ECN

Energy research Centre of the Netherlands

Reference Projection Energy and Emissions 2010-2020

PBL Netherlands Environmental Assessment Agency

ECN-E--10-049 December 2010

Acknowledgement
This report has been written for the Projectbureau Schoon en Zuinig (Project Office Clean and Efficient) of the Dutch Ministry of Housing, Spatial Planning and the Environment and the Dutch Ministry of Economic Affairs. This report contains the English translation of the Dutch report ‘Referentieramingen Energie en Emissies 2010-2020, registered under ECN report number ECN-E--10-004. The ECN project number is 50046. The PBL report number is 500161005. The contact persons of this project are coordinating authors Bert Daniëls of ECN (tel. +31-224-564426, e-mail: daniels@ecn.nl) and Sonja Kruitwagen of PBL (tel. +31-30-2743526, e-mail: sonja.kruitwagen@pbl.nl).

In addition to the coordinating authors a large number of employees of ECN and PBL have contributed to this study: Luuk Beurskens (ECN), Pieter Boot (ECN), Eric Drissen (PBL), Jeroen van Deurzen (ECN), Hans Elzenga (PBL), Gerben Geilenkirchen (PBL), Joost Gerdes (ECN), Coen Hanschke (ECN), Michiel Hekkenberg (ECN), Anco Hoen (PBL), Benno Jimmink (PBL), Sander Kieboom (PBL), Sander Lensink (ECN), Stefan Luxembourg (ECN), Marijke Menkveld (ECN), Pieter Kroon (ECN), Kees Peek (PBL), Arjan Plomp (ECN), Marian van Schijndel (PBL), Ad Seebregts (ECN), Jos Sijm (ECN), Jeffrey Sipma (ECN), Sietske van der Sluis (PBL), Joost van Stralen (ECN), Casper Tigchelaar (ECN), Martine Uyterlinde (ECN), Martijn Verdonk (PBL), Paul Vethman (ECN), Cees Volkers (ECN), Wouter Wetzels (ECN), Alessia de Vita (ECN), Harry Wilting (PBL). The English translation was conducted by Marlies Kamp (ECN). The final layout was done by Kim Stutvoet-Mulder (ECN).

Abstract
The Reference projection 2010-2020 examines the future development of Dutch energy use, greenhouse gas emissions and air pollution up to 2020. The Reference projection is based on assumptions regarding economic, structural, technological and policy developments.

With regard to the latter, the “Schoon en Zuinig” (Clean and Efficient) policy programme for energy and climate, introduced in 2007, plays an important role. According to Schoon en Zuinig, greenhouse gas emissions have to be reduced by 30% in 2020 compared to 1990; the annual energy efficiency improvement has to increase to 2% and the target share of renewable energy production in total consumption in 2020 is 20%. To assess the effects of the policy measures from the Schoon en Zuinig policy programme, the Reference projection explores three policy variants: one without policies introduced after 2007, one including only post-2007 policies that are already fixed, and one including proposed policy measures as well. Here, policies refer to Dutch as well as to European policies.

The results indicate that the climate and energy targets will not be reached with the current instruments. Including proposed policy measures, the estimated greenhouse gas reduction will amount to 16-24% relative to 1990, the renewable energy share will rise to 13-16% and the annual energy efficiency improvement between 2011 and 2020 will amount to between 1.1 and 1.6%.

European targets for greenhouse gas emissions can be reached, especially in the case of implementation of the proposed policies. As for renewable energy, the implementation of proposed policies is imperative for attaining the target, but likely to be insufficient.

Current European targets for air pollutants are within reach. 2020 emission levels of most air pollutants are lower than the current 2010 National Emission Ceilings, with the exception of ammonia, where there is a substantial chance that the 2020 emissions will exceed the 2010 ceiling. However, ceilings are likely to become more stringent towards 2020.

Contents

List of tables

List of figures

List of boxes

Summary

S.1 Introduction

In this Reference projection the development of energy use and greenhouse gas emissions and other air-polluting substances in the Netherlands are mapped for the period until 2020. It takes into account the economic recession of 2009 and 2010 and a moderate growth of the economy in the period 2011-2020. This Reference projection contains the current insights and anticipated energy prices and the price of CO_2 emission allowances. Recent policy changes and new insights in emission factors are also included. Uncertainties with regard to economic growth, price developments and effectiveness of policy are expressed by means of uncertainty bandwidths.

The previous Reference projection of 2005 and the update of 2009 only sketched the developments under fixed policy conditions. The current projection is dedicated to the working programme *Clean and Efficient*, which is still partly in the intended policy stage. The projection maps the effect of the working programme *Clean and Efficient*, including European Policy as of 2007. The projection shows how energy demand, the share of renewable energy and the emissions of greenhouse gases will evolve in the medium term for three policy variants: (1) without the new national and European policy as of 2007; (2) with fixed national and European policy, and (3) implementation of the intended national and European policy. The elaboration and implementation of intended policy is uncertain, which is partly due to the fall of the Balkenende IV cabinet.

A comparison of the projection with the policy objectives will show if, in what areas and to what extent the policy is insufficient. The variant addressing performances for fixed policy (RR2010-V) sketches the expected policy gap in 2020. The variant for intended policy (RR2010-VV) shows to what extent the intended policy of the Balkenende IV cabinet would close the policy gap. This projection is not an outlook that examines all conceivable policy options. However, it can be used as a starting point for searching additional policy that can be used to realise the targets after all.

Part of this study is dedicated to projecting the anticipated emissions of air polluting substances: nitrogen oxides (NO_x), sulphur dioxide (SO_2), ammonia (NH_3), particulate matter and volatile organic compounds (NMVOC). These substances are covered by the European Emission Ceiling and are also called NEC substances (national emission ceiling). The projection of these substances is based on fixed policy only.

S.2 Developments in energy use

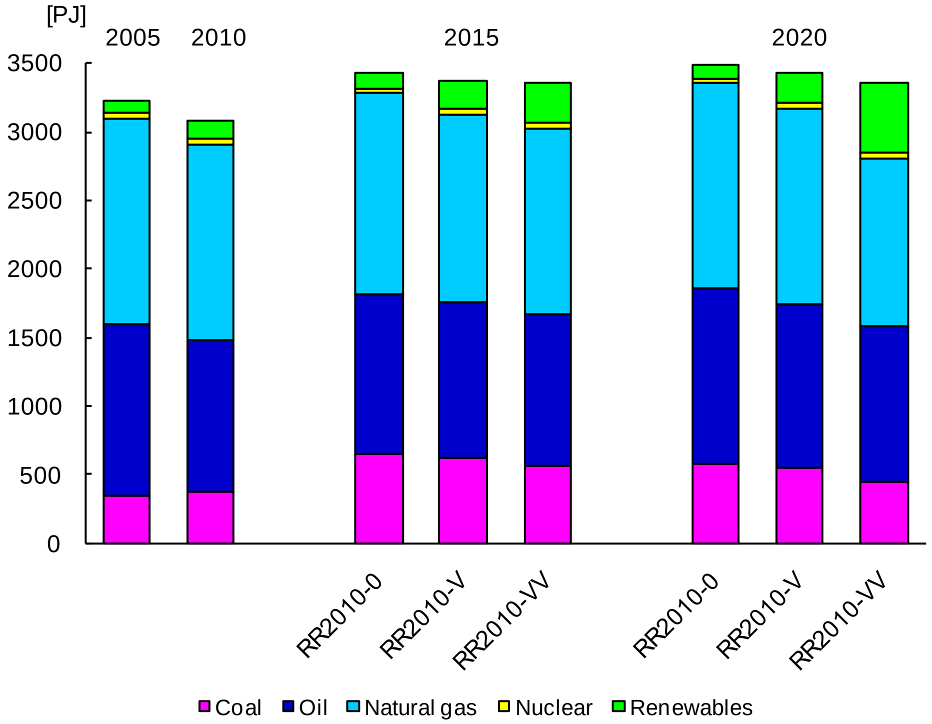

Figure S.1 *Energy mix 2005-2020*

The energy use in the Netherlands decreased between 2005 and 2010, which was partly due to the economic recession. After that period, there is a distinct increase in anticipated energy use. Especially the use of coal will increase significantly between 2010 and 2015 as a result of new electricity plants that will enter into operation.

As more policy is implemented, the increase in energy use will be more modest and the share of renewable energy will increase significantly (Figure S.1; RR2010-VV). Among other things, the implementation of intended policy will lead a total fossil fuel use in 2020 that is about 100 PJ lower than in 2010.

S.3 Developments in greenhouse gas emissions

Fluctuations in energy use affect the greenhouse gas emissions: there is a decrease until 2010 and an increase between 2010 and 2015 as a result of new electricity plants that will enter into operation.

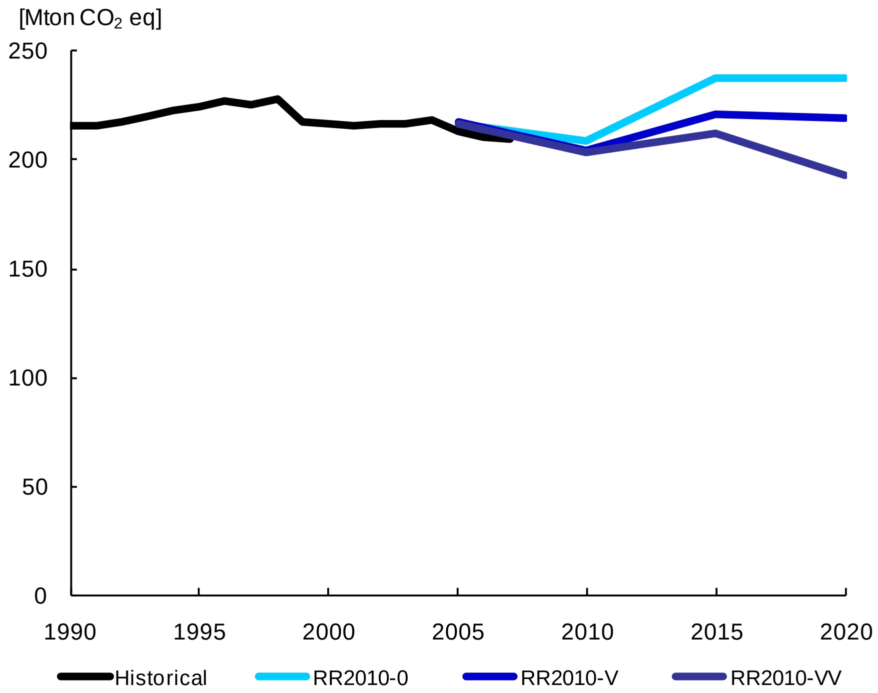

Figure S.2 *Greenhouse gas emissions 1990-2020*

- With fixed policy the projected greenhouse gas emissions in 2020 amount to 219 (198-229) Mton CO_2 equivalents (Figure S.2; RR2010-V). Roughly speaking the emissions have stabilised compared to 1990.
- Without Clean and Efficient policy the emission in 2020 would have amounted to 237 (217-249) Mton CO_2 equivalents (Figure S.2; RR2010-0).
- If intended policy is implemented, greenhouse gas emissions in 2020 will decrease to 193 (174-207) Mton CO_2 equivalents (Figure S.2; RR2010-VV). The emissions of this variant decrease particularly after 2015.
- The only clear decrease in the emission development trend can be seen when intended policy is implemented (Figure S.2).
- No conclusions can be drawn about target range based on the above-mentioned developments in emissions (see Section S.6).

S.4 Policy Effects

The total effect of the Clean and Efficient policy is an emission reduction of over 44 Mton. Almost 19 Mton can be ascribed to the fixed Clean and Efficient policy and about 26 Mton can be ascribed to intended policy. Figure S.3 shows the contribution of the various measures and sectors to the total policy effect of 44 Mton. The largest contribution is provided by the intended production of renewable energy, followed by decreased fuel demand from traffic, reductions of other greenhouse gases and a lower electricity demand in the built environment. Some smaller negative side effects can also be observed: deployment of CHP is limited due to the increase in renewable energy and heat and lower electricity demand.

