Climate-sensible dairy sector in the Netherlands

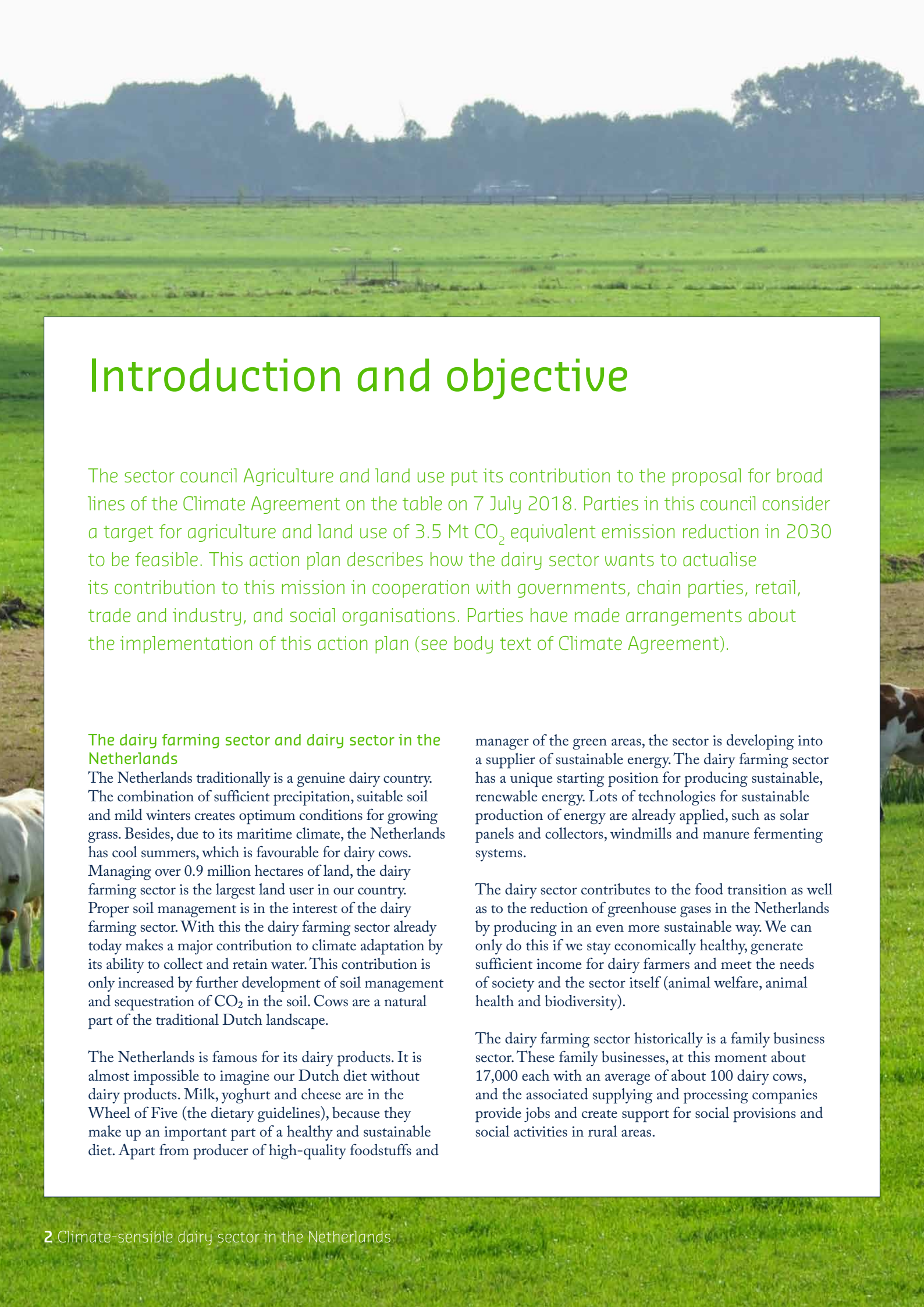
Towards an energy-neutral dairy farming sector in 2030

LTO Nederland

NAJK

Nederlandse Melkveehouders Vakbond

nzo
nederlandse zuivel organisatie



Introduction and objective

The sector council Agriculture and land use put its contribution to the proposal for broad lines of the Climate Agreement on the table on 7 July 2018. Parties in this council consider a target for agriculture and land use of 3.5 Mt CO_2 equivalent emission reduction in 2030 to be feasible. This action plan describes how the dairy sector wants to actualise its contribution to this mission in cooperation with governments, chain parties, retail, trade and industry, and social organisations. Parties have made arrangements about the implementation of this action plan (see body text of Climate Agreement).

The dairy farming sector and dairy sector in the Netherlands

The Netherlands traditionally is a genuine dairy country. The combination of sufficient precipitation, suitable soil and mild winters creates optimum conditions for growing grass. Besides, due to its maritime climate, the Netherlands has cool summers, which is favourable for dairy cows. Managing over 0.9 million hectares of land, the dairy farming sector is the largest land user in our country. Proper soil management is in the interest of the dairy farming sector. With this the dairy farming sector already today makes a major contribution to climate adaptation by its ability to collect and retain water. This contribution is only increased by further development of soil management and sequestration of CO_2 in the soil. Cows are a natural part of the traditional Dutch landscape.

The Netherlands is famous for its dairy products. It is almost impossible to imagine our Dutch diet without dairy products. Milk, yoghurt and cheese are in the Wheel of Five (the dietary guidelines), because they make up an important part of a healthy and sustainable diet. Apart from producer of high-quality foodstuffs and manager of the green areas, the sector is developing into a supplier of sustainable energy. The dairy farming sector has a unique starting position for producing sustainable, renewable energy. Lots of technologies for sustainable production of energy are already applied, such as solar panels and collectors, windmills and manure fermenting systems.

The dairy sector contributes to the food transition as well as to the reduction of greenhouse gases in the Netherlands by producing in an even more sustainable way. We can only do this if we stay economically healthy, generate sufficient income for dairy farmers and meet the needs of society and the sector itself (animal welfare, animal health and biodiversity).

The dairy farming sector historically is a family business sector. These family businesses, at this moment about 17,000 each with an average of about 100 dairy cows, and the associated supplying and processing companies provide jobs and create support for social provisions and social activities in rural areas.

Existing sustainability initiatives and results

In the past six years, NZO (the Dutch Dairy Association) and LTO Nederland (the Dutch Federation of Agriculture and Horticulture) have taken initiatives in the Sustainable Dairy Chain to proactively respond to the various sustainability themes.

The Sustainable Dairy Chain is working on a future-proof and sensible dairy sector. The objectives for the Sustainable Dairy Chain for the year 2020 include climate-neutral development, continuous improvement of animal health and animal welfare, preservation of outdoor grazing, biodiversity and the environment. The in more detail specified objectives are realistic but surely challenging as well.

Dashboard with Carbon Footprint Monitor

All dairy farmers have had 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 gases achieved by the sector throughout the chain.

Results to date

The Dutch dairy sector signed the Covenant for a clean and economical agricultural sector already in the year 2008. The dairy sector focuses on CO_2 reduction by taking measures concerning energy saving, reuse of energy, sustainable generation of energy and energy efficiency. Besides, the Dutch dairy industry also signed the LTA3 agreement. The objective of this agreement is to achieve an energy efficiency of 2% per year between 2005 and 2020. The dairy industry achieved this objective already in 2016.

One of the objectives of the Sustainable Dairy Chain is 2% improvement of energy efficiency per year in 2020 compared to 2005. This target was already reached in 2016. The use of energy is still decreasing, also thanks to the Energy Scan. Every dairy farmer has access to this scan, which provides insight into the use of energy at the farm and indicates the areas that still leave room for improvement. By the way, the differences in use of energy between dairy farms show that here there are still opportunities to reduce the use of energy.

Generation of sustainable energy at dairy farms has massively increased in the past few years. In 2017, 19% of the dairy farmers had solar panels on the roofs of the sheds and this percentage is still growing. Additionally, more and more dairy farmers place windmills at the farm and manure mono-fermentation plants are installed. Most dairy farmers generating sustainable energy use this energy for their own farms. When they generate more energy than they actually need, the surplus is delivered to the public electricity or gas supply.

The Sustainable Dairy Chain aims at a 20% reduction of greenhouse gases in 2020 compared to 1990. The greenhouse gas methane is, among other things, produced during the fermentation process in the intestine and rumen inside the cow, which sets a natural limitation for drastic reduction. The aim is to make optimum use of minerals and so also reduce the emission of greenhouse gases. For example, by means of higher feed efficiency. Other measures a dairy farmer can take are extending the cow longevity and retaining more permanent grassland with more clover and using less chemical fertiliser. With the Carbon Footprint Monitor all dairy farmers can calculate the carbon footprints of their own farms and compare these with those of others. In this way they gain insight into their points for improvement. In the Netherlands, the average greenhouse gas emission per kg milk is 1.15 CO_2 equivalent per kg milk (this globally is 2.4 CO_2 equivalent per kg milk).

