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A sustainability charge on meat



Committed to the Environment

A sustainability charge on meat

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For more information on this study please contact the project leader [Robert Vergeer](#) (CE Delft)

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Summary

This study, commissioned by the True Animal Protein Price Coalition (TAPP Coalition), sets out a proposal for a policy package to incentivize the farming sector to reduce its environmental footprint and encourage consumers to adopt a more sustainable diet. Without appropriate financial policies, in the form of taxes or subsidies, the earnings model of sustainable agriculture and livestock farming is constrained. It is desirable, furthermore, that the policy package is equitable and does not lead to a disproportionately high financial burden for lower-income households. The study reflects two of the core premises the Dutch government has set for the Climate Agreement:

1. Use of cost-effective policy instruments, and
2. Equitable allocation of costs and benefits.

Textbox 1 - What is a 'sustainability charge'?

In this study, a 'sustainability charge' is a charge equal in value (in Euros) to the social costs resulting from the environmental impacts of meat consumption. In this report, a sustainability charge is chosen because this factors the social costs of meat into the price, allowing consumers to make sustainable choices based on prices.

This study addresses the following concrete questions:

- What form could a policy package take, comprising a meat sustainability charge in tandem with subsidy for the farming sector and purchasing power compensation for households?
- How can such a charge be suitably elaborated?
 - What would be its effects on the environment and on economic welfare?
 - How can the revenues be used to reduce the footprint of the agricultural sector and compensate for purchasing power losses, particularly for low-income households?

We conclude that a meat sustainability charge can be introduced within a time frame of two years. It can be collected at supermarkets and butchers/poultry sellers (without requiring import/export corrections) or, alternatively, at abattoirs/importers (which would require such corrections).

As with the plan for a Dutch minimum price for CO₂, we propose raising the charge rate incrementally. Phased introduction allows the livestock sector as well as consumers to grow accustomed to the charge, giving them time to adjust. In 2030, the charge precisely covers the social costs associated with the environmental footprint of meat production. This matches the horizon of the Dutch Climate Agreement.

Based on previous research, these social costs are estimated at 2.04 €/kg for chicken, 4.50 €/kg for pork and 5.70 €/kg for beef and veal. These estimates encompass the costs associated with greenhouse gas emissions, other pollutant emissions, land-use impacts on biodiversity and livestock diseases. These figures will need to be adjusted as understanding of the impact of meat production improves or as the sector reduces its footprint.



The sustainability charge leads to an estimated 4.2 Mt/a reduction in CO₂-eq. emissions (of which 2.7 Mt/a in the Netherlands¹) in 2030. Welfare increases by around € 800 million². Besides the lower greenhouse gas emissions, this is also down to reduced ammonia, NO_x and particulate emissions, among other environmental benefits. There will also be a decline in livestock diseases.

Introduction of the sustainability charge will reduce the social costs of meat consumption. As the charge is collected by the state, there will be additional government revenue. This revenue can be recycled to compensate low and middle-income households for purchasing power losses and/or incentivize the livestock sector to further reduce its environmental footprint.

¹ On the assumption that the livestock holdings are in the Netherlands.

² This figure does not factor in (partial) replacement of meat products by other products. We estimate this would mean loss of 15-25% of the welfare gains (see Appendix J).



1 Introduction

1.1 Background

The Dutch National Climate Agreement includes far-reaching proposals for agreements with the agricultural sector, including livestock farming, to reduce its greenhouse gas emissions and other environmental impacts. The envisaged policy package addresses both the production and the consumption side. On the production side, there is scope for a range of measures to reduce the sector's footprint. On the consumption side, suggested policies include public information explaining to consumers the environmental impact of their consumption patterns. Without appropriate financial policies, the earnings model of sustainable agriculture and livestock farming is constrained, and the Climate Agreement consequently states that parties should cooperate on developing an adequate set of financial policies. Appropriate financial incentives are seen as a key driver of the required behavioural changes on the part of both producers and consumers.

At the request of the True Animal Protein Price Coalition (TAPP Coalition) in this study, CE Delft elaborates a proposal for a financial instrument that incentivizes the sector to reduce its environmental footprint while encouraging consumers to adopt more sustainable eating habits. In line with the Cabinet's response to the Draft Climate Agreement, the instrument is designed to be cost-effective, with costs and benefits equitably shared.

Textbox 2 - What is a 'sustainability charge'?

In this study, a 'sustainability charge' is a charge equal in value (in Euros) to the social damage resulting from the environmental impacts of meat consumption. In this report, a sustainability charge is chosen because this factors the social costs of meat into the price, allowing consumers to make sustainable choices based on prices.

In this study, we answer the following concrete questions:

- What form could a policy package take, comprising a meat sustainability charge in tandem with subsidy for the farming sector and purchasing power compensation for households?
- How can such a charge be suitably elaborated?
 - What would be its effects on the environment and on economic welfare?
 - How can the revenues be used to reduce the footprint of the agricultural sector and compensate for purchasing power impacts, particularly for low-income households?

1.2 Methodology in brief

This study consists of three basic steps:

1. Design variants of a meat sustainability charge in the form of an External Costs Charge (see Section 2.1).
2. Determine its effects on meat consumption, emissions and welfare.
3. Analyse use of the ensuing revenue for reducing the livestock sector's footprint and compensating households for losses in purchasing power.

In designing variants of the sustainability charge, the following procedure was adopted:

- We first sketch an ideal picture, as a long-term perspective, in which the polluter pays for the pollution and other impacts arising in each link of the meat production chain.
- We then design two variants of the sustainability charge:
 - one variant that is relatively simple to implement;
 - one variant that is more complex in design but closer to the ideal picture.
- We compare the variants with respect to their administrative burden, implementation costs, legal constraints and impacts on consumption and production.
- Finally, we discuss several follow-up steps in pursuit of the ideal picture.

In all of this, we use a variety of relevant sources, principal among which are Netherlands Statistics (CBS) data on the meat production chain, LCA results on the various categories of meat (CE Delft, 2011), contacts with the Netherlands' Inland Revenue Service (tax department) and customs officials, and expert opinion.

To determine the charge's impacts on Dutch meat consumption, aggregate emissions and welfare, we use price elasticities, emission factors and environmental prices. In addition, we carry out a first-pass analysis of the effects of a sustainability charge deployed on a European scale. All of the impacts should be seen in the light of uncertainties associated with the elasticities, emission factors and environmental prices used, and how livestock farming interventions are modelled. The results should be seen as an approximate estimate of the anticipated effects.

In analysing use of the ensuing revenues, we discuss options for recycling them to compensate purchasing power losses and/or supporting the livestock sector to further reduce its footprint. Again, we use a range of sources, including FAO, the Netherlands Environmental Assessment Agency (PBL), CBS and previous studies by CE Delft.

For further information on the methodology, we refer readers to Appendix A.

Advisory Board

The study benefitted greatly from reviews and input from the Advisory Board set up by the True Animal Protein Price Coalition (TAPP Coalition). This board comprised:

- Jeroom Remmers - TAPP Coalition;
- Floris de Graad - Dutch Vegetarian Society;
- Sandra Beuving - Dutch Animal Coalition;
- Jan Paul van Soest - Dutch Food Transition Coalition;
- Pablo Moleman - ProVeg.

1.3 Project scope

This study is concerned with three categories of meat:

1. Chicken.
2. Pork.
3. Beef (including veal).

From the perspective of tax evasion and a broader incentive to reduce external costs, consideration might be given to introducing a similar sustainability charge for other animal-protein products like fish, dairy produce and eggs. These issues are briefly discussed, without any in-depth coverage of design parameters or impacts.



1.4 Report structure

Chapter 2 discusses the potential design of a meat sustainability charge. Chapter 3 reviews its estimated impacts on Dutch meat consumption, the environment and welfare. Here, we also present the main impacts of a sustainability charge introduced on a European scale. Chapter 4 examines various options for revenue recycling.

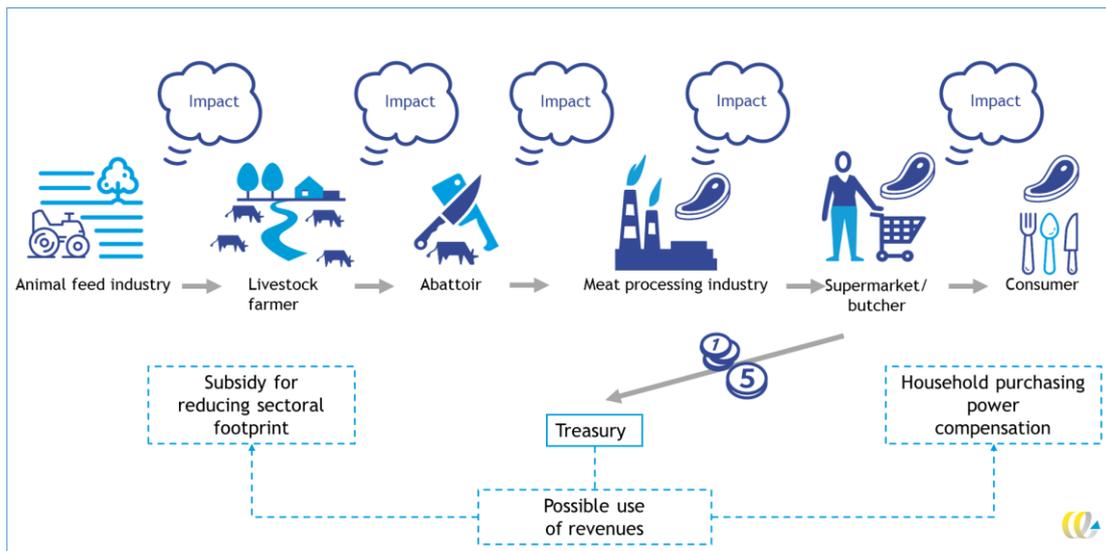


2 Sustainability charge design

2.1 External Costs Charge (ECC)

The sustainability charge could take the form of an External Costs Charge (ECC) (CE Delft, 2018b), a financial policy instrument designed to make consumers pay the full external costs associated with the products they consume. The explicit aim of the ECC is thus to incorporate the impacts occurring in the entire supply chain in final consumer prices, in line with the Polluter Pays Principle. In its design, the ECC can best be compared with Value Added Tax (VAT), where the value added in each production link is subject to a tax. With the ECC, it is the external costs added in each production link that are taxed; for the meat production chain, see Figure 1. The ECC thus creates a (price) incentive for consumers to reduce the footprint of their dietary habits. Such an incentive is similar to that of other charges like fuel duty, for example. The ECC differs, however, in incentivizing not only consumers but also producers all the way up the supply chain, encouraging them to adopt (new) methods or technologies to reduce the external effects arising during production of the goods or switch to production of other goods with lower-impact external effects.

Figure 1 - Ideal picture of meat sustainability charge in the form of an ECC



Ideally, the ECC would be based on the external costs added in each production link and be implemented across the economy. This would create optimum price incentives for both producers and consumers to avoid external impacts. This ideal situation is a long-term perspective, as it assumes the external effects of every link in the production chain and the technology used at every location are known. This is not currently the case and is out of the question for the time being. The ECC can be designed as a two-edged sword if the revenues are used (partly) as a subsidy for measures to reduce the sector's footprint. A further portion of the revenues can be used to compensate households for purchasing power losses.

In this study, we elaborate how initial steps can be taken towards such a long-term perspective. We do so with reference to two variants: one rudimentary, the other more ambitious. We then analyse possible further steps in pursuit of the ideal picture embodied in the ECC (cf. Figure 1).

2.2 Two variants

In the present study, we elaborate two variants of a ECC-type sustainability charge: a ‘Basic variant’ and a ‘Plus variant’. The first can be rolled out in the short term, for which we see two options. The Plus variant is more ambitious and will need more time to implement. Finally, we analyse possible further steps en route to the ECC ideal picture (see Figure 2).

Basic variant

The Basic variant can be implemented in the relatively near term. In this variant, the external costs associated with the meat categories analysed (beef, pork and chicken) are passed on to consumers in their entirety and it is at that level that the right incentive to reduce meat consumption is created. The incentive for producers remains limited, though, because they can do virtually nothing to avoid or reduce the charge.

There are two options for the Basic variant, differing in charge point. In the first, it is the supermarket or butcher selling the meat to consumers that collect the charge. In the second, it is charged on meat sales to abattoirs, or on imports of carcasses and (meat) products.

Plus variant

The Plus variant is more complex, but creates the right incentive not only for consumers but also for producers, who can now avoid (some of) the charge by switching to production methods that reduce external costs.

Figure 2 depicts the two variants of the meat sustainability charge schematically. They are discussed in more detail in Section 2.2.1 and Section 2.2.2.

Figure 2 - Variants of the sustainability charge analysed in this study

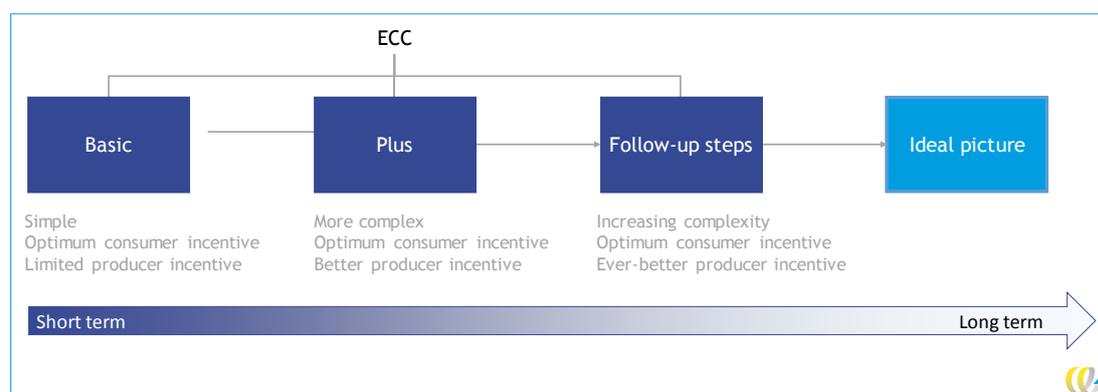


Table 1 - Features of the two variants of the meat sustainability charge

Element	Basic variant		Plus variant
	Option 1	Option 2	
Charge point	Sales to consumer	Sales to abattoir and import	As in Basic variant
Charge payer	Supermarket and butcher/ poultry seller	Abattoir and importer of carcasses and meat (products)	As in Basic variant
Charge base	Quantity of (processed) meat		As in Basic variant
Charge unit	kg (processed) meat		As in Basic variant
Charge rate	Standard		Differentiated at farm/enterprise level + standard for other links in the chain
Party registered	N.a.		Livestock farmer
Emissions registration system	N.a.		As per existing systems for Dutch and EU livestock farmers; opt-in with benchmark for non-EU-producers
System for meat source traceability	N.a.		As per existing system, thus meeting EU obligations, partly under development

In this chapter we consider the following design aspects of the two variants:

- the charge payer;
- the charge base and charge unit (on what is the charge levied?);
- the charge rate;
- the emissions registration system (for the Plus variant);
- the system for meat source traceability (for the Plus variant).

2.2.1 Basic variant

Charge payer and charge point

The Basic variant is a standardized sustainability charge on meat and meat-containing products. There are two options.

In Option 1, the charge is levied at the consumer³ sales point, with the retailer paying a charge based on the weight and type of meat sold. By locating the charge point here, around 85% of consumer sales of meat and meat products are covered by the sustainability charge. Those liable for the charge are supermarket outlets and butchers/poultry sellers⁴.

In Option 2 of the Basic variant, the charge is paid by abattoirs and meat importers and the charge point is meat sales (abattoirs) or meat imports (importers). Besides abattoirs, the

³ Strictly speaking, this should be ‘final consumer’, as we are talking about meat for private consumption.

⁴ In the Basic variant, consumers sales from the sales points livestock farmers and restaurants would be exempt from the charge. Although these could be included, this would mean tens of thousands of additional parties paying the charge, accompanied by a parallel rise in administrative burden. At the same time, the amount of meat consumed from such outlets is minor compared with supermarket and butcher sales. In the Netherlands around 15% of consumer meat/meat product sales are from non-supermarkets/butchers; see (RIVM, 2018).



meat processing industry is also a major meat importer and will also be liable to the charge. This variant is similar to the existing Dutch sales tax on soft drinks (see Textbox 3).

Textbox 3 - Comparison with sales tax: no import/export corrections required

The structure of Option 2 for the Basic variant of the sustainability charge is similar to the existing Dutch consumption tax on non-alcoholic drinks: fruit and vegetable juices, mineral waters and lemonades. This charge is levied per litre. The sales tax is not levied on the products sold to consumers, but on products *produced in or imported to* the Netherlands; if the product is exported or processed in production of other foods or beverages there is a rebate. Analogously to the sales tax, in Option 2 import/export corrections will be required. In Option 1 (charge point = consumer sales point) no such corrections are necessary.

Charge base and charge unit

The charge is levied on the amount of meat sold or imported (charge base), either as pure meat or products in which meat is processed. The charge unit is the mass (kg) of meat sold. This means producers of meat-containing products must provide the parties paying the charge information on the mass of (processed) meat. To the extent that those paying the charge themselves make products in which meat is processed, they will have to register the amount of meat involved and derive the sustainability charge to be paid to the Treasury.

Charge rate

To give consumers and the sector an opportunity to adapt to the sustainability charge, the charge rate has been kept low in the first few years, gradually rising until it reflects the full external costs. Phased introduction was also the preferred route for the CO₂ minimum price, for example. Here we work with a charge rate representing 10% of the external costs in 2021, rising to full cost coverage in 2030, the horizon of the Dutch Climate Agreement.

Table 2 reviews of the level of the sustainability charge for the various types of meat: pork, beef and chicken. As can be seen, it is highest for beef and lowest for chicken.

The charge rate is based on the external costs of the following items (CE Delft, 2019):

- greenhouse gas emissions, causing climate change;
- other emissions, causing environmental pollution that ultimately damages human health, ecosystems, materials, buildings and raw material availability;
- land use-related impacts on biodiversity;
- livestock diseases.

The literature cites a number of other categories of external costs that we have *not* reflected in the charge rate: animal welfare, health impacts of meat-eating, noise nuisance and several other impacts like soil desiccation and depletion and antibiotics resistance.

It makes sense to review the charge rates periodically, so any changes due to internal factors (reduced livestock farming impacts) or external factors (e.g. new environmental prices) can at any rate be made transparent. This would also provide an opportunity to do the sums on additional aspects not presently included in the rates reported. We recommend that it be announced beforehand whether and how such things are to be included in the charge. For example, if the charge is to change, two years notice should be given. In this study we work consistently with the rates reported in Table 2.