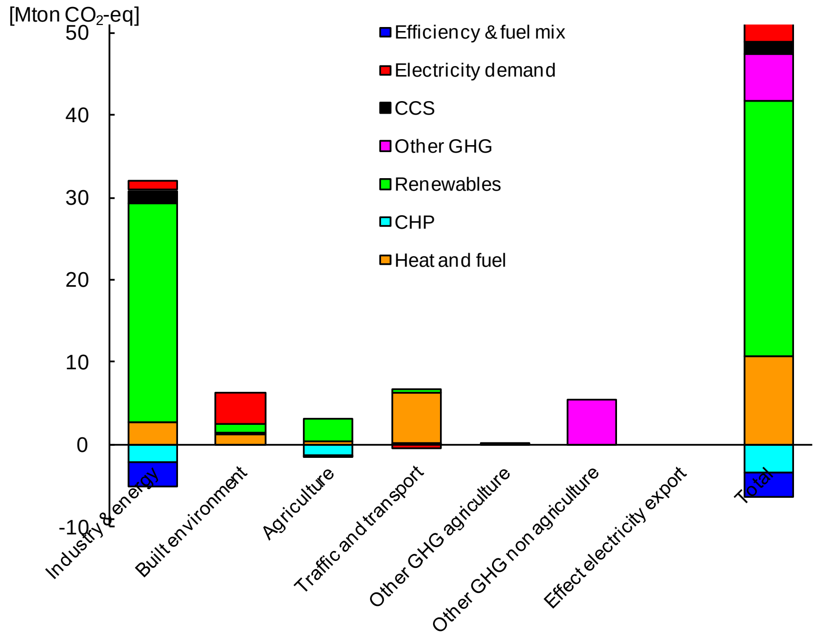

Figure S. 3 *Policy effects greenhouse gas emissions per sector and category of measures*

S.5 Clean and Efficient targets

The Balkenende IV cabinet has the following targets:

- Decrease the greenhouse gas emissions with 30% in 2020 compared to 1990.
- Increase the energy saving pace to on average 2% annually in the period 2011 to 2020.
- Increase the share of renewable energy to 20% in 2020.

Figure S.4 illustrates the three separate targets and the expected realisations for the three policy variants.

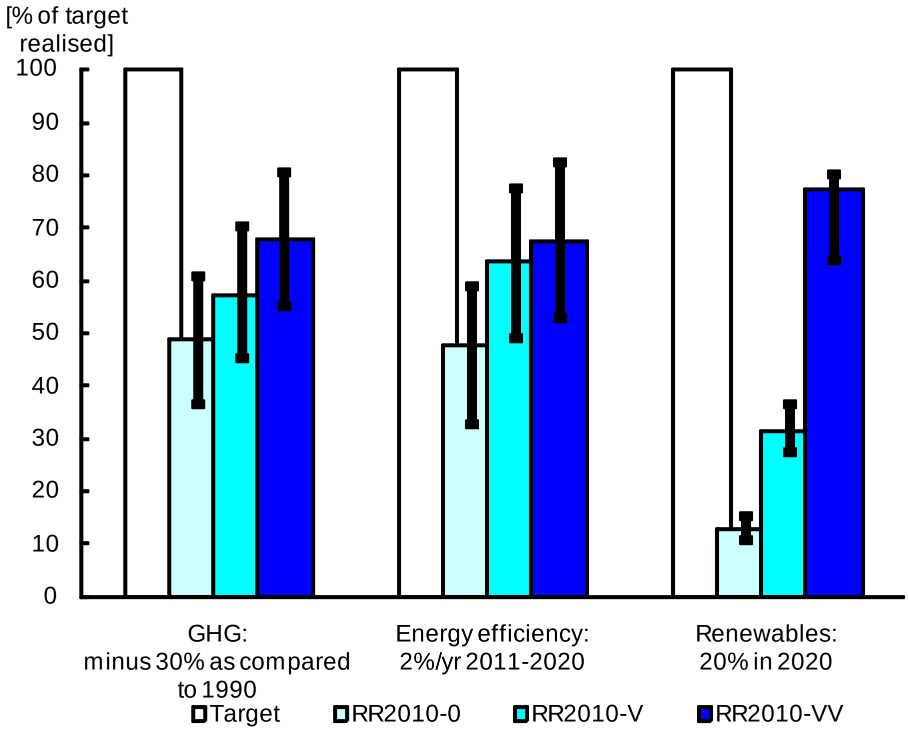

Figure S. 4 *Clean and Efficient: targets and realisations*

S.6 Greenhouse gases: -30% in 2020 compared to 1990

The Dutch target of 30% reduction compared to 1990 corresponds to an emission target of 150 Mton in 2020. Part of the greenhouse gas emissions in the Netherlands is produced by sectors covered by the European emission trading system (ETS) as a result of European legislation. These ETS sectors include electricity plants, refineries and the largest part of industry. A European emission ceiling will enter into force as of 2012. The main non ETS sectors are traffic, the built environment and part of agriculture.

The Balkenende IV cabinet declared that the reduction target of 30% applies both to ETS and to non ETS sectors, separately. This results in an emission target of 63 Mton for ETS sectors and 87 Mton for non ETS sectors.

As the ETS allows companies to trade their emission allowances, additional emission reduction within ETS sectors in the Netherlands will not result in additional emission reductions in Europe. After all, the European emission ceiling is fixed. Therefore, the Balkenende IV cabinet decided to book the 21% reduction compared to 2005 as agreed upon in Europe for the Dutch emissions covered by the ETS, regardless of whether or not the actual reduction is realised within the Netherlands. This means that the realisation of the Dutch ETS businesses for the target is fixed at 75 Mton, regardless of the actual emission. Only the emission reduction outside the ETS sectors can make direct contributions to the national greenhouse gas emission target. As for the effect of fixed policy, 13 Mton of the total effect of 19 Mton of emission reduction is covered by the ETS. Over 5 Mton is not covered by non ETS, thus contributing to the national emission target. If intended policy would be implemented, the amount of emission reduction outside the ETS would increase to 12 Mton.

As the realisation of the ETS businesses is fixed at 75 Mton, the policy deficit in the ETS sectors is 12 Mton by definition. The policy deficit in the non ETS sectors amounts to 16 Mton when fixed policy is implemented and will decrease to 9 Mton when intended policy is implemented (see Table S.1).

Table S.1 *Total greenhouse gas emissions, targets and realisations*

	No C&E* policy	Fixed policy	Intended policy	Target 2020
	Emission greenhouse gases (physical) 2020 [Mton CO_2 eq]			
ETS	130	116	97	
Non ETS	108	102	96	
Total	237	219	193	
	Realisation greenhouse gases 2020 [Mton CO_2 eq]			
ETS	75	75	75	63
Non ETS	108	102	96	87
Total	183	177	171	150
	Policy deficit [Mton CO_2 eq]			
ETS	12	12	12	
Non ETS	21	15	9	
Total	33	27	21	

* Clean and Efficient.

S.7 Renewable energy: 20% in 2020

The renewable energy target amounts to a share of 20% of total energy demand in 2020. The main policy instrument for achieving this target is the renewable energy subsidy scheme SDE, a subsidy scheme for the production of renewable energy. In fixed policy, the budget for the SDE scheme amounts to about 1 billion euro annually, including obligations from the former subsidy scheme environmental quality of electricity production (MEP). Based on the subsidy amount, the share of renewable energy will amount to about 6% (190 to 240 PJ). The intended expansion of the SDE subsidy scheme will result in a renewable energy share of about 15% (440 to 500 PJ). The required subsidy finance will increase to 3 to 4 billion euro annually in 2020. The 20% renewable energy target will not be achieved this way.

S.8 Energy saving: average of 2% annually in 2011-2020

Energy demand is partly influenced by the energy saving pace. Without Clean and Efficient policy the pace will not go higher than 0.7 to 1.2% annually. In case of implementation of fixed policy, the energy saving pace amounts to 1 to 1.5% annually between 2010 and 2020. Implementing intended policy will increase the energy saving pace to 1.1 to 1.6%. The annual 2% target will thus not be achieved.

The energy saving pace will increase especially in the built environment and the transport sector, both in the variant with fixed and the variant with intended policy. In the built environment this is mainly the result of the European standards for electrical appliances resulting from the Ecodesign guideline. In transport, the tightening of the European CO_2 standardisation of vehicles has led to decreased fuel consumption. This trend is enhanced by the national fiscal incentives for buying energy efficient cars.

S.9 European targets

The European Commission requires the Dutch sectors that are not covered by the emission trading scheme to reduce their greenhouse gas emissions with 16% in 2020 compared to 2005. The fixed policy will probably not suffice to meet the European emission target. By implementing intended policy, the target will most likely be realised.

On top of that, there is also a renewable energy target of 14% of heat, transport fuels and electricity demand. Realising the 14% renewable energy target also requires implementation of intended policy. Given the uncertainties with regard to the policy effects, the implementation of intended policy does not guarantee that the target will be realised.

S.10 Conclusions greenhouse gas emissions and energy

The greenhouse gas emissions and energy use in the Netherlands will only decrease in absolute terms compared to 1990 if intended policy is implemented. This is also necessary to meet the European targets set for the Netherlands. Still, full implementation of intended policy is insufficient to meet the *Schoon en Zuinig* targets.

S.11 Emissions of air-polluting substances

The emission of air-polluting substances partially relates to energy use, but it also depends on other factors. For example, the emission of ammonia mainly depends on the number of animals and the use and storage of manure.

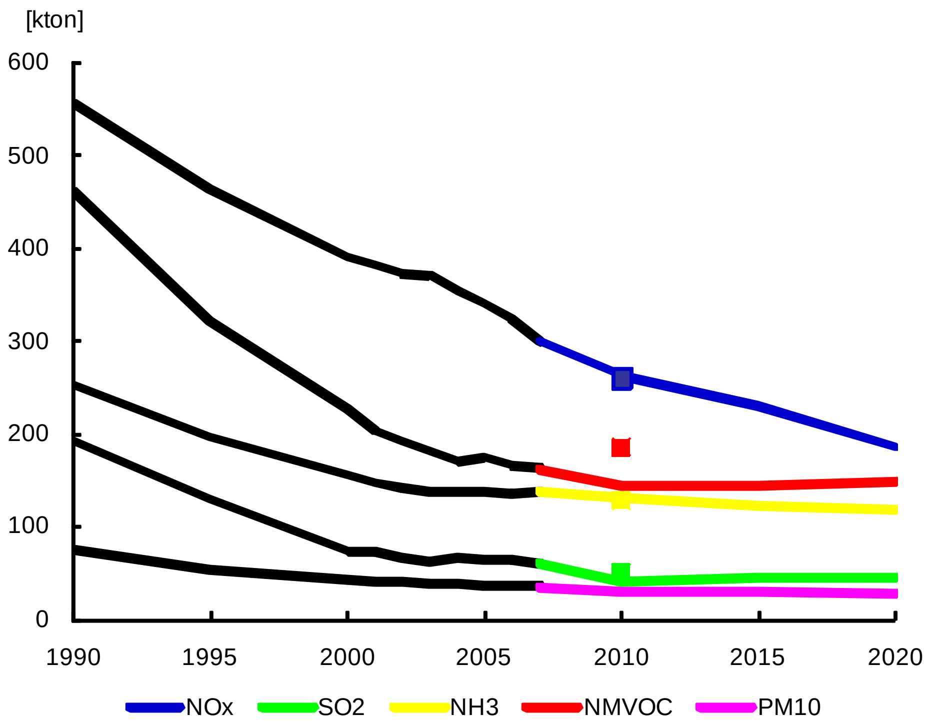

Figure S. 5 *Emissions NEC substances and targets 2010*

Nitrogen oxides (NO_x)

The current EU target for NO_x emissions as of 2010 amounts to 260 kton. Between 2010 and 2020 the NO_x emission will decrease with 30%. The projected emission of NO_x in 2020 amounts to 185 kton (bandwidth 162-224). This is mainly due to the decreasing NO_x emission in traffic. Although the traffic volume increases with about 20%, the European emission standard for passenger cars and lorries results in an emission reduction by a factor 2 to 3 per driven kilometre.