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.

Also when fulfilling the ambition of reducing the greenhouse gases, all measures will have to be assessed for their impact on the other sustainability objectives that are important to society and the sector. Efficiency measures that help to reach the greenhouse gas reduction objectives can be contrary to other sustainability objectives, such as increasing biodiversity. Therefore an integral assessment for sustainability is always to be made.

Land-relatedness

Recently, a broadly composed commission (dairy farmers, NGOs, central government and provinces) made recommendations with respect to the theme land-relatedness in 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 society as well. Actually, the aim at land-relatedness means a choice for more feed from own land and more grassland, in which grassland absorbs much more carbon than maize land.

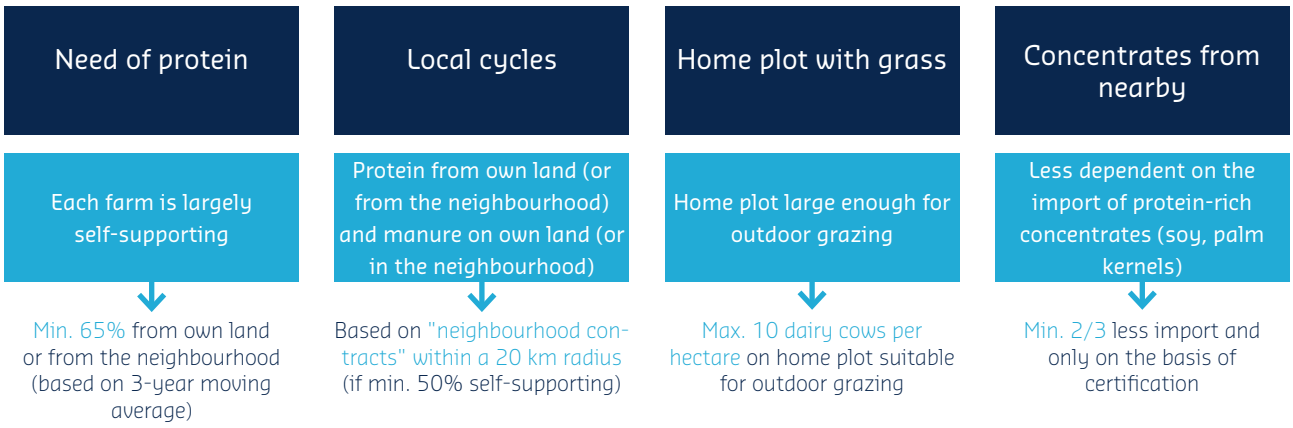
Parties in the Climate Council support the advice of the Land-relatedness Commission.

Environmental space and ammonia

The dairy sector wants to keep developing itself within the environmental preconditions applicable in the Netherlands. In connection with this, the sector performed an important task in the area of phosphates in the past period. Such far-reaching developments can only be established when the limits are set for a longer period, not only for phosphates or greenhouse gases but also for other dossiers, such as ammonia. It is of major importance to dairy farmers that they have a view of the environmental space for the future, a situation in which production can take place within the environmental limits and that they can work towards. In order to be able to give a clear picture for the coming years, clarity must be provided to the dairy farming sector with respect to ammonia. At this moment, also the measuring and calculating methodology is unclear to the dairy farming sector. This is undesirable and broad agreement is to be reached about this in the short term as well in order to provide the sector clarity about the various environmental conditions for the coming years and enable it to act upon this integrally.

Building blocks for land-related dairy farming in 2025

(advice of the Land-relatedness Commission)



Climate ambition dairy sector 2030

In line with the existing objectives of the Sustainable Dairy Chain in the area of greenhouse gases, the Dutch dairy sector takes its responsibility with respect to a task concerning the reduction of greenhouse gases in 2030.

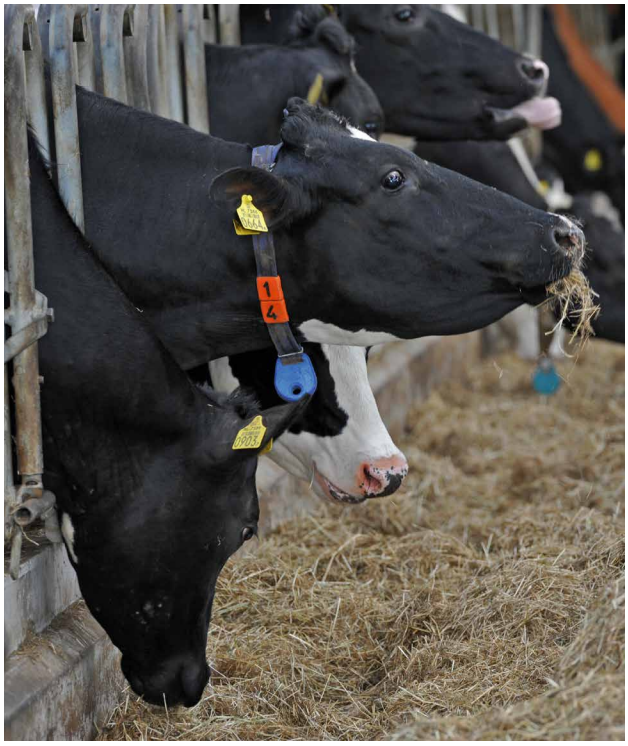
In this ambition, the following matters have been taken into account:

- The starting point is a land-related and visible dairy farming sector in the Netherlands. This implies that a situation in which all cows are in the sheds all year round, the sheds are completely closed and emissions in the sheds are collected by air washers (a situation that is potentially very effective for reducing greenhouse gases) is not deemed to be desirable by the sector and is also not supported by society.
- The arrangements included in the Climate Agreement do not hamper an integral approach towards sustainability in the dairy sector, including, for instance, the implementation of the recommendations of the Land-relatedness Commission (see **Annex 1**); these recommendations are considered to be conditional for the further development of the dairy farming sector.
- A number of greenhouse gas reducing measures require more detailed research, but implementation before 2030 is considered to be possible. These measures have not or to a limited degree been included in the own ambition for the dairy sector.
- The realistic potential (not only based on model calculations but on field data as well) and the cost-effectiveness of the various measures were taken into consideration. All this on the basis of our current knowledge and insights.
- Emphasis is laid on the fact that for realisation of the basic image 2030 (PBL, Netherlands Environmental Assessment Agency), taking existing and proposed policies into account, a substantial reduction of greenhouse gases is achieved already. Here think, for instance, of phosphate rights and longevity (fewer young cattle). This makes an additional reduction up to 2030 an ambitious task, as is also stated by the government.
- The problem concerning the peatlands, which requires an area-based approach with a separate package of measures, was not taken into account here. This package of measures is to be worked out for each region in the coming period.

Reduction greenhouse gases: ambition and measures

The dairy sector sees opportunities for a reduction of greenhouse gases in 2030 of a total of 1.6 Mt CO_2 equivalent, consisting of, among other things:

- Measures in the areas of "Animal and Feed" and "Manure storage and Manuring": 0.8 Mt methane in CO_2 equivalent[1] (assuming that the government will set a specific task for methane). Here we can think of measures such as extension of longevity, adjustment of the composition of feed, additives and better use of roughage, methane oxidation at outside storage, manure mono-fermentation and replacing a part of the grass by clover in order to reduce the use of chemical fertiliser. Improvement of the soil fertility is taken into account with respect to manure processing.
- Measures in the areas of "Soil and Crop" and "Energy saving and Generation of sustainable energy" at the dairy farm: 0.8 Mt CO_2 equivalent (the main part of which consists of "Energy saving and Generation of sustainable energy"). Here we can think of measures such as less ripping up of grass, improvement of crop rotation, catch crop through sowing after harvesting or through under-sowing, pre-coolers, frequency controllers and lighting, sun PV and windmills.



- The decreased dependence on the import of protein-rich concentrates (soy and palm kernels) as a result of the implementation of the recommendations of the Land-relatedness Commission will lead to additional reduction of greenhouse gases abroad. This climate benefit abroad is estimated to be about 1 Mt CO_2 equivalent in 2030. It is important that this climate benefit is one way or another included in the overall picture of the greenhouse gas reduction of the dairy sector.

Annex 2 gives an overview of the greenhouse gas reducing measures.