Table 2 - Sustainability charge rate by type of meat (€/kg meat) - phased increase

	2021	2025	2030
Beef/veal	€ 0.52	€ 2.69	€ 5.70
Pork	€ 0.41	€ 2.13	€ 4.50
Chicken	€ 0.18	€ 0.95	€ 2.04

Source: Calculations by CE Delft based on the Dutch Environmental Prices Handbook (CE Delft, 2017) and the EU28 version of that Handbook (CE Delft, 2019); methodology according to 'De echte prijs van vlees' (The true price of meat) (CE Delft, 2018a).

Note: The environmental costs of CO₂ rise in step with the reference year. The charge rate gradually increases from 10% of the external costs in 2021 to full cost coverage in 2030.

2.2.2 Plus variant

This variant of the ECC expands on the Basic variant, creating a greater incentive for producers to reduce their environmental footprint. This makes it more complex in design, however, in some cases requiring (further) development of systems that will take a considerable time to accomplish. The charge point, parties paying the charge and charge unit remain the same; the aspects that change are explained below.

Charge base: differentiated rate based on livestock farmer external costs

The charge rate is based on the environmental footprint of meat production on the livestock farmer's holding. This means that meat from farmers with low external costs is charged at a lower rate per kg than meat from holdings with higher external costs. For the links upstream of the livestock farmer (feed production) and downstream (abattoir, meat processing, sales) there is a standard charge rate (as in the Basic variant).

To keep implementation of the Plus variant as simple as possible, we differentiate the charge rate for impacts for just a single link in the meat production chain: the livestock farmer. It is here that a relatively high proportion of the polluting emissions occur (see Appendix G). In Section 2.4 we discuss options for differentiating the charge rate according to the external costs of other links in the chain, too.

The charge rate is set per kilogram of meat and differentiated according to the external costs of environmental and climate damage due to livestock farm emissions. We have opted here to work with the four categories of emissions from this sector with the most damaging external impacts: NH₃, particulates (PM_{2.5} and PM₁₀), NO_x and CO₂-eq. These are charged for at rates covering the external costs of the ensuing environment damage (see Textbox 4) (CE Delft, 2018a). See Table 3.

Textbox 4 - External costs of environmental damage

Pollutant emissions to the environment can cause external costs if these substances are unhealthy for humans, animals or other life forms, for example. To the extent that these costs are not included in the market price of the product, they are referred to as 'external costs'. In CE Delft's Environmental prices Handbook (2017) the external costs are expressed in Euros: a so-called 'environmental price'. Environmental prices are indices representing the 'price to society' of environmental pollution, and express it in Euros per kilogram pollutant. Environmental prices thus stand for the economic welfare lost when one additional kilogram of the substance concerned ends up in the environment. External costs may also derive from matters other than pollutant emissions, such as land use, livestock diseases and their associated costs, and zoonoses (animal diseases that can be transmitted to humans) and the resultant costs of human health damage.

These charge rates will need to be regularly adjusted to account for changes in population composition, population density, and scientific understanding of a range of issues, including the impact of emissions on human health, biodiversity and climate change.

Table 3 - Charge rates for noxious livestock farming emissions

Pollutant emission	Charge rate (€/kg emission)
Particulates (PM ₁₀ -eq.)	62.10
NH ₃	30.50
NO _x	34.70
CO ₂ -eq.	0.09

Source: CE Delft (2017).

Note: These charge rates are for emissions in the Netherlands; for emissions elsewhere the rates will be different, because of differences in population density, among other factors. The environmental price of PM₁₀-eq. has been corrected because agricultural particulate emissions are by nature generally less noxious than the national average (CE Delft, 2018a).

Registration obligation

The systematics of the Plus variant means that beef/dairy, pig and chicken farmers will be obliged to register emissions of the above four pollutants. Table 4 reports how many holdings will be subject to such an obligation.

Table 4 - Number of farmers required to register

Type of livestock farmer	Number
Beef/dairy farmers	24,195
Pig farmers	3,815
Poultry farmers	1,855
Total	29,865

Source: CBS (2017 data).

Emissions registration system

We now move on to discuss the emissions registration system for livestock farmers, first indicating what kind of obligation Dutch and foreign farmers will (or will not) need to be under, then how registration might be organized.

Economic allocation

Livestock farmers commonly produce cheese, milk or eggs in addition to meat. We propose to allocate emissions across these various products on the basis of economic value. This means establishing a general distribution key for this purpose that can be applied to all livestock holders. This key will need to be periodically updated.

Opt-in for foreign livestock farmers

To minimize the administrative burden for livestock holders with only a small market share in the Netherlands, we propose the following:

- Dutch farmers are subject to mandatory emissions registration. For some emissions this is already the case; for the remainder they can feed in to current systems (see below).

- Foreign farmers can opt in to emissions registration if they so choose. In that case, the charge rate for the meat sustainability charge is based on their registered emissions. Emissions registration is not compulsory, though. Foreign livestock holders not signing up will be charged a standard rate per kg meat, based on the average emissions of (Dutch) livestock holders producing the same type of meat.

Design of emissions registration

We propose monitoring and registration of the following emissions:

- particulates (PM₁₀-eq.);
- ammonia (NH₃);
- nitrous oxide (NO_x);
- CO₂-eq.⁵.

Below, we indicate the existing emissions registration (ER) systems on which this registration can be based. Appendix F provides an overview of the systems currently in force for the Netherlands, the EU and worldwide.

Ammonia and particulates

For these emissions, Dutch livestock farmers can hook up to existing ER systems for agricultural holdings, via the so-called Combined Registration⁶. These annually reported data are currently used to establish the following emissions:

- ammonia, under the *Regeling ammoniak and veehouderij* (Rav, Regulations on Ammonia and Livestock)⁷;
- particulates under the *Wet milieubeheer* (Environmental Protection Act) and *Omgevingsvergunning Beperkte Milieutoets* (OBM, All-in-One Permit for Physical Aspects limited environmental impact assessment)⁸.

This means data on the ammonia and particulate emissions of Dutch livestock holders are already available at farm level, or there is an existing system under which these can be registered.

At the EU level, ammonia and particulate emissions are registered nationally under the NEC directive (EU 2016/2284)⁹. This directive lays down national ceilings for a number of pollutants. This registration gives an indication of sectoral averages, which do not necessarily hold at the individual farm level.

For non-EU livestock holders, it has been assumed that these do not yet register all their emissions, or that existing ER systems do not map exactly onto the above provisions. Besides the costs of monitoring, non-EU livestock holders who opt in will therefore also incur development costs in order to hook up to the system.

⁵ In which all greenhouse gas emissions are rated according to their contribution to climate change compared with CO₂, enabling summation.

⁶ Annual reporting for farm operators, providing data for farm statistics and legislation on nutrients, or in connection with subsidies. [RVO: gecombineerde opgave](#)

⁷ [InfoMil: Regeling ammoniak en veehouderij \(Rav\): huisvestingssystemen](#)

⁸ [InfoMil : Landbouw Fijnstof](#)

⁹ [InfoMil: NEC-stoffen](#)



NO_x

For Dutch livestock farmers, a farm-level form of ER can be developed based on the so-called NEMA methodology. For nitrogen oxides (NO_x), national ceilings have also been set under the NEC directive (EU 2016/2284)¹⁰. These emissions are calculated using standard emission factors for the various manure management systems according to the cited methodology (Lagerwerf, et al., 2019). As yet, there is no NO_x registration at the individual farm level. As there are records of the manure management system used by every Dutch livestock holder, though, no additional information will be required to calculate a holding's NO_x emissions.

Under the NEC directive, EU countries monitor NO_x emissions at the national level. Once again, this only provides an indication of sectoral averages. Whether farm-specific NO_x emissions can be calculated depends on the availability of information on the manure management system used.

For non-EU livestock farmers, we again assume that they do not yet register all their emissions, or that existing ER systems do not map exactly onto the above provisions. Besides the monitoring costs, non-EU livestock farmers who opt in will therefore also incur development costs in order to align with the system.

CO_2 -eq.

Greenhouse gas (GHG) emissions are not currently measured at the individual farm level, so we propose developing a dedicated methodology. Under the national Climate Agreement, the pig-farming and dairy sectors have already stated their intention to develop carbon footprint monitoring systems (Rijksoverheid, 2019), and before 2021 the government is to assess whether such systems are suitable for monitoring and reporting at the farm level. These monitoring systems are being developed around a simple European methodology like the Product Environmental Footprint (PEF) (EC, 2019). It is as yet unclear whether the other meat sectors are working on developing a monitoring system.

Below, we indicate what a universal methodology for calculating livestock farming GHG emissions might be based on. On livestock holdings such emissions have three main sources:

- energy use (CO_2);
- manure management (CH_4 and N_2O);
- gut fermentation in ruminants (CH_4).

Emissions due to energy use (and production) can be calculated using farm-specific data. For the emissions from manure management and gut fermentation, there are models as well as emission factors in the NEMA methodology that factor in the parameters of livestock category, feed type, manure management system and so on. This means that even with the currently available data, a good estimate can already be made of farm-specific GHG emissions.

System for traceability of meat origin

Under the Netherlands' General Food Law (*Algemene Levensmiddelen Verordening*) the origin of all meat sold to consumers in the EU must be fully traceable. What this means is that every meat processing enterprise must be able, within 4 hours, to provide full information on their suppliers and customers, across all products (Vlees.NL, 2019). When it

¹⁰ [InfoMil: NEC-stoffen](#)

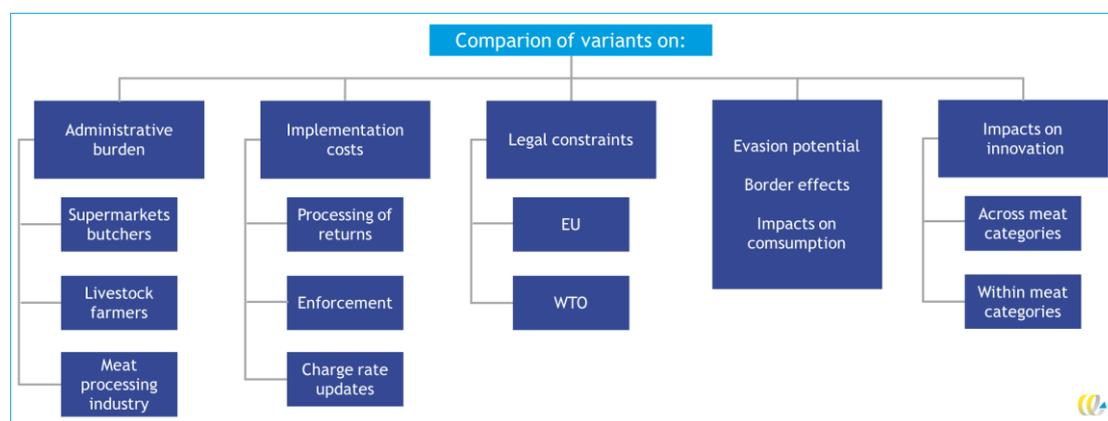


comes to meat origin traceability, then, existing systems can simply be used, with labelling information being used to ascertain the livestock farmer supplying the meat. One example of such a system is the GlobalGAP number (GGN). This code is printed on the label, allowing the meat's origin to be established via the GlobalGAP website (Vries, et al., 2016). A 2016 analysis by the Sustainable Food Alliance (AVV) and the Dutch ministry of Economic Affairs indicated, however, that it was not yet possible to trace the (farm) origin of all the meat. While this was feasible for some types of meat¹¹, particularly for products containing processed meat (from multiple farms) and even for certain single types of meat, it was still not always feasible to unambiguously determine the farm of origin. Initiatives are currently underway to resolve these issues at some point in the future.

2.3 Comparison of variants

In this section we compare the variants on a number of criteria (see Figure 3).

Figure 3 - Criteria for variant comparison



Note: Because the charge is levied on meat sold for consumption, import/export corrections are unnecessary.

We first discuss the administrative burden. For the various links in the chain, we report what the costs entail and provide an indication of their magnitude. We then consider government implementation costs, followed by legal constraints. We also consider evasion potential, possible border effects and impacts on meat consumption. Finally, we assess impacts on innovation in the meat sector.

¹¹ [Vlees traceren mogelijk via QR-code.](#)

Table 5 provides a synopsis of the results of the comparison of variants.

Table 5 - Comparison of variants: a synopsis

Criterion	Basic variant		Plus variant
	Option 1	Option 2	
Administrative burden	Reporting of consumer sales of meat by supermarkets/butchers. Reporting of meat weight in products by meat processing industry.	Reporting of sales from abattoirs + carcass imports, meat and meat products by abattoirs and meat processing industry.	+ On-farm emissions registration. Partial hook-up to and further development of current systems, partial tailored development. Meat origin traceability: hook-up to current system (no extra costs), still under development to satisfy EU legislation.
Government implementation costs	Processing of returns and compliance checks by Inland Revenue. Creation of monitoring system and update of charge rates based on adjusted emissions or improved understanding of emissions damage.	Ditto + checks on import and export corrections + financial transactions for export compensation for abattoirs and meat processing industry.	+ Registration checks.
Legal constraints	High		EU and WTO rules provide scope, but potential conflicts depend on precise design.
Evasion potential	Partly desirable (vegetable proteins), partly undesirable (other animal proteins).		
Border effects	Particularly for butchers		
Impacts on meat consumption	Similar		
Impacts on meat sector innovation	Incentive for switch to products with less meat or meat with less environmental impact.*		+ Incentive for livestock farmers to reduce footprint of production methods.

* The sustainability charge rate decreases from beef to pork to chicken, in line with their respective environmental impacts, giving production of chicken meat a cost edge over pork and beef, for example.

2.3.1 Administrative costs at farm/enterprise level

The distribution of administrative costs across livestock farmers, abattoirs, meat processors, supermarkets and butchers/poultry sellers depends on the charge design: Basic variant 1 or 2, or Plus. In the Basic variant, the administrative costs are paid mainly by the party paying the charge; see Table 6. The nature of these costs is explained below.



Table 6 - Party paying the meat sustainability charge

	Option 1: Supermarkets and butchers as charge point	Option 2: Abattoirs and meat processing industry as charge point
Supermarkets	6,000	
Butchers & poultry sellers	2,420	
Abattoirs		365
Meat & meat product wholesalers		315
Meat processors		1,115
Total	8,420	1,795

Source: CBS (values for 2017).

Livestock farmers

In the Basic variant there are no administrative costs for livestock farmers. In the Plus variant there are, however, although the additionality is anticipated to be limited, because for the four pollutants in question use can be made of existing registration and monitoring systems.

Abattoirs

In Option 2 of the Basic variant, abattoirs are the charge point, paying the government a charge for each carcass sold to Dutch customers (exports are exempt from the charge). To enable this, there will need to be investments in IT systems for returns, as well as in a system for recording the weight of meat sold and the proportion going to Dutch customers. A further analysis of the extent of import/export corrections is provided in Textbox 5.

Textbox 5 - Administrative costs and import/export corrections with abattoir/importer as charge point

One option is to collect the sustainability charge from abattoirs/importers. The charge then becomes a 'slaughter tax'. In this form of the Basic variant, fewer charge-paying parties are burdened with filling out forms. This is offset by the need for import/export corrections, though, which are needed because consumers buy meat and meat products deriving from carcasses supplied by both Dutch and foreign abattoirs. Conversely, some of the animals slaughtered in the Netherlands are exported. Without import/export corrections, meat from animals slaughtered abroad would not be charged on sale in the Netherlands, while meat exports would be. We therefore propose that imports be taxed, but exports exempted.

The value of these import/export corrections would make up a considerable fraction of the value of domestic production. Imports and exports relative to Dutch domestic production are as follows:

Table 7 - Imports and exports as a percentage of Dutch domestic production

	Production	Import	Export
Abattoirs	100%		102%
Meat processing	100%	40%	70-80%

For export corrections, this means that abattoirs, wholesalers and meat processors would need to record the proportion of their output exported, i.e. sold to foreign buyers. For import corrections, it would mean them having to record the fraction of their procurement for their meat (products) bought abroad, so the appropriate charge can be paid to the government. This is a complex administrative challenge.



Meat processors and meat (product) wholesalers

In Option 1 of the Basic variant, with supermarkets/butchers/poultry sellers serving as charge point, meat processors will be subject to only a modestly higher administrative burden: they will have to report to the supermarkets/butchers/poultry sellers the amount of meat in their products. We assume the enterprises in question already have this data available. For a start, they are obliged to register the ingredients and report them on labels. We would presume, furthermore, that for budgetary reasons meat processors will keep tabs of the amount of meat in their products. In some cases this information is indeed reported on the label for marketing purposes.

In Option 2 of the Basic variant, with abattoirs/importers serving as charge point, meat processors will have to pay a charge on imported meat, i.e. they are the ones paying the charge. At the same time, meat processors will receive a rebate on the charge paid on exported meat and meat processed in exported products. To enable this, there will need to be investments in IT systems for returns, as well as in a system for recording the amount of meat they sell and the proportion going to foreign customers. A further analysis of the extent of import/export corrections is provided in Textbox 5.

To a certain degree, the systems can be designed centrally: meat processing firms will not need to develop a separate system for each of their branches.

The administrative costs for meat processors are the same in the Basic and Plus variants.

Supermarkets and butchers/poultry sellers

In Option 1 of the Basic variant, it is the supermarkets/butchers/poultry sellers that are liable to the charge and therefore pay it to the government. To enable this will again require investments in IT systems for returns, as well as in a system to record the amount of meat sold and the types of meat (products) concerned.¹² In the Plus variant, we propose that they also – in line with obligations under the European General Food Law Regulation – calculate the charge rate for products with mixed meat based on the emissions of the livestock holders. These rates they can establish based on track-and-trace data on the emissions of the farmers supplying the meat, and can be periodically adjusted.

To a certain degree, the systems can be designed centrally: supermarket chains will not need to develop a separate system for each of their outlets. On the other hand, the assortment of meat (products) may differ from outlet to outlet, particularly if franchises are involved. Individual supermarket outlets will therefore need to keep a record of the types of meat (products) sold and what charge rates thus apply.

2.3.2 Government implementation costs

The government will incur implementation costs on four aspects:

1. Processing of returns

First of all, the government will have to process the returns from supermarkets and butchers/poultry sellers. This can be largely automated, but will mean developing an appropriate IT system.

¹² This kind of administrative burden is comparable with that of a sales tax. Unfortunately there are no data available on the administrative costs associated with this tax (a review study, for example), so that no quantitative estimate can be given.



2. Enforcement and checks

Enforcement and checks will also be necessary:

- in the Basic variant, it will mean checking returns from supermarkets and butchers (Option 1) or abattoirs and the meat processing industry (Option 2);
- in the Plus variant, livestock farmers' emissions registration will also need checking.

These can be spot checks by the Inland Revenue, similar to those currently carried out for excise duty and sales tax. One complicating factor is that in the Plus variant, checks on livestock farms will require tax inspectors to be acquainted with the emissions registration system, for which they will need training. Enforcement could be carried out in collaboration with the Food and Consumer Product Safety Authority.