Sulphur dioxide (SO_2)

The current EU target for SO_2 emission amounts to 50 kton as of 2010. The projected emission of SO_2 in 2020 amounts to 46 kton (bandwidth 41 – 49). The SO_2 emission increases with 10% between 2010 and 2020. The main sectors contributing to the SO_2 emissions include the industry, refineries and the electricity sector. Until 2010 the emissions in industry and refineries decreased, which was mainly due to the economic recession. From 2010 onwards emissions start increasing again in industry due to economic growth. The emissions of refineries stabilize between 2010 and 2020 as a result of the implementation of the sector ceiling. In the electricity sector, the emissions increase due to expansion of generation capacity (new electricity plants). The emissions stabilize between 2015 and 2020 as a result of the implementation of the sector ceiling.

Ammonia (NH_3)

As of 2010, the EU ceiling for NH3 emissions amounts to 128 kton. The projected NH3 emission amounts to 118 kton in 2020 (bandwidth 102-138), 102 kton of which is emitted by agriculture. Between 2010 and 2020 the NH3 emission decreases with about 10%. Due to market developments the total livestock is expected to stabilize roughly at the level of 2007. Some differences can be noticed at the level of specific animal species. The reduction in NH3 emission is mainly realised due to additional requirements for stables.

Particulate matter (PM_{10})

The particulate matter emission (PM10) remains more or less stable between 2010 and 2020. The projected PM10 emission in 2020 amounts to 29 kton (bandwidth 25-35). There is no EU target for PM10 emissions. Industry, traffic and agriculture make the largest contributions to the emission. In industry the emission increases, following the pattern of economic developments. The emission in traffic decreases due to the use of soot filters. Agriculture shows a mixed picture: on the one hand the emission increases due to housing requirements in view of animal welfare; on the other hand new companies or companies that expand are required to take additional emission reduction measures, which leads to a reduction in the emission. On balance, the emission in agriculture in 2020 is about the same as in 2010. This projection has also mapped the emission of ultrafine particles ($PM_{2.5}$). As their emission data are derived from the PM_{10} data, their development is more or less the same.

Volatile organic compounds (NMVOC)

The NMVOC emission increases with a few percent between 2010 and 2020 and amounts to 149 kton in 2020 (bandwidth 132-168). The EU target amounts to 185 kton as of 2010. Especially the emissions from traffic and the energy sector decrease. This decrease is contrasted by an increase in emission by all other actors. The consumer emissions show the largest increase as a result of the use of cosmetics and other care products, paint and cleaning products.

S.12 Conclusions about air polluting substances

The current EU ceilings for air-polluting substances are within reach. The insights gained during this projection learn that in case of implementation of fixed policy the projected emissions of most substances in 2020 are lower than the current EU ceilings. One exception is NH3, which has a ceiling in the projected bandwidth, which could result in 2020 emissions that are higher than the ceiling. The EU ceilings will be tightened before 2020.

1. Introduction

1.1 Objective and scope

This Reference projection provides insight in the expected developments in energy and emissions up to 2020 in support of Dutch energy, climate and air policy. It provides answers to the questions if the national policy objectives for 2020 are within reach and if the Netherlands will be able to comply with the European obligations. Both the European and Dutch authorities have formulated policy objectives for the amount of greenhouse gas emission, the emission of air-polluting substances, the share of renewable energy and the energy saving pace in the Netherlands. This report helps assess if targets are within reach and provides a reference in preparation of new policy.

The main reason for publishing this new Reference projection was the policy process of the Clean and Efficient (Schoon en Zuinig) programme. The Dutch Minister of Housing, Spatial Planning and the Environment planned on reporting to the Dutch Lower Chamber about the progress in this dossier in the spring of 2010 and to announce additional policy measures to realise the targets, if needed. The policy process of Clean and Efficient is at a standstill now that the Dutch cabinet has resigned and the additional policy package will only be sent to the Chamber for information purposes. This projection can now serve as preparation of possible policy amendments by a new Cabinet. Apart from the above-mentioned reason for publishing a new Reference projection, ECN and PBL periodically update the Reference projection because insights about future expectations are subject to change.

The energy and climate targets for 2020 can be characterised as intermediate targets. Limiting the global temperature rise to two degrees requires drastic emission reduction in the long term, including in the Netherlands. This report does not address the question to what extent the 2020 targets and the measures implemented for realizing these targets fit in the long-term perspective. Neither does this report analyse which policy options are conceivable. This projection only presents the effects of fixed and intended policy as announced by the Balkenende IV Cabinet. The costs of fixed and intended policy have not been calculated either. The question if the fixed or intended policy measures constitute a cost-effective policy package is thus outside the scope of this projection.

1.2 Outline approach

To be able to sketch an image of the energy and emission developments in 2020, an image of the demographical and economic development is needed first. Demographical developments influence the economic developments (potential labour force) but they are also relevant for the number of dwellings, for example. A macro view is given on the economic developments until 2020. This view is subsequently translated into volume developments in sectors. The energy use and the volume of emissions depend on the amount of goods and services that is produced and consumed. In addition, projections are made for the energy prices. Policy also influences the deployment of energy and the amount of emissions, i.e. European and Dutch energy and climate policy. A significant outcome of the European climate policy is the price for CO_2 emission allowances. Among other things.

The emission of the so-called other greenhouse gases is barely related to energy use. In agriculture, the volume of the livestock is an important variable for the emission of the greenhouse gases methane and nitrous oxide. The livestock volume also influences the NH3 emissions significantly. Combining the demographical and economic developments and the resulting volume developments for 2020 with the energy and CO_2 prices and the effect of policy results in a background view for establishing the energy use and emission volume. Including specific developments in sectors, the deployed fuel mix and the emission factors results in an overall picture of the emission.

This projection presents not only the energy and emission projection under fixed policy conditions; it also maps the expected effects of intended Clean and Efficient policy. To interpret the effects of the total Clean and Efficient policy package, the projection shows how the emissions would have developed without Clean and Efficient Policy. The air-polluting emissions are only projected under fixed policy conditions.

The projection can be characterised by a business as usual image: except for changes in policy, this projection assumes trend wise developments. As the future is surrounded by uncertainties by definition, the projection also maps the uncertainties of the main assumptions and translates them into effects on energy use and emissions. The uncertainties are ultimately presented as a bandwidth reflecting a 90% reliability interval.

Differences with previous projection
This new projection differs in many ways from the previous Reference projection (ECN/PBL, 2005), which was updated most recently in 2009 (ECN/PBL, 2009). Beside the changes in policy, this projection is based on calculations with different prices and economic growth. It also includes the latest insights in emission factors. As the Reference projection results from an integral calculation, it is difficult to derive the exact effect of the separate factors. In Appendix D the main differences are interpreted roughly.

1.3 Reading instructions

This report describes the assumptions and provides an outline explanation of the results of the projected emissions. Background reports will be published about several subjects, containing more detailed information. Nevertheless, the report elaborates several subjects because certain details are relevant for interpreting the results. These elaborations are usually incorporated in text boxes. A text box thus contains more in-depth information or additional explanation of a subject.

Chapter 2 addresses the used method and the general starting points of this report. Chapter 3 describes the energy and CO_2 developments per sector. Chapter 4 addresses the question what the energy supply will look like in 2020. Chapter 5 subsequently discusses the development of the other greenhouse gases and Chapter 6 describes the development of the air-polluting substances. Chapter 7 is a synthesis chapter in which the effects of the Clean and Efficient policy are analysed. Such a synthesis on air policy is not included in this report.

2. Method and starting points

2.1 Policy variants

Political decision-making is a continuous process. Not all policy included in this projection has the same status. Fixed policy, which has completed the political decision-making stage, is the most certain policy. But new energy and climate policy has also been announced. Political decision-making in this so-called intended policy has not yet been completed which makes the effects of the intended policy inherently more uncertain. The Balkenende IV Cabinet planned on implementing road pricing, but the resignation of the Cabinet unsettled these plans. Therefore this Reference projection distinguishes policy variants, i.e. a variant that maps only the effects of fixed policy and a variant that maps the effects of fixed and intended Clean and Efficient policy. To be able to interpret the total effect of Clean and Efficient policy, there is also a variant without Clean and Efficient policy. A full policy overview is included in Appendix B. The chapters discuss only the policy components that have a substantial effect and do not aim to be exhaustive.

The starting points of the fixed policy are as much as possible derived from public documents and discussed with involved ministries if needed. All policy that passed the decision-making stage by October 2009 will be considered fixed policy.

The intended Clean and Efficient policy is primarily derived from the working programme Clean and Efficient and supplemented by other proposed measures for energy and climate policy, such as the surcharge on the electricity price to generate additional funding for subsidizing renewable energy. In those cases where intended policy lacked concreteness the ministries have indicated which implementation this Reference projection should use.

All policy variants use the same assumptions for economy, demography and energy and CO_2 prices. The only difference is the assumed policy.

In the figures and tables of this report the three policy variants are indicated by abbreviations (1) RR2010-0, which is the variant without Clean and Efficient policy; (2) RR2010-V which is the variant with fixed policy; and (3) RR2010-VV which is the variant with fixed and intended Clean and Efficient policy. One exception is constituted by the air-polluting substances; their emissions were only projected under fixed policy conditions.

2.2 Uncertainty analysis

The projection also maps the main uncertainty factors and their influence on energy use and emissions. The uncertainties with regard to general assumptions about economy, demography and energy and CO_2 prices are translated into an uncertainty in energy use and emissions per sector. Moreover, the characteristic uncertainties per sector have also been mapped.

These different uncertainty factors were used to calculate the bandwidths in energy use, emissions, saving pace and amount of renewable energy. This was done for the Netherlands, and for the separate sectors, if relevant.

This report does not discuss the assumptions and results of the uncertainty analysis separately, but as part of the description of the sector, target range, policy, etcetera. Unless stated otherwise, the uncertainties apply to all three policy variants. The bandwidth applies to the variant with fixed policy; the bandwidth of the other two variants may show slight deviations. In case of large deviations, the bandwidth for the variant is mentioned separately.

Policy related uncertainties are important. The mapped policy uncertainties do not include the implementation of policy, but only the uncertainties in the effects of policy, given the policy starting point. The uncertainties do not bear upon the exact implementation of policy such as the exact standard, the available budget, etcetera. The policy uncertainties do include the uncertainties in the effect realised by policy in view of a certain standard, budget, etcetera. The reason why only this uncertainty is included in effects is the fact that interpretation of policy is not an uncontrollable external uncertainty but a choice of the Cabinet.

The uncertainty analysis also takes into account the uncertainties in the monitoring of emissions. On the one hand, this uncertainty depends on year after year of fluctuations as a result of weather conditions, for example. On the other hand, fluctuations may arise because emissions are difficult to establish by definition. In case of some substances the monitoring uncertainty is substantial and very determinant for the total uncertainty bandwidth. This is mainly the case with other greenhouse gases and NMVOC (see Chapter 5, Section 6.3 and Text box 2.1 (*Settling the account: dealing with targets in the end year*).

In the illustration of uncertainties in the tables, the bottom value of the bandwidth reflects a low value of the uncertain factor and the top value reflects a high value of the bandwidth. This could mean that the top has a negative value. A high CO_2 price will for example lead to lower emissions.

Box 2.1 *Settlement: dealing with targets in the end year*

2020, a cold year with little wind. Heating of dwellings and offices requires more gas than in an average year. Therefore the CO_2 emissions are higher than usual. The wind energy yield is lower than usual. Is this a major setback for realising the energy and climate targets?

Year after year of fluctuations in emissions constitutes uncertainty for the realisation of the targets. If these fluctuations are not controllable, there are ways to include them in the verification of the targets. Examples include a multi-annual accounting period and normalization.

Multi-annual settlement period
Realisation of the Kyoto target is verified based on the emissions of the period 2008-2012. This diminishes the role of accidental fluctuations: they are expected to more or less balance each other out in a multi-annual period.