Annex 3 gives an indication of the emission reduction of the possible measures in 2030. The climate ambition remains generically 0.8 Mt methane in CO_2 equivalent for measures in the areas of "Animal and Feed" and "Manure storage and Manuring" and generically 0.8 Mt CO_2 equivalent for measures in the areas of "Soil and Crop" and "Energy saving and Generation of sustainable energy".

Arrangements for more of less reduction

New insights and future developments in the area of carbon sequestration in the soil may benefit the dairy sector and will not be formulated as extra tasks. New insights with respect to the role of methane in the carbon cycle will either advance or burden the task of the dairy sector.

Energy saving, generation of sustainable energy and carbon sequestration by the dairy sector are included in the tasks for which the dairy sector takes its responsibility. The current chain approach for greenhouse gas reduction and monitoring in the dairy sector remains the starting point.

If the dairy sector and individual dairy farms can achieve a greater reduction of greenhouse gases in the course of the period up to 2030, this will be taken into account and settled in a possible task after 2030. This is to stimulate individual dairy farms to keep taking greenhouse gas reducing measures.

[1] *In conformity with EU 525/2013, Annex I*

Approach

With respect to the approach of the reduction of greenhouse gases for the dairy sector, we have looked into which lessons can be learned from the phosphate reduction file.

The lessons learned from the phosphate reduction file are:

- Collective and voluntary private measures will not lead to the required reduction: a business-specific approach is unavoidable.
- It should be indicated beforehand which measures will be taken if the reduction task will not be fulfilled.
- Efficiency measures should not adverse efforts with respect to other sustainability themes.

This leads to the following approach for the reduction of greenhouse gases:

- The dairy farmer implements greenhouse gas reducing measures appropriate for his/her farm on a voluntary basis and is responsible for reducing the greenhouse gas emissions at his/her farm.
- Implementation of these measures will be supported and stimulated by the dairy business, the central government, provincial and municipal authorities, water boards, banks, the feed industry and social organisations.
- An external and independent expertise and consultancy firm (managed and financed by the dairy business, the central government, provinces and municipalities) will advise and support the dairy farmer in taking greenhouse gas reducing measures appropriate for the farm and the operational management and in line with the possibilities of financing, investment, subsidy and fiscal instruments. Additionally, this organisation channels the requests for such instruments towards the central government and the provinces.
- Monitoring and measurement of results at business level takes place by means of the Carbon Footprint Monitor.
- The central government makes sure that the implementation of the climate measures will not be without obligations. The central government will, in consultation with other authorities, allow for accountability of individual farms with respect to climate performance in order to, if necessary, fulfil the sector tasks for greenhouse gas reduction. The central government will investigate whether the Carbon Footprint Monitor instrument can be used to provide a foundation for legal instruments for business-specific monitoring and settling.
- Clarity will be provided as soon as possible about the starting position for dairy farmers; this reference will be determined such, that so-called "forerunners" will not be discouraged but rewarded, e.g. by taking measures already taken into account.
- When determining the greenhouse gas reducing measures, the impact on the other sustainability goals that are felt to be important by society and sector are to be taken into consideration. This to guarantee the integrality of sustainability measures. The advice of the Land-relatedness Commission is an important precondition for sustainability. Parties in the Climate Council support this advice, among other things under the condition that the implementation does not have any adverse consequences for nature and environmental objectives.

Cow and shed

The sources of the methane emissions are the cow, the sheds and manure. Reduction of methane emission in particular by the cows is only possible to a certain extent, as cows emit methane by nature as a by-product of the digestion of grass and other feed. Adjustment of feed leads to less methane emissions.

Apart from adjusting the feed, air from the sheds could theoretically be discharged into an oxidation reaction field, as is also presently under study for manure storage. However, the dairy sector thinks it is very important that sheds are open and accessible as much as possible. A closed shed with air washers is not deemed appropriate.

Newly built sheds need systems with at-source separation of urine and faeces and/or daily removal of manure from the shed. The majority of the dairy farmers has sheds with a slatted floor and a manure pit. Consequently, adjustment of the existing floor for daily manure removal is required.

Manure storage

Animal manure adds minerals and organic substances to the soil and this makes it essential for the nutrients cycle of the dairy farm. Therefore, optimum use of manure at the own farm has priority. Apart from daily removing the manure from the shed and processing and storing this, emissions of methane in particular but also CO_2 and nitrous oxide are reduced by influencing the method of storing (cool, process fresh manure, adjust the pH value, oxygen level, separate).

At this moment studies are being conducted into new innovative shed systems that do not work with slurry and that achieve equal emission reduction results.

Also, daily removal of manure combined with manure processing further optimises the use of animal fertilisers. The dairy farming sector is already working on closing its nutrients cycle and can take further steps in this by reducing greenhouse gas emissions through the use of low-emission fertilisers on grassland or farmland.

Energy saving and production of sustainable energy

The dairy farming sector can make a substantial contribution to the reduction of the CO_2 emission by means of energy saving and by generating renewable energy. The dairy farming sector is perfectly suited for generating energy without hindering the food production through the use of solar panels on the shed roofs, small-scale windmills and manure mono-fermentation. This is already done, but there is still room for further development. The ambition is an energy-neutral dairy farming sector in 2030. For a future-proof business model of a dairy farmer it is crucial that energy saving and generation of sustainable energy are included in the climate ambition for which the dairy sector takes its responsibility.

Financing

The impact of the dairy farming sector on the climate has already been decreasing for years and this largely goes hand in hand with cost savings. Further decrease of the impact on the environment also requires measures that do not save costs but involve extra costs or that require investments with very long payback times. In order to still achieve this further reduction of the environmental impact, adequate financing from the governments is needed, for instance investment schemes, compensations for unprofitable peaks and tax facilities.

Annex 4 indicates which existing financing, investments and fiscal instruments of the central government can be used for greenhouse gas reducing measures.

The Ministry of Agriculture, Nature and Food Quality and the dairy sector make sure that existing financing, investment and fiscal instruments will be accessible for the greenhouse gas reducing measures and that sufficient financial means will be made available for this. Possibilities for new financial instruments are investigated in connection with this.

Knowledge and innovation

Additionally, it is necessary to set up a long-term knowledge and innovation agenda in cooperation with the central government and provinces to map out the possibilities for reducing the greenhouse gases also for the longer term. In the years to come, the dairy sector will keep investing in communication and knowledge-sharing programmes as well as in the development of various tools for dairy farmers to reduce the greenhouse gases. Besides, the sector will keep investing in various practice pilots and studies, such as "Koeien en Kansen"(cows and opportunities) and various "Vruchtbare Kringloop" (productive cycle) projects.
In order to fulfil the ambition of the dairy sector in connection with the reduction of greenhouse gases, knowledge and innovation with respect to the following clusters of reduction measures are essential, being "Manure storage and Manuring", "Animal and Feed", "Soil and Crop", "Energy saving and Generation of sustainable energy" and "Sheds".

Annex 5 gives an indication which knowledge and innovation programmes are provided for the short and for the longer term.

These knowledge and innovation programmes for most of the dairy-related topics have been included in de Knowledge and Innovation Agenda (KIA) Climate, Agriculture and Land use.

Pilots and demonstration projects

Dairy farmers will have to involve the climate task into their daily care for sustainable milk production, good agriculture practices and economically healthy operational management. Here it is important to watch the integrality of sustainability measures. In order to be able to implement this, demonstration and pilot projects are needed in which dairy farmers investigate together and under the guidance of consultants and knowledge institutions how greenhouse gas reducing measures can best be integrated, taking animal health and welfare, biodiversity and the environment into account. Examples of this type of projects are Vruchtbare Kringloop and Kunstmestvrije Achterhoek (NL) (productive cycle and chemical fertiliser-free Achterhoek), in which study groups study the nutrients cycle and the climate. In Friesland (NL), a project is started focused on a source-oriented approach towards reducing various emissions from manure. This involves an integral approach paying attention to local recovery of biodiversity.

Finally, examples are given of some started pilots and demonstration projects aimed at developing methods and stimulating farmers to sequestrate more carbon while using land and soil. It will be studied to what extent such pilots and demonstration projects can be rolled out further. Pilots and demonstration projects are also necessary to, based on the lessons learned, possibly expand the package of measures for greenhouse gas reduction and to solve bottlenecks in laws and regulations and financing. Chain parties and authorities support such pilots and demonstration projects.

