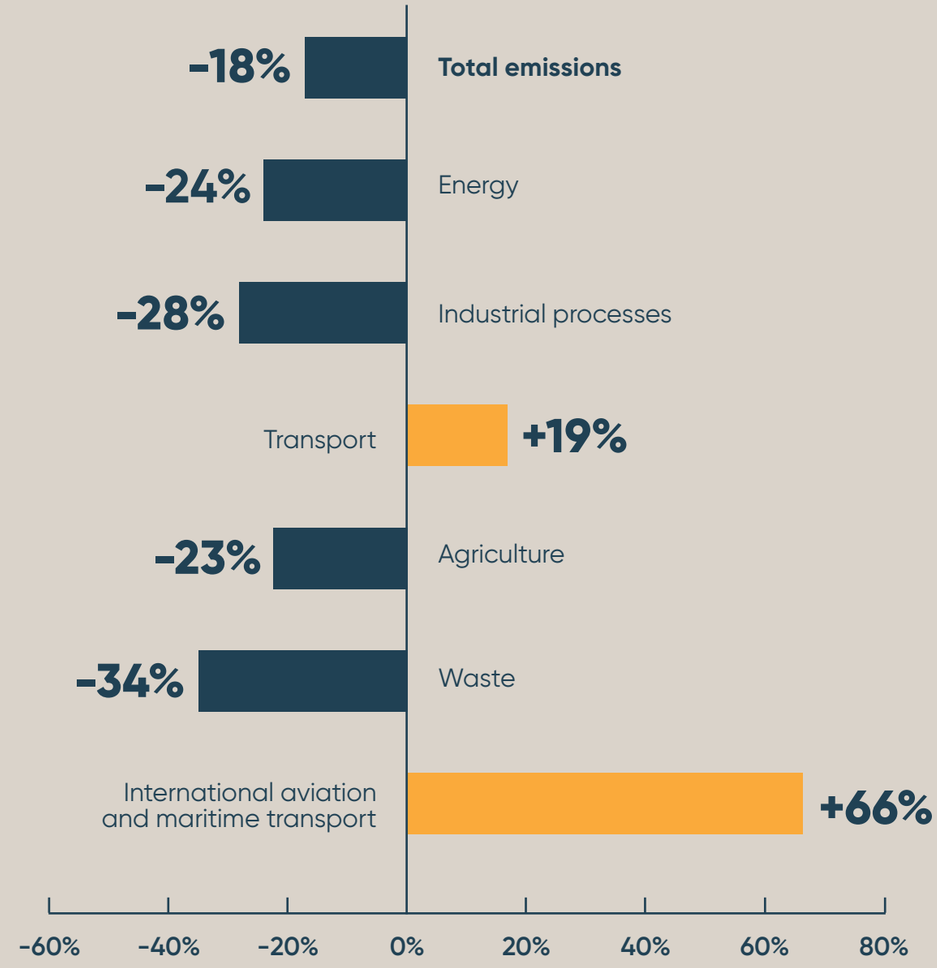
On the contrary, international aviation and maritime transport have increased their emissions substantially over the last 30 years (European Commission, 2015). Emissions from transportation was increased by 19% since 1990 and aviation and maritime transportation have increased its emissions by a whooping 66% over the last 30 years (European Commission, 2015). Other research has also shown that the tourism sector is a vast contributor to the GHG emissions – and it is a sector where emissions continue to grow (Lenzen et al., 2018).

Meanwhile it is important to note that greenhouse gases are natural and that they are all – especially CO_2 – an important part of nature. For example CO_2 is needed for plants to grow. The aim is thus not to bring the GHG emissions to zero, but to get closer to the natural level of emissions.

1990-2011

Changes in EU-27 GHG

by sector



Source: IPCC 2014

The European Agriculture Policy is **going green**

European initiatives support the international sustainability agenda, and with the latest proposed reform of the European Common Agriculture Policy (CAP) a “greening” of the direct payment system for European farmers can be changed into a more environment-friendly system.

Consequently, farmers who use farmland in a more sustainable way and care for natural resources as part of their everyday work, benefit financially. Such sustainable ways of using farmland includes diversifying crops, maintaining permanent grassland and dedicating 5% of arable land to ecologically beneficial elements.

This system will aim to secure environmental and climate benefits as part of the agricultural activity in order to counterbalance the fact that the markets still haven’t recognized the price on safeguarding biodiversity in farming (European Commission, 2017).

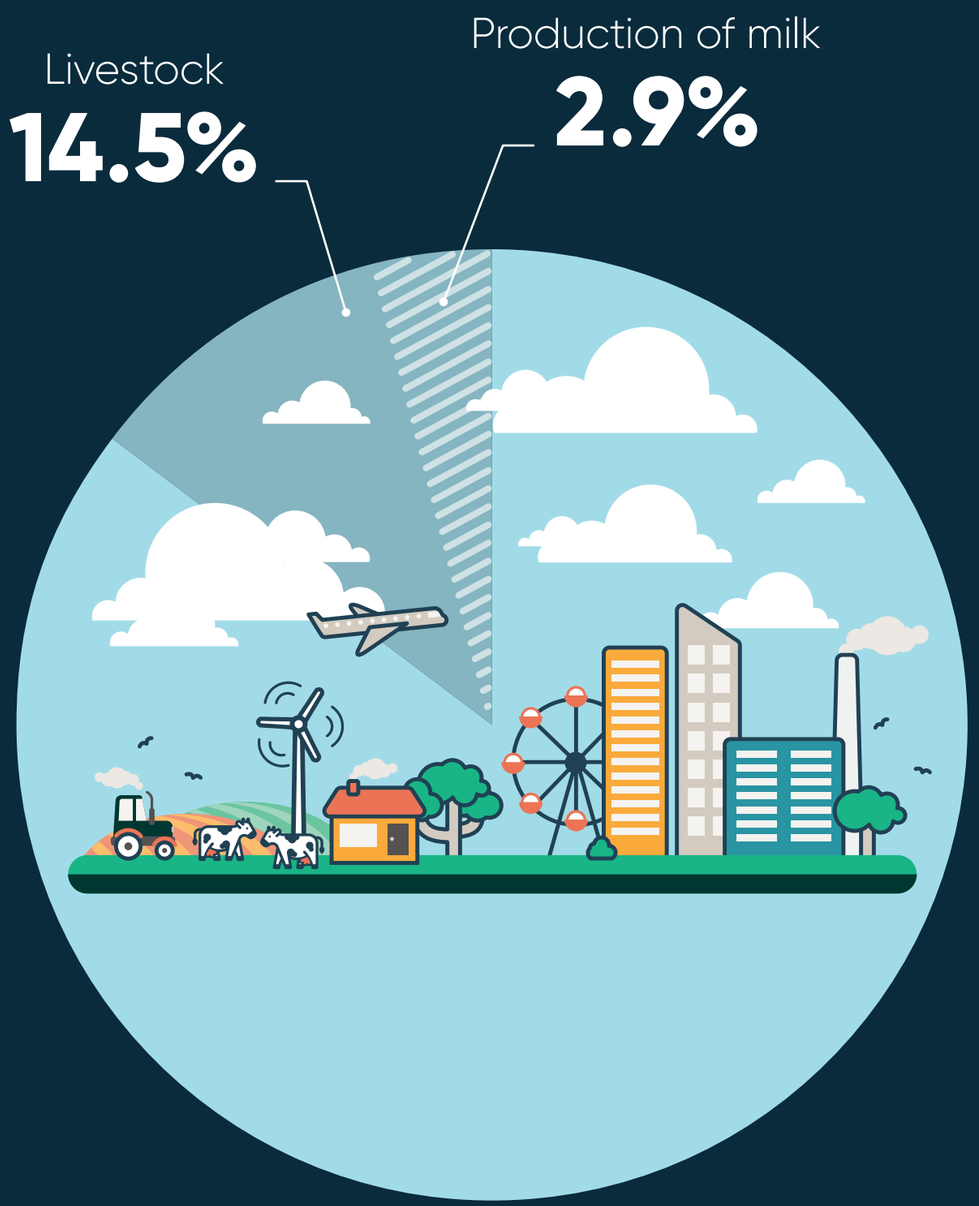
“Currently permanent grasslands in Europe sink up to 3.1 million tons of carbon every year”

FAO, 2013.

Grasslands **"suck out" carbon** from the air

Grasslands are major ecosystems and a form of land use that gives us a range of useful products. As grass is not edible by humans, livestock can process the grass and turn it into useful products and resources, such as milk, meat, hides, to name a few, but also key ecosystem services. This includes biodiversity, provision of clean water, flood prevention and carbon sequestration.