Normalisation
If fluctuations are (largely) linked to measurable factors, this will make it possible verify them with normalized realizations. In this process realizations are translated into standard situations. This way, energy used that is corrected for degree days can be translated into the use in an average year and the production of wind energy can be adjusted with correction for wind speed.

How do Clean and Efficient and the Reference projection deal with uncertainties resulting from annual fluctuations?
The work programme Clean and Efficient does not provide explicit information on how it deals with the uncertainties of the annual fluctuations. The Reference projection assumes that these fluctuations will be tested against normalised emissions and energy use, whenever possible. The calculated values are already based on standard assumptions for temperature, wind supply, etcetera. Uncertainties resulting from annual fluctuations have not been taken into account for these factors

2.3 Demography and economy

Demographical and economic developments

The environmental load in the period 2010-2020 has been calculated against a background of demographical and economic development, based on a most realistic estimate. Demographical developments were derived from prognoses made by CBS (Statistics Netherlands) about the population size and the development of the number of households. The macro-economic growth is based on the structural growth of the labour productivity of 1.7% annually, as used by CPB (Netherlands Bureau for Economic Policy Analysis) for long-term studies, and on an estimate of the growth of the working population.

Population size

The population size is based on the most recent population prognosis of CBS (van Duin, 2009). According to this prognosis the population size will increase from 16.4 million in 2008 to 17.0 million in 2020 (Table 2.1.), an average annual growth of 0.3%. The population growth is decreasing: in the last decade the annual growth rate 0.5%. The CBS also provides an uncertainty bandwidth for the population size in 2020, but it uses a reliability interval that differs from the reliability interval of 90% that we use here. From the CBS reliability interval a bandwidth can be derived for the 90% reliability interval. This bandwidth would range from 16.5 million to 17.5 million persons.

Despite the expected increase in population size, the potential working population (the number of persons aged 15 to 65) will decrease by 0.1% annually in the next decade. This is a unique development in the history of the Netherlands. Despite the fact that the total number of persons younger than 65 decreases, the number of persons aged 15 to 34 increases with 0.4% annually up to 2020 (Table 2.1). This is partly the result of continued immigration, A large share of the immigrants are aged 15 to 35 years. The number of persons older than 65 will increase from 2.4 million persons in 2008 to 3.4 million persons in 2020. The share of persons older than 65 in the total population will increase from 14.7% in 2008 to 19.7% in 2020.

Table 2.1 *Population developments 2008-2020 according to CBS*

	2008 [mln]	2010 [mln]	2020 [mln]	Annual growth 2008-2020 [%]
Total population	16.4	16.5	17.0	0.3
0-14 years	2.9	2.9	2.7	-0.6
15-34 years	4.0	4.0	4.2	0.4
35-64 years	7.1	7.1	6.7	-0.4
65+ years	2.4	2.5	3.4	2.8
Potential working pop.[1]	11.1	11.1	10.9	-0.1

Households

According to the CBS households prognosis the number of persons per household will further decrease in the next years. The average number of persons in a private household will decrease from 2.24 in 2008 to 2.14 in 2020 (van Duin en Loozen, 2009). As a result, the number of households will increase from 7.2 million in 2008 to 7.9 million in 2020. The uncertainty bandwidth for the number of households in 2020 is 7.3 to 8.5 million.

[1] The potential working population is the total population of the age group 15-65 years.

Table 2.2 *Number of households and distribution of number of households according to size*

	2008 [mln]	2010 [mln]	2020 [mln]	Annual growth 2008-2020 [%]
Population size	16.41	16.54	17.01	0.3
Total number households	7.24	7.35	7.86	0.7
Single person households	2.57	2.64	3.01	1.3
Multiple persons households	4.67	4.72	4.85	0.3
Average household size	2.24	2.22	2.14	-0.4

Macro-economic developments

The Reference projection assumes a structural growth of the economy that is based on the structural growth of labour productivity and on employment growth. As for labour productivity, CPB assumes a structural growth of 1.7% annually (CPB, 2006). Employment will be addressed at a later stage.

The Reference projection takes into account the impact of the credit crisis, which caused economic shrinkage in 2009 and 2010. The Reference projection uses the economic prognoses for 2009 and 2010 provided by the Centraal Economisch Plan 2009 of CPB (CPB, 2009). At that time, CPB anticipated an economic shrinkage of 3.5% for 2009 and ¼% for 2010[2].

The negative economic growth of 2009 and 2010 also affects the growth in subsequent years. Due to the credit crisis unemployment will rise and due to higher unemployment the wages will increase more slowly. The lower growth in labour costs means that businesses will be less inclined to invest in higher labour productivity to save costs. This will put the growth in labour productivity under pressure. In the period 2011-2020 the average annual growth of labour productivity is therefore below the structural level at an estimated growth rate of 1.4% annually. As a result of this lower growth of labour productivity less employment loss will occur and in 2020 unemployment will decrease to the average level of the last decade.

Employment

Employment depends on demand and supply of labour. The development of labour supply (i.e. the working population) depends on the development of the potential working population and the increase the labour productivity. The potential working population will decrease with 0.1% annually between 2011 and 2020. Employment is expected to increase in the next years. However, due to the higher unemployment that resulted from the credit crisis this increase will be modest. An annual growth of employment of 0.1% does not change the size of the working population between 2011 and 2020. The unemployment that arose because of the credit crisis will be solved by 2020 and return to a normal level. This means that employment will increase with 0.3% annually in the period 2011-2020.

The average economic growth between 2011 and 2020 is estimated at 1.7% annually (Table 2.3.) based on an annual growth in labour productivity of 1.4% and a growth of employment of 0.3% annually.

In the past the growth of labour productivity and employment fluctuated significantly from one year to the next. Over a longer period of time the average fluctuation is less significant. Taking

[2] After that CPB provided new quarterly forecasts for the economic growth in 2009 and 2010. The adjustments of June 2009 and September 2009 showed a rather gloomy picture, but more recent forecasts, i.e. the Centraal Economisch Plan of March 2010 (CPB, 2010a) anticipates -4% for 2009 and +1.5% for 2010. The depth of the economic recession thus seems to be less profound compared to the previous projection. The Reference projection was almost finished when the most recent CPB forecast was published. The CEP forecast of 2009, which was used for this Reference projection, seems to be nearest to the CPB forecast compared to the other forecasts that were published. The changes in emissions resulting from the latest economic insights are limited and stay within the bandwidth that is used.

into account the fluctuations in the past, this Reference projection assumes a bandwidth for economic growth of 1 to 2.5% for the period 2010-2020.

Box 2.2 *Similarities and differences with the medium term projection of CPB*

In March 2010 CPB published an economic outlook for the period 2011-2015 (CPB, 2010b). CPB estimates an average annual economic growth of 1.75% for this period. This is about the same as the 1.7% annual economic growth that is assumed for this period by the Reference projection. Looking at the various demand categories, CPB anticipates a higher growth for export and investments and a lower growth for private consumption and government consumption than the Reference projection. This could mean that the basic industry and agriculture, which both depend to a relatively large extent on export, will grow more significantly in the CPB forecast than in the Reference projection. However, CPB does not provide any forecasts for sectoral developments. For the Reference projection the macro-economic growth was projected in May 2009, whereas the MLT projection of CPB was published on 16 March 2010.

Consumption

According to CPB the disposable income and consumption will decrease in 2009 and 2010 as a result of the credit crisis. In the period 2010-2011 the disposable income will lag somewhat behind the economic growth, because other expenditure that must be financed from the economic growth will increase more rapidly. In the last decades consumer expenditures increased by 0.3% more rapidly annually than the disposable income. As for the period 2011-2020, it is assumed that the growth of consumer expenditure will be 0.3% higher annually than the growth of the disposable income[3], which is in line with the development of the last decades and the scenarios described in Huizinga and Smid (2004).

Table 2.3 *Annual economic growth, disposable income and consumer expenditure*

	Growth per capita [%]			Growth Dutch economy [%]		
	2009	2010	2011-2020	2009	2010	2011-2020
Economic growth (GDP)	-3.8	-0.8	1.4	-3.5	-0.3	1.7
Disposable income	-0.6	-0.8	1.3	-0.3	-0.5	1.6
Consumer expenditures	-0.6	-0.8	1.7	-0.3	-0.5	1.9

The growth in consumer expenditure is not evenly divided among the various types of domestic expenditure. Food, clothing, rent and rental value, gas, electricity and water expenditure increase more slowly than the total average; holiday and leisure expenditure grows faster.

Developments in production sectors

When establishing the environmental burden it is important to know the economic developments of the individual production sectors because they show large differences in environmental burden per produced euro. The credit crisis mainly affects the industry (Table 2.4.). The industrial shrinkage in 2009 and 2010 is therefore much larger than the shrinkage of the entire economy. The public sector and the government are less affected by the credit crisis; they still experience growth in 2009 and 2010.

In the period 2011-2020 the differences in growth among the various sectors are smaller than in the crisis years 2009 and 2010. The tertiary services and industry show a higher than average growth in 2011-2020. The chemical industry is the largest growing industry. The growth in the base metal industry is also higher than the average of the entire industry. The foods industry has a somewhat lower growth. The growth of the other sectors lags far behind the average economic

[3] Consumption expenditure of households can grow more rapidly than the dispensable income if households also tap into their savings and other property titles. These may also include pension savings (Huizinga en Smid, 2004, p. 39).

growth, which is mainly due to the mineral extraction that is expected to shrink significantly between 2011 and 2020 because of the decreasing gas extraction. Where relevant, Chapter 3 will further address the development of the sub sectors and their corresponding volume developments, energy demand and emissions. The assumed development of the livestock is described in Section 6.4.

Table 2.4 *Annual growth of the value added tax according to sector*

	2009 [%]	2010 [%]	2011-2020 [%]
Agriculture	-3.4	0.8	1.5
Industry	-7.9	-0.7	1.9
Tertiary Services	-4.0	-0.4	2.3
Public Services and Government	1.4	0.9	1.7
Other	-3.1	-0.8	0.3
Total	-3.5	-0.3	1.7

2.4 Fuel and CO_2 prices

Commodity prices of fuels
Commodity prices are the trading prices, excluding the cost of delivery and taxes and surcharges.

The Reference projection assumes an oil price of $70 per barrel as of 2010, which is based on the euro-dollar exchange rate of mid 2008. The bandwidth used for the calculations is $40 to $100 per barrel, which is in line with the CPB study of the oil price in the long term (CPB, 2010). This bandwidth is related to the structural price level and does not take temporary peaks into account. At $70 per barrel the price amounts to €8/GJ.

The gas price is on average about €6.5/GJ between 2010 and 2020, which corresponds to about 19ct/€m^3. The projection assumes the same relative bandwidth as for oil: 11 to 27 €ct/m^3.

The coal price is on average about €2.2/GJ. The coal price has a less volatile history, which is why the projection assumes a smaller bandwidth: €1.8 to 2.7€/GJ.

The electricity prices are not used as input for the projection, but they are a result in which fuel prices, CO_2 prices and the development of generation capacity play important roles. Section 4.1 provides an explanation of the prices calculated in the projection.

Box 2.3 *The effect of the dollar rate on the oil price*

The projection assumes an oil price of $70 per barrel and a bandwidth of $40-$100 per barrel. The current oil price (on 9 March 2010) is $81 per barrel (http://www.finanzen.net/rohstoffe/oelpreis). However, these oil prices cannot be easily compared, because the value of the dollar also changes.

As a result of the often heavy fluctuations in the exchange rate of the dollar compared to the euro and other currencies, the price in dollars often provides a distorted picture. An oil price expressed in euros would be more meaningful to provide a price level for European consumers and businesses than a price expressed in dollars. The $70 used in the projection has been translated into an oil price in euros by means of an exchange rate of mid 2008 (€1 is $1,53).