Accompanying policies and conditions

Accompanying policies are necessary to fulfil the ambition for 2030, in any case:

- Make available adequate financing from the authorities for dairy farmer to take measures, such as investment schemes, compensations for unprofitable peaks and tax facilities.
- Make arrangements with the feed industry to decrease the methane emission through the feed trace.
- Include the greenhouse gas reducing measures in the National Strategic Plan in the framework of the new Common Agricultural Policy (CAP).
- Draw up a demand-driven long-term innovation agenda in a cooperation between authorities and the dairy sector.
- Detail the statement in the government agreement granting that for sustainable products higher revenues can be achieved in the market, which can then be passed on to the dairy farmers.
- Room in the environmental policies of provinces and municipalities for greenhouse gas reducing measures, such as manure processing, windmills, shed adjustments and the like.

Additionally, acknowledgement of products resulting from manure processing as green fertiliser in order to decrease the use of chemical fertiliser, thus reducing fossil energy and nitrous oxide and allowing the build-up of more organic substances in the soil, is of major importance. Authorities and the dairy sector are committed to this in the framework of the European policy with respect to this theme.

In order to be able to fulfil the ambition of greenhouse gas reduction in 2030 with the proposed approach, the following **preconditions** are essential for all parties:

- The Climate Agreement includes clear tasks for the different sectors of industry, built environment, mobility, energy, and agriculture and land use. This provides clarity for the sectors concerned. In intermediate evaluations any adjustments of the tasks for each sector are designed such, that shifting from other sectors to the task for agriculture is avoided.
- All sectors in agriculture and horticulture are to be made responsible for a secured and tangible task concerning the reduction of greenhouse gases.
- New insights and future developments, including carbon sequestration in the soil, may advance the ambition of the dairy sector and will not be formulated as extra ambition. New insights with respect to the role of methane in the carbon cycle will advance or burden the task of the dairy sector.
- Energy saving, generation of sustainable energy and carbon sequestration by the dairy sector are included in the tasks for which the dairy sector takes its responsibility.
- Acknowledgement by all parties of the Carbon Footprint Monitor instrument for business-specific monitoring of the greenhouse gas reduction. The central government will investigate whether the Carbon Footprint Monitor instrument can be used to provide a foundation for legal instruments for business-specific monitoring and settling.
- The central government makes sure that the implementation of the climate measures will not be without obligations. The central government will, in consultation with other authorities, allow for accountability of individual farms with respect to climate performance in order to, if necessary, fulfil the sector tasks for greenhouse gas reduction.
- The Climate Agreement should not hamper an integral approach towards sustainability in the dairy sector, including, for instance, the implementation of the recommendations of the Land-relatedness Commission; these recommendations are considered to be conditional for the further development of the dairy farming sector.
- The current chain approach for greenhouse gas reduction and monitoring in the dairy sector remains the starting point. The dairy sector will thus monitor the greenhouse gas reduction not only at the national level but at chain level as well. This will results in a broader greenhouse gas reduction by the dairy sector than just the national ambition. This will be included in the overall picture.
- If the dairy sector (and individual dairy farms) can achieve a greater reduction of greenhouse gases in the course of the period up to 2030, this should be taken into account and settled in a possible task after 2030. This is to stimulate individual dairy farms to keep taking greenhouse gas reducing measures.
- Adequate contribution from all stakeholders to the business model of dairy farmers with respect to environmental performance and securing these arrangements.

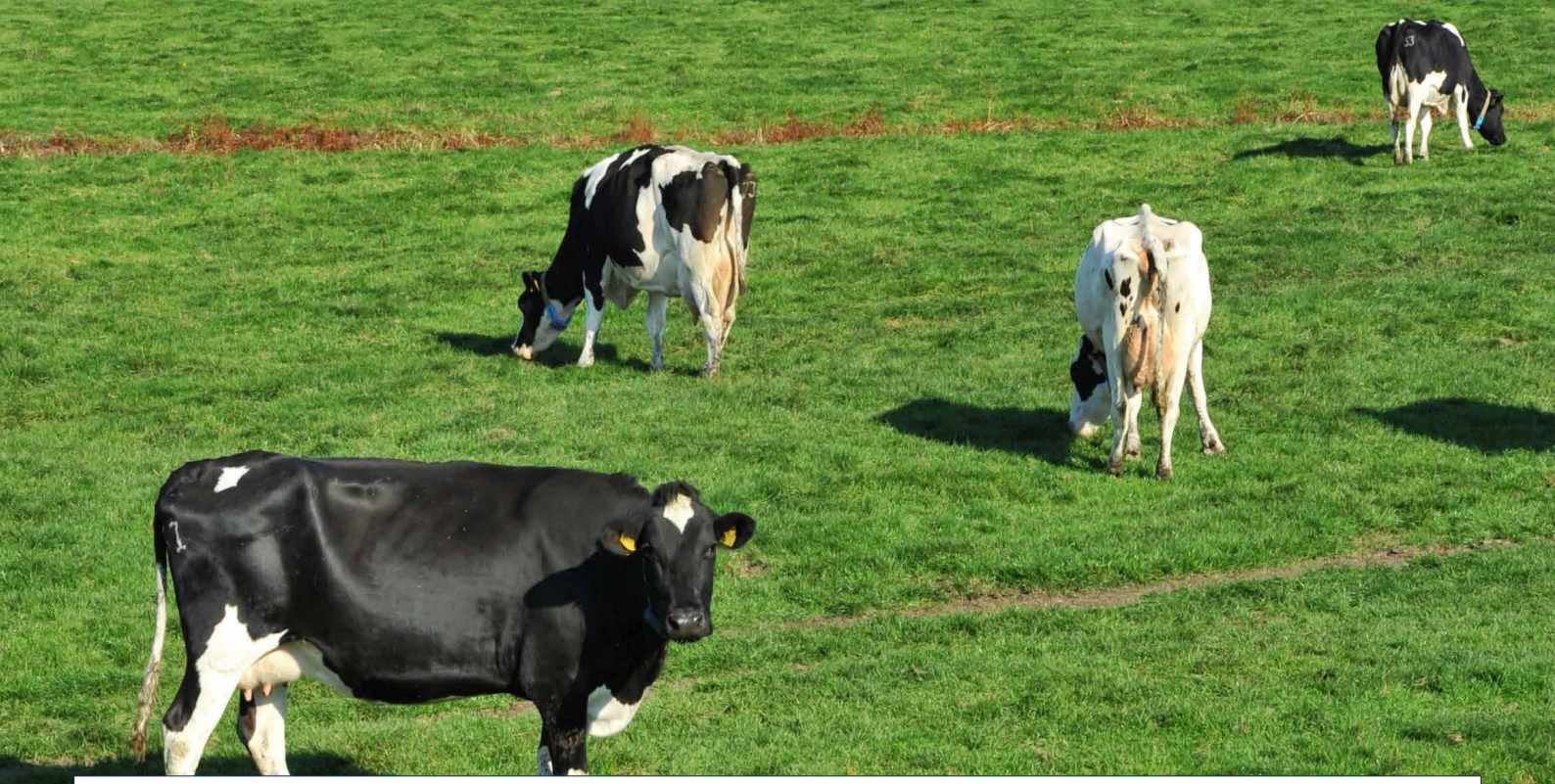
If the above accompanying policies and preconditions as well as the secured contribution from all stakeholders (see section "Roles and responsibilities") cannot be adequately actualised, this will have consequences for the feasibility and achievement of the ambition for 2030 as formulated by the dairy sector.

Business model for dairy farmer with respect to environmental performance

In this business model several parties take their responsibilities. These parties support the business model for dairy farmers given below. This business model can consist of higher proceeds, lower costs and more room for development and/or space to use.

How	Supporting parties
Higher proceeds	
Higher price for farm milk by marketing more sustainable dairy products (with climate performance component)	• Dairy industry • Retail • Nature and environmental organisations • Central government
Reward for climate performance based on the Carbon Footprint Monitor	• Dairy industry through sustainability programmes
Production of sustainable energy: wind, sun, fermentation	• Central government; SDE+ scheme • Provincial and municipal programmes and arrangements
Reward for carbon sequestration in the soil	• Central government • Parties outside the dairy sector

How	Supporting parties
Lower costs	
Energy-saving measures at the farm	• Energy scan at dairy companies
Financing instruments and fiscal measures as well as financial contributions for greenhouse gas-reducing measures from the central government (as uniform as possible) (including CAP/POP)	• Central government • Provinces • Municipalities
Lower interest at banks based on climate performance for dairy farms using the Carbon Footprint Monitor	• Banks
Lower rental prices in case of build-up of organic substances in the soil and longer lease periods	• All parties leasing land
Acknowledgement by EU of products resulting from manure processing as chemical fertiliser	• Commitment by government with the support of all parties towards the EU.
Use of more animal fertiliser instead of chemical fertiliser	• Central government
Production/composition of chemical fertiliser based on less fossil resources (natural gas, fossil P and K)	• Chemical fertiliser industry
Link between subsidy for removal of asbestos roofs and shed improvement measures; uniform arrangement	• Central government • Provinces • Municipalities
More room for development and/or use	
Provide room for development in environmental policy for climate measures (shed adjustments, new energy, etc.). See roles and responsibilities	• Provinces • Municipalities
Provide room for development in the framework of the Nature policy/Nature Conservation Act by energetic implementation of the "PAS" (programmatic approach for nitrogen) and by setting up and implementing development-oriented management plans for the Natura2000 areas	• Provinces • PAS partners, including the dairy sector • Parties involved in drawing up Natura2000 management plans, including the dairy sector
Sequestration of CO_2 by farmers in wooden landscape elements (e.g. hedgerows) throughout the Netherlands	• Government, provinces
Collective investments in nature reserves and woods	• Dairy organisations



Roles and responsibilities

Several parties have responsibilities and roles in fulfilling the climate ambition of the dairy sector. The below-mentioned roles and responsibilities will be worked out in more detail with all parties in the first quarter of 2019, including drawing up an implementation plan. Additionally, it will be checked with parties whether the arrangements made are complied with. The "Uitwerkgroep Veehouderij" (dairy farming work-out group) will facilitate and coordinate this process.