3. Creation of monitoring system and updating of charge rates

Finally, a monitoring system will have to be set up and the charge rates of the meat sustainability charge, and its constituent elements periodically updated to account for improved understanding of emissions and impacts. The implementation costs will be lower for the Basic variant than for the Plus variant.

4. Import/export corrections

In the Basic variant, with abattoirs/importers as charge point, there will need to be import and export corrections. This means the government will have to give abattoirs and meat processors a rebate on all meat exported, over which they will have paid the sustainability charge.

2.3.3 Legal constraints

The issue of legal constraints is concerned with potential conflicts with EU legislation on taxation and the internal market, and with WTO rules on international trade.

On this criterion the Basic variant scores high. There are no conflicts with tax rules, since EU member states have jurisdiction over their own taxes. Although some taxes like VAT and energy taxes are subject to certain regulations, member states are always at liberty to introduce a new tax on a basis not covered by EU regulations.

Neither is there any conflict with EU or WTO rules, as all meat would be taxed the same (based on its environmental footprint), regardless of its origin. The same holds for the administrative costs for meat sector enterprises, which stand on equal footing regardless of the country they are based in.

In the Plus variant, there may be conflicts with EU or WTO rules, however, because in this variant the charge rate is based (in part) on the livestock holder's true external costs, for calculation of which four categories of emission need to be recorded. Foreign livestock farmers can opt in to the emissions registration system; if they choose not to do so, they will be charged at a standard rate.

Under both EU and WTO rules, national governments may in principle base a tax on environmental criteria (CE Delft, 2017), but the tax must then be designed such that it does not conflict with other rules or premises of relevant legal frameworks. Whether or not this is the case will depend on the precise design of the sustainability charge. Issues meriting due attention to minimize the risk of conflict include:

- lower charge rates (via the opt-in system) must be available for foreign livestock farmers (EU);
- foreign products may not be adversely affected by the benchmark used (WTO/GATT);



- the emissions registration system must be sufficiently fine-meshed to identify real-world differences in external costs, also for foreign livestock holders (WTO/GATT);
- the emissions registration system must not lead to disproportionately high administrative costs for foreign livestock farmers; due allowance must also be made for the special status of developing nations (WTO/TBT).

For a more detailed discussion of legal constraints, see Appendix B.

2.3.4 Potential for charge evasion

In both variants, there is potential for evading the charge by switching to production of other foodstuffs. Such evasion is partly desirable, partly not.

Evasion is desirable if there is a switch to production of foodstuffs with a similar nutritional value to meat, but a smaller environmental footprint in production. A case in point is replacement of animal proteins by vegetable proteins, which have a smaller footprint than (food based on) animal proteins.

Evasion is undesirable if there is a switch to production of substitutes for beef, pork or chicken that are still animal proteins, with a relatively large environmental footprint, but which are not subject to the sustainability charge, such as lamb or goat meat, or cheese. In this study, the sustainability charge is based on the aforementioned three types of meat. Consideration might be given to extending the system to other categories as well as dairy in order to cut off this evasion route. The administrative costs would then be somewhat higher, with horse breeders, sheep/goat farmers and dairy producers also becoming subject to the charge. In both variants, dairy farmers are already included in the charge, which means the number of additional holdings (horse breeders and sheep/goat farmers) required to register their emissions would total around 3,500¹³.

The potential for evasion does not differ between the two variants.

2.3.5 Border effects

For supermarkets and butchers located near borders we anticipate a limited decline in sales owing to consumers switching to foreign sales points. In the case of supermarkets, we anticipate this effect being very minor. Around 20% of consumer food expenditure is on meat, so over 80% of the items in the supermarket trolley will be unaffected by the sustainability charge. For butchers/poultry sellers it will be different, though, as the lion's share of their turnover will be impacted by the charge.

2.3.6 Impacts on consumption

Impacts on consumption will be similar in both variants, with approximately the same sustainability charge being passed on to consumers in both cases. The higher price of meat will lead to a reduction in its consumption, to the extent quantified in Chapter 3.

2.3.7 Impacts on innovation in the meat production chain

Impacts on innovation in the meat production chain differ in the two variants. The Basic variant creates an incentive for meat producers and processors with a large environmental footprint to switch to meat with a smaller footprint. More specifically, cost considerations

¹³ If fish were also included in the scope of the sustainability charge, this would mean including a little under 1,000 fishery enterprises, too.



will motivate a switch from beef to pork to chicken. The Plus variant will provide an additional incentive to innovate within the same type of meat towards livestock housing systems with less environmental impact. Textbox 6 reviews the overall scope for innovation.

Textbox 6 - Potential sustainability innovations in livestock farming

- **More outdoor grazing, e.g. >1,500 or 2,500 hr/a (rather than the minimum standard of 120 x 6 = 720 hr/a):** lower ammonia, methane, CO₂ and NO_x emissions - good for biodiversity and natural behaviour.
- **Wildflower-rich grassland with high species diversity:** good for surface and subsurface biodiversity; more soil organic matter (CO₂ capture), increasing water permeability and storage.
- **Lower-footprint livestock housing systems with lower ammonia emissions.**
- **Gas-tight slurry provisions:** lower methane emissions and gas capture in sealed space for useful application.
- **Slurry aeration systems:** lower methane and hydrogen sulphide emissions.
- **Manure capture robots:** lower ammonia and other emissions and less antibiotics use because of reduced hoof and udder problems.
- **Feed mixing systems:** improved rationing efficiency, so lower environmental footprint in feed production.
- **Sealed silage storage and other particle emission reduction measures:** lower particulate emissions.
- **Separate capture of manure and urine:** avoids substantial methane and ammonia emissions.
- **Maximum utilization of waste streams as feed:** lower environmental footprint in feed production.
- **Manure dilution with water before application on grassland:** lower ammonia, methane, CO₂ and NO_x emissions; good for biodiversity and natural behaviour.
- **Sewerage systems in pig and dairy sheds, removing manure on (almost) daily basis, then separation and gas-tight collection:** lower ammonia, methane, CO₂ and NO_x emissions; good for biodiversity (thick fraction).

Sources: Milieulijst 2019 and expert judgement.

2.4 Potential follow-up towards ECC ‘ideal picture’

In the previous sections, we described the design and implications of two variants of the first phase of meat sustainability charge based on the concept of External Cost Compensation (ECC). In the introduction to this chapter, we sketched the ‘ideal picture’ of how such an ECC might look in the future. In that ideal set-up, the ECC creates a price incentive not only for consumers but for producers, too, encouraging them to make their livestock practices more sustainable. Ideally, the ECC should be based on the social and environmental footprint of each and every production link and be implemented across the entire economy. This would give both producers and consumers optimum price incentives to avoid externalities, i.e. impacts.

In this section, we sketch a few options for follow-up steps that can be taken additionally to the two variants elaborated, and consider some of the implications.

2.4.1 Broadening the charge to other animal proteins

In this study, the sustainability charge is limited to three types of meat: beef, pork and chicken, but the charge base could be extended to other sources of animal protein like goat meat, lamb, horsemeat, cheese, milk and fish, with the benefit that these sources of animal protein would then likewise be sold at their ‘true price’.

With the Basic variant as starting point, this would lead to scarcely any increase in administrative costs. A track-and-trace system for product origin would need to be set up,



though. There are currently no such systems for dairy or fish, but these could be designed analogously to those for meat.

With the Plus variant as starting point, there would be a limited increase in administrative costs. Apart from the reporting obligations under the Basic variant, horse breeders, sheep/goat farmers, other livestock breeders/holders and fisheries would also need to report their emissions, which would mean setting up appropriate systems. The number of parties obliged to register are shown in Table 8.

Table 8 - Increase in number of Dutch parties obliged to register if charge base is extended to other meat, fish and dairy

Type of livestock holder, etc.	Number
Total, Basic variant	29,865
Horse breeders	1,410
Sheep & goat farmers	2,065
Other livestock breeders and holders	980
Fisheries	960
Total with expanded charge base	35,280
Increase	5,415 (18% more than Basic variant)

Source: CBS (2017 data).

When it comes to implementation costs, expanding the system to include these sources of animal proteins again requires the ‘true price’ of meat/fish to be determined.

2.4.2 Extension to restaurants, snack bars and other caterers

If the charge point is supermarkets/butchers, another step towards the ‘ideal picture’ is to extend the parties paying the charge to other meat sales points like restaurants, cafés, snack bars and other caterers. Around 85% of meat (products) are sold to consumers in supermarkets, butchers and poultry outlets, with the remaining 15% sold in restaurants, cafés, snack bars and by catering firms at events or in company canteens (RIVM, 2018).

To include this last 15% of meat sales in the charge, these outlets could be made subject to the same obligation. The number of extra parties paying the charge is shown in Table 9.

Table 9 - Increase in number of Dutch parties paying the charge if charge base is extended to restaurants, cafés and other caterers

Type of establishment	Number
Total, Basic variant	8,420
Restaurants	14,920
Snack bars	14,625
Other caterers	9,785
Total with expanded charge base	47,750

Source: CBS (2017 data).

For restaurants, snack bars and other caterers it will by no means be straightforward to determine the weight of meat in each of the products sold, as it is not only, or even mainly, standard products from the meat processing industry that are sold, where the meat content is known. There are several options for keeping the administrative costs within reasonable



bounds. The charge rate could, for example, be based on a representative menu for which the associated emissions are periodically assessed to arrive at the ‘true price’ of the menu. Another option would be to base the total sustainability charge on meat procurement figures, leaving it up to the catering outlet whether and how they pass on costs to customers.

2.4.3 Improving price incentive visibility via charge point at livestock farms

A drawback of the two basic variants described in Section 2.2 is that the charge point is at consumer outlets rather than where the emissions take place: livestock holdings. The price rise associated with the environmental footprint only becomes visible in consumer sales, which means that information then has to be passed back up the supply chain for it to be able to lead to improved, ‘greener’ meat procurement patterns. There is consequently only an indirect incentive for livestock farmers to operate more sustainably.

Taking livestock farmers as the charge point would have the advantage of them being directly and individually confronted with the costs of their emissions, giving them a far more direct incentive to produce more sustainably. For the procurers of the meat, too, there would be a more direct incentive to buy meat from farmers producing sustainably.

One disadvantage of this system, though, is that all the meat from Dutch farmers would be subject to the charge, including that being exported. On the other hand, none of the meat imported would be charged. This holds not only for live animals and carcasses, but also for meat products and products in which meat is processed. For these products, import and export corrections would have to be applied. In Appendix H, we give an idea of the magnitude of such corrections relative to domestic trade flows. The conclusion is that import/export corrections, as a percentage of domestic trade, may be very substantial.

2.4.4 Including multiple supply chain links in the sustainability charge

One key link of the supply chain to include in the differentiated charge rate of the Plus variant is animal feed production, which accounts for 54-69% of the external costs associated with meat production. To a major extent this damage occurs abroad, where much of the (concentrated) feed is produced. This differs from sector to sector, though, with external costs varying substantially depending on the type of feed. Utilizing waste streams as feed has a considerably smaller footprint and may also provide a solution to waste problems. Given the large contribution of feed to external costs, this provides major scope for livestock farmers to take action on this point. If feed is included in the sustainability charge at the farm level, it will create a strong incentive for greening the sector.

To determine the emissions of our four pollutants would require monitoring and registration during feed production, which is not currently feasible. For CO₂-eq. there is a Dutch database (FeedPrint (WUR, in progress)) that reports the emissions associated with many types of animal feed, including those sourced abroad. This means it can be used, up to a point, for foreign livestock farmers. When it comes to particulates, ammonia, NO_x and (possibly) land use it not yet clear whether detailed figures are available, though.

There are (approximate) averages available for various types of feed in other existing databases such as Agri-footprint (2019), which also hold for foreign livestock farmers. More detailed monitoring of the emissions associated with production and procurement of feed at the farm level requires a monitoring system and extension of these databases.



2.4.5 Charge differentiation based on additional sustainability impacts

The four emissions, according to which the charge rate is differentiated in the Plus variant, are the principal drivers of external costs. A fifth negative aspect of meat production is the land use devoted to feed production and animal grazing, which also generates considerable external costs. It therefore constitutes the next item that merits inclusion in the reporting according to which the charge rate is differentiated.

Feed production and grassland for grazing are the main drivers of land use in the livestock sector. For non-grazers (i.e. poultry and pigs) it is mainly feed production that contributes to land use. To determine land-use impacts, it is therefore necessary to include both land use on the farm itself and that associated with feed production. Such data may already be available in databases like Agri-footprint and Feedprint; alternatively, it could be further developed in these databases.

A further option is to also include animal welfare, stench nuisance and health damage due to meat consumption in the system on which the sustainability charge is based. These aspects have not been taken on board in the present study; elaboration would require further investigation.

2.4.6 Including additional emissions in the system

The emissions according to which the charge is differentiated in the Plus variant have in part been identified based on considerations on existing registration and monitoring systems. In principle, it would be an improvement to include more emissions in the system and there is a development underway that might make this feasible in the future.

A major advance when it comes to establishing and registering emissions at the farm or enterprise level is the Product Environmental Footprint (PEF), which since 2013 has been under development under the auspices of the European Commission as part of the 'Single Market for Green Products Initiative' (EC, 2019). In the PEF method, for each individual product group specific methodological rules are defined for calculating relevant environmental impacts: the PEF Category Rules, or PEFCR. A consistent methodology guarantees a level playing field and, with time, it is expected that emissions registration according to the PEFCR will be incorporated into EU policy.

Among other things, the PEF and PEFCR include requirements concerning (primary) data, system boundaries and allocation rules¹⁴. Approved databases, methodologies and standard emission factors are also listed. These lists can be used to establish how feed from foreign producers or land use for food production are to be calculated, for example. Under the PEF rules, it is recommended to hook up to the National Emissions Registration. Satisfying the PEFCR is therefore in line with current trends and emissions registration at both the national and European level.

Development of PEFCR is currently in a transitional phase. In the pilot phase of the PEF, 19 PEFCR were developed. For meat products, PEFCR are currently lacking. The list with additional, yet to be developed PEFCR will be announced in October 2019.

¹⁴ For dairy farmers there is a rule for allocating emissions across milk and meat production, based on the weight ratio of milk and meat output on the farm, including a correction factor. This allocation rule had already been developed by the International Dairy Federation (IDF) and has now been incorporated in the PEFCR for milk and dairy products.



3 Impact analysis

This chapter reviews the impacts of the meat sustainability charge. We begin by discussing the impacts on emissions and welfare. Next we consider the impacts on meat consumption, government revenue and consumer purchasing power. We also look briefly at the impacts of a variant in which the charge is rolled out at the European level.

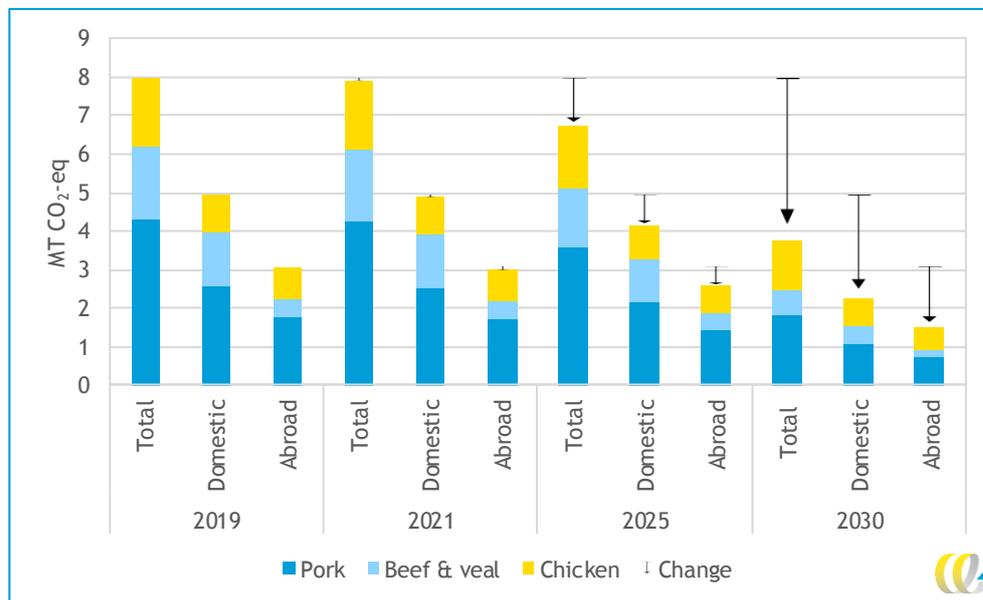
Appendix A provides a more detailed discussion of our assumptions regarding current meat consumption, valuation of externalities and price elasticities.

For all the impacts, it holds that these should be seen in the light of uncertainties with respect to the elasticities used, emission factors and modelling of interventions in livestock farming and environmental prices. The results are merely estimates of the magnitude of the anticipated impacts.

3.1 Impact on emissions

Reduced meat consumption in the Netherlands leads to reductions in CO₂-eq. emissions both at home and abroad. By 2030 the total reduction amounts to 4.2 Mt CO₂-eq./a, of which 2.7 Mt in the Netherlands and 1.6 abroad¹⁵. See Figure 4.

Figure 4 - Impact of sustainability charge on CO₂ emissions due to reduced meat consumption (gross*)



Source: Calculations by CE Delft based on FAOSTAT (2019) and CE Delft (2012); (2017); (2018a); (2019).

Notes: Impacts on consumption are independent of the variant adopted. Assuming all livestock farming is in the Netherlands.

* Impacts not corrected for increased CO₂ emissions due to greater consumption of meat substitutes. We estimate this will offset 15-25% of the welfare gains (see Appendix J).

¹⁵ On the assumption that the livestock farms are in the Netherlands.



Table 10 - Impact of sustainability charge on CO₂-eq.-emissions and land use (domestic and abroad) (gross*)

	2021	2025	2030
Change in CO ₂ -eq. emissions (Mt)	-0.1	-1.2	-4.2
of which in the Netherlands (Mt)	-0.1	-0.8	-2.7
Change in land use (ha)	-8,000	-117,000	-393,000

Note: Assuming all livestock farming is in the Netherlands.

* Impacts not corrected for increased CO₂ emissions due to greater consumption of meat substitutes. We estimate this will offset 15-25% of the welfare gains (see Appendix J).

3.1.1 Welfare impacts

Meat production contributes to climate change through greenhouse gas emissions and has impacts on human health, ecosystems and buildings/materials. As a result of land use, pesticides and manure, there are impacts on biodiversity. When livestock holdings are concentrated, meat farming can generate social costs through the outbreak and spread of animal diseases and zoonoses (animal diseases that can be transmitted to humans).