The “locking up” of carbon (also called sequestration) in soil has a key role in the context of climate change. Permanent grasslands can extract carbon from the atmosphere and store it in the soil. This means that the emissions of greenhouse gases as carbon can be mitigated by the use of grasslands. Currently, permanent grasslands sink up to 3.1 million tons of carbon every year. And the potential for “locking up” of carbon in the land is even bigger. The permanent grasslands could sink even more tonnes of carbon in the future.



What is the **dairy sector's share?**

Food production in any form has an impact on climate. Whether it is the production of animal or vegetable foods, production emits greenhouse gases and thus impacts the climate.

When using the Life Cycle Assessment method, the total livestock sector accounts for 14,5% of all human-induced emissions globally. This relates to all livestock both ruminant and monogastric. If we look exclusively on ruminants the share is 10%, which includes both cattle and smaller ruminants. When zooming in on the production of milk and production of meat linked with milk, the sector is accountable for 4% of the global emissions. And from this, emissions from the production of milk emits 2,9% (FAO, 2013).

These numbers are based on the Life Cycle Assessment methodology, see more about the methodology above.

When assessing the sustainability of the dairy sector, it is also important to look at other aspects of sustainability than the emission of greenhouse gases. Keeping this in mind, we must consider aspects such as contribution to biodiversity, clean water, effects on health and nutrition, feeding a growing population, and the sector's influence on economic growth and empowerment. In the Rotterdam Declaration the international dairy sector committed itself to take on the role of diminishing the impact on climate change and contributing to solving the problems of feeding and expanding world population.