Contribution and primary responsibility of all parties concerned
Dairy sector (primary sector and processing industry)
Describe in more detail and design a business-specific approach (taking all those who have already worked on the reduction into account), in consultation with the central government, including the more detailed description of the packages of (technical) measures for reducing greenhouse gas emissions.
Include and secure not yet registered matters in the Carbon Footprint Monitor
Further secure the Animal Nutrient Cycling Assessment, together with the central government
Advice from Land-relatedness Commission: • A minimum of 65% protein from own land or from nearby in 2025 through sustainability programmes • Make the protein energy algorithm from the own land more robust (check for purchase of concentrates; secure home-cultivated protein) • Stimulate the cultivation of protein on own land together with knowledge institutions, seed suppliers and feed industry • Stimulate expansion of the home plot, business plots, together with the provinces • Master class Protein (knowledge and education programme), together with knowledge institutions and feed industry • Cooperate with arable sector with respect to regional cycles
Reward for climate performance based on the Carbon Footprint Monitor
Invest in communication and knowledge-sharing programmes as well as in the development of various tools for dairy farmers to reduce greenhouse gases. Besides, the sector will keep investing in various practice pilots and studies, such as "Koeien en Kansen" (cows and opportunities) and various "Vruchtbare Kringloop" (productive cycle) projects.

Contribution and primary responsibility of all parties concerned
Central government
The central government makes sure that the implementation of the climate measures will not be without obligations. The central government will, in consultation with other authorities, allow for accountability of individual farms with respect to climate performance in order to, if necessary, fulfil the sector tasks for greenhouse gas reduction. The central government will investigate whether the Carbon Footprint Monitor instrument can be used to provide a foundation for legal instruments for business-specific monitoring and settling.
Support for the integral approach towards sustainability in the dairy sector in conformity with the approach for sustainable dairy farming in the framework of the Ministry of Agriculture, Nature and Food Quality vision "Waardevol en verbonden" (valuable and connected).
The Ministry of Agriculture, Nature and Food Quality and the dairy sector make sure that existing financing, investment and fiscal instruments, such as MIA/VAMIL and green financing, will be accessible for the greenhouse gas reducing measures and that sufficient financial means will be made available for this. In connection with this the possibilities for new financial instruments are investigated.
Set up a demand-driven long-term innovation agenda together with the dairy sector.
Advice from Land-relatedness Commission: The Ministry of Agriculture, Nature and Food Quality will in the framework of the reconsideration of the manure legislation try to find out how manure legislation can contribute to closing cycles, while specifically looking at "neighbourhood contracts" and updating the manuring standards, as mentioned in the advice of the Land-relatedness Commission.
The central government, supported by all parties, will commit itself to acknowledgement by the EU of products resulting from manure processing as green fertiliser in order to decrease the use of chemical fertiliser, thus allowing reduction of the use of fossil energy and nitrous oxide and build-up of more organic substances in the soil.
Grant that for sustainable products higher revenues can be achieved in the market, which can then be passed on to the dairy farmers. In order to strengthen the position of the farmer in the chain and to offer the appropriate preconditions for establishing business models for sustainability, the ACM will, among other things, start developing the agri-nutri monitor, which will provide insight into price setting, as a means to establish business models for sustainability.
Include the greenhouse gas reduction (and sustainability in general) in the National Strategic Plan in the framework of the new CAP.
Educational institutions include climate and possibilities for greenhouse gas reducing measures into their curricula.
The central government works on a revision of the lease policy, taking long-term relationships between landlords and tenants and sustainable soil management as points of departure.
Provinces
Responsibility/role: Environmental policy (general) Contribution: Province and municipalities stimulate the application of climate measures (including shed adjustments) and generation of sustainable energy at dairy farms in the framework of their environmental policies. In 2019, the dairy sector, provinces and municipalities will inventory opportunities and bottlenecks in this area and study and implement improvements where necessary (such as the development of the instrument for general periodic inspections for sheds in cooperation with the central government).
Responsibility/role: co-designer/implementer CAP/POP Contribution: In 2019, the central government and provinces will in consultation with the dairy sector include measures in the CAP/POP for stimulating climate-friendly dairy farming (innovation, share knowledge, disseminate knowledge, demos and investments (sheds)). The central government and provinces will, in consultation with the dairy sector, include greenhouse gas reduction (and sustainability in general) in the more detailed formulation of the National Strategic Plan in the framework of the new CAP.
Responsibility/role: (regional) policy for innovation and promotion of sustainable agriculture. Contribution: As from 2019, provinces will integrate the climate task for agriculture into the provincial innovation and stimulating policy for agriculture and agricultural chains. Here provinces investigate a more uniform approach. This also involves the link with the asbestos removal task.

Contribution and primary responsibility of all parties concerned
Provinces (continued from previous page)
Responsibility/role: nature and landscape policy. Contribution: • in 2019, study with the dairy sector and municipalities the possibilities for strengthening landscape structures (such as hedgerows) for sequestration of CO_2 and improving the landscape quality. • with the dairy sector and nature organisations study the possibilities/make arrangements about investments by the dairy sector in woods and nature reserves for CO_2 storage and other nature/wood objectives. Sequestration of CO_2 is assigned to the climate performance of the dairy sector.
Responsibility/role: formulate regional energy strategies in more detail with municipalities and water boards Contribution: Generation of energy will in the future become an important part of the business model of dairy farms/is an important element in the sustainability of dairy farms. Provinces, municipalities and water boards involve the role and position of the dairy farming sector as a producer of energy in the more detailed formulation and implementation of regional energy strategies in 2019.
Responsibility/role: stimulate generation of sustainable energy. Contribution: support for generation of sustainable energy from provincial energy programmes.
Provinces and municipalities are committed to an energetic processing of permit applications from the dairy sector for climate-related measures. In 2019, sector and governments will study which opportunities and bottlenecks play a role in the acceleration and implement improvements where necessary.
Municipalities
Responsibility/role: Environmental policy (general) Contribution: Province and municipalities stimulate the application of climate measures (including shed adjustments) and generation of sustainable energy at dairy farms in the framework of their Environmental policy. In 2019, the dairy sector, provinces and municipalities will inventory opportunities and bottlenecks in this area and study and implement improvements where necessary (such as the development of the instrument for general periodic inspections for sheds in cooperation with the central government).
Responsibility/role: (regional) policy for innovation and promotion of sustainable agriculture Contribution: As from 2019, municipalities will integrate the climate task for agriculture into the municipal policy for innovation and promotion for agriculture and agricultural chains. Here municipalities investigate a more uniform approach. This also involves the link with the asbestos removal task.
Responsibility/role: nature and landscape policy Contribution: • in 2019, study with the dairy sector and provinces the possibilities for strengthening landscape structures (such as hedgerows) for sequestration of CO_2 and improving the landscape quality. • with the dairy sector and nature organisations study the possibilities/make arrangements about investments by the dairy sector in woods and nature reserves for CO_2 storage and other nature/wood objectives. Sequestration of CO_2 is assigned to the climate performance of the dairy sector.
Responsibility/role: formulate regional energy strategies in more detail with municipalities and water boards Contribution: Generation of energy will in the future become an important part of the business model of dairy farms/is an important element in the sustainability of dairy farms. Provinces, municipalities and water boards involve the role and position of the dairy farming sector as a producer of energy in the more detailed formulation and implementation of regional energy strategies.
Municipalities and provinces are committed to an energetic processing of permit applications from the dairy sector for climate-related measures. In 2019, sector and governments will study which opportunities and bottlenecks play a role in the acceleration and implement improvements where necessary.