At the same time, many people find the sight of grazing cattle an attractive landscape feature, which may translate to higher house prices and thus external benefits. Other kinds of green landscape may possibly be valued either higher or lower. It is also possible that reduced meat consumption and therefore production does not lead directly to fewer cows out in the fields, and thus to a loss of this kind of landscape. It is these kinds of issues that determine the potential external benefits. For a conservative estimate they have been included in the analysis.

The sustainability charge will mean less meat is consumed in the Netherlands and therefore a reduction in both external costs and any external benefits. By reducing climate impacts and environmental damage, reduced meat consumption will mean an increase in welfare, on the one hand, but also a loss, as consumers spend more on meat and consume less of it¹⁶. On balance, the impact on welfare will be positive; see Table 11.

Table 11 - Welfare impacts of sustainability charge

	2021	2025	2030
Welfare impacts (€ mln), of which:	14.5	218	791
Climate	8	137	555
Environment	20	286	982
Animal diseases	1.5	18	61
External benefits	-0.5	-5	-16
Consumer and producer surplus*	-14	-218	-791

Source: CE Delft calculations based on FAOSTAT (2012) and CE Delft (2012); (2017); (2018a); (2019).

Note: Impacts not corrected for increased CO₂ emissions due to greater consumption of meat substitutes.

We estimate this will offset 15-25% of the welfare gains (see Appendix J).

* Consumer and producer surplus: reduced welfare due to consumers spending more on meat and cutting its consumption.

¹⁶ In economic terms: the consumer and producer surplus both decline. If a consumer is willing to pay more for a product than its current market price, they *profit* by consuming it, as they are paying less than the value they ascribe to its use. Economists refer to this as the consumer surplus. If the market price goes up as a result of a sustainability charge, the consumer surplus declines. Analogous reasoning holds for the producer surplus.



3.1.2 European variant

Below we present a rough, exploratory analysis of the impacts of introducing a meat sustainability charge on a pan-European scale. To that end, we first establish the charge level at that scale, then consider the impacts on welfare and government revenue.

Level of the European sustainability charge

To establish the required level of a sustainability charge on a pan-European scale, we value the emissions using exclusively European environmental prices, in line with the methodology set out in our study 'De echte prijs van vlees' (The true price of meat) (CE Delft, 2018a). The European environmental prices are lower than their Dutch equivalents, mainly because the Netherlands is more densely populated than most other regions of Europe. This means the European sustainability charge works out slightly lower than the Dutch one.

Table 12 shows the level of the European charge for the various types of meat. As in the Dutch variant, the charge is highest on beef and lowest on chicken. Once again, the charge level increases over time with a view to securing the two degrees climate target.

Table 12 - European sustainability charge for different types of meat (€/kg meat weight) - phased increase

	2021	2025	2030
Beef/veal	€ 0.42	€ 2.22	€ 4.77
Pork	€ 0.32	€ 1.69	€ 3.61
Chicken	€ 0.15	€ 0.80	€ 1.73

Source: CE Delft calculations based on the Environmental Prices Handbook, EU28 version (CE Delft, 2019); methodology according to (CE Delft, 2018a).

Note: The environmental costs of CO₂ are based on the specific environmental price for the reference year. The charge rate gradually increases from 10% of the external costs in 2021 to full coverage in 2030.

Main European impacts

Table 13 summarizes the main impacts of a pan-European meat sustainability charge. In 2030, the reduction in CO₂-eq. emissions is up to 119.6 Mt/a. In 2030, the net welfare impacts amount to € 8.8 billion (benefits) and government revenues to € 32.2 billion.

Table 13 - Impacts of a European meat sustainability charge

	2021	2025	2030
Reduction in CO ₂ -eq. emissions (Mt)	2.4	34.5	119.6
Welfare impacts (€ bln), of which:	0.3	2.5	8.8
Climate	0.2	1.9	7.9
Environment	0.4	2.8	8.9
Animal diseases	0.0	0.3	0.9
External benefits	0.0	-0.1	-0.2
Consumer and producer surplus	-0.3	-2.5	-8.8
Government revenues (€ bln)	6.1	27.3	32.2

Source: CE Delft calculations based on FAOSTAT (2012) and CE Delft (2012); (2018a); (2019).

Note: Impacts not corrected for increased CO₂ emissions due to greater consumption of meat substitutes. We estimate this will offset 15-25% of the welfare gains (see Appendix J).

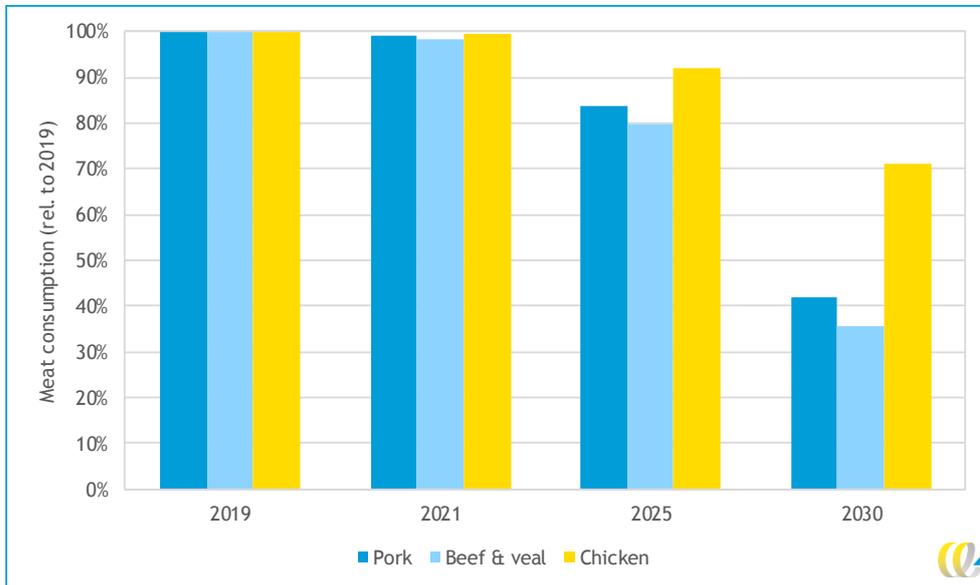


3.2 Impact on meat consumption

We return to a sustainability charge introduced solely in the Netherlands. As discussed In Section 2.2, the charge level rises by 10% annually until equalling the calculated total external costs per kilogram meat in 2030. The higher the meat price, the more consumption will decline.

Figure 5 shows the charge’s projected impact on Dutch meat consumption. As can be seen, reduced meat consumption already starts to be visible in 2021, eventually falling (in terms of total meat weight) from 45.3 kg per capita in 2019 to 23.1 kg in 2030 (of which 9.3 kg pork, 2.5 kg beef/veal and 11.3 kg chicken). The price elasticity data used are reported in Appendix A.4.

Figure 5 - Impact on Dutch meat consumption of meat sustainability charge (both variants) expressed as meat weight relative to 2019



Source: CE Delft calculations based on FAOSTAT (2012) and CE Delft (2012); (2017); (2018a); (2019). For price elasticities see Appendix A.4.

3.3 Impacts on government revenue and purchasing power

The direct aim and impact of the meat sustainability charge is to reduce the footprint of meat consumption. Because the charge is collected by the government, the residual meat consumption means tax revenue for the Treasury. As Table 14 shows, in 2021 this revenue amounts to € 265 million. Because of the phased increase in charge rate (see Section 2.2) the sustainability charge rises relatively faster than consumption falls, which means tax revenues increase over time.

Table 14 - Government revenue from the sustainability charge

Year	Government revenue (€ mln)
2021	265
2025	1,176
2030	1,356

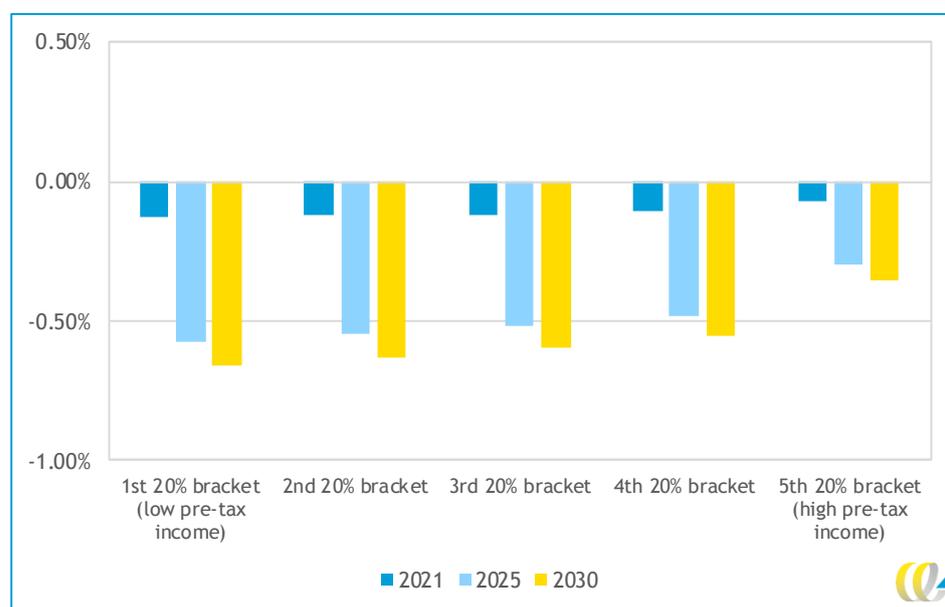
Source: CE Delft calculations based on FAOSTAT (2012) and CE Delft (2012); (2017); (2018a); (2019).



Household spending on meat products varies with income. Below, we show the purchasing power impacts (impacts on disposable income) of introducing a meat sustainability charge for households in different income brackets. This does not yet factor in any recycling of government revenues to households by way of compensation. In calculating disposable income, neither was any allowance made for reduced spending on meat and possible increased spending on other products (rebound effects).

As can be seen, in 2021 purchasing power is down by between 0.05 and 0.15%, depending on income bracket. The loss of purchasing power rises to between 0.4 and 0.7% in 2030. Note that the percentage is lower for those with higher incomes.

Figure 6 - Percentage loss of disposable income due to introduction of a meat sustainability charge (as yet, without compensation)



Source: CE Delft calculations based on FAOSTAT (2012), CE Delft (2012); (2017); (2018a); (2019) and CBS.

Note: These calculations assume the sustainability charge is passed on to consumers and factor in the incrementally rising charge rate and declining meat consumption. Reduced expenditure on meat and any additional expenditure on meat substitutes are not included.



4 Recycling of revenues

This chapter analyses two possible uses for the revenues of the meat sustainability charge:

1. Compensation of purchasing power impacts.
2. Incentives for more sustainable agriculture and livestock farming.

In the first case, the revenues are used to compensate the loss of purchasing power of certain groups. This may possibly include the sector itself, for they will be confronted with a cost increase that may lead to a decline in their profit margins (if the costs are not passed on one-to-one) and in sales (if demand falls when costs are passed on). Households, too, could be compensated, as the higher cost of meat consumption will mean decreased purchasing power.

In the second case, the revenues could be used to further incentivize sustainability measures (by influencing behaviour). Various groups could be targeted. If the revenues are used to encourage further greening of the livestock/meat sector itself, this would entail supporting the sector in reducing the adverse impacts to which the sustainability charge is geared, which would in turn imply the charge having less impact on the costs incurred by the sector.

Under the terms of this study, we were asked to elaborate the following options for recycling government revenues:

- Subsidy for further reducing the farming footprint¹⁷:
 - incentives for climate measures;
 - government buyout of livestock rights.
- Purchasing power compensation for households:
 - increasing the health care allowance;
 - lowering the 9% VAT rate;
 - specific compensation for low-income households.

Based on the potential of sectoral climate measures, we selected an appropriate package and analysed their impact. How the charge revenues would be recycled (in 2030) is summarized in Table 15:

Table 15 - Allocation of revenues for sectoral greening and household purchasing power compensation

Revenue use	Sum (€ mln)
Climate measures, sector	135
Financial incentives for herd reduction, sector	150
Purchasing power compensation, households	1,071
Total	1,356

¹⁷ For a number of other options suggested by the TAPP Coalition but not pursued in this study, see Appendix I.



4.1 Subsidy for reducing farming footprint

4.1.1 Climate measures

Part of the charge revenues can be used to fund greenhouse gas reduction measures in agriculture and livestock farming. Below, we elaborate a variant encompassing a number of measures set out in the framework of the Dutch Climate Agreement. We also indicate that there are other options for encouraging such a shift, as well as other measures that can be incentivized - for example, measures more in line with systemic change to move the farming sector as a whole towards greater sustainability, with the various aspects targeted reinforcing one another. In this connection, the reader is also referred to the scope for dovetailing with the Common Agricultural Policy (CAP) (see Section 4.1.3). The systems perspective is examined by assessing the extent to which each of the climate measures analysed also incentivizes other sustainability aspects (see below under the heading 'Side-effects of climate measures').

A subsidy to encourage climate measures could, for example, be designed as a subsidy covering the 'unprofitable component' of the measure concerned, to achieve cost neutrality for the sector (or regular profit margins).

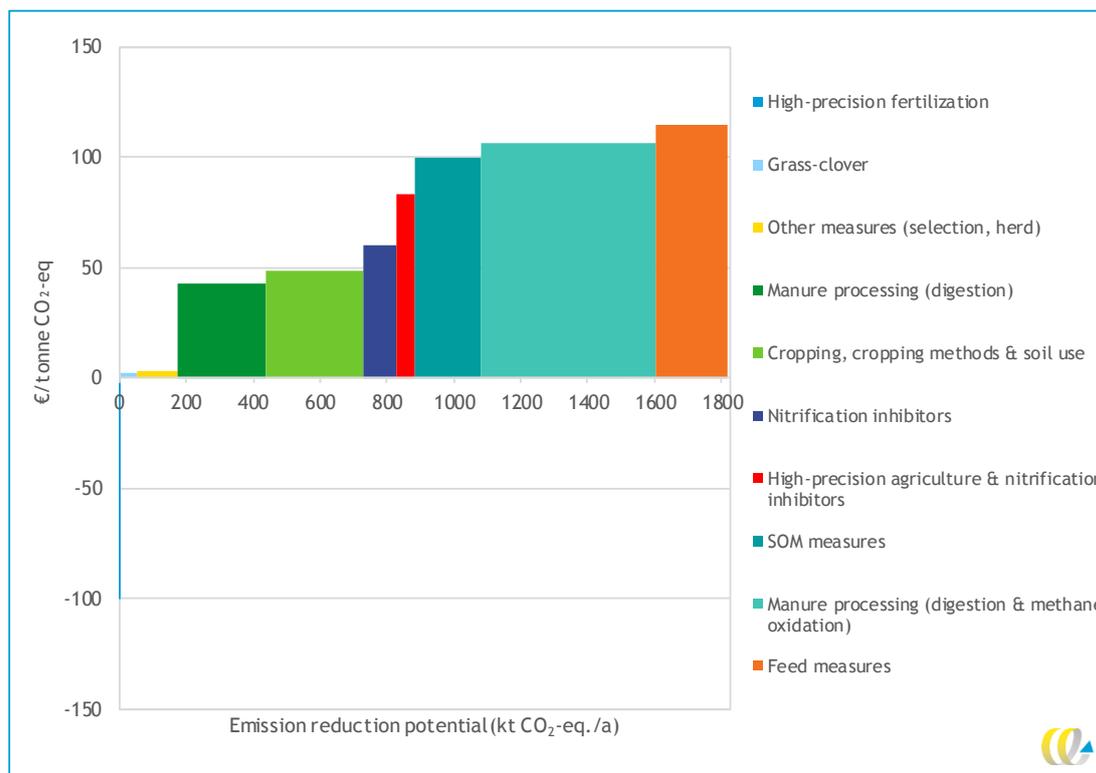
When proposals were being put forward for the 'main pillars' of the Climate Agreement, numerous measures for the farming sector were long-listed, leading later to the proposal set out in the definitive Agreement. For these measures, a CO₂-eq. emissions reduction of approx. 1.5 Mt was noted in the Climate Agreement (upper bound of range¹⁸).

Below, we estimate the extra CO₂-eq. reduction that could be achieved with an additional subsidy rising to € 135 mln annually in 2030 and geared specifically to some of these measures. In drawing up the package, we allowed for the still available reduction potential. As can be seen in Figure 7, around 1.8 Mt additional cuts are feasible compared with the measures identified in the Climate Agreement. This reduction overlaps partly with the reduction achieved through reduced meat consumption, and so cannot be entirely summed.

We also discuss the side-effects these measures would have on other environmental impacts.

¹⁸ Source: pers. comm. PBL.

Figure 7 - Package of additional climate measures in the agricultural sector (costs and CO₂-eq. reduction)



Source: CE Delft calculations based on (PBL, 2018).

Side-effects of climate measures

In the matrix below, we indicate the anticipated side-effects of the measures in Figure 7 on other environmental impact categories (see Table 16). For background on these estimates, see Appendix C. With respect to the qualitative valuation appraisal given in this matrix, a ‘+’ means positive (light green/green) and a ‘-’ negative (light orange/orange). Positive appraisals mean lower emissions, manure surpluses and costs and higher biodiversity.

Many of the measures are geared towards improving the efficiency of farm operations to reduce greenhouse gas emissions. As the measures are geared (very) specifically to greenhouse gas formation and emission, in many cases this improved efficiency will not lead to lower emissions of ammonia, nitrates, phosphates or particulate matter, nor to a reduction of stench. In other words, these measures do not lead to overall more efficient, more sustainable farm operations. It is anticipated, though, that many of the climate measures will affect biodiversity, as more intensive and/or more efficient farm operation means increased pressure on land use and consequently on biodiversity.

In dairy farming, positive side-effects are to be expected from cropping measures and increased planting of clover (and other leguminous plants) in grassland, and in arable farming and horticulture from increasing soil organic matter (SOM) content. Grass-clover and increased SOM are both beneficial to soil life (i.e. biodiversity), while at the same time increasing the soil’s capacity to retain and supply water. Both measures contribute to a more natural form of farming geared to the earth’s natural cycles.

Increased SOM also allows considerably more CO₂ to be fixed in the soil.



Table 16 - Selected side-effects of climate measures on other environmental themes

	Ammonia emissions	Nitrate emissions	Phosphate emissions	Manure surplus	Biodiversity	Stench nuisance	Particulate emissions	Naturalness*
Dairy farms								
Cropping, cropping methods & soil use	0	0	0	0/+	-/+	0	0	0/+
Feed supplements	0	0	0	0	0	-/0	0	-
Manure processing (digestion/CH ₄ oxidation)	-/+	0	0	0	-/0	0/+	0	-/0
Nitrification inhibitors	0	0	0	0	-/0	0	0	-
Grass-clover	0	-/0	0	0	+	0	0	+
Longer lifespan, fewer calves	0/+	0	0	0	-/0	0	0	-
Pig farms								
Manure processing (digestion)	0	0	0	0	0	0	0	0
Arable and horticulture								
High-precision farming & nitrification inhibitors	0	0/+	0/+	0	-/0	0	0	-/0
Improving SOM-content**	0	0/+	0	0	+	0	0	+

Note: Appraisal of side-effects based on expert judgement.