News coverage about the oil price always refers to a price in dollars, though. As a result an oil price in euros is not meaningful at all for most people. Therefore the Reference projection also reports the oil price expressed in dollars. To be able to establish the difference between the assumed price and the current price a correction should be made for the changes in the exchange rate. The below table shows how the price of $70 (2008 dollars) is translated into euro at various exchange rates. A cheaper euro implies a higher oil price. On 9 March 2010 the value of the euro is $1.36 instead of $1.53. Thus $70 per barrel for Euro countries is similar to $79 per barrel mid 2008.

The current oil price, as stated earlier, is $81/barrel, which is just as expensive for Euro countries as $91/barrel would have been mid 2008. The current price is thus approaching the ceiling of the bandwidth used by the projection.

Exchange rate ($/€) => oil price in dollars of 2008

1.9	=>	56	More expensive Euro
1.8	=>	60	
1.7	=>	63	
1.6	=>	67	
1.5 **3**	**=>**	**70**	Mid 2008
1.5	=>	71	
1.4	=>	77	
1.3 **6**	**=>**	**79**	9 March 2010
1.3	=>	82	
1.2	=>	89	
1.1	=>	97	
1	=>	107	Cheaper Euro

Price of CO_2 emission allowances

Those businesses that are engaged in the European emission trading system must also take the CO_2 price into account. The projection assumes a CO_2 price of €20/ton CO_2 for the period 2010-2020, using a bandwidth of €10 to €40/ton CO_2. The economic recession has resulted in a surplus of allowances in the period 2008-2012. Businesses are allowed to use (part of) this surplus in the period 2013-2020. As the economic growth has also been moderated, the demand for CO_2 allowances in this projection increases more slowly, resulting in prices that remain structurally lower than anticipated before the recession until 2020.

End user prices

Commodity prices and CO_2 prices constitute only part of the price that citizens and businesses pay for energy. The commodity price is the dominant price component only for large users such as electricity plants and large industrial businesses. In the case of small and medium-sized businesses the energy taxes and supply costs are just as important or even more important.

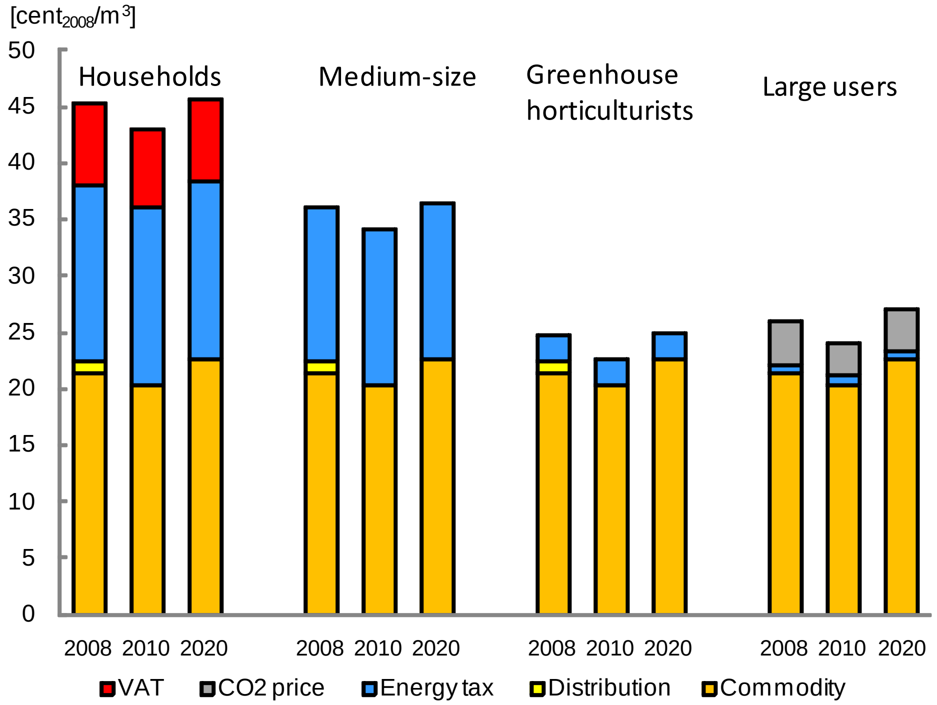

Figure 2.1 *Indicational breakdown of marginal prices per user category for natural gas*

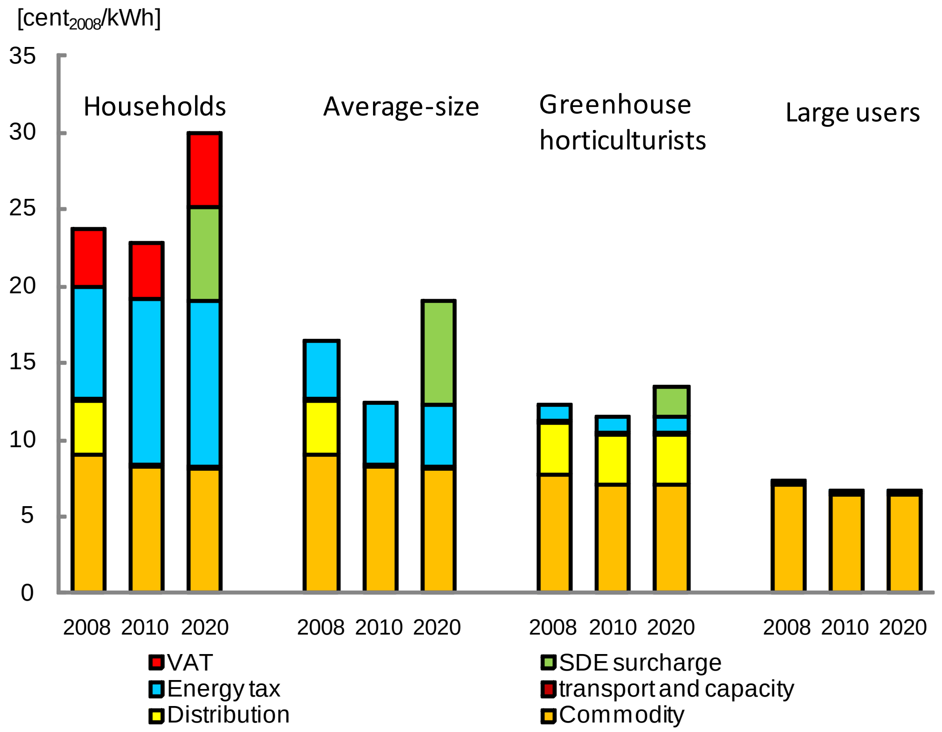

Figure 2.2 *Indicational breakdown of marginal prices per user category for electricity*

The figures provide an indication of the natural gas and electricity prices for various categories of energy users. To visualize the SDE surcharge, the electricity price shown here entails the variant with intended policy. Figure 2.1 also shows the share of the CO_2 price in the marginal costs for natural gas use of ETS participants.

Box 2.4 *The impact of CO_2 and fuel prices on energy use and emissions*

Higher CO_2 and fuel prices make energy more expensive and energy saving and transition to renewable energy more rewarding. Yet, the effect of a higher oil or gas price is not always as significant as what may seem obvious at first. Moreover it may take a long time before the effect has fully developed. Many different aspects play a role in weakening the role that price stimuli may play in energy use.

Fixed price components
Especially in the case of small users and transport fuels a large part of the price is not composed of the trade price of oil or gas; its main components are taxes, supply tariffs or excises. Relatively speaking, a large increase in the oil price, for example, implies a much smaller increase for the end user.

Share of energy in costs
Energy usually takes up a relatively small share in the total cost of an activity, which is why little attention is paid to them. Even in the energy intensive industry, for example, the share of labour in the costs is usually much larger than the cost of energy. In the rest of the industry, especially in the services sector, the share of energy in the total cost is much smaller. That is why companies often pay more attention to other aspects when making investment decisions, such as labour costs or product quality. Even in households the cost of energy is usually low compared to other costs.

Split incentives
In the case of house-renting the person carrying the cost of the energy saving measure is usually not the person who benefits from these measures. The landlord can take measures but he will not benefit from the results, whereas the tenant is not allowed to take measures while he would benefit from the results. This does not only apply to dwellings, but also to companies that rent office space or equipment.

Policy
In some cases policy has already resulted in implementing measures that would be unprofitable with the current energy prices. Thus, policy cuts away the ground from under the feet of the price incentive.

Slowness and natural moments
An industrial installation may last up to forty years in some cases and a dwelling much longer than that. After installing or construction there are limited options for lowering the energy use. Therefore it may take quite some time before a higher energy price takes full effect. It is not until replacement or renovation is needed that the higher energy price will be transferred onto a new decision.

Uncertainty
The energy price often does not stay high for a long time. Energy prices can be very volatile and any measure that will only be profitable in case of high energy prices will not be taken if the investor expects the energy prices to lower again.

Cushioning
An increase in the gas price may lead to a higher electricity price, but this effect is usually relatively smaller. Higher gas prices may cause electricity producers to increase the deployment of coal-fired plants, which limits the effect on the cost price of electricity.

2.5 Other

Change in average temperature
This projection takes into account the expected change in average temperature[4]. A higher average outdoor temperature decreases the energy use for heating, but increases the energy use for cooling.

Use of historical data
The figures and tables in the projection show the projected development of energy use and emissions together with the available historical data. The data on energy use and CO_2 emissions were taken from MONIT[5]. These data are based on the emission registration, the CBS data and NEA. The data from MONIT have been adjusted to visualise the structural trends. This means that MONIT corrects for changes in the observation system of CBS (e.g. changes in the sector division used by CBS) and that it corrects for annual fluctuations in the outdoor temperature.

The emission data for other greenhouse gases and air-polluting substances (the so-called NEC substances) were taken from the emission registration.

Linking to historical data
The adjusted historical data on energy use and CO_2 emissions are used as a starting point for the Reference projection, but in a number of cases the projection data and historical ranges are not well-attuned. There can be various reasons for this. Sometimes the available historical data are not well-attuned. Some of the historical ranges contain fluctuations that are not included in the calculations, for example due to large maintenance work to installations. Moreover, a number of sectors are not monitored by CBS. The energy use of these 'other users' (construction, agriculture, services) is derived by deducting the data of the other sectors from the total energy use of the Netherlands. The agricultural energy use is still estimated based on LEI data and construction is also estimated, leaving the services sector as the last entry. In this sector the historical ranges have the lowest reliability.

Data received after calculations
After the calculations were finished some new historical data on the energy use became available. Especially in the case of other users (construction, agriculture, services) these ranges can show relatively large deviations from the used ranges. As these data are expected to become the new standard they were used for the historical data in the figures, despite the fact that they were not the starting point of the calculations.

5-year intervals
In a number of cases the link between projection and history are distorted because the projection shows only 5-year intervals and the historical ranges are annual ranges. The manner in which the energy and emissions decrease in the run-up to the recession of 2010 cannot be visualised by the projection. The underlying calculations do take this into account.

4 The projection assumes the same trend as the WLO [CPB/MNP/RPB 2006].
5 MONIT is the acronym for 'Monitoring the Development of National energy use, Information and Trend analysis'. MONIT has data on energy use. Production of electricity, production of renewable energy en emissions of greenhouse gases and air-polluting substances, in various sectors of the Dutch society. Data are available for the period 1990-2006. In addition to historical data, the system also contains energy and emission series of various scenarios and projections.

3. Energy and CO_2

3.1 Introduction

In 2008 the Netherlands emitted 207 Mton CO_2eq of greenhouse gases and the energy use in the Netherlands amounted to 3349 PJ. Both data have been corrected for temperature: emissions and use have been translated into a year of temperatures according to the long-term trend.