Chapter 2

Aligned national perspectives

The European dairy sector

Facts

France

58 462 dairy farms

762 processing sites

62 dairy cows/farm on average

23.8 billion liters

Ireland

18 000 dairy farms

30 processing sites

76 dairy cows/farm on average

7.5 billion liters

Denmark

4 100 dairy farms

61 processing sites

127 dairy cows/farm on average

4.7 billion liters

Belgium

7 215 dairy farms

45 processing sites

72 dairy cows/farm on average

4.8 billion liters

Northern Ireland

3 428 dairy farms

12 processing sites

92 dairy cows/herd

2.2 billion liters

Netherlands

16 500 dairy farms

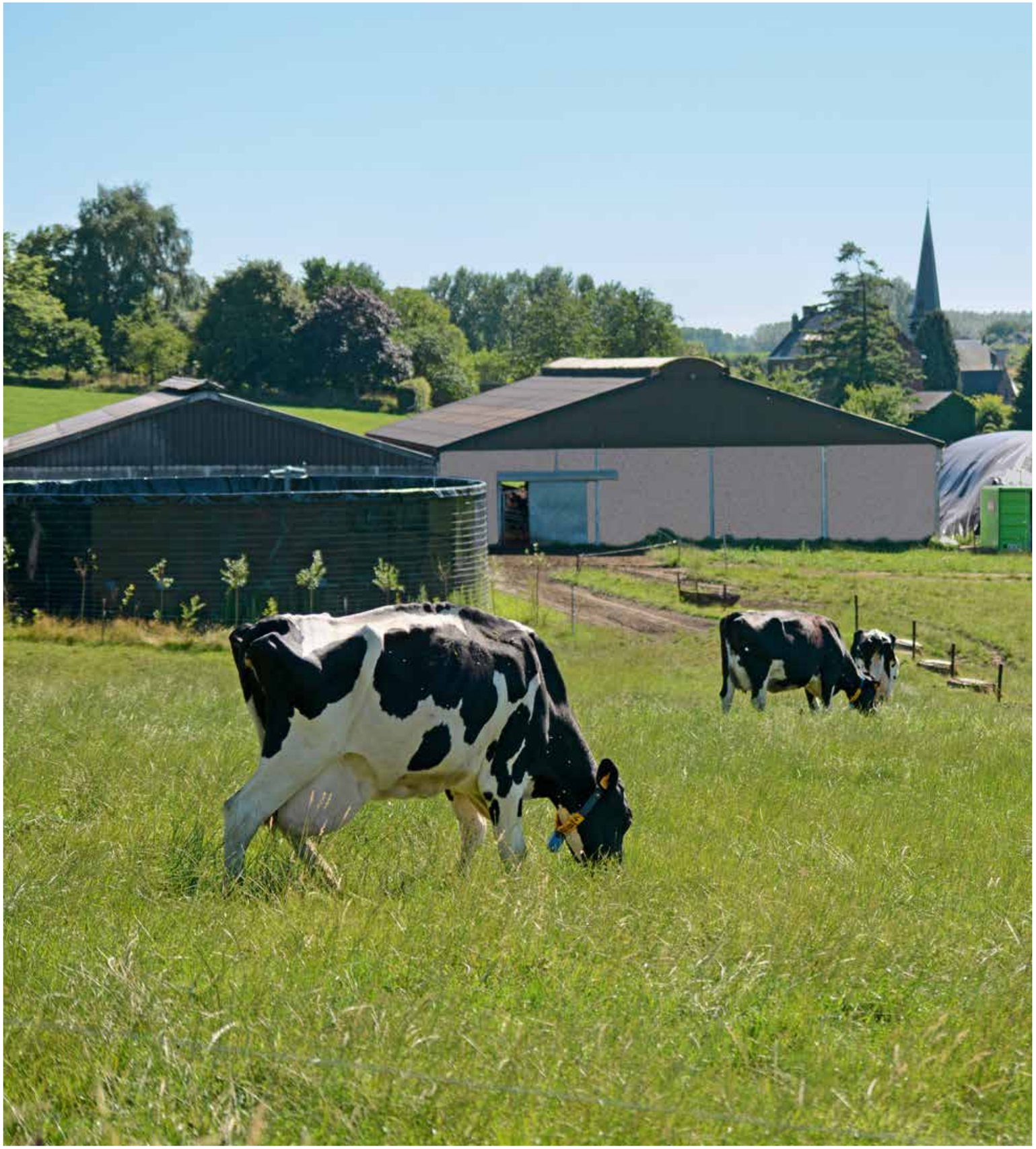
53 processing sites

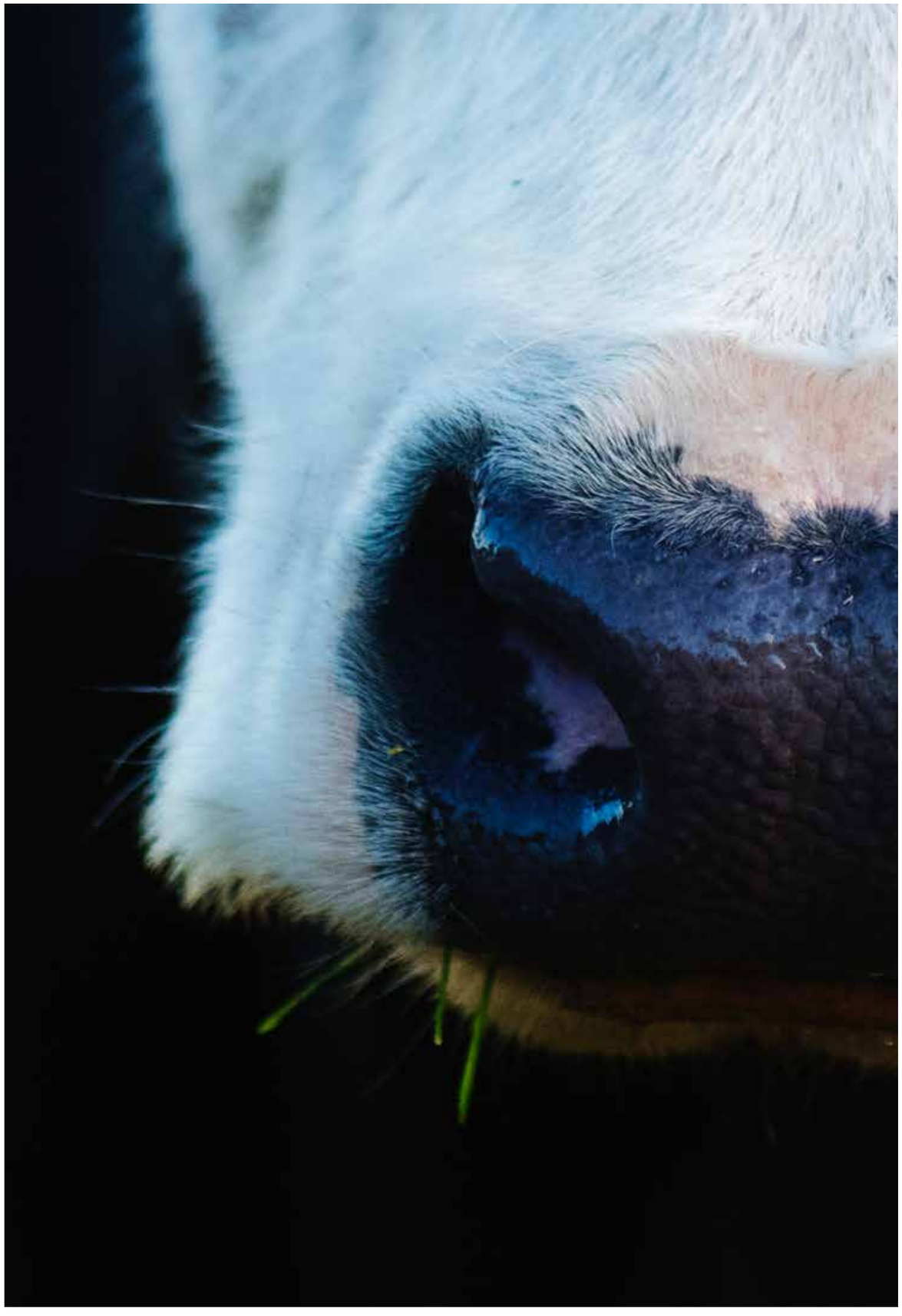
97 dairy cows/farm on average

13.9 billion liters

The national approaches **to reduce GHG emission** and environmental impact

The European dairy sector has a crucial role in supporting nutritious and balanced diets and also in the responsible management of ecosystems and taking proactive actions to address environmental degradation and climate change, while promoting biodiversity. It holds a key role in promoting and delivering sustainability and sustainable development in Europe and over the last three decades, the sector has evolved to achieve better sustainable growth ambitions and environmental outcomes. Like all forms of food production, including plant-based foods, the dairy sector is an emitter of greenhouse gases and must be ready to take on the responsibility of reducing its impact on the climate. However, efficient, innovative and well-managed farms and dairy processing businesses are contributing positively to social, economic and environmental outcomes. This chapter gives an overview of the pro-active actions implemented in each country, adapted to each national context, to address environmental impact and climate change.





The national approaches **to reduce GHG emission** and environmental impact

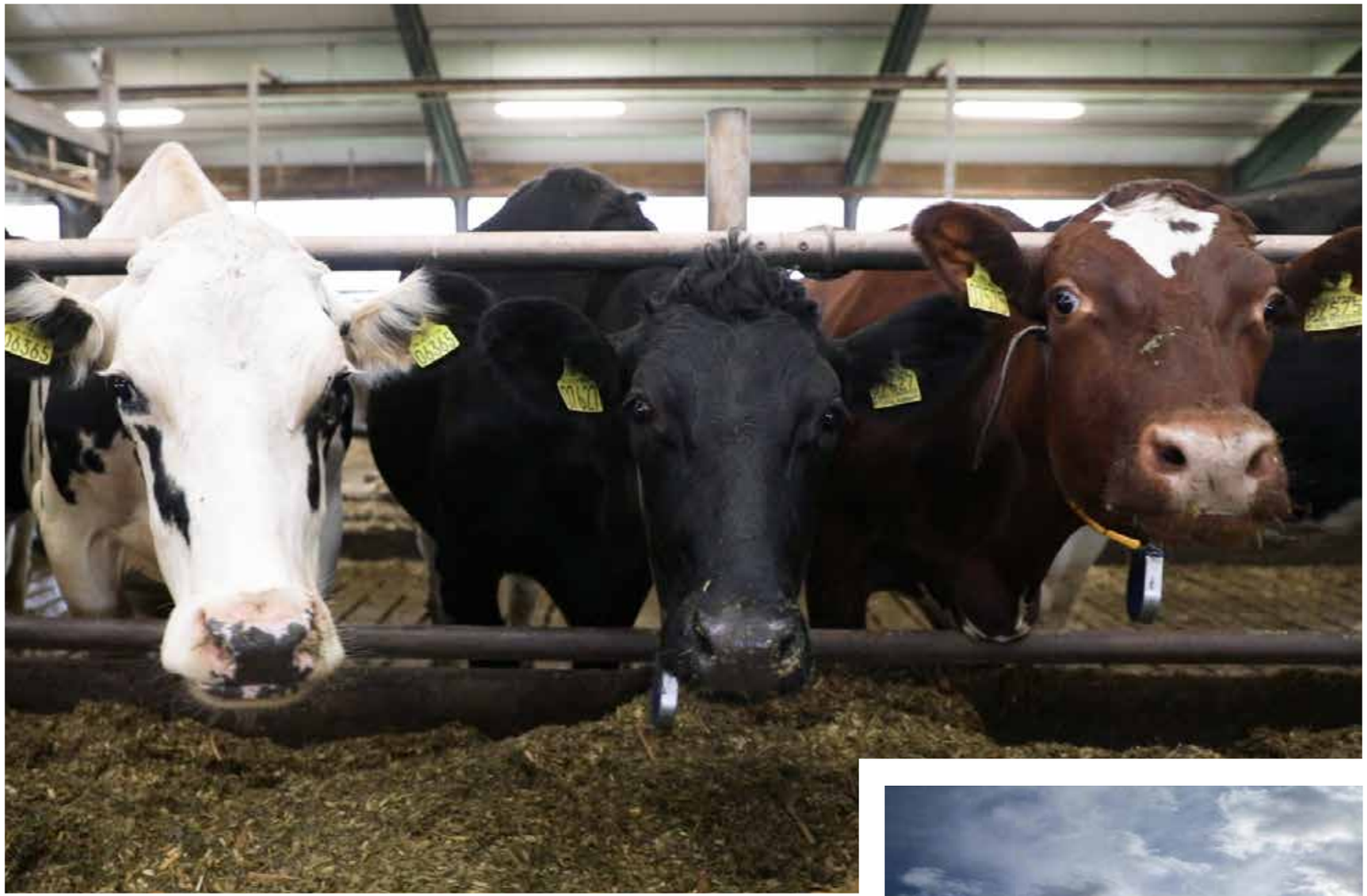
Ireland's dairy industry solutions

In 2016, Dairy Sustainability Ireland was established, a pro-active industry led, whole of sector and whole of Government partnership which is working to develop and implement new approaches to dairy farm sustainability at both economic and environmental levels. This new initiative has been established to help farmers meet environmental targets, improve profitability and to copper fasten Ireland's reputation as a world leader in grass-fed dairy production. This represents the globe's first 'whole of sector/ whole of government' approach to addressing the challenges of our industry. The introduction of the Sustainable Dairy Assurance Scheme, the first national dairy scheme of its kind anywhere in the world is a clear indication of dairy farmer's commitment to farm sustainability. It sets out requirements for best practice on Irish dairy farms in animal health and welfare, land management, biosecurity, safe farming practices and the production of quality milk. Close to 100% of farmers are now certified in the Scheme which is an indication of their commitment to operating and maintaining the highest possible sustainability measures. Dairy Sustainability Ireland set out to provide real solutions to reconnect with stakeholders and give positive environmental outcomes for all, along with improved farmer incomes and overall company sustainability. A DSI forum was established containing all 14 members of Ireland's dairy processing industry, including the Specialised Nutrition companies. These were joined by all the main farm organisations, and finally they were augmented by the relevant state agencies, including the Department of Agriculture, Food and the Marine, Department of Housing with Responsibility for Water, the EPA, Bord Bia, Teagasc, and the Local Authorities.

Northern Ireland's GHG calculator

In recent years, AFBI research alongside other national and international scientific studies has led to the development of an important new tool that accurately calculates the GHG footprint per litre of milk across a range of different milk production systems. The easy-to-use 'BovIS GHG calculator' accounts for all activities within a farm that are sources of GHG emissions, such as emissions from rumen fermentation, manure management, fertiliser manufacture and application, and concentrate production and transportation. Ultimately this information is giving farmers the means to review where inefficiencies may exist and develop mitigation strategies that will help reduce carbon footprint. Results from the BovIS GHG calculator on data collected at AFBI Hillsborough demonstrate that production efficiency, rather than the specific production system itself, is the key determinant of the carbon footprint of milk production. How does it work? The online calculator is available to all producers and, located with the suite of BovIS applications, users are guided through a user-friendly e-questionnaire collecting information that relates to farm management and annual production. This includes the land area for grass and cereal production, number of cows and heifers and milk production, concentrate input and grazing management, fertiliser input and manure management, and fuel and electricity used. The calculator then produces a summary report which shows the emissions produced by each part of the farming system. Through calculating their carbon footprint, producers can investigate ways to reduce the GHG emissions from their dairy enterprise.