* 'Naturalness' refers to an 'authentic' and 'natural' mode of production; for dairy farming this also includes aspects of animal health and animal welfare.

** This measure can also be applied in dairy farming; its impact on greenhouse gas emissions falls under LULUC (Land Use and Land Use Changes) and may not therefore be counted as a reduction under the Paris Agreement.

Animal health and welfare are elements of what we have termed 'naturalness'. These are relevant only for climate measures on dairy farms. Manure digestion on pig farms and measures in arable farming and horticulture have no impact on animal health or welfare. Adding synthetic chemicals to the system (to feed or manure, for example) involves a serious risk of adverse impacts on animal health. A longer life-span for dairy cattle and fewer calves is only feasible if the animals are healthier and can indeed grow older. In this respect, these measures have a positive effect. At the same time, increased milk production per cow increases the risk of problems with both animal welfare and animal health. To what extent and how these risks are addressed by dairy farmers will determine the concrete effect on animal welfare and/or health. These measures are at odds with 'natural', robust farm operation, though.

4.1.2 Buyout of livestock rights

Another option for encouraging the sector to reduce its environmental footprint is government buyout of livestock rights. Under the Dutch Climate Agreement, for example, the government has set aside € 100 million for a voluntary scheme for livestock farmers in the so-called peat pasture district in the west of the country to cease operations, with buyout of rights one of the options.



Here, we examine the budget required, additional to what has been agreed in the Climate Agreement, for further buyout of livestock rights, rising incrementally to 10% of the national cattle herd in 2030¹⁹. We also sketch the positive environmental and climate impacts this could have.

Based on the prices for livestock rights and the total number of production rights available in the Netherlands, we calculated the cost of a 10% reduction in national livestock numbers (see Table 17).

Table 17 - Cost of buyout of production rights for a 10% reduction in national livestock numbers

	Pigs	Poultry	Dairy cattle	Total
Production rights (x 1,000)	8,698	67,162	84,900	
Cost per unit reduction (€ per prod. right)	160	25	215	
10% reduction: annual cost through to 2050 (€ mln)	10	12	128	150

Note: This calculation makes allowance for gradual buyout of production rights in the period 2020-2030 for the aforementioned sums, a 3% interest rate and write-off through to 2050 (average: 25 years). The price of a livestock right is assumed to remain constant.

Through to the year 2050, a 10% reduction of the Dutch dairy cattle, poultry and pig herds would come at an annual cost of € 150 million²⁰.

Impact of herd downsizing on ammonia and greenhouse gas emissions

Dutch farming sector ammonia emissions total over 110 kt annually (CBS Statline; PBL Environmental Balance), with the bulk due to livestock holdings (sheds and manure storage) and manure spreading on fields. While downsizing herds would reduce emissions from sheds and manure storage, because overall manure use would remain unchanged and there would only be less manure to be processed or exported, manure-related ammonia emissions would remain unchanged. A 10% reduction in livestock numbers would reduce ammonia emissions from sheds and manure storage by the same percentage and thus by 5.5 kt/a.

In 2015, greenhouse gas emissions from Dutch farming totalled 33.5 Mt CO₂-eq., of which 22.8 Mt CO₂-eq. from livestock farming (PBL, 2019). Downsizing dairy herds and reducing pig and chicken numbers would cause an approximately proportionate decrease in this latter figure, i.e. by around 2.3 Mt CO₂-eq. This reduction overlaps partly with the reduction resulting from reduced meat consumption and so cannot be entirely summed.

If the cost of livestock numbers reduction (dairy, pigs and chickens) is expressed in terms of avoided greenhouse gas emissions, this translates to a cost effectiveness of around € 65 per tonne CO₂-eq. As can be seen from Figure 7, this is a fairly average figure for the farming sector. This sum also achieves a reduction in ammonia, stench and particulate emissions locally, regionally and nationally, and allows for demolition and clean-up of livestock facilities.

¹⁹ For further background to the calculations see Appendix D.

²⁰ The above assumes livestock numbers are evenly reduced across all livestock categories, but consideration could certainly be given to focusing more specifically on those categories with the highest social costs and on regions where environmental impacts are greatest. It is for good reason that government-planned herd shrinkage is geared primarily to pig farming in southeast Brabant. A more focused downsizing scenario would have a greater impact on the various atmospheric emissions and thus on air quality.



4.1.3 Dovetailing with the CAP

Besides reducing greenhouse gas emissions, good farming practices have local effects that are harder to measure. These include improved soil management (with its positive impact on (soil) biodiversity), animal welfare, manure policy (with its influence on water quality), and optimal use of biomass streams, all of which tie in with the notion of ‘circular agriculture’. These are all issues on which the sector should be even more focused. The revenues from the sustainability charge can be used to incentivize more sustainable agriculture. For the most effective use of funds, it makes sense to align policies with existing systems. One option, then, is to dovetail with the new European Common Agricultural Policy (CAP) and the system of ‘green payments’ being established within it, which by definition help reduce environmental footprints.

The details of the CAP are currently being finalized for the period 2021-2027. The CAP is traditionally built around two ‘pillars’: direct income support (Pillar 1) and rural development (Pillar 2). For the coming period, the budget is to be reduced and at the same time a start made with a (limited) trend towards more spending on sustainability and less on direct income support. In the new CAP, Pillar 1 is to be split in two: the traditional direct payments, for which certain minimum sustainability requirements will be set, and so-called ‘green payments’, the terms of which can be decided nationally by Member States and which will establish further, tighter sustainability requirements.

Textbox 7 - Environmental Council recommendations: ‘green payments’, points system and private-sector sustainability schemes

In the recommendations set out in its report *Europees landbouwbeleid 2021-2027* (European Agricultural Policy 2021-2027) the Netherlands Council for the Environment and Infrastructure (Rli) proposes using the CAP ‘green payments’ to promote ‘circular agriculture’, by linking them to a points system built around a complementary set of sustainability criteria (environment, climate, biodiversity, soil, water, animal welfare, landscape, public health). With this points system, the ‘green payments’ can be linked to private-sector sustainability schemes.

If a system like the one set out in Textbox 7 is established, this would be an excellent basis to tie in with for recycling the revenues of the meat sustainability charge. A major advantage of a (fully) developed system, including control and monitoring systems, is the limited additional administrative burden to farmers. Dovetailing with an existing system also means that extra funds will also go largely to actual implementation, as the system is already established. Thirdly, tying in with market-based sustainability schemes means collaboration among supply-chain parties to improve sustainability, with parties having a shared interest in creating sales opportunities and profitable market niches.

4.2 Revenue recycling to households

We now move on to review the impacts of three specific options for compensating households for purchasing power loss, as requested by the TAPP coalition. For this purpose, we earmark the sustainability charge revenues remaining after deduction of subsidies for further reduction of the sector’s environmental footprint, viz. a total of around € 1 billion. The compensation considered takes the following form:

- increasing the health care allowance;
- lowering the 9% VAT rate:
 - as a sub-variant, the coalition asked us to look at lowering the 9% VAT rate to 5% for fruit and vegetables only.
- compensation specifically for low-income households.

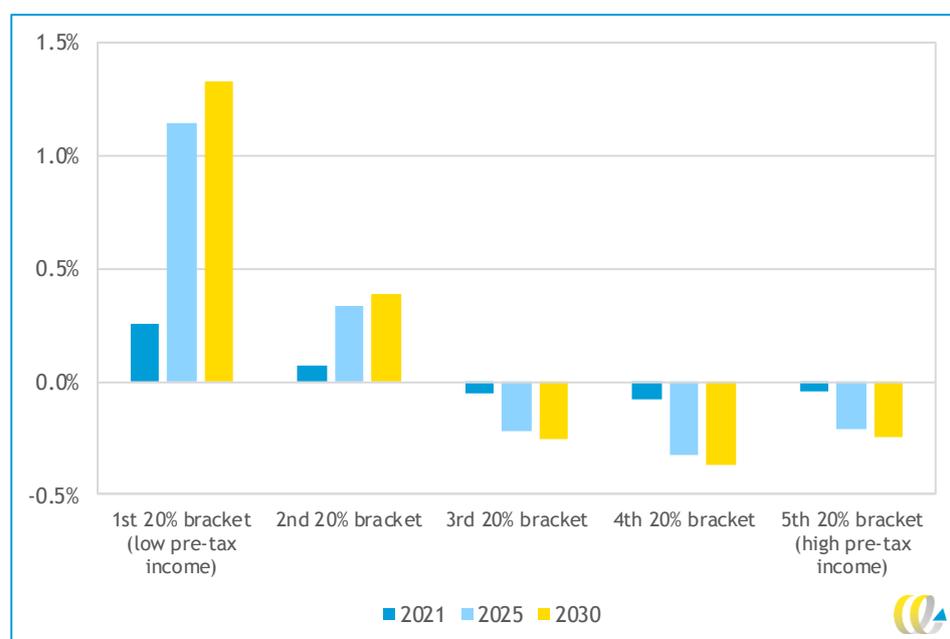


Finally, based on the above options, we were asked to construct an illustrative package that maximizes neutralization of household income effects. This is presented in Section 4.2.4.

4.2.1 Increasing the health care allowance

One way to compensate household purchasing power loss is to increase the health care allowance: government support to households on health insurance expenditure. Whether a household is eligible for such an allowance, and its level, depends on income. Figure 8 shows the impact on purchasing power if total outlay on the allowance rises with the remaining revenues from the meat sustainability charge, broken down for household in different income brackets. This is combined with the loss of purchasing power due to the meat sustainability charge calculated earlier. The data used for this calculation are reported in Table 18. As can be seen from the table and figure, there is now an improvement for the two lowest 20% income brackets. The purchasing power loss of the other brackets is less than 0.5%.

Figure 8 - Percentage change in disposable income following increase in health care allowance by a fixed percentage (net effect)



Source: Calculation based on CBS (2017).

Note: The figure shows the net purchasing power effects of the income compensation designed to compensate the purchasing power loss due to the meat sustainability charge. In the underlying calculation, it is assumed that every household getting health care allowance sees the allowance increase by the same percentage. The higher incomes receiving the allowance get it for adult offspring still living in the parental home (see Appendix E).

Table 18 - Change in disposable income due to an increase in health care allowance (2030)

Income bracket	1st 20%	2nd 20%	3rd 20%	4th 20%	5th 20%
Disposable income	€ 12,000	€ 21,600	€ 29,250	€ 40,450	€ 71,500
Change in 2030					
Sustainability charge	-€ 79	-€ 136	-€ 174	-€ 222	-€ 251
Increase in allowance	€ 239	€ 219	€ 101	€ 72	€ 77
Total	€ 159	€ 83	-€ 73	-€ 150	-€ 173

4.2.2 Lowering the 9% VAT rate

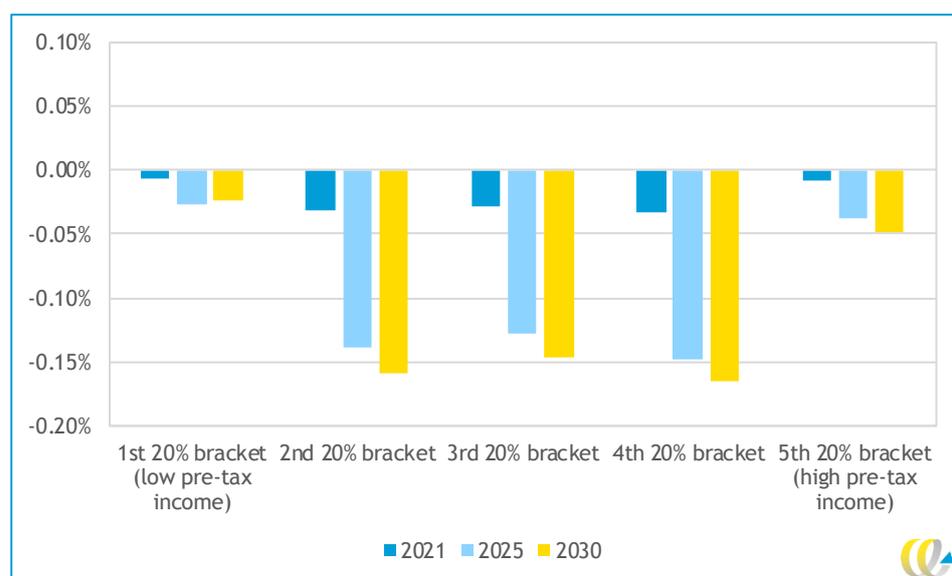
Another means of compensating household purchasing power loss is to lower the 9% VAT rate. In the Netherlands this VAT category raises around € 7.3 billion government revenue annually, of which about € 6 billion from households²¹. If meat sustainability charge revenues are used to lower the low VAT rate, this could be brought down incrementally as shown in Table 19.

Table 19 - Maximum lowering of low VAT rate

	Current rate	2020	2025	2030
VAT rate (lowered from 9% to...)	9.0%	8.7%	7.6%	7.4%

Household expenditure on low-VAT products varies depending on income. Below we report the net purchasing power effects for households in different income brackets. In Table 20 these effects are broken down.

Figure 9 - Percentage change in disposable income due to lowering the VAT rate (net effect)



Source: CE Delft calculations based on CBS consumer expenditure data.

Note: The figure shows the net purchasing power effects of the income compensation designed to compensate the purchasing power loss resulting from the meat sustainability charge.

Table 20 - Change in disposable income due to lowering the 9% VAT rate (2030)

Income bracket	1st 20%	2nd 20%	3rd 20%	4th 20%	5th 20%
Disposable income	€ 12,000	€ 21,600	€ 29,250	€ 40,450	€ 71,500
Change in 2030					
Sustainability charge	-€ 79	-€ 136	-€ 174	-€ 222	-€ 251
Lowering 9% VAT rate	€ 76	€ 102	€ 132	€ 155	€ 217
Total	-€ 3	-€ 34	-€ 43	-€ 67	-€ 34

²¹ CE Delft calculations based on CPB (2017).

Lowering the 9% VAT rate on fruit and vegetables

Instead of lowering the 9% VAT rate across the board, it can be reduced specifically on fruit and vegetables. Besides providing purchasing power compensation, this would also help encourage a healthy, sustainable lifestyle. In practical terms, it could be rolled out by lowering the VAT rate for these products to the minimum rate permitted, thus introducing a second lower VAT tier in addition to the 9% rate (as permitted under the European VAT directive (EU, 2006)). Examples of EU Member States already distinguishing a lower VAT tier for fruit and vegetables are shown in Table 21. The Netherlands could follow suite.

Table 21 - EU Member States with a second lower VAT rate for fruit and vegetables (EC, 2019).

EU Member State	% VAT on fruit and vegetables In tier with supplementary lower rate	% VAT In 'normal' tier, with lower rate	Remarks
Spain	4%	10%	Rate below minimum % for low tier in EU directive (5%), for which Spain has been granted an exemption.
Latvia	5%	12%	
Poland	5%	8%	Applies only to certain kinds of fresh fruit and vegetables.

Note: The UK and Ireland have a 0% VAT rate on all food for human consumption (with a handful of exceptions).

Table 22 shows the percentage to which the VAT rate on fruit and vegetables could be lowered if 80% of the meat sustainability charge revenue was allocated to such a reduction.

Table 22 - Maximum reduction of low VAT rate (fruit and vegetables)

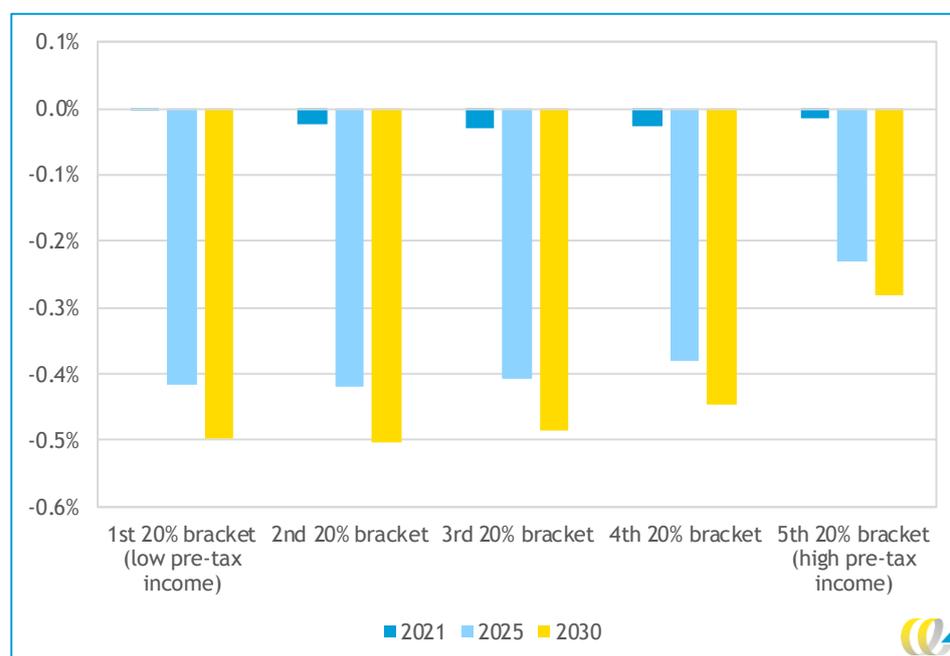
	Current rate	2021	2025	2030
VAT rate (low)*	9.0%	5.9%	5.0%**	5.0%**

* Minimum VAT rate: 5%.

** Lowering VAT to the minimum rate still leaves the following sums available for further deployment: 2025: € 663 mln; 2030: € 805 mln.

Figure 10 shows the purchasing power effects for households in various income brackets if the VAT rate for fruit and vegetables is lowered. As can be seen, this form of compensation has less impact on disposable income than across-the-board reduction of the low VAT rate. The reason for this is that households spend some 2-2.5% of their disposable income on fruit and vegetables, compared with 20-40% on the whole gamut of products and services subject to the lower VAT rate (CBS, 2015). In addition, there remains a sum that is not yet allocated here (see Table 22).

Figure 10 - Percentage change in disposable income following a lowering of the VAT rate on fruit and vegetables



Note: The figure shows the net purchasing power effects of income compensation designed to compensate the purchasing power loss resulting from the meat sustainability charge.