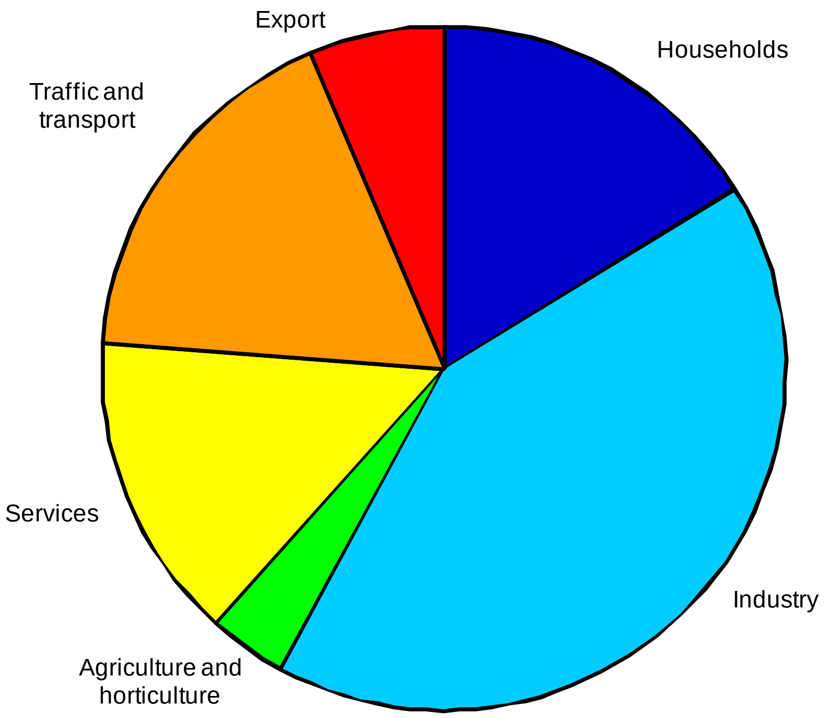

Figure 3.1 *Distribution primary energy according to sector, 2008*

The division of the primary energy use contains only the end user sectors. The energy losses of the energy companies in primary use have been allocated to the sectors to which they supply energy. The export of energy is not part of primary use, but the conversion losses of the export are[6]. This amounts to 6% of the primary use. At 40% the industry is the largest user in primary use. Almost half of this use consists of so-called feedstocks: The use of energy (e.g. petroleum) as a raw material, for example for plastics. Households and Traffic each use about 17%, followed by the services sector at nearly 15%. At the bottom of the list is agriculture at 4%.

The distribution of CO_2 emissions shows quite a different picture. It shows the emissions in the sectors where they were emitted; the energy companies are included here. The largest source of CO_2 emissions is the energy companies (38%), followed by traffic (23%) and industry (19%). Households (10%), services (6%) and agriculture (4%) conclude the list. The CO_2 emission takes up 85% of the total Dutch greenhouse gas emissions.

6 Especially the export of oil products is very important in the Netherlands.

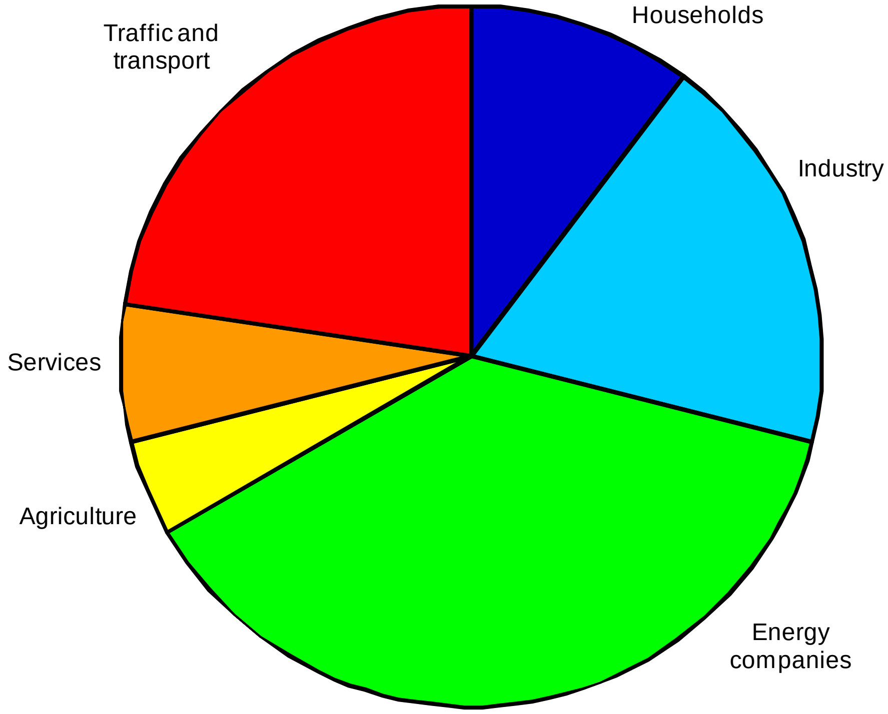

Figure 3.2 *Distribution of greenhouse gas emissions according to sector, 2008*

3.2 Industry

Introduction

The Netherlands has many large chemical businesses. Therefore, the share of the industry in the total primary energy use is high at about 40%. The total CO_2 emission of the industry was 32.9 Mton; including industrial cogeneration in which energy companies participate 40.5 Mton.

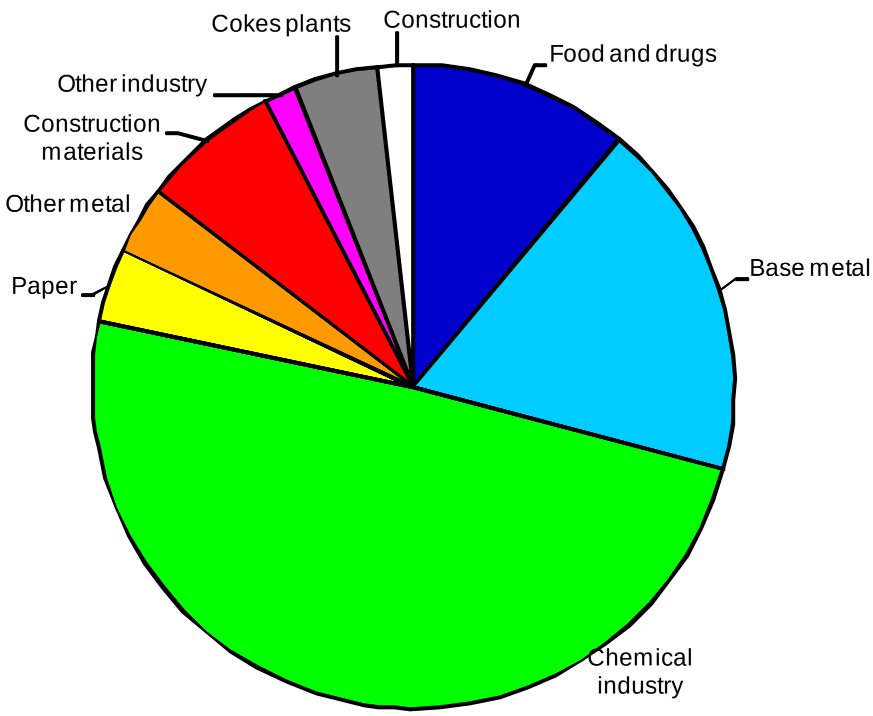

Figure 3.3 *Distribution of CO_2 emissions according to industrial sector, 2008*

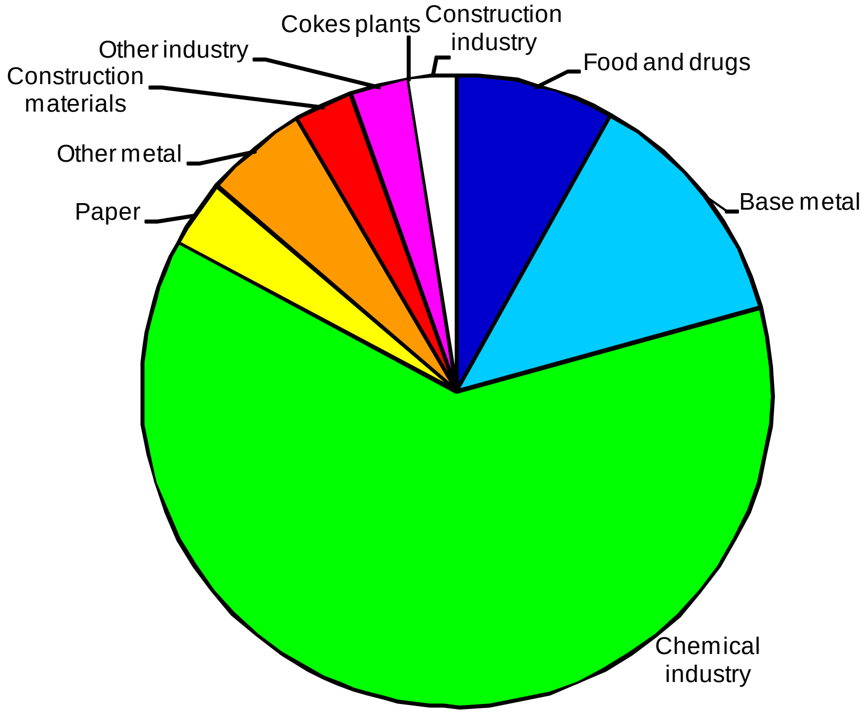

Figure 3.4 *Distribution industrial primary use according to sector, 2008*

Almost half of all primary energy in the industry is used for non-energetic purposes. Examples include the use of naphtha in cracking processes and of coking coal for steel production. The non-energetic use in the organic basic chemistry increased exceptionally in the energy statistics of the last years. In 2007 the statistics show a trend break caused by a change in the definition of the CBS.

Drivers
The economic crisis led to a steep fall in world trade and in the demand for industrial products. The energy-intensive industry and the metal industry are among the most severely affected sectors.

Recuperation of the economy will lead to resumption of the growth of the added value. The chemical industry has a relatively large average growth in the period 2011-2020 at 2.6% annually. The Netherlands continues to be an attractive production location for chemical industry due to the presence of strong clusters of companies and good logistics.

Corus Steel aims to increase its production significantly in the short term and intends to continue growing up to a production volume of 10 million tons in 2020[7]. The growth in the metal industry amounts to 1.7% annually. The food and feeds industry has an average annual growth of 1.3% and the other industry grows 2% annually.

Many industrial companies cater for their heat demand by means of CHP plants, thus saving energy. After a strong increase in industrial CHP in the 1990s, this growth stagnated. The projection shows a slight growth of CHP until 2020.

The yield of CHP has become more uncertain as a result of the liberalised electricity market. To suffer less from low electricity prices in off-peak hours, being able to deploy installations in a flexible manner would be favourable.

---

7 Personal communication C. Pietersen based on public statement of a senior executive of Tata.

Policy

The large energy-intensive industrial companies are engaged in the European Emission Trading System (ETS). However, the emission trade only encourages energy saving to a limited extent, because the price of CO_2 allowances will not increase significantly until 2020.

For long time Dutch energy policy has been based to a large extent on voluntary covenants. Industrial parties close long-term agreements with the government about energy saving, emission reduction and renewable energy.

The Covenant Benchmarking Energy Efficiency and the Long-term Agreement Energy Efficiency 2001-2012 (LTA2) expire in 2012. The variant without Clean and Efficient does not have a sequel. The Clean and Efficient policy does: These two covenants were recently replaced by new long-term agreements. In October 2009 all companies participating in the emission trade signed the Long-term Agreement Energy Efficiency for ETS enterprises (LEE). A large number of smaller and less energy-intensive companies acceded to the new Long-term Agreement Energy Efficiency 2001-2020 (LTA3) in 2008.

By signing covenants, businesses commit themselves to formulating energy saving plans, monitoring and implementation of long-term studies. The Environmental Protection Act obliges non-ETS businesses to take measures with a payback period up to five years; the covenants play a facilitating role in the actual implementation of these measures. Chain efficiency will receive more attention in the new covenants, but there is no distinct elevation of the ambition level or improved enforceability. Therefore, the new covenants will not result in a trend break. The differences in policy between the variants with fixed policy and intended policy are too limited for the industry.

Results

Due to the economic crisis, the primary energy use of the industry dropped abruptly between 2008 and 2010. However, in the period of economic recuperation after 2010 the primary energy use starts growing again.