The national approaches **to reduce GHG emission** and environmental impact



The French dairy sector's "low carbon dairy farm"

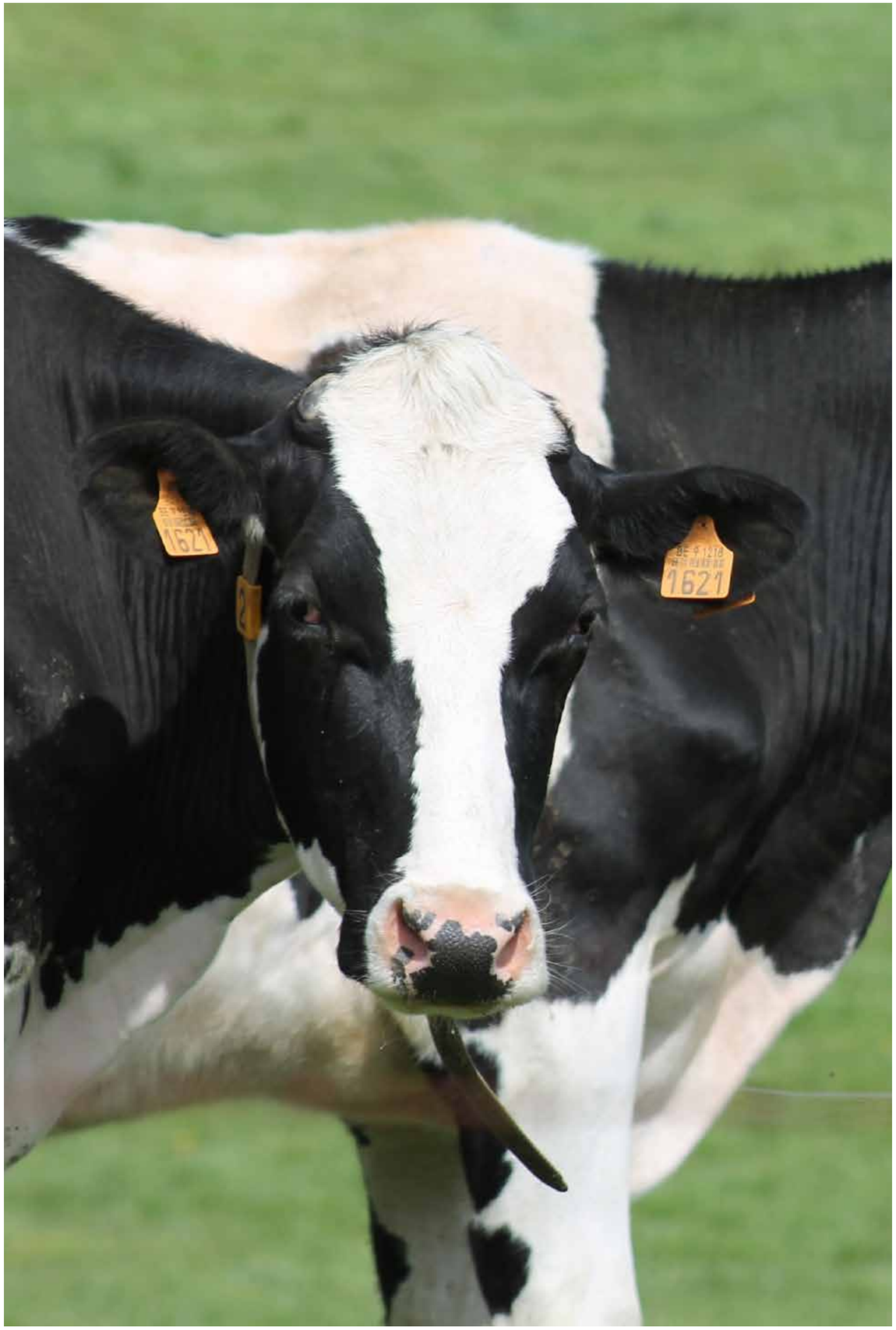
The French Dairy sector demonstrated the sincerity of its commitment to fight against climate change by launching the “Low carbon dairy farm” program in 2015, which was selected as an agricultural solution at COP 21 in Paris. Moreover, it directly refers to and works with the “4 per 1000” initiative, which aims to compensate the CO_2 increase in the atmosphere thanks to carbon storage in soils. According to the FAO, Western Europe is one of two zones where environmental performance of dairy production is the best and where there is still potential for improvement. The dairy sector’s ambition is to make France a “low carbon” dairy farming land, which is sustainable and competitive, and to promote the progress already made. In France, this initiative is coordinated by CNIEL (French Dairy Interbranch Organization). French dairy farmers are supported in their steps to reduce the GHG emissions of their farm based on a techno-economic environmental assessment, which is adapted to individual specificities and situations. This assessment, based on the CAP’2ER® tool, helps the farmer and the advisor to estimate GHG emissions, the energy consumption but also its positive contribution to biodiversity, its capacity to nourish (number of people fed by the farm) and the carbon stored. Levers of action are identified to support the farmer to reduce his/her carbon footprint on the farm, and economic and technical performances as well. An individual action plan adapted to the assessed farm and to the farmer’s objectives is then developed. This initiative brings together farmers, cooperatives and private processors, as well as agricultural advisor organisations, in the fight against climate change. At the end of 2018, over 8400 dairy farms had already carried out this environmental assessment. The dairy sector’s objective is to involve all of the 58 000 French dairy farms by 2025. As they improve their environmental performances, the farmers also strengthen their sustainability. Environmental and techno-economic performances are strongly correlated. Less input on the farm, better grazing management, these are both ecological actions with potential economic gains. Therefore, the top 10% of the farms with the lowest GHG emissions also have a superior average gross margin of 10 euros for 1 000 L of the milk they produce.

The Belgium Dairy sustainability solution

In 2012, the Belgian dairy industry started a dialogue with the agricultural organizations. On the one hand, to map the sustainability efforts of the dairy sector, and to investigate how dairy farmers can become even more sensitized on the other hand. In order to maximize the impact, it was decided to roll out a sector-wide sustainability program throughout the dairy chain. Sensitization, monitoring, and communication are the three cornerstones of the program. In addition, there is a follow-up of scientific research from which results are being translated into practice. The joint program was named ‘Sustainability monitoring throughout the dairy chain’ and focuses on three stages:

1. The production of milk in dairy farms
2. The transport of milk from the dairy farm to the dairy factory
3. The processing of milk in the dairies

The national approaches **to reduce GHG emission** and environmental impact



Thus, an important part of the chain has been covered. Both the initiatives of dairy farmers and the industry are mapped out. All actors are encouraged through benchmarking to make (more) progress. A sector-wide approach is quite a challenge. Listing all sustainability efforts of more than 7 000 dairy farms via inspection visits requires a great deal of time and manpower and is also a tough job in terms of logistics. We opted for inspection visits since this offers the best guarantee to map the actual efforts on the ground. Since all dairy farms are inspected every 3 years on the IKM (Integral Quality Milk) specifications relating to the quality assurance and the production method, it was decided to extend this inspection visit with the sustainability monitoring. The advantage of this is that, at the same time, independent inspectors make an inventory of the sustainability initiatives. At the start of 2014, after 2 years of consultation and preparation, the sustainability program for dairy farming could be rolled out in Belgium. The efforts of the dairy industry have been inventoried since 2006.

Denmark: The potential of increasing carbon sequestration

Cows are ruminants and emit the greenhouse gas methane which is produced by fermentation in the rumen. That is why SEGES, a professional knowledge and innovation centre with a focus on agricultural operations, is investigating how to compensate for the emission of methane from cows. A current example is a project where the potential for increased carbon sequestration in agricultural soils is being examined. Carbon sequestration is a part of the carbon balance that exists in the soil where carbon is constantly being stored and degraded. Many, both international and national, research projects are currently looking into how these balances can be affected. There is a lot of solutions and we have to make an effort in many ways. One of the conclusions is that there is a need for making an effort in many different ways at the same time. This is necessary in order to sufficiently decrease the emissions of greenhouse gasses to reach the climate goals that we have obligated ourselves to in the Paris Agreement. An increased afforestation of woody plants, like a forest, is an important factor in order to sequester more carbon in the soil. Some of the most important initiatives are sowing of crops, ploughing of straws instead of incineration at heat and power plants and an increased number of grass fields. When it comes to grass fields it is central that we do not fail to exploit them. A utilization of grass, for example either by grazing or harvest of the grass to produce feeds secures that the roots of the grass are growing which ultimately ensures that more carbon is sequestered in the soil. The type of grass is not insignificant either as the content of clover can contribute to sequestering nitrogen and thereby increase photosynthesis. This entails an increased biomass which also can sequester more carbon in the soil. Within the project, effort has been put into finding methods of taking account of the carbon sequestration in the soil in the evaluations of sustainability that are made at the individual farms with the tool called RISE.