Contribution and primary responsibility of all parties concerned
Central government, provinces, municipalities and network operators
Include arrangements of the Climate Council in regional energy strategies/environmental visions, including attention for relationship infrastructure (construction of energy networks) and stimulating possibilities.
Parties will make sure that the (energy) infrastructure will have sufficient capacity to enable dairy farmers to supply the desired amount of energy to the network within the set terms of the subsidy decisions issued to them.
Site management organisations commit themselves to lower rental prices in case of build-up of organic substances in the soil and longer lease periods.
Banks
Lower interest at banks based on climate performance for dairy farms using the Carbon Footprint Monitor.
Feed industry
The dairy sector and feed sector make arrangements about reducing the methane emission through the feed trace by (i) improving the feed conversion (development of feed that contributes to less emission of methane), (ii) sensible use of additives by setting up an admission board for approving methane emission reducing additives in feed (with respect to animal health, food quality and safety), and (iii) providing dairy farmers insight into the climate footprint of foodstuffs for livestock. Nevedi investigates the possibility to set up guidelines for this together with the feed sector and to move things into the right direction through certificate schemes and the like. If the desire exists for enforcing collective measures, it should always be considered whether a covenant with Nevedi is the appropriate means for this. The instrument of "Algemeen Verbindend Verklaring" (universally binding statement) would, if an appropriate organisational legal form is in place, be possible.
Use the "white list" for certain matters.
Retail
The Dutch Food Retail Association stimulates its members to contribute to a better position of farmers and market gardeners, which will demonstrably promote sustainable production, including the reduction of greenhouse gases. The possibility to include the climate performance in the SPECS (product specifications determining the procurement policy) is being investigated.
Nature, environment and site management organisations
Build support: actively explain and support the measures in the agreement and the approach of the dairy sector in the media and in talks with stakeholders, politicians, government and with the constituencies of various parties.
Actively plead for and contribute to the business model as included in this action plan of the dairy sector.
Site management organisations commit themselves to lower rental prices in case of build-up of organic substances in the soil and longer lease periods.

Climate ambition towards 2050

The coming years, the dairy sector will look at measures and consequences for possible tasks concerning the climate for agriculture in 2050. This must also include a discussion within the EU, in which in the framework of level playing field it should be investigated which measures the various member states have already taken and which they will take, and in which regions of the EU (dairy) cattle farming can best take place for environmental and climate reasons.

The conclusion of the PBL is also relevant to this discussion: "contraction of activities causing a lot of emissions is also a way to reduce greenhouse gases. It is conditional, however, that these activities and emissions will not show up anywhere else in the world (carbon leakage). Based on these conditions, most volume measures will be dropped." (PBL report, 28 March 2018).

Finally, it is noted that the Climate Agreement of Paris promotes a climate change and development with a low level of greenhouse gases in a way that does not endanger the production of food.

Food consumption (sustainable diets)

In the debate about making our food more sustainable there is a common rule of life to reduce the ecological footprint of our diet: "eat less animal and more vegetable products". This rule is not differentiating enough to ensure a diet with a smaller ecological footprint. Not all vegetable-based products have a small ecological footprint. Here think of exotic fruit that has to be flown in. Also, not all animal-based products have an equally large ecological footprint.

The Dutch dairy sector agrees that the share of vegetable-based products in our diet might be increased. However, this should not be at the expense of a satisfactory diet. Dairy contains many important nutrients that are essential for our health. When avoiding dairy products, other foodstuffs have to ensure the intake of nutrients. It is often assumed that a diet without dairy has less impact on the environment than a menu that includes dairy. Recent research has shown that avoiding dairy does not or hardly decrease the ecological footprint. A diet without dairy needs many other (vegetable-based) products to provide the same nutrients. All in all, these products have an equally large ecological footprint as dairy has. Therefore it is important for a sustainable and healthy diet to look at the environmental impact of a product per kilogram nutrients instead of per kilogram product. From this perspective the dairy sector makes a contribution to the measures with respect to food consumption as provided in the Climate Agreement.

Annex 1

Advice from Land-relatedness Commission

Focal point on the horizon...

- The future Dutch farming sector will be land-related
- Grass will be the basic feed of the cow
- Local cycles:
  - roughage of own land or from nearby land
  - every dairy farmer will use the manure for the own business or nearby
- Strengthening of the position of Dutch dairy in the market and in society

Building blocks for land-related dairy farming in 2025

(advice of the Land-relatedness Commission)

Need of protein	Local cycles	Home plot with grass	Concentrates from nearby
Each farm is largely self-supporting	Protein from own land (or from the neighbourhood) and manure on own land (or in the neighbourhood)	Home plot large enough for outdoor grazing	Less dependent on the import of protein-rich concentrates (soy, palm kernels)
↓	↓	↓	↓
Min. 65% from own land or from the neighbourhood (based on 3-year moving average)	Based on "neighbourhood contracts" within a 20 km radius (if min. 50% self-supporting)	Max. 10 dairy cows per hectare on home plot suitable for outdoor grazing	Min. 2/3 less import and only on the basis of certification

Importance of dairy farming areas

Crucial for social acceptance

- Provide an attractive landscape and cows in the meadows
- Food supplier: produced locally and in a sustainable way

Basis for good environmental quality and living environment

- Local cycles
- Care for soil
- Less transport
- Contribute to climate targets
- Contribute to biodiversity
- Support Dutch culture landscape

Strengthening of economic perspective

- Improve market position
- Compensate for social services
- Less dependent on import of raw materials

Annex 2

Greenhouse gas reducing measures

Category	Measures
Manure storage and manuring	• Acidify manure • Methane oxidation • Manure mono-fermentation • Precision manuring • Nitrification inhibitors • Replace a part of the grass by clover
Animal and Feed	• Extension of longevity of dairy cows • Adjust the composition of feed and improve use (roughage and concentrates) • Additives
Soil and crop	• Less ripping up of grassland • Improve rotation of temporary grassland and maize • Catch crop after growing maize • Reward carbon sequestration
Energy saving and production of sustainable energy	• Pre-coolers • Heat recovery • LED-lighting • Solar panels • Manure mono-fermentation • Windmills
Sheds	• Separate manure and urine • Further develop sheds
Instruments	• Carbon Footprint Monitor at dairy farm • Decision-making tool for carbon footprint • Energy scan • Protein from own land • Measuring equipment for sheds • Reward carbon sequestration

Effects of greenhouse gas reducing measures

Measures	Greenhouse gas CO_2: carbon dioxide CH_4: methane N_2O: nitrous oxide	Description
Manure storage and Manuring		
Acidify manure	N_2O, CH_4	Acidify the manure by means of sulphuric acid and so decrease CH_4 emission from shed and storage. Besides, the measure has a major impact on the NH3 emission from animal manure and with that also on indirect N_2O emission.
Methane oxidation outside storage	CH_4	Storage of manure in closed outside storages and then oxidation of the released methane by bacteria. The methane is then converted into carbon dioxide, which has a much lower greenhouse gas effect than methane has.
Manure mono-fermentation	N_2O, CH_4	The fermentation of slurry for the production of biogas. This reduces the methane emission from manure. Additionally, electricity is generated by cogeneration with which the farmer compensates a considerable part of the farm's energy demand.
Precision manuring	N_2O	Includes a combination of raising the effectiveness of (products of animal) manure and the use of GPS technology when manuring. This respectively decreases the release of nitrogen by chemical fertilisers and a lower supply of nitrogen will be sufficient because of a more efficient use of manure.
Nitrification inhibitors	N_2O	Addition of these substances slows down the conversion of ammoniacal nitrogen into nitrate and so prevents the emission of N_2O. Additionally decreases the wash-out of nitrogen, which has a direct effect on the N_2O emission. The largest potential is to be gained by adding to animal manure and chemical manure.
Replace a part of the grass by clover (grass-clover mixture)	N_2O	Clover can bind nitrogen from the atmosphere, thus reducing the need for chemical fertiliser. The emission reduction as a consequence of less use of chemical fertiliser results from less application and less production of the chemical fertiliser N.
Animal and Feed		
Extension of longevity of dairy cows	N_2O, CH_4	Improved animal management paying more attention to the health of the dairy cows can extend the longevity. In this way less young cattle is to be held to keep the milk production at the required level and so the total number of cows can be reduced.
Adjustment of composition of feed	CH_4	The methane emission can be reduced by a better feed composition and by introducing low-methane concentrates.
Additives	CH_4	Add nitrate to the feed, thus reducing the methane emission from rumen fermentation.