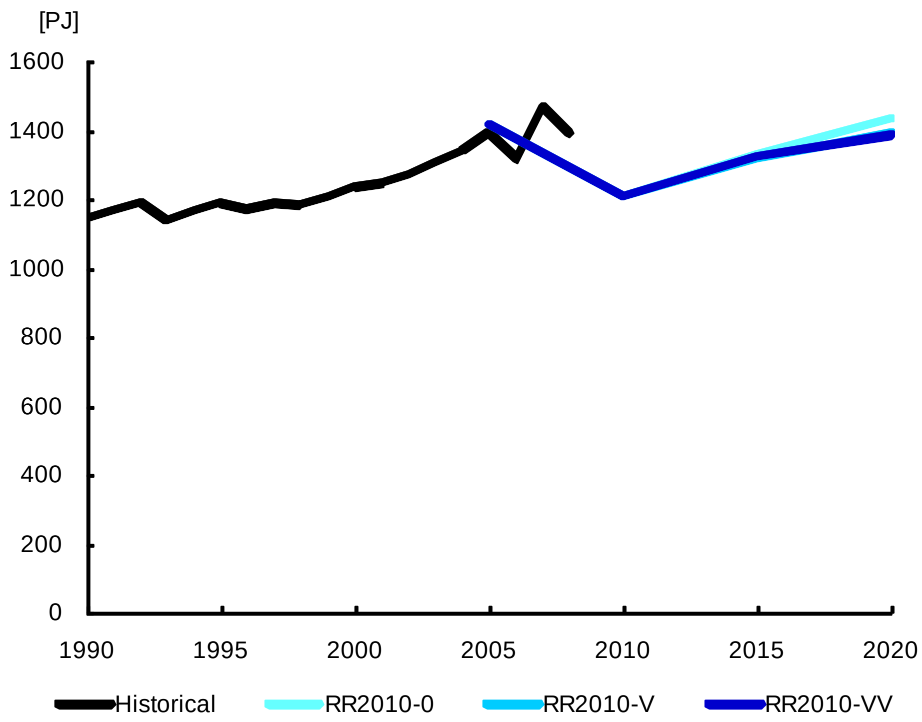

Figure 3.5 *Primary energy use industry 1990-2020*

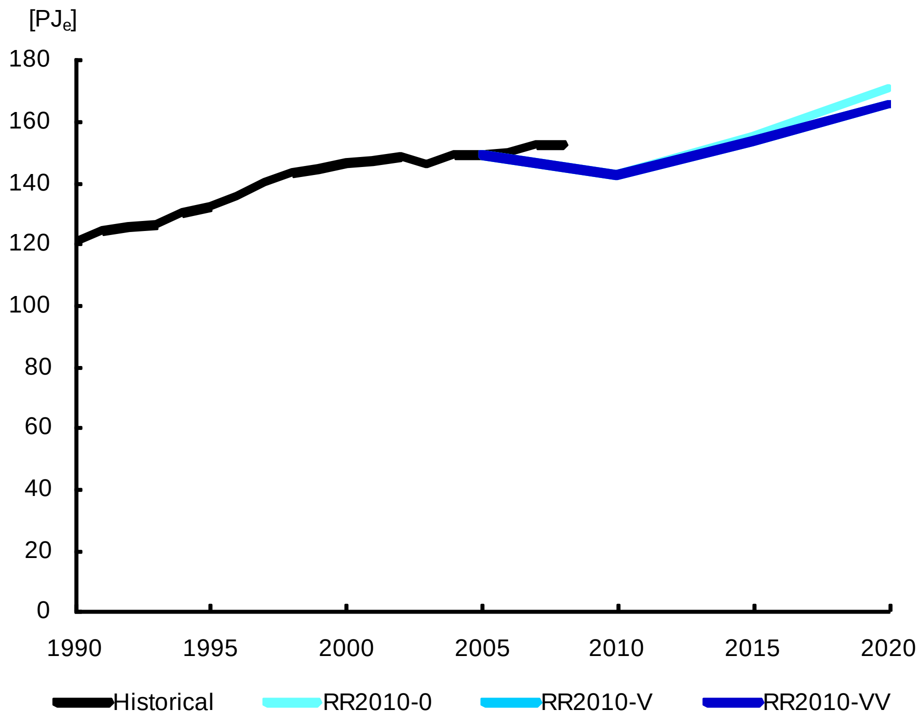

Figure 3.6 *Final electricity use industry 1990-2020.*

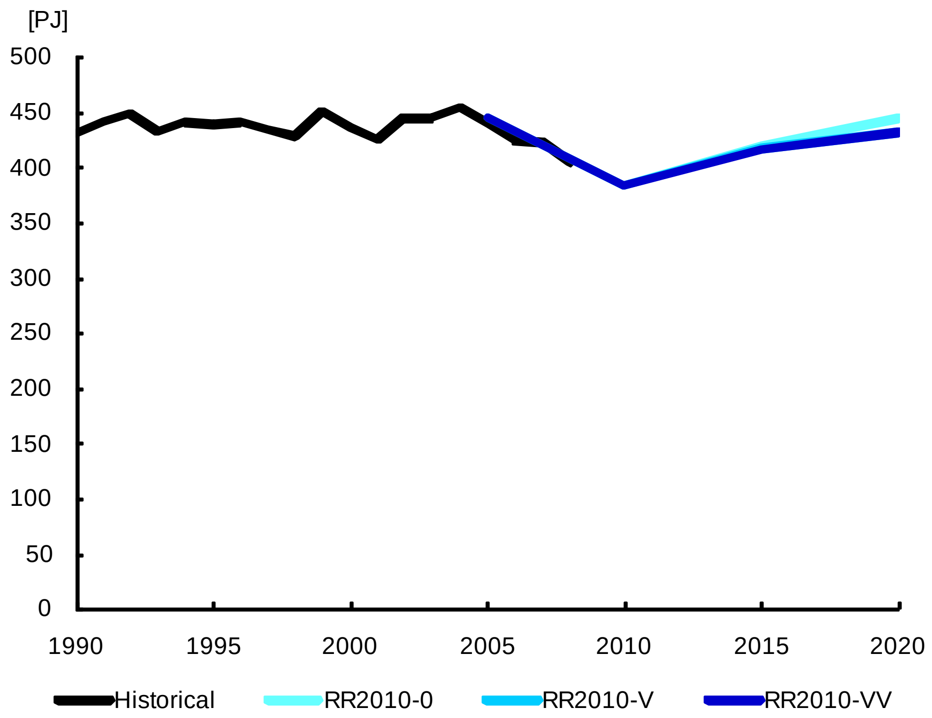

Figure 3.7 *Final thermal use industry 1990-2020*

As a result of the intended covenant policy, the energy saving pace will keep up to speed in the variants with fixed and intended policy. In the variant without Clean and Efficient policy there are no successors to the existing covenants, resulting in a drop in the energy saving pace when these covenants end. The European Ecodesign Directive establishes standards for appliances, which increases the energy saving.

Box 3.1 *The effect of covenants*

In addition to the European Emission Trading System, the covenant policy is the main pillar of the Clean and Efficient policy in the industry. The covenants for the industry do not encompass a result obligation with regard to a certain saving pace, but only a commitment. Companies are obliged to implement certain cost-effective measures with a payback period of up to five years. It is difficult to determine how effective such covenants are. It is also difficult to establish how covenants affect decision-making in businesses.

The Reference projection assumes that the covenants in the industry will not lead to implementation of measures that are not cost-effective. The covenants are expected to result in better utilisation of options that are cost-effective. The underlying assumption is that covenants increase attention for energy saving measures and result in better knowledge of the options. This decreases the chance of measures not being implemented because they are not known or because of an overestimate of risks or costs.

Based on the above, the covenants in the projection result in additional energy saving in the industry of about 0.2%-point annually compared to the situation in which the existing tradition of covenants and long-term agreements will not be continued. Compared to history the energy saving pace is not accelerated. The new covenants do not encompass intensification compared to the old ones. Due to the differences in approach the success of the covenants does vary from one sector to the next.

The increase in saving pace with 0.2%-point per year leads to an increase of the saving pace of approximately 20%. The energy saving pace is established according to the Protocol Monitoring Energy Saving (PME). It is difficult to compare the PME saving figures with the reported results of the Long-term Agreements, because the coverage and system boundaries of the methods are different. The LTA only reports about the businesses participating in the LTA, which are positive about energy saving. Moreover, the deployment of renewable energy and implemented chain projects contribute to the total energy efficiency according to the LTA method, whereas in PME these are not visible or allocated to other sectors.

A complete overview of studies on covenants can be found in Chapters 2 and 3 of Dijkgraaf et al. (2009).

The differences in results between the variants with fixed policy and intended policy are very limited for the industry. There is a significant difference in deployment of CHP, though. It is lower in the cases of fixed and intended policy than without Clean and Efficient policy. See section 4.2 for decentralised CHP.

Especially the large growth of Corus and the chemical industry cause the industrial CO_2 emission to increase from 32,8 Mton in 2008 to 39,2 Mton in 2010.

Uncertain factors

The main uncertain factors with regard to the development of energy use are the economic growth and its distribution across the industrial activities. There is also quite some uncertainty about the non energetic use. Higher fuel and CO_2 prices lead to more energy saving, both in final use and as a result of CHP. The additional use of CHP increases industrial CO_2 emissions but also lowers the emissions of the power sector.

The tables below show the influence of the most important uncertain factors on CO_2 emissions and electricity demand.

Table 3.1 *Uncertain factors CO_2 emission industry (Mton)*

[Mton CO_2]	Uncertainty range deviation 5-95%		
Description uncertain factor	Lower value	Upper value	Variant
Economic growth, choice of location companies and distribution of growth over activities	-3.1	3.1	
Fuel prices	1.2	-1.2	
CO_2 prices	0.3	-0.6	
Cost and potential of saving measures	-0.9	0.9	
Statistics/emission factors	-1.6	1.6	
Development of non-energetic use	-0.9	0.9	
CHP IND: Economic growth, choice of location companies and distribution of growth over activities	-1.5	1.5	
CHP IND: Fuel prices	-3.0	0.4	
CHP IND: CO_2 prices	-2.2	0.4	
CHP IND: Cost development and barriers CHP	-1.5	1.5	
Electricity covenants and other energy policy	0.9	-0.9	V, VV
VV Policy: Effectiveness other policy industry	0.2	0.0	VV

Table 3.2 *Uncertain factors electricity demand industry*

[PJ_e]	Uncertainty range deviation 5-95%		
Description uncertain factor	Lower value	Upper value	Variant
Economic growth, choice of location companies and distribution of growth over activities	-16.5	16.5	
Fuel prices	5.0	-5.0	
CO_2 prices	1.7	-3.3	
Cost and potential of saving measures	-5.0	5.0	
Electricity covenants and other energy policy	5.0	-5.0	V, VV

3.3 Traffic and transport

Introduction

In 2008 the sector traffic and transport was responsible for about 23% of the Dutch CO_2 emissions under Kyoto. The Dutch CO_2 emissions in traffic and transport are dominated by road traffic with a share of approximately 90%. Half of the remaining share can be allocated to mobile equipment. CO_2 emissions of international shipping and aviation above Dutch territory are not allocated to the Dutch CO_2 emission total under Kyoto.

This chapter will only address the CO_2 emissions in the sector traffic and transport. The emissions of other greenhouse gases (CH_4 en N_2O) are described in Chapter 5. The contribution of other greenhouse gases in the total greenhouse gas emissions (in CO_2 equivalents) by the sector traffic and transport is limited though (about 1%).

Main (volume) developments 2005-2020

New updates volume prognoses were established for the sector traffic and transport in the Netherlands for the new projections. The main drivers of growth in passenger and goods traffic are the demographical and economic developments and price developments. The volume prognosis for goods traffic on roads, by rail and by inland shipping in the Netherlands has been established with the model TRANSTOOL (TNO, 2009). The growth of the passenger car traffic has been derived from existing analyses with the National Model System (Landelijk Model Systeem, LMS) in the framework of the study Welfare, Prosperity and Quality of the Living Environment (WLO). These LMS results have been corrected for the starting points of the new projection by means of elasticities (Hoen et al., 2010, to be published). The volume prognoses for the other traffic categories have been established on the basis of existing studies or by extrapolating the realised volume trends in the period 2000-2008.