The national approaches **to reduce GHG emission** and environmental impact

The Netherlands: Dashboard with carbon footprint monitor
In the past six years, NZO (the Dutch Dairy Association) and LTO Nederland (the Dutch Association of Agriculture and Horticulture) have taken initiatives in the Sustainable Dairy Chain to proactively respond to the various sustainability themes.

All dairy farmers have received a clear overview of the indicators that have an effect on the environment and climate in a dashboard as from 1 January 2018. The Environment and Climate Dashboard provides insight into the business performance for the most important environment, climate and biodiversity indicators. The emission of the entire dairy sector will be annually monitored by Wageningen Economic Research and shown in the sector report of the Sustainable Dairy Chain. The Environment and Climate Dashboard gives every dairy farmer insight into the emission of greenhouse gases of the own dairy farm (carbon footprint). Knowing the carbon footprint at business level, dairy farmers can take appropriate measures to reduce the emissions. The carbon footprint is calculated in compliance with the internationally prescribed rules (Life Cycle Analysis). Also in view of the far future, it is of major importance that the sector can continue to use this instrument as a tool for the dairy farmer as well as an instrument to account for the total reduction of greenhouse gasses achieved by the sector.

The Sustainable Dairy Chain aims at a 20% reduction of greenhouse gases in 2020 compared to 1990. The greenhouse gas methane is, among others, produced by the fermentation process in the intestine and rumen of the cow, which sets a natural limitation for reduction. The aim is to optimize the use of minerals, which contributes to the reduction of greenhouse gas emissions as well; by means of better feed efficiency for example. Other measures a dairy farmer can take are extending the cow's lifetime, retaining more permanent grassland with more clover and using less fertilizer. The carbon footprint monitor helps dairy farmers to calculate the carbon footprint of their farms and compare these figures with others. This insights helps them to improve.

Integrality of sustainability measures
The Sustainable Dairy Chain proactively takes initiatives to respond to the various sustainability themes. In connection with this, there is a continuous search for balance and an integral approach towards objectives and measures. All supporting their policy in reducing the greenhouse gasses, and other sustainability objectives important to society and the sector. Efficiency in reducing the greenhouse gas can be contrary to other sustainability objectives, such as increasing biodiversity. Recently a commission of dairy farmers, NGOs, national government and provinces made recommendations with respect to the theme land-related dairy farming. The sector will implement these recommendations in the coming period. Preserving the land-related character of dairy farming is not only the wish of the sector but of the society as well. In fact, the aim at land-related dairy farming means more feed from their own land and, last but not least, more grassland, so more absorption of carbon.

An aligned European approach

Northern Ireland

Development of new **feed rationing systems** for dairy systems for dairy cows (UK Feed-into-Milk Models)

AFBI research has shown that high-yielding dairy cows need 30-40% more energy to maintain their body activities than has been recommended through previous feed rationing systems.

That ground-breaking discovery was made using the indirect open-circuit respiration calorimeter chambers, a state-of-the-art facility which AFBI has been using to measure energy utilisation efficiencies of dairy cows since 1992.

As a result a new DEFRA-funded project called "Feed into Milk" was set up. A major objective was to develop a new energy rationing system using calorimeter data from dairy cows gathered by AFBI and the University of Reading.

The new energy rationing system is now used across the UK to formulate rations for dairy cows and has even been adopted as a reference programme to compare the production efficiencies of dairy systems throughout the EU.

"Feed Into Milk" is a valuable tool which dairy farmers can use to calculate the forage and concentrate needs for a dairy herd in a way that boosts production efficiency and also cuts environmental pollution – for example, through manure nitrogen and methane emissions.

The "Feed Into Milk" models can even be used to develop carbon calculators for dairy cattle, so that farmers can estimate levels of greenhouse gases emitted by their production system and draw up emission-cutting strategies tailored to conditions on their own farm.

France

Jean-Marc Burette, dairy farmer

Interview
Reducing the carbon footprint at a dairy farm level

As dairy farmers in Fleurbaix (Pas-de-Calais), Jean-Marc and Elizabeth Burette are working to reduce the carbon footprint of their farm. Thanks to their efforts, they have reduced their footprint by 20% between 2015 and 2018, from 1.15 kg CO2/kg milk.

How did you commit to a "low carbon" initiative?
"Within the European EuroDairy program framework, I benefited from a techno-economic environmental assessment. The assessment and technical support tool CAP'2ER® helped us to establish a carbon diagnosis on our farm in 2015. Based on these results, I implemented various actions. The diagnosis was assessed in 2017 and 2018 and the results confirmed the improvement of my carbon footprint".

What were your improvement levers?
"There are several actions. I try to ensure food autonomy by growing the food needed by the dairy cows on my farm. Approximatively 95% of the food is produced on the farm. I also adjusted feed rations to the real needs of my cows. By doing so, and weighing the food, we reduce the carbon footprint. The choice of which protein we give to the cows is also an improvement lever. Proteins provide amino acids which are necessary to maintain life support system, growth, reproduction and lactation. Instead of using soy to complement corn silage, I preferred rapeseed as it is a metropolitan protein which means less transportation. After a battery of tests, I bought a precision-type seed drill to reduce fertilizer rates without reducing rapeseed yields. I also try to make a better use of livestock manure. I keep up to date with the last solutions to reduce energy use on the farm. For example, we installed a heat recovery unit for the milk collection and I use this energy to heat the water necessary for cleaning the milking machine".

On which improvement levers are you currently working?
"I'm developing plant cover based on leguminous plants between two crops to reduce the use of artificial fertilizers. The seeds feed my animals and the soil feeds my crops! For example, faba bean captures carbon dioxide (CO_2) in the air through the photosynthesis process and stores it in the soil".

Belgium

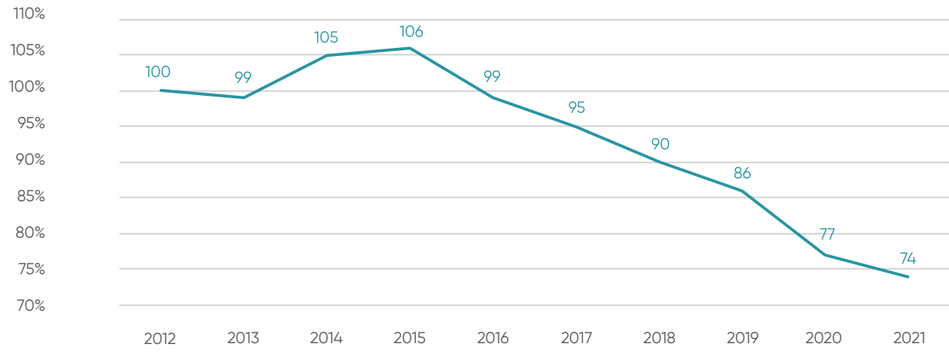
Milcobel about upgrading condensation water to drinking water quality:

"We have to **remain sparse,** even when reusing water"

Milcobel, the largest dairy company in Belgium with 2 700 dairy farmer associates, has a clear vision. Farmers use their expertise to run their own farm, while Milcobel ensures a sustainable long-term perspective, through a correct and transparent marketing of their milk. The upgrading of recuperated water to drinking water quality fits perfectly in this vision. “We already reduced water consumption by 15% over the past 3 years and our plans for the future are even more ambitious”, according to Didier Creyelman, Group Engineering & Environment Manager, and Eddy Leloup, Director of Co-operative Affairs. Every year, the dairy cooperative Milcobel collects 1.5 billion liters of milk from its members to process and commercialize. This corresponds to almost 40% of the milk in Belgium. The milk is processed into powders, ingredient cheese (e.g. Mozzarella), consumer cheese and milk drinks.

How does Milcobel embrace sustainability as a cooperative?
"As a cooperative, we are in the middle of the sustainability triangle of the planet, profit, and people. For us, these 3 p's go hand in hand. We also place sustainability within a comprehensive chain approach. Everything starts with the dairy farm. The sustainability monitoring program is an interprofessional initiative that we valorize within our sustainability approach, with a core system to further stimulate sustainability. This is followed by the milk collection, which we also monitor and try to improve, for example by reducing the fuel consumption per 1 000 liters of milk collected. Finally, we process the milk in our factories. For all our sites, we are certified for the ‘sustainable entrepreneurship’ charter. We try to look 3 to 5 years ahead around themes such as energy and water.”