Table 23 - Change in disposable income due to lowering the VAT rate on fruit and vegetables (2030)

Income bracket	1st 20%	2nd 20%	3rd 20%	4th 20%	5th 20%
Disposable income	€ 12,000	€ 21,600	€ 29,250	€ 40,450	€ 71,500
Change in 2030					
Sustainability charge	-€ 79	-€ 136	-€ 174	-€ 222	-€ 251
Lowering VAT rate on fruit and vegetables	€ 19	€ 28	€ 32	€ 41	€ 49
Total	-€ 60	-€ 109	-€ 142	-€ 181	-€ 202

Introducing a 5% VAT rate for fruit and vegetables would mean increased complexity in terms of delineation and enforcement. It would also require changes to the ICT used for VAT returns.

4.2.3 Dedicated compensation of low- and middle-income households

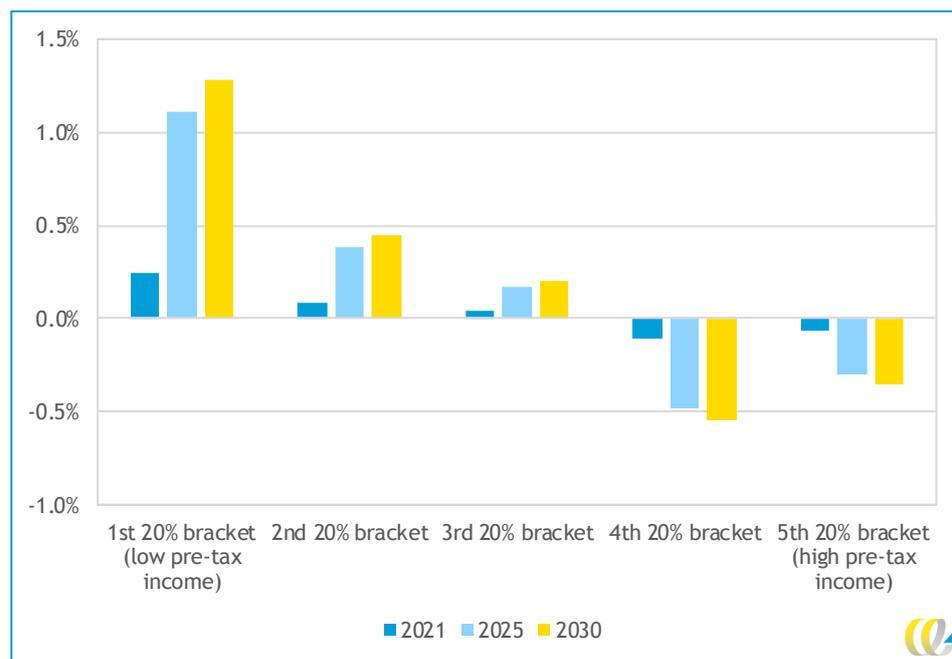
In the above compensation options, some of the purchasing power compensation goes to households with a higher income. Below, we examine an option with lump-sum compensation specifically for low and middle-income households, i.e. those in the bottom three 20% brackets. This compensation could be deployed through an increase in social benefits and introduction of an income-indexed cut in income tax. Table 24 shows the envisaged reduction in income tax for the average household in the lowest 60%.

Table 24 - Average compensation per household for lowest 60% incomes

	2020	2025	2030
Annual compensation per household	€ 46	€ 202	€ 233

Figure 11 shows what this means for the net purchasing power of households in all five income brackets; the underlying data are reported in Table 25.

Figure 11 - Percentage change in disposable income after dedicated compensation (net impact)



Source: CE Delft calculations based on CBS data.

Note: The figure shows the net purchasing power effects of income compensation designed to compensate the purchasing power loss resulting from the meat sustainability charge.

Table 25 - Change in disposable income due to dedicated compensation (2030)

Income bracket	1st 20%	2nd 20%	3rd 20%	4th 20%	5th 20%
Disposable income	€ 12,000	€ 21,600	€ 29,250	€ 40,450	€ 71,500
Change in 2030					
Sustainability charge	-€ 79	-€ 136	-€ 174	-€ 222	-€ 251
Dedicated compensation	€ 233	€ 233	€ 233	€ 0	€ 0
Total	€ 154	€ 97	€ 59	-€ 222	-€ 251

The option of dedicated compensation would increase the complexity of the tax system. It would also require changes to the ICT for returns.

4.2.4 Illustrative overall package: subsidy for livestock ‘greening’ and neutralisation of income effects for low and middle incomes

We conclude this section by elaborating an illustrative revenue recycling package combining two main elements:

1. A subsidy for reducing the livestock sector’s footprint.
2. Neutralisation of income effects for low and middle-income households.

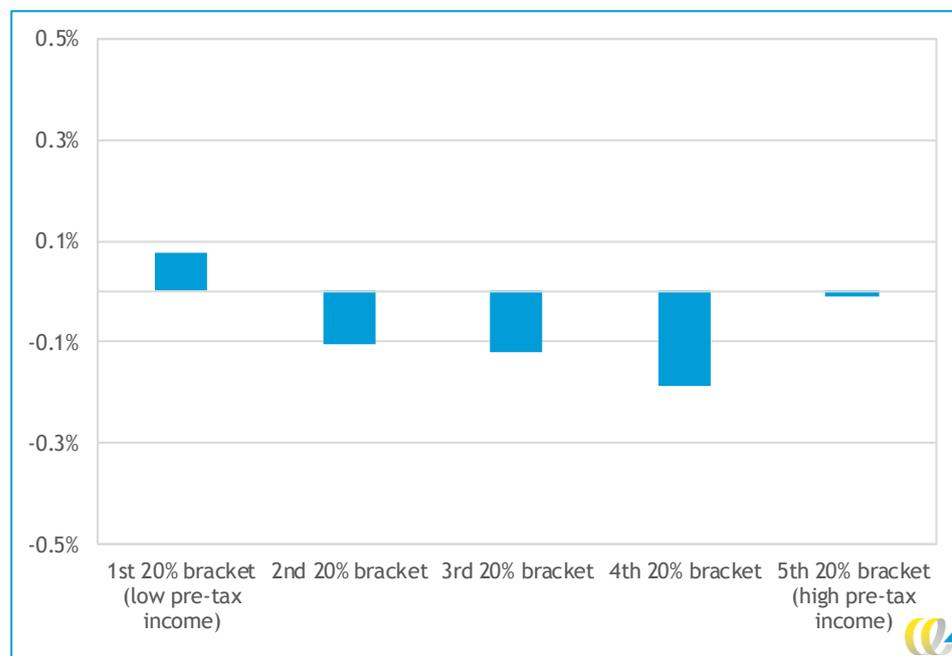
The package is summarized in Table 26.

Table 26 - Revenue recycling package for sectoral ‘greening’ and household purchasing power compensation (2030)

Revenue recycling to:	Bedrag (miljoen €)
Sectoral climate measures	135
Financial incentives for herd reduction	150
Lowering VAT on fruit and vegetables (to 5%)	266
Lowering 9% VAT on other products/services (to 7.9%)	722
Increased health care allowance	0
Dedicated compensation for low and middle incomes	83
Total	1,356

The resulting income effects are shown in Figure 12.

Figure 12 - Percentage change in disposable income due to illustrative compensation package in 2030 (net effect)



Source: CE Delft calculations based on CBS data.

Note: The figure shows the net purchasing power effects of income compensation designed to compensate the purchasing power loss resulting from the meat sustainability charge.

5 Conclusions

In this study, commissioned by the Coalition for a True Animal Protein Price (TAPP Coalition), CE Delft has elaborated a proposal for a financial stimulus package that incentivises the livestock farming sector to reduce its environmental footprint and consumers to adopt a more sustainable diet.

The study addresses the following concrete questions:

- What form could a policy package take, comprising a meat sustainability charge in tandem with subsidy for the farming sector and purchasing power compensation for households?
- How can such a charge be suitably elaborated?
 - What would be its effects on the environment and on economic welfare?
 - How can the revenues be used to reduce the footprint of the agricultural sector and compensate for purchasing power losses, particularly for low-income households?

We conclude that what we have termed the ‘Basic variant’ is a feasible means of introducing a meat sustainability charge in the relatively near term. To this end, in Section 5.1 we outline a roadmap for implementation and present a concrete schedule for roll-out that we deem feasible.

The sustainability charge can be collected at supermarkets and butchers/poultry sellers (without requiring import/export corrections) or at abattoirs/importers (which would require such corrections). As with introduction of a minimum price for CO₂, we propose raising the charge rate incrementally. Phased introduction allows the livestock sector as well as consumers to grow accustomed to the charge, giving them time to adjust. We also examined a second variant, in which in 2030 the charge rate precisely covers the social costs associated with the environmental footprint of meat production. This matches the horizon of the Dutch Climate Agreement.

Based on previous research, these social costs are estimated at 2.04 €/kg for chicken, 4.50 €/kg for pork and 5.70 €/kg for beef and veal. These estimates encompass the costs associated with greenhouse gas emissions, other pollutant emissions, land-use impacts on biodiversity and livestock diseases. These figures will need to be adjusted as understanding of the impact of meat production improves and as the sector reduces its footprint.

The sustainability charge leads to an estimated 5.2 Mt/a reduction in CO₂-eq. emissions (of which 2.7 Mt/a in the Netherlands²²) in 2030. Economic welfare increases by around € 800 million²³. Besides the lower greenhouse gas emissions, this is also down to reduced ammonia, NO_x and particulate emissions, among other environmental benefits. There will also be a reduction in livestock diseases.

Introduction of the sustainability charge will reduce the social costs of meat consumption. As the charge is collected by the state, there will be additional government revenue.

²² On the assumption that the livestock farms are in the Netherlands.

²³ This figure does not factor in (partial) replacement of meat products by other products. We estimate this would mean loss of 15-25% of the welfare gains (see Appendix J).

The coalition asked us to look at a revenue recycling package combining subsidies to the livestock sector to reduce its footprint with income support for households to neutralize purchasing power impacts. In ‘greening’ the livestock sector, we were asked to assess what additional greenhouse gas emission cuts could be achieved by earmarking additional funds for several climate measures from the Dutch Climate Agreement and government buyout of livestock rights. The subsidy for sectoral climate measures would yield an additional reduction of 1.8 Mt/a CO₂-eq/a. in 2030 over and above the Climate Agreement, buyout of livestock rights a further 2.3 Mt/a. These reductions cannot simply be added to those resulting from the sustainability charge.

With regard to compensation of purchasing power losses, we were asked to assess the effects of compensation via a reduction of VAT, an increase of the health care allowance and dedicated income compensation for low and middle-income households. With dedicated compensation, low and middle-income households benefit in terms of purchasing power. If the health care allowance is increased, the two lowest 20% income brackets benefit. With compensation by way of lower VAT only the poorest 20% benefit.

It is also feasible to opt for a mix of these forms of income compensation, so purchasing power effects are restricted to at most (minus) 0.2% of disposable income, while the lowest income brackets gain.

5.1 Roadmap for implementation

Below, we set out an implementation roadmap for the sustainability charge, indicating the steps required in the legislative process and for development of systems and enforcement protocols in order to roll out the sustainability charge according to the respective variants.

The Basic variant requires the development of legislation and several IT and administrative systems. If a start were to be made immediately and ambitious scheduling adopted, we estimate roll-out could be achieved within two years at the soonest. In that case, the government could announce that a sustainability charge on meat is to be introduced in two years (a credible ‘stick’) and initiate the legislative process. We then reckon with around 18 months lead time for elaborating the parliamentary bill plus explanatory memorandum, consultations and implementation in the fiscal plan, among other necessary steps. In parallel, work could then be started on preparing development of the returns system and arrangements for enforcement (in the form of random checks) and Inland Revenue checks. The livestock sector can also start developing their information systems.

In the Plus variant, roll-out depends on further development of an effective track-and-trace system for meat origins. In cooperation with the sector, existing emissions monitoring systems will also need to be fine-tuned (ammonia and particulates) or developed (NO_x and greenhouse gases), which we estimate would take 5-10 years. For subsequent steps, the roadmap depends on the specific step. The ‘ideal picture’ of the ECC remains out of reach in this 10-year period, but can be pursued in the longer term.

Table 27 - Roadmap for the sustainability charge

Variant	Basic	Plus	Follow-up steps	'Ideal picture'
introduction date	Within 2 years at soonest	5-10 years	Depends on specific step	Longer term
Deployment agenda	Legislation on sustainability charge by government/parliament	Ditto		
	Development of Inland Revenue returns system	Ditto		
	Development of system for higher price of (meat) products by supermarkets/butchers	Ditto		
	Development of system for reporting amount of meat in products by meat processing industry	Ditto		
	Development of Inland Revenue enforcement protocol	Ditto		
	Only if sales charge point is at abattoirs/importers: Development of system for import/export corrections*	Ditto		
		Development of emissions registration system by government		
		Emissions registration by livestock farmers		
		Further development of track-and-trace system		
		Extension of enforcement protocol by Inland Revenue		

* If the charge point is consumer sales, no import/export corrections are required.



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A sustainability charge on meat

Appendices



A Methodology and data

For the calculations in this study, we followed the methodology adopted in our earlier (Dutch-language) study ‘The true price of meat’ (CE Delft, 2018a). In this appendix, we describe the variables and associated sources on which these calculations are based.

A.1 Meat categories

The social costs of meat depend very much on the additional products supplied by the livestock concerned (such as eggs or milk) plus the age at which it is slaughtered.

As in (CE Delft, 2018a) we therefore distinguish the following categories:

- meat from beef cattle: cows bred solely for their meat;
- meat from dairy cattle: cows bred for dairy production;
- meat from calves (veal);
- meat from pigs (pork);
- meat from laying hens: hens bred for their eggs;
- meat from broiler hens: hens bred solely for their meat.

Data on environmental and climate footprints are based on Dutch production.

A.2 Valuation of externalities

Valuation of Dutch emissions followed the Dutch version of the Environmental Prices Handbook (CE Delft, 2017). Valuation of foreign emissions, animal diseases and the external benefits of outdoor cattle grazing followed from ‘The true price of meat’ (CE Delft, 2018a).

For our first-pass analysis of roll-out of the charge in Europe, we worked with the same premises and values as in the ‘The true price of meat’, to maintain constant ratios for consumption of beef (dairy vs. beef cattle) and chicken meat (broiler vs. laying hens).

A.3 Meat consumption

As our baseline for current meat consumption, we used the data available at Wageningen University & Research (WUR) (2018) for the Netherlands and FAOSTAT (2012) for Europe. As can be seen in Table 28, the figures used for the Dutch and the European analyses differ.

Table 28 - Current meat consumption in the Netherlands and Europe (kg carcass weight per capita per annum)

Type of meat	Netherlands	Europe
Pork	36.5	34.73
Beef	Beef: 15.4; veal: 1.3	15.23
Chicken	22.1	23.33

Source: WUR (2018); FAOSTAT (2012).



A.4 Price elasticities

The impact of the sustainability charge on consumer meat consumption and expenditure on the respective products was calculated using price elasticities. The ‘own price elasticity’ of demand measures – under an assumption of sufficient supply – the relative decline in the amount of a product sold following an increase in its price. An own price elasticity of -1 means that a 10% price rise leads to a 10% fall in demand. Product turnover (price times demand) will then fall by 1% (NB $(110\%)*(90\%)-100\%$).

Inter-product substitution was determined using the ‘cross-price elasticity’ of demand: the relative increase in the amount of product A sold following an increase in the price of competing product B. A cross-price elasticity of 0.5 means the amount of product A sold as a result of substitution rises by 5% when the price of product B rises by 10%.

The price elasticities known for the Netherlands were validated against accepted values from other countries. In doing so, we based ourselves on meta-analyses of own price elasticities in the U.S. by Andreyeva et al. (2010), own price elasticities in Europe, Australia and North and South America by Gallet (2010) and cross-price elasticities in the EU by Wirsenius et al. (2011).

Besides the own price elasticity of meat, the own and cross-price elasticities of the individual kinds of meat need to be determined to estimate any shifts within the assortment of meat consumed. To this end we distinguished pork, beef, beef mince, chicken and other meat. A range of studies have shown that the own price elasticity of beef mince is very high (Mangen & Burrell, 2003) and that the elasticity of beef is generally higher than that of pork or chicken (Andreyeva, et al., 2010; Gallet, 2010; Wirsenius, et al., 2011). The price elasticity of beef mince is even higher. The relatively low price of chicken and pork may well mean consumers are less sensitive to changes in the price of these products.

In all likelihood, the price elasticity of meat will be lower in the near term than in the long term. This is because consumers are not always able – or willing – to change their behaviour all at once, for lack of sufficient good meat substitutes, for example, or a paucity of recipes. If the incentive is strong enough, in the future more alternatives will probably be introduced, making it easier for consumers to adapt their dietary patterns and thus increasing meat price elasticities.

To estimate the short- and long-term elasticities we used the ranges emerging from the meta-analysis by Andreyeva et al. (2010). The central value, for the medium term, we estimated based on several studies (Gallet, 2010; Wirsenius, et al., 2011; Mangen & Burrell, 2003). By deliberately estimating own price elasticities lower, substitution effects can be factored in without having to use cross-price elasticities.

Table 29 - Price elasticities (short and long term)

Year	Pork	Beef	Beef mince	Chicken
2021	-0.2	-0.3	-0.5	-0.2
2025	-0.6	-0.8	-1	-0.6
2030	-1	-1.2	-1.5	-1

Note: The same price elasticities were used for our outline analysis for Europe.



B Legal aspects of Plus variant

In terms of legal constraints on the External Cost Charge (ECC), there are three potential areas of conflict: EU legislation on fiscal issues and on the internal market, and WTO international trading rules.

B.1 EU legal framework

Product taxes, in contrast to import duties, are subject to Article 110 of the Treaty on the Functioning of the European Union. This Article prohibits (i) higher taxes on imported products comparable with domestic products and (ii) product taxes that are protectionist in nature. In the *Outokumpu Oy* case, the European Court of Justice ruled that Member States may base distinctions in product tax on production methods for reasons of environmental protection. The Plus variant is a benchmark application of the ECC to meat. Such application can be deemed in breach of Article 110 if lower charge rates that are feasible via the Monitoring, Reporting & Verification (MRV) system are not available to EU farmers. The fact that the domestic products can be taxed higher than the EU products is not relevant for compliance with Article 110. The benchmark for EU products must be compared with the lowest tax level for domestic products.

B.2 WTO legal framework

B.2.1 General Agreement on Trade and Tariffs (GATT)

The ECC on meat would be national in scope. Article III of GATT prohibits use of taxes or other domestic charges for the purpose of protecting domestic products. This general principle stems from Article III:1, which forms the basis for the more specific obligations of, *inter alia*, Articles III:2 and III:4. A system using a different, less advantageous, benchmark for foreign producers and the MRV opt-in system may both be in violation of Article III if these put foreign products at a disadvantage.