Measures	Greenhouse gas CO_2: carbon dioxide CH_4: methane N_2O: nitrous oxide	Description
Manure storage and Manuring (continued from previous page)		
Improvement of use of roughage	CH_4, N_2O	Better use of roughage (e.g. by means of a higher feed efficiency) and better animal management can increase the milk production of cows and decrease the methane emission. Consequently, fewer dairy cows need to be held and the related CH_4 and N_2O emissions will drop.
Breeding programmes focused on rumen and intestine fermentation	CH_4	At the breeding farm selection of animals with lower greenhouse gas emissions from rumen and intestine fermentation.
Soil and Crop		
Less ripping up of grassland	CO_2	Ripping up of grassland for grassland renewal leads to loss of carbon in the soil.
Improve rotation of temporary grassland and maize	CO_2	Includes improvement of the crop rotation between grassland and maize. This allows for build-up of carbon in the soil.
Catch crop through sowing after harvesting or through under-sowing	CO_2	A catch crop is usually sown to prevent wash-out and with that loss of nutrients in the autumn (after harvesting). Additionally, a catch crop also ensures sequestration of carbon and the intake of nitrogen, which reduces the demand for chemical fertiliser. Under-sowing of catch crop in the maize and sowing catch crop after harvesting the maize is a measure to take in more organic substances into the soil.
Land-relatedness Commission	CO_2	Implementation of the advice from the Land-relatedness Commission. More protein from own land or from the direct neighbourhood, less supply of protein from far away.
Energy saving and production of sustainable energy		
• Pre-coolers • Function controllers • Heat recovery • LED-lighting • Solar panels • Manure mono-fermentation • Windmills		
Sheds		
• Separate manure and urine • Further develop sheds		
Instruments		
• Carbon Footprint Monitor at dairy farm • Decision-making tool for carbon footprint • Energy scan • Protein from own land • Measuring equipment for sheds		

Annex 3

Indication of the emission reduction of the various measures in 2030 displayed

Measure	Directly applicable	Realistic estimation 2030 by Dairy farming sector (in Mt CO_2 eq)	Remarks
Manure storage / manuring			
Acidify manure	investigation	CH_4: 0.32 N_2O: 0.02 Total: 0.34 (PBL report spring 2018)	Research is necessary; the Commission of Fertiliser Experts gave the government a negative advice in connection with the use of sulphuric acid. Not include measure
Methane oxidation in sheds	investigation	CH_4/N_20: 0.6 (PBL report spring 2018	Possibility of methane oxidation in sheds (airomix) is still in its infancy. Not include measure
Methane oxidation outside storage	yes		
Manure mono-fermentation	yes		
Precision manuring	yes		
Nitrification inhibitors	investigation		Low entry reduction: study necessary into animal health and milk quality
Ambition of dairy farming sector: total manure storage / manuring		**CH_4: 0.3** **N_20: 0.1**	
Animal and Feed			
Extension of longevity of dairy cows	yes		
Adjust composition of feed (low-methane concentrates) and improve use of roughage	yes		
Additives	yes		Low entry reduction: study necessary into animal health and milk quality
Breeding programmes focused on rumen and intestine fermentation			
Ambition of dairy farming sector: total animal and feed		**CH_4: 0.5** **N_20: 0.04**	

Measure	Directly applicable	Realistic estimation 2030 by Dairy farming sector (in Mt CO_2 eq)	Remarks
Soil and Crop			
Carbon sequestration including: A) Less ripping up of grassland, B) Improve rotation of grassland and maize C) Catch crop through sowing after harvesting or through under-sowing D) Replace a part of the grass by clover	yes		
Land-relatedness Commission	implement		• Less maize and more grass in feed • Shift from maize to grassland: • More grass in agriculture crop rotation plan
Ambition of dairy farming sector: total soil van crop		**CO_2: 0.2** **N_20: 0.07** **Additional:** **CO_2: 1.0 (less soy/palm from abroad)**	
Energy			
Pre-coolers	yes		
Frequency controllers	yes		
Heat recovery	yes		
Low-energy lighting	yes		
Manure mono-fermentation	yes		
Sun PV	yes		
Windmills	yes		
Ambition of dairy farming sector: total energy		**CO_2: 0.6**	

Annex 4

Financing, investment and fiscal instruments from the central government

(to be worked out in more detail by the Netherlands Enterprise Agency)

	Potential commitment for climate by dairy sector	Directly applicable in dairy farming sector	What is needed
Present financial support generic			
1. Innovation loan	low	perhaps	make applicable for agriculture
2. Guarantee SME loans	low	yes	
3. Guarantee business financing	low	yes	
4. Early phase financing	medium	perhaps	green start-ups for projects
5. R&D tax credit	high (dairy companies in particular)	yes	
Present financial support CO_2-specific			
1. Renewable energy	medium (related to SDE)	yes	
2. Stimulation of Sustainable Energy Production (SDE+)	high	yes	extension with subsidy on avoided CO_2 from sources other than energy
3. Green projects scheme	low	yes	
4. Energy investment allowance (EIA)	high	yes	
5. Environmental investment allowance (MIA)	high	yes	adjustment (e.g.. methane oxidation)
6. Arbitrary depreciation of environmental investment (VAMIL)	high	yes	adjustment (e.g. methane oxidation)
7. Energy tax	low	no	?
8. Storage of sustainable energy	low	no	?
Per sector: Built environment			
1. Subsidy energy saving private house (SEEH)	medium	perhaps	must also be possible for commercial buildings (check)
2. Investment subsidy for sustainable energy (ISDE)	medium	yes	
3. National energy-saving fund (NEF)	low	no	can be used for agriculture?
4. Urban energy	low	no	similar arrangement for agricultural areas?

	Potential commitment for climate by dairy sector	Directly applicable in dairy farming sector	What is needed
Per sector: Industry			
1. Demonstration energy innovation (DEI)	medium	yes	add methane to point of departure
2. Subsidy renewable energy: see above			
3. Subsidy programme indirect emission costs ETS	low only for dairy companies	yes	
4. Subsidy Biobased Economy and Green Gas (BBEG)	low	yes	
5. Energy and industry JIP	low	yes	chain projects seem to be fundable, try for Sustainable Dairy Chain projects?
6. System integration study	low	no	
7. Subsidy socially responsible innovation (MVI) – Energy	low	no	
8. SME Innovation Stimulation Top sectors (MIT)	low	yes	
Per sector: Agriculture			
1. Guaranteed loan for agriculture	low	yes	
2. Direct payment CAP	medium	yes	use for climate measures dairy plan (e.g. land use)
3. SEED Capital	medium	perhaps	use for innovations necessary for low emission
4. Investments environmental-friendly measures	high	yes	is to be set up again
5. Market introduction energy innovations	high, provided that it is applicable to dairy	yes	make applicable to dairy farming sector (methane)
6. Energy efficiency and renewable energy greenhouse farming (EHG)	high, provided that it is applicable to dairy	yes	make applicable to dairy farming sector (methane)

Annex 5

Knowledge and innovation programme for dairy farming sector

Theme	Knowledge and innovation questions
Emission reduction in soil and land use in agriculture	
(Manure storage and Manuring) **Agricultural soil and manuring** Both manuring and conversion of the crop rotation plan have influence on the nitrous oxide emissions. The underlying physiological processes are complex.	There are three promising research line for the short term: a) In order to be able to monitor the effects of technical operations, further research into the actual emission and variation in the emission of nitrous oxide in connection with manuring and other tillage/changes in crop rotation is required. b) Further development of precision agriculture and technologies for manuring with optimum accuracy and adequacy substantially raises the effectiveness of the manure release in relation to the actual use by the crop. This research is a combination of technology development (smart fertilisation) and development of new manuring products (e.g. "slow release" fertilisers). c) Further development of precision agriculture and technologies for manuring with optimum accuracy and adequacy substantially raises the effectiveness of the manure release in relation to the actual use by the crop. This research is a combination of technology development (smart fertilisation) and development of new manuring products (e.g. "slow release" fertilisers). In the long term: Drastic reduction of nitrous oxide emission through use of circular manuring products by: a) Development of fundamental knowledge is required with respect to dynamics in the soil in connection with mineral use and the production of nitrous oxide in order to be able to develop new technologies that can adequately restrain the production of nitrous oxide. b) Development of a new generation of manuring products (produced without using fossil resources and without emission) and technologies. c) Development of an integral sustainable crop rotation plan, paying special attention to improvement of crops with a growing pattern and mineral use pattern that minimise nitrous oxide emissions and increase the effective use of minerals. However, the degree of production of below-ground biomass, the effect on carbon sequestration, biovitality, etc. is of major importance.