Development and projection of the use of water pr ton milk 2012-2021 (2012 = 100)



How do you recover heat and reuse your water?
"We consume a lot of heat, but also recover a lot of residual heat. This heat is, as much as possible, reused in our processes. This also applies to water. We obtain a lot of condensation water from processing milk to milk powder. A part of this water can be used for the ‘cleaning in place’ of the installations. Of course, not all steps require water of drinking quality, but for rinsing our installation as the final cleaning step, it does apply. Therefore we extract water from the product – milk- that is supplied.”

You invested in the technology of reverse osmosis (RO).
“Yes, and we also want to expand this system. RO or reverse osmosis ensures that you can top up water, like condensation the water, to drinking water quality. For this, the water – that is recovered from the cheese and milk powder production – is pushed through a membrane under pressure. Water molecules can pass through, larger molecules remain behind. By this filtering effect, demineralized water is created, permeate, to which a fraction of city water is added afterwards to avoid problems with corrosion. The residual water, retentate, accounts for another 10 to 15% and goes to water treatment. For this project, we work together with ‘De Watergroep’, which upgrades the water on site and thus has to deliver less city water. A win-win for both parties! The projects in Langemark and Kallo are currently in the implementation phase. On the one hand, an extra RO is added in Langemark, so that the permeate of the whey can be upgraded to drinking water quality (polishing). On the other hand, in Kallo, condensation water that comes from the evaporation process of the powder production is upgraded to drinking water quality with an RO installation. "

What are your ambitions in the area of water recovery?
"We currently upgrade to 150,000 m3 of water per year through RO technology. Within 2 years, that volume will increase to 400,000 m3 on an annual basis, corresponding to 100 extra Olympic swimming pools of recuperated water. This, together with other water-saving measures, provides us with an additional 15% reduction in the total water consumption of the group in the coming years. Not bad, if you also take the expected growth in milk collection into account. Our company culture is transforming and the results of our sustainable efforts are being visualized and followed up. On the one hand, we continuously want to improve technically – for example, via RO – but on the other hand, we also want to reduce water consumption. Even though we work on the reuse of water, we have to continue using water sparsely. That is why our mindset has to change. We constantly have to adapt our corporate culture and we need to monitor practical applications. This may involve small interventions, for example, the conveyor belts in the cheese factories do not rinse continuously, but only if cheese passes. Or stop sleep consumption during weekend or periods of a planned standstill. All these small interventions can all together record great results. Eventually, this also lowers our costs and increases our sustainability. "

Agriculture plays a key role in the Danish transition towards reaching the reductions in greenhouse gas-emission needed to meet the goal of the Paris Agreement. Therefore, the agricultural sector needs to look at new ways to reduce their emissions. Professor Jørgen E. Olesen from Aarhus University points towards solutions with optimization of the use of slurry and storing carbon in the soil.

If Denmark is to reach the EU goal of a 33% reduction in greenhouse gas-emissions in 2030, it will require new technological solutions in the agricultural sector. Professor at Aarhus University, Jørgen E. Olesen, emphasizes the potential of the slurry from the Danish dairy cows. The slurry can be transformed to biogas, that be used in the production of electricity as a substitute for natural gas or as fuel.

"The transformation to biogas requires that we build more biogas facilities. If we go that way, we can use some of the surplus energy from windmills to upgrade the biogas to pure methane, which can be used as a substitute for natural gas on the Danish gas grid. Increased production of biogas – also as fuel for transportation – is a very ideal part of the green transition,"
says Professor Jørgen E. Olesen.

Professor Olesen also points out that the agricultural sector should work with acidification of slurry, where one adds sulfuric acid to the slurry which reduces the emissions of methane and ammonia. One can also add nitrification inhibitors which reduce the emission of nitrous oxide and the leaching of nitrogen.

The agricultural sector will be able to reduce its emission of greenhouse gasses with up to 22% with these solutions, Professor Jørgen E. Olesen points out.

Investments in new technologies are also necessary

After 2030 the above-mentioned solutions won't be enough to meet the international goals, Professor Jørgen E. Olesen emphasizes. Therefore, we also need to look at other solutions. Currently, scientists are researching in ways to collect the methane from the dairy cows, and such a technology might be a good solution in the future. Furthermore, we should start looking at how we can store carbon in the soil:

"The carbon that is already in the air, we can remove by planting trees and let the trees soak up the carbon. Then you cut down the trees, and burn them in a power plant, condense the carbon and pump it into the underground"
Jørgen E. Olesen explains.

When you burn the wood in power plants you create pyrolysis, which means that you heat up the wood to a very high temperature where you degas the carbon. The mass that is left is called bio-coke. The bio-coke can be used in agriculture to improve the soil and the use of bio-coke reduces the emission of nitrous oxide from the soil.

"If we are to keep our agricultural production while reducing our greenhouse gas-emission, we need to develop these new technologies as fast as possible,"
Professor Jørgen E. Olesen concludes.

The article is a short version of an interview with Jørgen E. Olesen in the magazine mejeriÅRET 2017-18

About Jørgen E. Olesen:
Director of the Department for Water and Climate at the Institute for Agroecology at Aarhus University. His research mainly focuses on climate change and agriculture. He is a former member of the IPCC, the Danish Government's Climate Commission and the Ethical Council.

Beemster 2030: **sustainable and diverse**

"National discussion regarding agriculture often meets opposition. Solutions more often appear in the concrete translation from abstract policy to a regional application. We'll have to make it happen together". That is how director Oscal Meuffels of the Dutch Dairy Association (NZO) summarized the 'farm session' at the Beemster on 30 October 2018. With a view of the stables of dairy farm Koezicht there was a lively meeting led by television presenter Elles de Bruin about the sustainable outlines of the Beemster in 2030.

The Beemster is a peatland formed at the start of the 17th century thanks to the reclamation of the former fresh water lakes. The typical symmetric pattern of fields and ditches can still be found in the region that once was reclaimed by 43 mills. The project was financed by rich Amsterdam citizens who wanted a flourishing agricultural region. In 2018, dairy farming is the most important economic activity in the region. As a result, the local population - about ten thousand inhabitants - maintained their 'own identity', says director Mardiek Voorneveld of the lower Netherlands tourism agency Bureau Toerisme Laag Holland even if the occasional city dweller moves to an authentic farmhouse. Moreover, mass tourism also does not take place despite the fact that the reclamation of the Beemster is on the UNESCO World Heritage list since 1999.

Visitors

Whilst the meeting partners seem reticent to receive buses of tourists, they would like more Amsterdam citizens to come visit the Beemster. The continuation of a vital dairy farm industry to keep the Beemster green is an important foundation. Young citizens especially are a welcome sight to dairy farmers, so they can better understand where their daily food comes from. (Bio)diversity is key to increase the attractiveness of the region, landscape architects Saline Verhoeven and Pieter Veen emphasize. Dairy farmer and sustainability consultant Niek Konijn also says that more organic elements are required in the business operations of farmers to ensure a sustainable future for the region and to maintain social support. By developing a vision for the future of the Beemster, using sustainability as the connecting factor - dairy farmers, other companies, banks and local authorities can join together and resolve opposition.

Regulations

The national policy regarding sustainability and the dairy industry does not always have a positive effect says group chairman Nico de Lange of the Beemster Polder Party. 'The regulations are all tangled up, it changes constantly. They don't get it in The Hague,' says the local politician. Policymakers do not fully grasp how it works in practice state the dairy farmers who are present. Provincial council member Hein Struben acknowledges that policy 'from the top' sometimes has an unfortunate effect. According to Sijas Akkerman, this is partly due to the fact that there is a significant amount of developments at the same time and no one has a real idea of how they affect each other. Thus, entering into a dialog and inviting politicians and civil servants to see the workplace with their own eyes - as dairy farmer Jacob Willig does during every campaign period - requires constant attention. Fitting regulations will follow suit.

Windmills

The conclusion of the meeting seems to stimulate dairy farmers who want to drive a future-proof business. This is achieved, for example, through a less rigid policy. Take windmills, for example. Currently they are forbidden in the Beemster because they supposedly cause landscape pollution while windmills have been at the cradle of the region in the first place. Nowadays there are smaller and nicer-looking mills that would fit the landscape and can increase the generation of power significantly, dairy farmer Frank de Wit shows. Provincial council member Struben immediately writes down the name of the manufacturer. The dairy farmers understand that more diversity in the flora and fauna as well as better accessibility - e.g. through bicycle paths through the fields - can increase the attractiveness of the region for nature-seekers from Amsterdam. But simply acquiring valuable production land without financial compensation will not happen. So it would have to be a joint effort. Lea Sterenborg of the Rabobank says that financing will not be an issue.