Violations of Article III may still be compatible with GATT if they are covered by the general exemptions set out in Article XX of GATT. Article XX(g) permits measures associated with exhaustible natural resources, which in the case *US - Gasoline* were interpreted by the Appellate Body of the WTO as including clean air and could extend to a healthy atmosphere. However, Article XX prohibits measures implemented in such a way as to discriminate arbitrarily or unjustifiably between countries where the same conditions hold. In this respect, the Appellate Body of the WTO observed, in its report on *US - Shrimp*, that adherence to national policy measures may not be required internationally without due observance of differing circumstances in other countries.



B.2.2 WTO Agreement on Technical Barriers to Trade (TBT Agreement)

Another potential source of concern is the WTO Agreement on Technical Barriers to Trade. TBT Article 2.1 is contravened if (i) a provision discriminates against imported products relative to domestic products; and (ii) this difference in treatment cannot be justified by a legitimate regulatory distinction. To count as 'legitimate', a pollution-related distinction must be calibrated to the amount of pollution (or emissions) caused by livestock raised under different conditions.

In its report in *US - Country of Origin Labelling*, the Appellate Body judged that competitive discrimination against imported products, such as higher compliance costs, can also create an incentive for using domestic products. The ECC on meat may have this kind of practical impact, in the form of additional costs for smaller-scale producers or non-availability of MRV certification for foreign producers. TBT Article 12.3 also creates an obligation to make due allowance for the special development, financial and trading needs of developing nations, for example by helping them limit the complexity of monitoring systems or supporting them with implementation.

Finally, the Plus variant would mean Dutch inspectors having to carry out checks in other countries. There are no WTO obstacles to this, as long as there is no discrimination as to treatment of livestock farmers in comparable countries.



C Background on side-effects of climate measures

C.1 Dairy farming

The measures under the heading '*crops, cropping methods & soil use*' mean farmers sourcing more (high-protein) feed from their own fields, with less maize cultivation and more (permanent) grassland. Many of these measures stem from standing agreements with Dutch dairy farmers on 'land-based' management, i.e. extensive management. As livestock housing and land utilization will scarcely be affected, any impact on emissions is likely to be negligible. At the farm level there will, across the board, be a decline in the manure surplus as more farmers spread more of their manure on their own land. At the sectoral level, though, the manure surplus will remain unchanged.

With respect to biodiversity, these measures will have a varying impact. Intensively managed holdings with high external feed inputs and high manure exports will perhaps use their land even more intensively, adversely affecting biodiversity. On many holdings, including those more extensively managed, grassland acreage will increase, though, which may benefit biodiversity.

For those out in the countryside, an increase in land-based dairy farming will re-establish the traditional, 'natural' image of such farming. At both the farm and the sectoral level, though, substantial effort and thus investment will be required before every farmer finds sufficient new land near his holding. In this study (and in the analysis by the Netherlands Environmental Assessment Agency, PBL) these costs have not yet been factored in.

The measure '*high-precision fertilization*' for dairy farmers seeks to achieve more efficient fertilization of grassland. By scanning the soil, it can be accurately determined where nutrients are required and precisely how much, thus minimizing both excess and deficiency and reducing farm methane emissions.

The measure '*feed supplements*' covers deliberate addition of products and/or ingredients to dairy cow feed to inhibit methane production in the gut. The chemical industry is developing specific supplements to this end and feed producers have experience with adding fats or fatty matter to concentrates, for example. Whether these chemical additives have much effect on other impacts is unclear, given their novelty and farmers' unfamiliarity with them. Side-effects are likely to be limited, with it knocking on most for stench production. Including fats, fatty matter and/or chemical supplements in feed may tarnish the natural image of cattle as ruminants feeding on grass (and maize), though.

The heading '*manure processing*' covers two types of technology: capture and oxidation of passively generated methane, and active manure digestion for additional methane production and use. As yet, the former has scarcely been deployed on farms and its potential side-effects are virtually unknown. In contrast, there are many years of experience with manure digestion. In the past that was mainly co-digestion, with up to 50% other organic matter being added to the manure. In this study, though, the measure refers to 'mono-manure digestion', with 100% manure.



On a farm with manure processing, ammonia emissions may either increase or fall. On the one hand, the manure must be stored airtight to minimize escape of methane, and with it ammonia. On the other hand, digesting the manure leads to decomposition of organic matter (OM), the bound nitrogen being converted to ammonia that can escape to the air when the digestate (digested manure) is spread on the land. This decomposition of OM means there is less OM available for soil organisms than in fresh manure, and because digestate is more akin to artificial fertilizer in its mode of action, there is likely to be a (minor) adverse effect on biodiversity in terms of soil life. Capture of manure vapour and subsequent combustion (in the case of digestion) or oxidation may reduce stench nuisance, particularly if this process takes place with 'day-fresh' manure, thus reducing the amount of manure stored in open barn systems. A dairy farm with facilities for manure digestion or methane oxidation looks far more like a 'factory farm', though, which combined with the biodiversity impact reduces the 'naturalness' of the farming system.

'Nitrification inhibitors' are chemicals that slow down conversion of ammonia to nitrate by soil bacteria, thus reducing nitrate and nitrous oxide emissions. Having been assessed under hazardous substances legislation, several products have now been approved for the European and thus also Dutch market. As they have scarcely yet been used in this country, however, we have little grasp of any long-term (side-)effects. Impacts on other emissions and biodiversity cannot be ruled out. One of the approved compounds (dicyandiamide, DCD) is toxic to white clover, for example, and given these compounds' mode of action there are likely to be impacts on other bacteria and consequently soil life more generally, and thus biodiversity. This kind of influencing of soil life through chemical additives is at odds with the 'naturalness' of dairy farming and dairy produce. This side-effect becomes even more pronounced if residues (can) find their way into milk or meat, even though they may not actually be toxic.

'Grass-clover' refers to the sowing of leguminous plants like clover in grassland to bind atmospheric nitrogen. This bound nitrogen can then be taken up by the grass, reducing artificial fertilizer use. If the bound nitrogen is not utilized at some time, though, there is a risk of it leaching out as nitrate. One or more leguminous species mixed in with the grass increases the diversity of soil life and the grassland itself and thus benefits biodiversity. Combined with reduced fertilizer use, this improves the 'naturalness' of the dairy farm and dairy production.

The measure **'Longer lifespan, fewer calves'** encompasses dedicated 'climate-friendly' herd selection based on milk production and animal lifespan. The more successful selection is in terms of lifespan, the fewer calves will be needed to replace the milk-giving cows. It should be noted, though, that under the Sustainable Dairy Chain initiative the sector already pledged to increase dairy cattle lifespan back in 2012, but has still not succeeded in that aim. Whether the 'climate-friendly' selection proposed would also require special breeding and/or selection methods is unknown. This measure may have a positive impact on ammonia emissions, particularly if calf numbers are reduced. More so than at present, further specialization of selection and breeding programmes will probably be geared to greater herd uniformity with fewer different breeds. This means a loss of (livestock) biodiversity. Depending on the selection and breeding methods adopted and the ensuing results, this measure may impact negatively on the 'naturalness' of dairy farming.

C.2 Pig farms

The Dutch government has signalled its intention to buy up a substantial number of ‘pig rights’ to address problems in intensive livestock farming areas in the south and east of the Netherlands. Such a move would have a range of environmental impacts, which we have subsumed under the heading ‘*pig farming shrinkage*’. A reduction in pig numbers would reduce atmospheric emissions of ammonia, greenhouse gases, stench and particulates. It would also decrease the manure surplus. Emissions to soil and water would not be affected, since these are governed by nutrient input standards, which this measure leaves unchanged.

In our present context the measure ‘*manure processing*’ on pig farms refers to centralized collection and digestion of manure for methane production and use. The resultant digestate can potentially be separated into a thick and thin fraction and the process heat generated used to sterilize it or process it to manure granulate. These last steps are required to be able to export the digested and processed manure. Without this measure, a comparable amount of manure would need to be exported or otherwise processed in the Netherlands, generating emissions either domestically or abroad. As an industrial activity taking place on a business estate, centralized manure processing would have no effect on the atmosphere or ‘naturalness’ of the pig farms themselves.

C.3 Arable farming and horticulture

The ‘precision’ part of the measure ‘*high-precision farming & nitrification inhibitors*’ encourages arable farmers and horticulturalists to adopt fertilization and cropping regimes characterized by maximum specificity. Improved nutrient utilization leads to higher crop revenues and possibly to reduced nitrate leakage to the environment. ‘*Nitrification inhibitors*’ are chemicals that inhibit ammonia-to-nitrate conversion by soil bacteria, thus reducing nitrate and nitrous oxide emissions. Having been assessed under hazardous substances legislation, several products have now been approved for the European and thus also Dutch market. As they have scarcely yet been used in this country, however, we have little grasp of any long-term (side-)effects. Impacts on other emissions and biodiversity cannot be ruled out. Given these compounds’ mode of action there are likely to be impacts on other bacteria and consequently soil life more generally and thus on biodiversity. This kind of influencing of soil life through chemical additives is at odds with the ‘naturalness’ of plant food production. This side-effect becomes even more pronounced if residues (can) find their way into vegetables, even though they may not actually be toxic.

The measure ‘*improved SOM-content*’ is concerned with ‘fixing’ CO₂ in the soil by increasing soil organic matter (SOM) content. In arable farming, there are several potential methods: leaving crop residues on the land, where their SOM can be taken up by the soil; more use of compost; opting for more extensive crop rotation; and growing crops that leave more OM in the soil, such as cereals rather than potatoes or flower-bulbs. This measure has a positive impact on biodiversity, both directly (different crops) and indirectly (soil organisms). Overall, it improves the ‘naturalness’ of arable farming and horticulture.

In this realm, there are major opportunities, not only for these two sectors, but also for dairy farming. With more permanent grassland, harbouring more wild flowers and deeper-rooting grasses, and less cultivation of maize, there is plenty of progress to be made here. Apart from the substantive perspective of this ‘land use measure’, though, it should be noted that it will not lead to greenhouse gas emission reduction in any legal sense.



D Background on buy-out of livestock rights

This appendix explains how the budget required for government buy-out of 10% of phosphate rights and livestock rights was calculated.

D.1 Number of phosphate, pig and poultry rights

To keep livestock (dairy cattle, pigs and poultry), farmers must have the requisite number of manure production rights. In the case of pig and poultry, these rights are expressed in 'units', for dairy cattle and phosphate rights in 'kg phosphate'. Table 30 shows the total number of production rights that Dutch farmers currently have.

Table 30 - Background data used for calculating buy-out of livestock and phosphate rights

	Pigs*	Poultry *	Dairy cattle**
– No. of livestock rights (x 1,000 units)	8,698	67,162	84,900
– No. of phosphate rights (x 1,000 kg phosphate)			
Animals per unit pig and poultry right or per kg phosphate right	Fattening pig = 1.00 Sow incl. piglets = 2.74	Broiler chicken = 0.48 Laying hen = 1.00	Cow = 32.4 to 49.3 kg Heifer (1-2 y) = 21.9 kg Calf (0-1 y) = 9.6 kg

* Source: RVO - Table 11 Standard conversion factors for pig and poultry units 2019-2021.

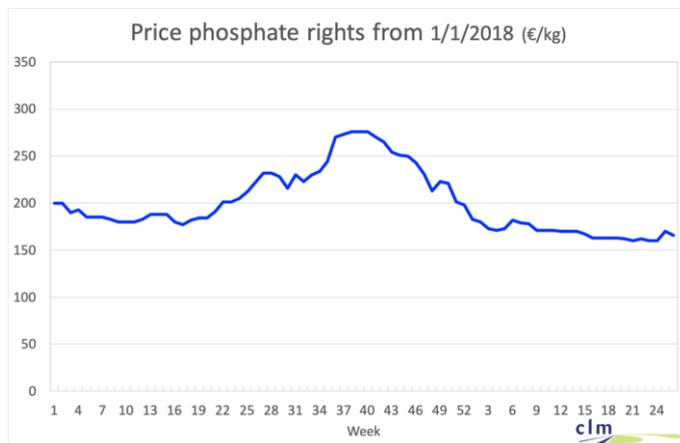
** Source: RVO - Table 6 Nitrogen and phosphate production indices per head of dairy cattle 2019-2021.

The number of production rights a farmer needs for his pigs or poultry depends on the type of animal concerned. A laying hen counts for 1.00 and a broiler chicken for 0.48 poultry right, a sow (incl. piglets up to 6 weeks old) for 2.74 and a fattening pig for 1.00 pig right. For dairy farmers, the required number of phosphate rights is expressed in terms of the amount of phosphate the dairy cattle and heifers excrete in their manure, a standardized figure based on milk production and age. A dairy cow producing 5,000 kg milk a year needs 32.4 kg phosphate rights, one producing 11,000 kg milk a year 49.3 kg rights. For heifers, the number depends on age and is either 21.9 or 9.6 kg phosphate rights a year.



D.2 Price of phosphate, pig and poultry rights

Supply and demand of pig, poultry and phosphate rights and therefore their price are determined by pig, poultry and dairy farming efficiency. Following introduction on 1 January, 2018, phosphate rights for dairy cattle varied in price between € 160 and € 276 per kg (source: Boerderij.nl). This fluctuation may be due partly to 2018 being the first year in which there was trading and consequently price formation.



The pricing of pig rights is an issue that has received a great deal of attention in recent years in connection with the planned partial buy-out of these rights by the government later this year. Source: *Prijontwikkeling van varkensrechten* (Pig right price trends), Robert Hoste, Michiel van Galen, Roel Jongeneel, Ana González Martínez, Cor Wattel (WUR), supported by Jan Pijnenburg and Paul Bens (DLV Intensief Advies).

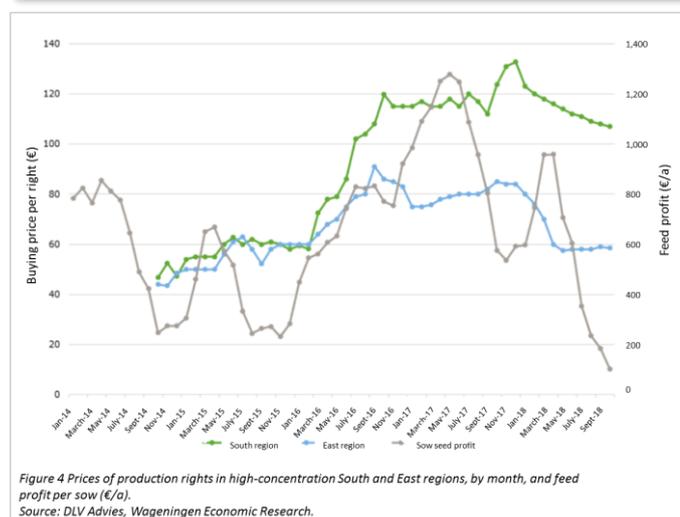


Figure 4 Prices of production rights in high-concentration South and East regions, by month, and feed profit per sow (€/a). Source: DLV Advies, Wageningen Economic Research.

Dutch livestock rights are not freely tradeable. They may be traded from the South and East (where intensive livestock farming is concentrated) to other parts of the country, but not vice versa, to avoid further build-up in those regions. This zoning has major consequences for prices in the respective regions. At the end of last year, for example, the unit price was € 110 in South and € 60 in East. The cited study reviewed likely prices in the near future, concluding that these would probably be considerably lower in 2019, but subsequently rise again to about the same as at the end of 2018.

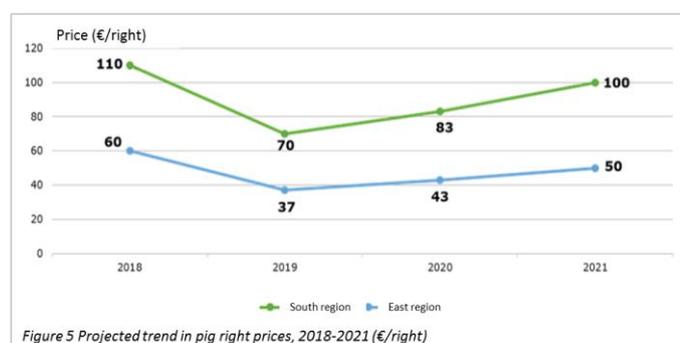


Figure 5 Projected trend in pig right prices, 2018-2021 (€/right)

As of mid-2019, the price of a pig right (average of supply and demand price) reported on various trading platforms were around € 125 (South), € 50 (East) and € 40 (other). The price of a poultry right was about € 18-20. Table 31 gives an idea of recent prices.

Table 31 - Price of livestock and phosphate rights

	Pigs	Poultry	Dairy cattle
Livestock right, €/unit (South region)	125		
Livestock right, €/unit (East region)	50	19	
Livestock right, €/unit (other regions)	40		
Phosphate right, €/kg			165
Price used in calculations (€ per unit and kg)*	160	25	215

* This price allows for the price of the livestock and phosphate rights, including a 'surcharge' of around 20% for flanking measures and demolition and clean-up of livestock facilities.

This leads to the following costs:

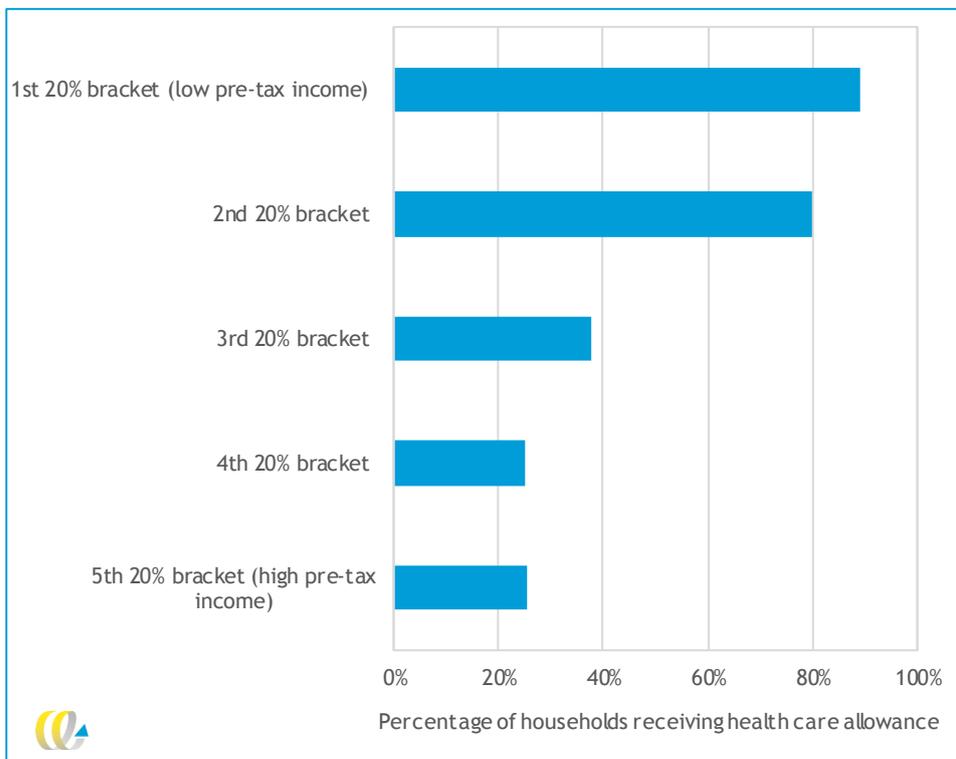
Table 32 - Cost calculation

	Pigs	Poultry	Dairy cattle
Production rights (x 1,000)	8,698	67,162	84,900
Cost per unit livestock numbers reduction (€ per unit)	160	25	215
10% reduction in livestock numbers			
Costs, one-off (€ x million)	139	168	1,825
Costs, annual (€ x million)	10	12	128

E Background on health care allowance for households in various income brackets

Figure 13 shows the percentage of Dutch households currently receiving health care allowance, broken down by income bracket. The higher brackets receive the allowance for children over 18 still living at home.