Theme	Knowledge and innovation questions
Carbon sequestration	
(Soil and Crop) CO_2 sequestration in cultures, effects of (deeply rooting) crops, mechanisation, wood below and above the ground, how to strategically manage soil layers: there is still a lot to discover.	In the short term: a) Validated technologies are required for monitoring CO_2 in the soil and assigning them to measures. Here it should be checked if there are possibilities to design these systems such, that any possibilities for valorisation (including carbon credits) could be created. b) Knowledge is to be gained with respect to CO_2 sequestration in larger cultures, the effect of, e.g., deeply rooting crops, wood below and above the ground and how to strategically manage the soil layers. Also insight is needed into the effects of rotation and farmland planning and various types of mechanisation with respect to the effects on CO_2 sequestration in the longer term. c) Research is required into the possibilities to disconnect mineral processes involving C, N (and P), making sure that a higher level of C in the soil does not involve mineral losses.
	Longer term: Increase of carbon sequestration in biomass in the soil is of major importance. However, additional biomass production for the purpose of emission reduction of other sectors raises the emission in agriculture. Logically, this affects the agriculture ambition, as a result of which this ambition is brought up for discussion. The ambition of extra sequestration can be fulfilled by finding ways that allow for flexibility in land use and that go beyond the current potentials, through: a) Manipulating the C-N dynamics in agricultural systems. This is about gaining fundamental knowledge of build-up and breakdown of C and N in plant, animal, manure and soil. This also involves knowledge about the processes of the production of nitrous oxide (influence of soil biology, physics and chemistry). b) Disconnection of C, N (and P) making sure that a higher level of C in the soil does not involved higher N emissions and possible losses of the amount of P in the soil. c) Search for possibilities to change the relation between land use and carbon sequestration and, if possible, develop new combinations of land use (e.g. agroforestry).

Theme	Knowledge and innovation questions
Dairy farming sector: reduction of the emission of methane and nitrous oxide There are two ways to reduce the emission from animals: making the animals emit less methane and reducing the emission from the manure.	
(Animal and Feed) **Rumen and intestine fermentation** Reduction of methane emission by rumen and intestine fermentation or levelling out the effects of this.	The most important directions for solutions for this in the short term are: a) There is a need for a state-of-the-art study into the possibilities and effects of feed additives. Presently, this study is conducted for cattle financed from the climate funds assigned in the government agreement (climate envelope 2018). Additionally, there will be a need for testing promising feed additives in vitro, in vivo and in daily practice in the coming years. More attention is asked for possible effects on the cow and possible effects on the food safety and the quality of farm milk. b) There is a need for knowledge and innovation that contribute to reducing the emissions of other ruminants and of monogastric animals, including the emissions of animals held as a hobby, such as sheep and horses.
	In the longer term: a) Fundamental research is required into how to prevent methane production in the rumen and intestines. Methane production is the way in which reactive hydrogen (H_2) is bound and so discharged from the rumen. The research question is focused on possibilities to have the microbiome in the rumen discharge the H_2 in another way than through methane, preferably in a way that makes extra useful nutrients available to the ruminant. This involves fundamentally innovative research for which success cannot be guaranteed. This may, for instance, involve "disabling" the methanogens (in whatever way, e.g. through antibodies), in which preferably the hydrogen is not lost but can be useful to the animal (such as acetic acid through acetogens). b) There is a need for fundamental knowledge that contributes to reducing the emissions of other ruminants and of monogastric animals, including the emissions of animals held as a hobby, such as sheep and horses. c) Breed animals with lower methane emissions. It is already known that there is a large genetic difference between animals with respect to methane production. Research is needed into the difference of methane emissions between animals, feed and breeds. The data obtained will then offer a basis for reducing the methane emission through phenotyping in breeding. d) Breakthrough in additives, ingredients and concentrates composition to further decrease the rumen fermentation than the present generation of additives. The first possibilities are promising, but fundamental breakthroughs are needed. There are various knowledge requests from the agribusiness about reduction of emissions by optimising concentrates and roughage. How to achieve improvement of the roughage quality and how to achieve reduction by changing the composition of roughage and concentrates and to prevent a shift. Another research question concerns further development/improvement of breeds and new crops that lead to reduction of the methane emission. e) There is a need for breakthroughs in reducing emissions from rumen and intestine fermentation, whether or not from the source.

Theme	Knowledge and innovation questions
(Manure storage and Manuring) **Shed and storage** An important source of heavy greenhouse gases (methane and nitrous oxide) are the shed systems and manure storage (both storage at the farm and storage in the field). Besides, manuring is an important source of nitrous oxide emissions.	The most important knowledge and innovation tasks towards 2030 particularly include the need for knowledge and innovation with which existing solutions can be made ready for implementation in daily practice. a) A starting point for the design of new shed/manure systems is at-source separation and processing of the manure as soon as possible after production. This requires research into cost-effective measures to reduce methane and nitrous oxide emissions in shed systems and manure storages. The reduction potential of downstream technologies is to be studied as well. The research task is focused on the question which technologies for de-manuring (rinse, direct separation in the manure pit, frequently remove the manure) and (direct) separation of the manure lead to the most effective reduction of methane and nitrous oxide. Also the possible reduction potential of downstream technologies is to be established. Examples of this are below-ground methane oxidation, above-ground methane oxidation, thermal oxidation, acidification of manure and cooling of manure whether or not combined with heat recovery. b) For a short-term effect it is necessary to determine the potential and technologies of accelerated conversion of existing sheds with slurry pits into integrally sustainable sheds. c) There is a need for knowledge about the emissions of methane and nitrous oxide from deep litter systems and about the possibilities to limit the emissions through (management) measures. The need for knowledge also includes the possible advantages and disadvantages of the use of deep litter manure for agriculture, soil, carbon sequestration and nature. d) Methane reduction technologies (usually based on source separation and new production from downstream technologies) ask for research into an optimally integral chain for manure processing and valorisation with a focus on integral reduction of methane and nitrous oxide emissions (from the production of the manure up to and including manuring). The need for knowledge also includes the possible advantages and disadvantages of the use of new manure flows for agriculture, soil and carbon sequestration.
	The following is required for the longer term: a) Breakthroughs in open shed systems focused on integrally sustainable systems (maximum animal welfare en transparency (visibility); low footprint; high flexibility for fast adjustment to new insights; no or minimum shift to other sustainability themes, such as biodiversity; sustainable building technologies). b) Fundamental and applied research is required into the possibility to concentrate methane in the shed air and to capture this paying special attention to capturing and processing gases in very low concentrations (methane, nitrous oxide, ammonia). c) An integral approach with technical breakthroughs in the entire manure chain for substantially reduced emissions of nitrous oxide and ammonia at storage, processing and use of circular fertilisers.

Theme	Knowledge and innovation questions
Energy saving and generation of sustainable energy	
Energy-neutral in 2030 Reduce the CO_2 emission from the use of fossil fuels in agriculture to zero and generate 100 PJ energy from non-fossil fuels in the agricultural area.	Short term: energy-neutrality in rural areas The primary sector has been busy generating renewable energy and saving energy for a long time already. By now, about 80% of the full energy use of the agricultural sector, excluding the greenhouse farming sector, comes from a renewable source. A part of the future need for energy in the Netherlands can be produced by the primary sector. This makes an energy-neutral primary sector in 2030 feasible. Energy saving: a) Practical research into how different energy technologies can be combined, making sure that maximum saving is linked with optimum generation. b) There is a need for knowledge and expertise about alignment with the neighbourhood in order to find regional smart grid solutions: For example, how to keep products with optimum use of energy (by means of smart drying or cooling of products and respond to demand and supply in the electricity market). c) Heat recovery from catabolism (manure and shed, composting), heat storage.
	Generation of energy: a) integration of solar panels into the farm system, b) biogas production, c) wind energy.
	For the far future new business concepts are looked into, giving individual businesses a climate footprint of zero and enabling them to together supply up to 100 PJ in case of a shortage of energy.
Soil and Crop	
100% land and water suitable for CO_2 sequestration and use in 2050.	Apart from a consistent demand for food and animal feed, the demand for biomass as a basic material for materials and biofuels and for sequestration for carbon in nature will increase. The ability to increase the biomass production with knowledge and innovation is worked on in this MMIP. • develop over 14,000 km^2 maritime space for the production of seaweed • biomass cultivation with doubled photosynthesis • climate-resistant nature

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Nederlandse Melkveehouders Vakbond (Dutch Dairy Farmers Union)
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This is the contribution of the Dairy Farming department of the Dutch Federation of Agriculture and Horticulture, the Dutch Agricultural Young People's Association, the Dutch Dairy Farmers Union and the Dutch Dairy Association to the Climate Agreement.