Farming neighbors

Four centuries ago the Beemster formed from the cooperation between Amsterdam investors and local agricultural entrepreneurs. Such an alliance between city and countryside seems more topical than ever. Dairy farmers and dairy producers together with others can make the Beemster a sustainable, diverse and innovative high-end region that not only has an economic yield, but also offers something in terms of recreation and education. The separated processing of milk from the Beemster into regional products that can be marketed as local food to citizens turns out to be difficult. Nevertheless, everyone realizes that the role of the consumer is also essential to achieve a more sustainable dairy industry. The Beemster dairy farmers gladly open their doors to visitors to show them the things they do and are willing to do in terms of sustainability. This coud lead to the consumer being prepared to pay a little extra in the stores for an innovative and sustainable natural product. More involvement and understanding on the part of citizens for neighboring farmers in the Beemster for a future-proof green back yard of the surrounding cities. Everyone at the table wants to contribute to this gladly.

Participants farm session Beemster

- Sijas Akkerman, director Natuur & Milieufederatie Noord-Holland
- Elles de Bruin, journalist and chairman of the day
- Niek Konijn, dairy farmer and sustainability consultant CONO
- Nico de Lange, group chairman Beemster Polder Partij
- Oscar Meuffels, director NZO
- Clemens and Sandra Oudshoorn, dairy farmers (Koezicht Beemster)
- Lea Sterenborg, director Commercie Rabobank Waterland en Omstreken
- Hein Struben, Provincial Council Member D66 Noord-Holland
- Jasper Veen, advisor public affairs NZO
- Pieter Veen, landscape architect agency Strootman
- Saline Verhoeven, project leader project Amsterdam Wetlands
- Mardiek Voorneveld, director Bureau Toerisme Laag Holland (Beemster)
- Jacob Willig, dairy farmer and chairman LTO Noord
- Frank de Wit, dairy farmer and director LTO Noord

Chapter 3

Sustainable diet

"A nutritious diet is not only constituted by healthy food items but also defined by the combination of foods in certain quantity"

How do we feed a **growing population?**

Data from the UN's Food and Agriculture Organization, FAO shows that one billion people suffer from hunger and a further billion people suffer from "hidden hunger", which is nutritional deprivation even when the supply of foods is sufficient, because of poor diet quality.

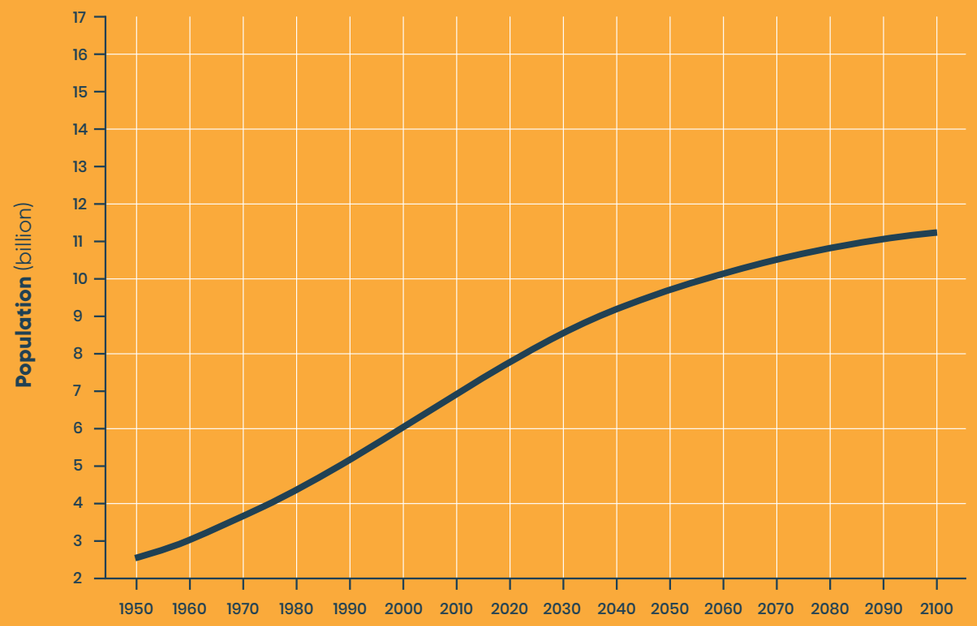
This need for available, affordable and nutritious diets for the growing global population is challenged by the need of reducing our use of resources and impact on the planet. How can these conflicting demands be met?

The need for a holistic concept of sustainable diet
In our search for new ways of producing and consuming foods in a sustainable manner our point of departure must be in a holistic concept of sustainable diets. Such a definition has been established by the FAO in 2010 with the publication Sustainable Diets and Biodiversity.

"Sustainable diets are those diets with low environmental impacts which contribute to food and nutrition security and to healthy life for present and future generations. Sustainable diets are protective and respectful of biodiversity and ecosystems, culturally acceptable, accessible, economically fair and affordable; nutritionally adequate, safe and healthy; while optimizing natural and human resources"

FAO, 2010.

World total population



Source: United Nations, Department of Economic and Social Affairs, Population Division (2017). World Population Prospects: The 2017 Revision esa.un.org/unpd/wpp/

"Sustainable diets are protective and respectful of biodiversity and ecosystems, culturally acceptable, accessible, economically fair and affordable; nutritionally adequate, safe and healthy"

"Eat less and **reduce your climate impact**"

Senior Researcher and Research Director Nicole Darmon of the French institute INRA has been researching how we eat in a sustainable way since 2010. The conclusion of her research is clear: We need to eat smaller portions, and then we need to reduce our consumption of meat and eat more plant-based. And our total consumption of dairy products shouldn't change drastically.

When we produce and eat food, we influence the climate. Therefore, it is important for a sustainable future that we look at how we eat to minimize climate impact of our diets while ensuring healthy, accessible and culturally appropriate diets.

Look at the whole diet – not at foods

At the French institute INRA (French National Institute for Agricultural Research) they are researching how we must eat in the future. Research Director and Senior Researcher Nicole Darmon says:

"We are highly inspired by the FAO's (UN Food and Agriculture Organization, Ed.) Definition of sustainable nutrition, a holistic approach to sustainability and our way of eating where to look at climate change, health, economy and culture. We are working to connect data on the four dimensions and, on that basis, examine how to eat sustainably"

Nicole Darmon.

And the conclusion from the research is clear: There are very few single foods that can meet all four dimensions at once. Therefore, it is more important to look at how to put together a sustainable diet with different foods rather than studying the foods individually. And here the French researcher says:

"The overall conclusion when looking at our diets is that we should eat less. About 200 calories less a day than we do today. In addition, we must eat less meat and more plant-based. Our consumption of dairy products should be on the same level as today - but we must eat a little less cheese and more yogurt and milk"

Nicole Darmon.

"Dairy products have a high nutritional quality," she continues. "They are cheap, culturally accepted and many of them do not have a particularly big climate print".

Changes in food habits are already under way

We can thus contribute to a more sustainable future by changing our diet, and the French researcher points to the fact that these changes must happen quickly. However, she also acknowledges that it is not realistic to make people radically change their eating habits from one day to the next. Therefore, she recommends that everyone makes the difference they can - albeit a little one - based on the diet they are eating currently.

And the change is already underway in many places:

"There are more and more flexitarians and people are more aware of the impact their food and diet has on our planet. But people still eat too much. And it's in fact on this matter you can make the biggest difference, "she says.