Figure 13 - Percentage of households receiving health care allowance, by income bracket, 2014



Source: CE Delft calculations based on CBS (2017).

F Registration/monitoring of emissions from livestock and feed supply chains

For the Plus variant (and its potential extension) it is essential to have incontrovertible data on NH₃, particulates, NO_x and CO₂-eq. emissions from both farms and feed supply chains. Table 33 summarizes the current situation with respect to registration of these emissions at the national, European and global level. In the Netherlands, ammonia and particulates are monitored on individual livestock farms, but this is not yet the case for NO_x or CO₂-eq., though the required data and methodologies are already available and could be used to set up farm-level systems. Data on animal feed supply chains are harder to come by and detailed figures would only be feasible for CO₂-eq.

Table 33 - Synopsis of emissions registration for NH₃, particulates, NO_x and CO₂-eq. for livestock and feed at national, European and global level

Emission	Livestock farms			Feed		
	Registration in NL?	Registration in EU?	Global?	Registration in NL?	Registration in EU?	Global?
NH ₃	Yes (at farm level via Rav)	Yes (at national level (NEC))	No	Negligible	Negligible	Negligible
Particulates	Yes (at farm level via Wm)	Yes (at national level (NEC))	No	No	Unknown	Unknown
NO _x	Yes (at farm level possibly via NEMA)	Yes (at national level (NEC))	No	No	Unknown	Unknown
CO ₂ -eq.	Yes (at farm level possibly via NEMA)	Yes (at sectoral level via Greenhouse gas monitoring mechanism)	Yes (at sectoral level via UNFCCC)	Yes (detailed data available in feedprint)	No (approx. data via Greenhouse gas monitoring mechanism)	No (approx. data via UNFCCC)

Abbreviations: NEC = National Emissions Ceiling (Directive); NEMA = National Emission Model for Agriculture; Rav = *Regeling Ammoniak en Veehouderij* (Regulations on Ammonia and Livestock); Wm = Environmental Protection Act; UNFCCC = United Nations Framework Convention on Climate Change.



G Meat production chain: emissions

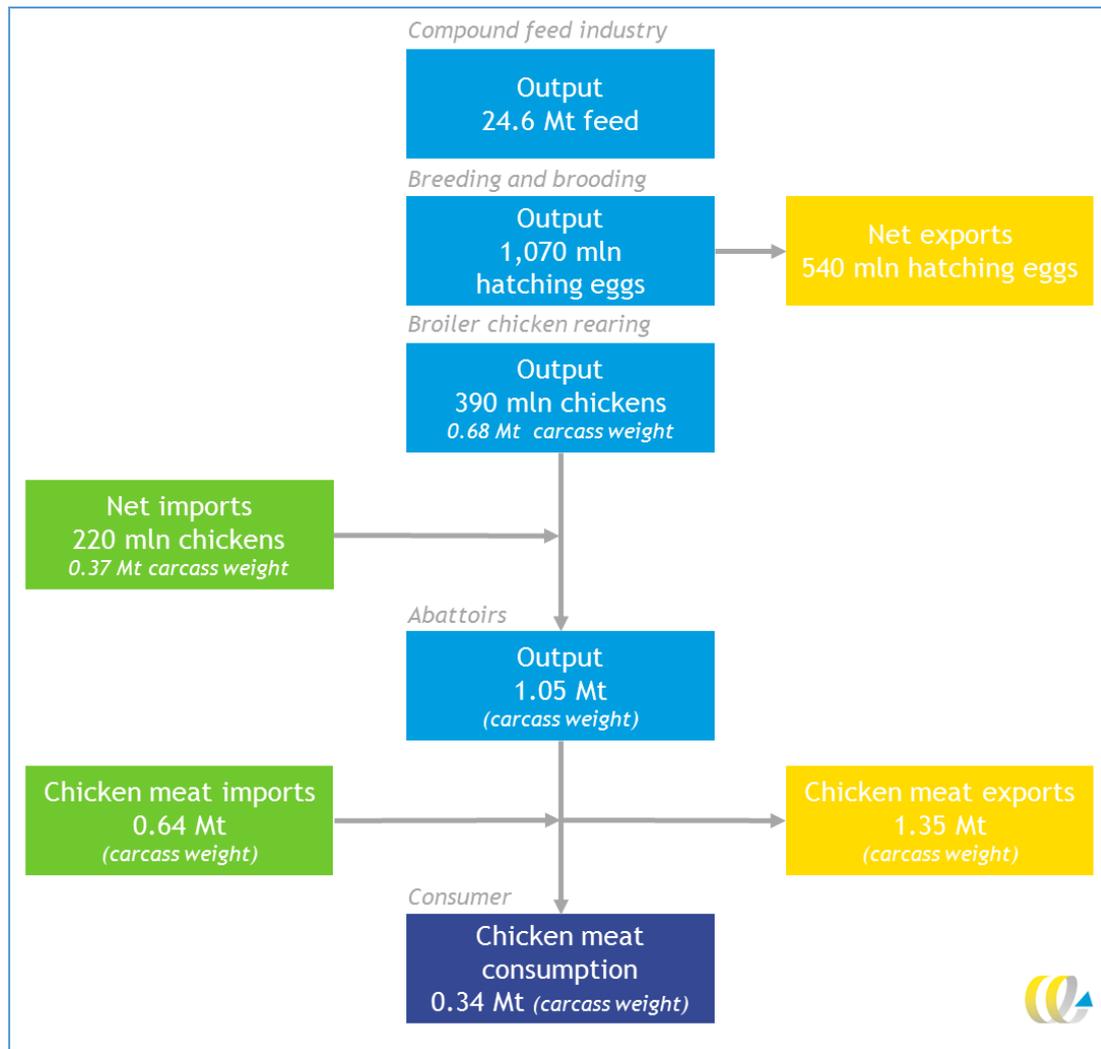
Table 34 - Environmental and climate footprint per link of meat production chain, Netherlands and abroad, per kg meat produced by Dutch livestock farmers

	Dairy cattle	Beef cattle	Chickens	Pigs
Netherlands	83%	80%	40%	37%
Livestock farming	45%	36%	22%	24%
Abattoirs	1%	0%	2%	2%
Feed	36%	44%	8%	6%
Retail	2%	1%	9%	4%
Abroad	17%	20%	60%	63%
Feed	17%	20%	60%	63%



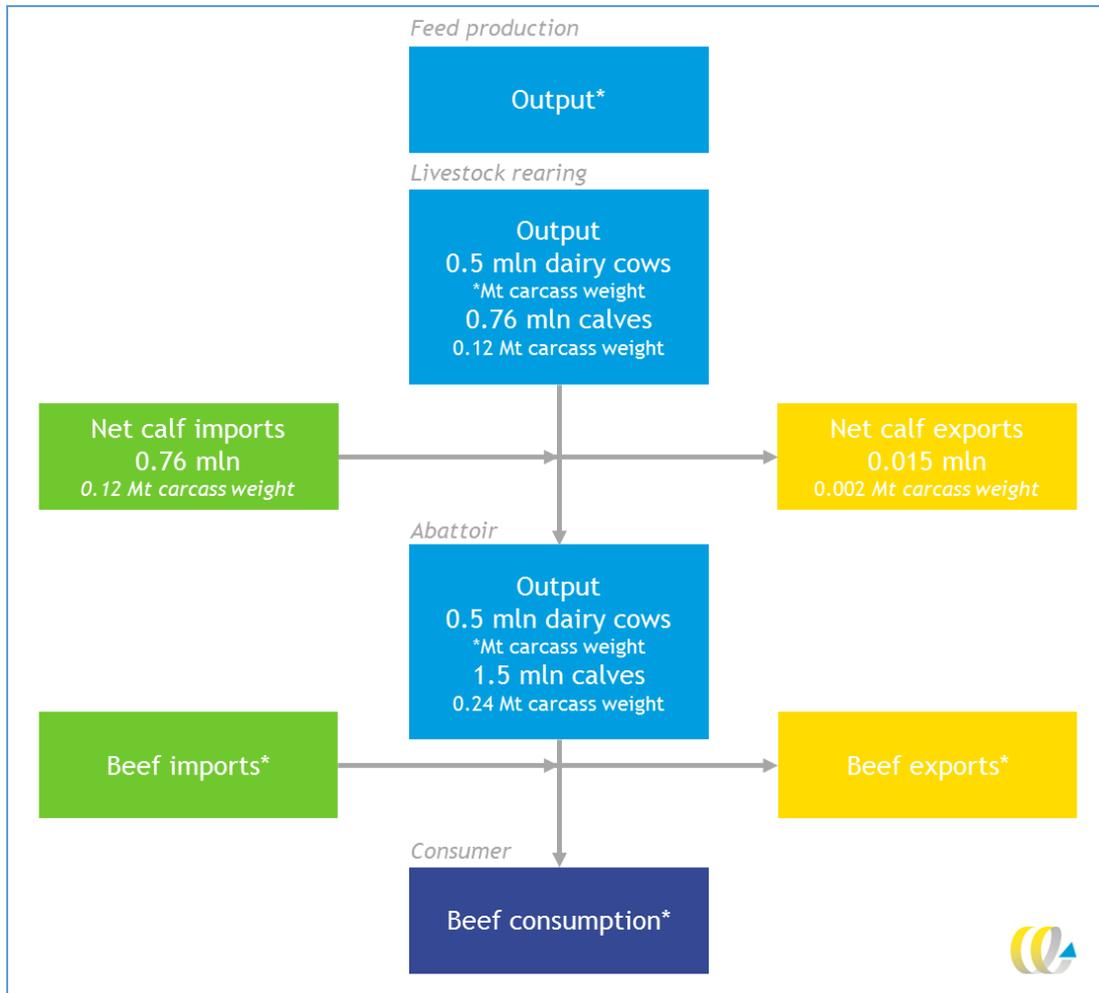
H Meat production chain: imports, exports and domestic trade

Figure 14 - Chicken meat production chain, 2016



Source: CE Delft calculations based on WUR (2019).
 For general data on meat processing, see end of this appendix.

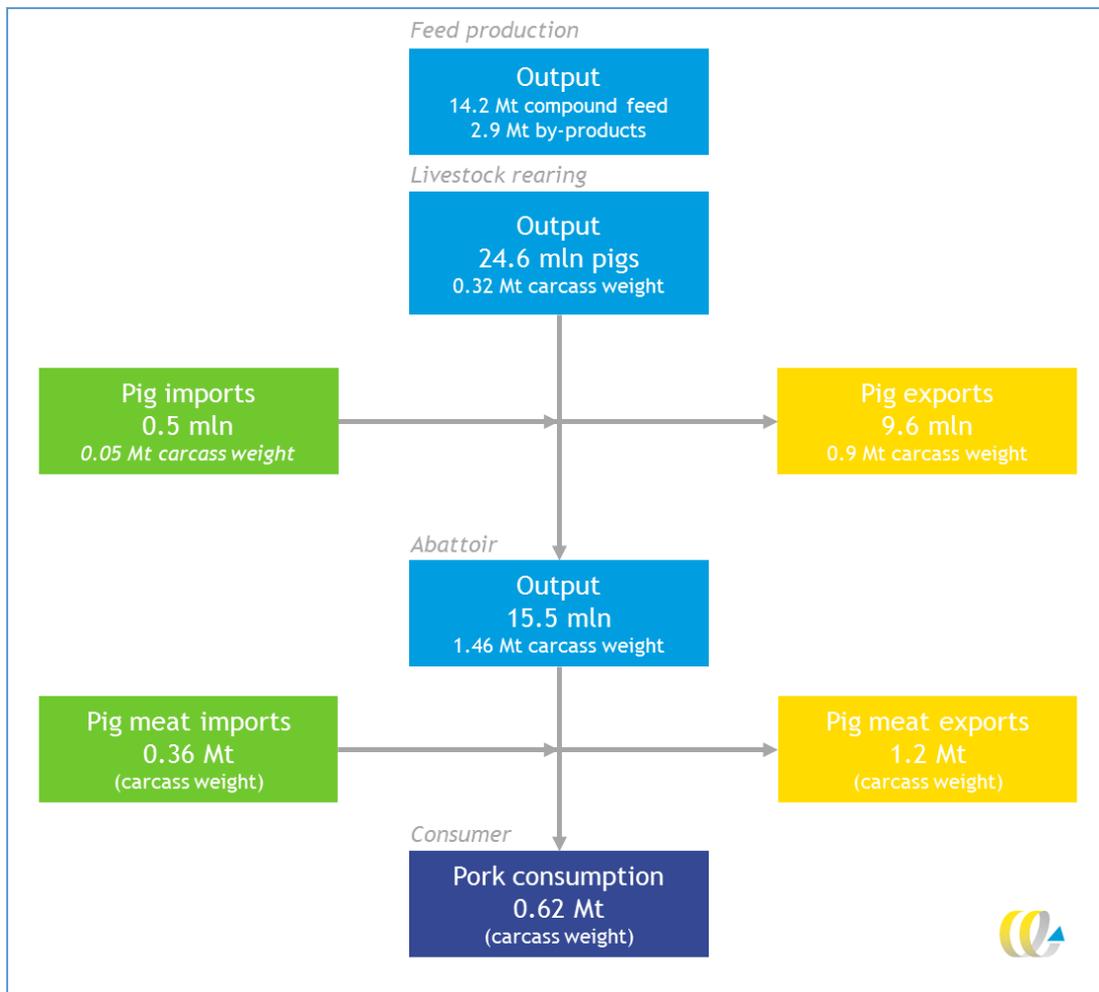
Figure 15 - Beef production chain (incl. veal), 2016/2017



Source: CE Delft calculations based on WUR (2019).

* Data intentionally omitted for lack of data. For general data on meat processing, see end of this appendix.

Figure 16 - Pork production chain, 2014/2015



Source: CE Delft calculations based on WUR (2019).
 For general data on meat processing, see end of this appendix.

Meat processing

The Dutch meat processing industry exports around 70% of its output, mainly within Europe (ING, 2013).

I Alternative options for sectoral footprint reduction

The Advisory Board discussed a wide range of alternative options for reducing the livestock sector's environmental footprint. In the present study, the following measures were not further considered:

- subsidy for switch to *Beter Leven Keurmerk* (animal welfare certification);
- subsidy for reducing ammonia emissions;
- subsidy for reducing particulate emissions;
- per-hectare subsidy for switch to 'circular agriculture';
- per-hectare subsidy for switch to 'eco-friendly farming';
- per-hectare subsidy for switch to 'organic farming';
- subsidy for improved animal welfare;
- subsidy for afforestation/reforestation of South American farmland;
- input to Green Climate Fund (for mitigation and adaptation in developing nations, as per the 2015 Paris Climate Accord);
- consumer subsidies to encourage healthier diets with more non-animal protein (e.g. free 'healthy' cookery lessons, public education, discount vouchers for fruit, vegetables, meat substitutes, etc.);
- innovation fund for sustainable proteins to encourage/develop production of new vegetable proteins;
- using the meat sustainability charge to achieve climate neutrality of all Dutch consumer meat sales (climate compensation: € 30/t CO₂-eq. reduction).

In selecting the measures for elaboration in the present study, our criteria were that these should:

- be national;
- go beyond the market;
- be concrete and preferably quantifiable;
- not create excessive extra administrative burden.

J Consumption and guidelines

In the Netherlands, meat consumption is currently around 50% higher than recommended by the National Nutrition Centre²⁴. Milk, too, is ‘overconsumed’: by about 30% relative to the recommended daily intake. Consumption of pulses (legumes) and nuts is far below the quantity advised, averaging only about 15%. For protein intake as a whole, we are also ‘overconsuming’, each of us getting around 80 grams a day, while 60 grams would on average be more in line with the guidelines (CE Delft, 2017) based on food consumption surveys and Nutrition Centre recommendations. In our country, average daily calorie intake stands at 2,192 kcal (RIVM, in progress).

Effective consumption is even higher, though, because there is considerable food wastage. Aggregate per capita food supply, i.e. actual consumption plus wastage, was an average 3,222 kcal a day between 2011 and 2013 (most recent statistics: FAOSTAT data). There will always be a certain amount of ‘surplus’, because some wastage is virtually unavoidable and is part and parcel of maintaining adequate supplies and interregional distribution. About half the current ‘surplus’ would probably suffice, though. There is most definitely overconsumption and a decline of about 500 kcal pppd in aggregate supply, i.e. consumption incl. wastage, would seem reasonable.

On average, supply/consumption of animal products is slightly over 1,000 kcal pppd, that of meat 390 kcal pppd. A 50% reduction in meat consumption, i.e. almost 200 kcal less, therefore translates to an approx. 500 kcal reduction in effective (over)consumption.

Calculations based on the price rises due to the sustainability charge and product price elasticities point to the average person eating slightly over 22 kg less meat per annum in 2030. This will not necessarily lead to an absolute reduction in daily calorie intake, with people (partly) substituting their meat by other (high-protein) products like pulses, cheese or nuts, production of which also comes with external costs. Table 35 gives an indication of the potential external costs due to either 50% or complete substitution of meat. These figures assume substitution based on equivalent calorie intake. The external costs of substitution depend very much on the product consumed as a substitute; cheese, for example, has a 2.5-3 times greater impact than tofu, and an approx. 10 times greater impact than lentils. Percentage substitution by various products is based on (Motivaction, 2015).

Table 35 - Estimated potential external costs due to meat substitution

	Absolute	As percentage of welfare impact
50% substitution, pppa	€ 6.25	
100% substitution, pppa	€ 12.51	
Total for Netherlands, 50% substitution (mln € external costs)	€ 107	14%
Total for Netherlands, 100% substitution (mln € external costs)	€ 217	27%

²⁴ This recommendation is a maximum recommended intake. Besides considerations of health and sustainability, it is based on current dietary habits and ‘consumer feasibility’.