Not only with consumers, you see changes, Darmon adds:

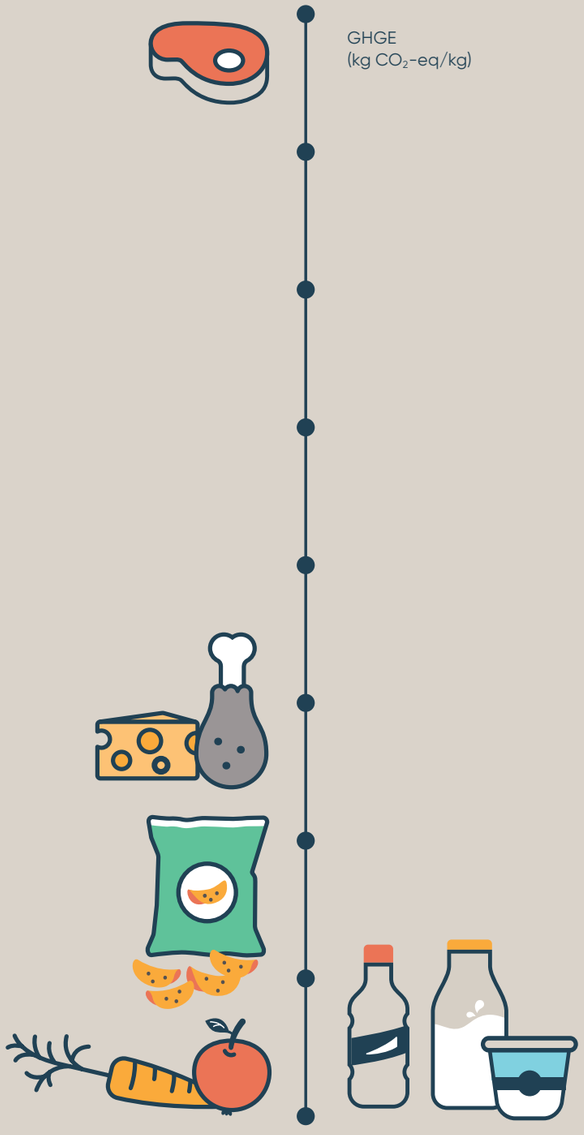
"In France, for example, new restrictions have been introduced on restaurants and the catering industry regarding food waste. New requirements to serve vegetarian meals are also introduced in public institutions. And the French food recommendations have also recently been revised with a focus on sustainability. Here, for example, it is recommended that the French eat moderate portions and eat far more legumes"

But we still have a way to go, she ends. And the sooner we get to change our diet, the better.

Facts about Nicole Darmon

Nicole Darmon is Research Director and Senior Researcher at the French Institute INRA (French National Institute for Agricultural Research). Since 2010, she has researched sustainable food and nutrition based on the UN Food and Agriculture Organization, FAO's definition of sustainable diet.

Plant-based vs. animal foods is too simplistic



Source: Darmon.

Carbon footprint is only **part of the picture**

Today the metrics for measuring the sustainability of foods is often solely linked to emissions of greenhouse gasses per kg food. When looking solely at this metric, animal products in general emit more carbon than plant-based products per kg of the product. Thus theoretically, carbon emission from diets could be reduced by eating only plant-based food.

But in reality, the calories and nutrients lost by avoiding animal products must be compensated by a lot of other plant-based products, which also have environmental footprint. In the LiveWell study a database was created that linked nutrient composition and GHGE data for 82 food groups, and models were built based on UK diet. The conclusion of the study showed that a sustainable diet that meets dietary requirements for health with lower GHGEs can be achieved without eliminating meat or dairy products (source Am J Clin Nutr doi: 10.3945/ajcn.112.038729).

A similar approach has been applied in the Netherland, with a nutrient calculation model, and the conclusions confirm that consuming less dairy product does not reduce the GHG emission of the diet, because when omitting dairy, which is very nutrient-rich, the nutrients have to be provided by other products.

When you add up the environmental effects of products that replace dairy, the same carbon emissions and land use are the result. Simply shifting between basic food groups to obtain a more sustainable diet gives disappointing results (Source : Stephan Peters, decreasing the environmental footprint of our diet, nutrition magazine).

Nutritional profiling **is key**

Nutritional value is often measured with the twin concept of energy density and nutrient density of foods, which is measured in kilocalories per 100 g. and nutrients per 100 g. or nutrients per 100 kcal.

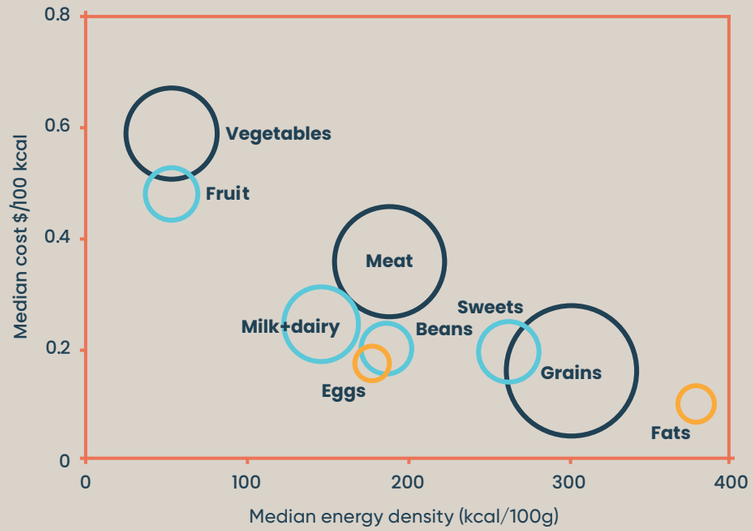
When looking at nutrient profiling of foods on kilocalories, fruits and vegetables provide very few calories per serving, whereas dairy and dairy products provide more calories per serving. At the other end of the scale with energy dense foods we in particular find grain snacks, candy and chocolate as well as fats and oils (Drewnowski, 2018).

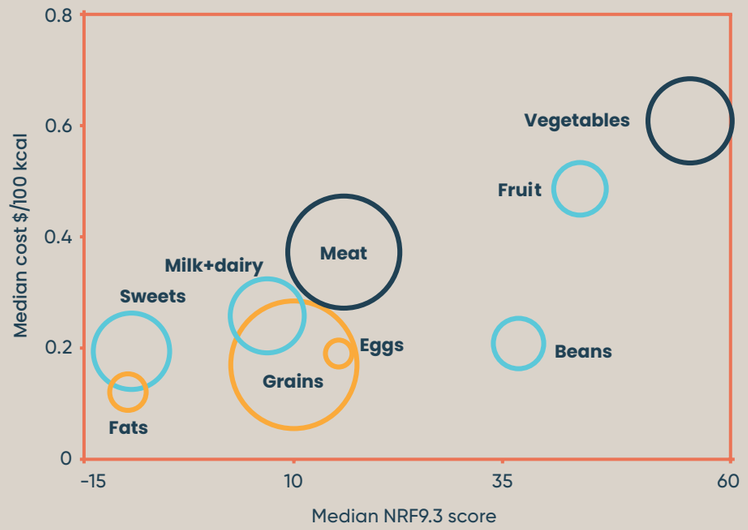
When we compare this to the measure of carbon footprints, we see that vegetables and fruits were precisely the group of foods that has the lowest carbon footprint per kg of product. But if these foods don't provide the necessary number of calories or nutrients, they cannot constitute a nutritional correct diet by themselves (Drewnowski, 2018).

These measures of nutritional value of different food groups demonstrate why it is important to couple the nutritional profiling with the carbon footprint. Moreover, we must also be attentive to the affordability and cultural appropriateness of the different foods.

Empty calories are the cheapest

Empty calories are often cheap whereas more nutrition-rich diets in general are cheaper, current research shows. (Drewnowski, 2018). The affordability of food is measured in terms of calories per penny, and by coupling this metric with the nutrient profiling and carbon footprint, we can determine which food is both climate-, nutrient and wallet-friendly.





Source: Drewnowski, 2018

A sustainable diet must be culturally appropriate

Different cultural, religious, political and social norms shape our views on food. While proteins from insects or green algae may meet a nutritional demand, they have different degrees of sensory or cultural appeal. In our search for the sustainable diet we must take these factors into a count as they have a major impact on food choices, both regionally and globally.

Selection of dietary sources of protein, in particular, may be determined by religion, society, and culture, in addition to economy. Furthermore, the amount and quality of protein from meat and dairy are higher than what can be obtained from any plant foods. As the search for affordable, nutrient-rich foods continues, the social and cultural drivers of food choice need to be addressed as well (Drewnowski, 2018).

Designing the sustainable diet

In designing a sustainable diet, the quantity consumed, must be taken into consideration first. (Masset G. et al, Which functional unit to identify sustainable foods? Public Health Nutrition, 2015).

As a matter of fact, the total quantity of food consumed explains a larger part of the food items' greenhouse gas footprint than the carbon intensity of the item itself. Furthermore, if the dairy products are replaced by other items, the CO_2 equivalent per calorie of the substituting food item must also be considered (Vieux F. et al, Greenhouse gas emissions of self-selected individual diets in France: Changing the diet structure or consuming less? Ecological Economics, 2012).

A limit to working with a complex model on sustainable diet is that models contain only limited environmental data on a limited number of products. This complex issue of evaluation of sustainable diet is still an emerging field of research, and the peer reviewed science on the matter is still sparse. There is still an incomplete coverage of relevant environmental areas of concern and associated metrics. The environment is not just greenhouse gas emission, but so far the majority of studies take only this indicator into account, ignoring carbon storage under grassland and ecosystem services provided by ruminant production like biodiversity maintenance. It is thus too early to drive any strong conclusions.

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