In RR2010-V the car mileage of road traffic increases on average 1% annually in the period 2008-2020. The total growth of road traffic in the same period amounts to nearly 13%. By implementing the price per kilometre, the growth in RR2010-VV is lower: the annual growth between 2008 and 2020 amounts to on average 0.4%.

The growth in passenger car traffic in the period 2008-2020 amounts to about 12% under fixed policy and 1% under intended policy. The goods traffic by road grows with approximately 16% under fixed policy and 15% under intended policy. In the same period the delivery van mileage increases with about 15 and 14% under fixed and intended policy.

The growth of the volume of non road traffic is limited and mainly determined by inland shipping and mobile equipment. There is no difference between situations with fixed or intended policy. The number of tonne kilometres in inland shipping increases between 2007 and 2020 with about 12%. The deployment of mobile equipment in the same period remains more or less stable.

Policy developments since 2007

This section provides an overview of the main policy measures that were announced or implemented since the announcement of the working programme Clean and Efficient. A distinction is made between fixed and intended policy and between European and national policy.

EU policy - fixed

- The CO_2 standard for new passenger cars was established on 18 December 2008. In 2015 the emission standard will be 130 grams CO_2/km. In 2012-2014, 65, 75% and 80% of the new cars in the EU must meet this standard.
- Mid 2009 the EU published Regulation (EC) 661/2009. This regulation stipulates that as of 2012 new passenger cars must be equipped with a gear shift indicator and a tyre pressure monitoring system. The regulation also contains standards for the maximum car tyre rolling resistance.
- On 17 December 2008 the new guideline for fuel quality (98/70/EC) was published. The revised guideline demands a 6% greenhouse gas emission reduction by means of biofuels or by preventing flaring, and on top of that two times 2% reduction by means of other options in the fuel production chain such as CCS and CDM.

EU policy - intended

- In addition to the 130 g CO_2/km for 2015, the European standard for the CO_2 emission of new passenger cars also contains a target of 95 g CO_2/km in 2020. This target has not yet been instrumented and therefore it is considered intended policy in this projection. In 2013 the standard will be reviewed and decisions will be taken on the subsequent trajectory and negotiations will start on how to instrument this target. In the assessment of the 95 g CO_2/km in 2020 it has been assumed that the instruments will be shaped in such a way that the targets will be met.
- The European proposal for CO_2 standardisation of delivery vans (COM(2007) 19 final). This proposal indicates a standard of 175 g CO_2/km that will become binding in 2012 and further tightened to 160 g CO_2/km in 2015. Meanwhile the European Commission published a more elaborate proposal that sets a standard of 175 g CO_2/km for the period 2012-2014 and a standard of 135 g CO_2/km for 2020. This proposal could not be included in the emission projections.
- On 17 December 2008 the new Renewable Energy Guideline was published. It contains a target for transport fuels: In 2020 at least 10% of the transport fuels must have been replaced by fuels from renewable sources. Biofuels must meet sustainability criteria. As this guideline

has not yet been instrumented in the Netherlands, the effect is not discounted in the scenario with fixed policy, but in the scenario with intended policy.

Dutch policy - fixed

- The fiscal measures from the Tax Package 2008, including the CO_2 surcharge for very inefficient cars ('slurp tax'), the differentiation of the additional tax liability for company cars (14% resp. 25%) and the discount on the tax on passenger cars and motorcycles (BPM) for hybrid cars.
- The fiscal measures from the Tax Package 2009, including the conversion of BPM into a CO_2 dependent surcharge and adding a new additional tax liability category (20%) for efficient cars.
- To prepare the implementation of the price per kilometre, the conversion of the tax on passenger cars and motor cycles into the annual circulation tax (ACT)[8] was started in 2008. Between 2007 and 2012 the BPM will be lowered with 5% annually and in 2013 the BPM will be lowered with 12.5% (compared to the level of 2007). At the same time the ACT will be increased. This conversion process until 2013 is also part of the fixed policy.

Dutch policy - intended

- In 2008 the Dutch cabinet decided to introduce the price per kilometre for passenger cars in the period 2012-2016. The ACT and BPM will be completely run down and the run-down of the BPM must be finished in 2018. The assessment of the price per kilometre was based on a variant with budget neutral and CO_2 dependent pricing. The pricing of the Road Pricing Act, which was published late November 2009, was not available in time.
- Moreover, the cabinet decided to introduce a kilometre price for goods transportation in 2011. Here, too, the tariffs from the act were not available in time. The intended policy assumes an expense neutral variant. The volume effects were derived from CE Delft (2009).

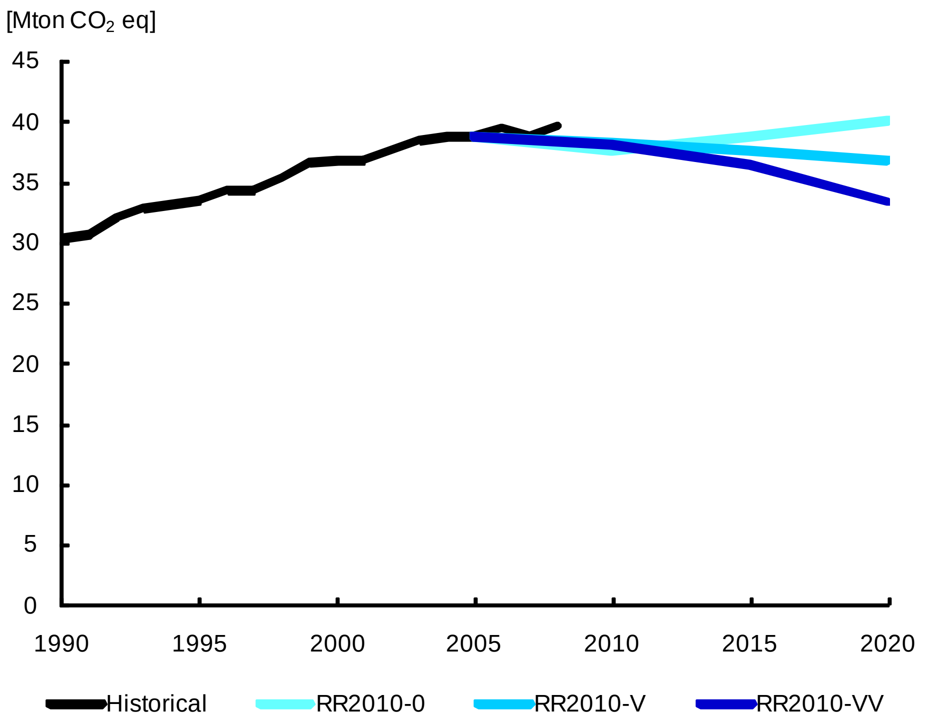

Figure 3.8 *CO_2 emissions traffic and transport*

[8] Dutch: motorrijtuigen belasting, MRB.

Results

The CO_2 emission projection for traffic and transport in RR2010-V amounts to about 36.9 Mton in 2020. Thus the CO_2 emissions are decreasing compared to 2008. This decrease can mainly be ascribed to the European CO_2 standardisation for passenger cars and the revised Fuel Quality Directive of the EU. The European CO_2 standardisation leads to a decrease in the average CO_2 emission per kilometre of the Dutch car fleet of about 15 to 20% in 2020. The revised Fuel Quality Directive is expected to result in a growth in the share of biofuels in the energy use of traffic and transport up to about 8.5% in 2020. Without these two measures the RR2010-V projection would have been about 5 Mton higher.

In RR2010-VV the kilometre price leads to a reduction in traffic volumes in especially passenger car traffic. The tightening of the CO_2 standard for passenger cars and the CO_2 standard for delivery vans leads to a (further) decrease on the CO_2 emissions of the Dutch passenger car and delivery van fleet. The CO_2 emission projection for traffic and transport in RR2010-V therefore amounts to about 33.3 Mton in 2020.

Based on the target for traffic and transport in the working programme Clean and Efficient of 30-34 Mton in 2020 and a medium projection of 33.3 Mton including intended policy, it can be concluded that there is no policy gap if the upper margin of the target is maintained. If the lower value of the margin of the target is maintained, then the policy gap amounts to 3 Mton.

Box 3.2 *New insights may result in setbacks*

After establishing the new Reference projection in January 2010, three new insights arose that influence the CO_2 projections of traffic and transport and the effect of the fixed and intended policy on these projections. These insights are briefly discussed below.

Increasing difference in CO2 emission of passenger cars between test and practise

The fuel use and corresponding CO_2 emission of passenger cars in practise is usually higher than in the European type approval test. These (and previous) Reference projections have assumed a practise correction factor of 10% for the present and for the various reference years. Based on the fuel consumption data of Travelcard, TNO ascertained that the difference between test and practise in the case of efficient cars is (much) larger than in the case of inefficient cars Ligterink en Bos, 2010). The increasingly lower CO_2 emission during the test is not fully adopted in practise, for example because high speeds are barely driven during the test. In this respect the test is not representative of the average use of the car in practise. If this trend continues, the deviation between CO2 emissions during tests and in practise will grow even further. If the current technological development continues, TNO estimates the additional use in practise in case of a standard value of 130 g CO_2/km at about 30% and in case of a standard of 100 g CO_2/km at about 40%. As a result the CO_2 emission projection for passenger cars in 2020 in the scenario with fixed policy may end up about 0.4 to 0.6 Mton higher. In the scenario with fixed and intended policy, the projection may end up about 0.7 to 1.0 Mton higher.

Different planning variants for introduction of kilometre price

The assessment of the environmental effects of the kilometre price for passenger cars is based on the introduction of the kilometre price between 2012 and 2016, in accordance with the cabinet decision of 2008. This planning does not take into account the uncertainties and risks in the start and duration of the project. Therefore, in addition to this deterministic planning, the Ministry of Transport, Public Works and Water Management also drew up three probabilistic planning variants that do take these uncertainties into account (see Ministry of Transport, Public Works and Water Management, 2009). In these variants, the kilometre price for passenger cars is introduced between 2014 and 2018 or between 2015 and 2019. Delaying introduction means that the effects on car possession and use and hence also the CO2 emission reduction in 2020 will be lower than calculated in the Reference projection.

By request of the Ministry of Transport, Public Works and Water Management, PBL studied the effect of the probabilistic planning variants on the CO2 emission reduction of the kilometre price in 2020. The pricing of the legal text on Kilometre price, offered to the Lower Chamber in November 2009, was also used in this analysis. The CO_2 emission reduction of the kilometre price in 2020 is calculated in the Reference projection at about 1.7 Mton[9]. If introduction would proceed in accordance with the probabilistic planning variants, the effect would turn out 0.2 to 0.6 Mton lower, depending on the planning variant (see also Geilenkirchen et al., 2010).

Efficiency development new lorries and tractors
The CO_2 projection for goods transport has assumed an autonomous efficiency development of new lorries of in total 7.5% in the period 2011-2020, both in the scenario with fixed policy and in the scenario with fixed and intended policy. This estimate is based on a TNO report of 2008 (De Lange et al., 2008). Recently, TNO indicated that this estimate might be too optimistic. It is true that in the last years lorries have become much more efficient per kWh (unit power), but this has been almost entirely compensated by an increase in the average engine power. On balance, the average fuel consumption of new lorries has barely decreased as a result. If this trend towards more motor power continues, it can be questioned if an autonomous efficiency development of 7.5% is feasible until 2020. ECN and TNO estimate that by using low rolling tyres and monitoring systems for tyre pressure the efficiency improvement can increase by a maximum of 4% until 2020. If this new insight had been included in the calculation of the medium projection, the outcome would have been 0.2 Mton lower.

Uncertain factors
Including uncertainties, the projection for traffic and transport including intended policy amounts to 30.6 to 37.1 Mton. The bandwidth is mainly determined by the following uncertain factors:
- population size,
- economic growth,
- the effect of the CO_2 standard for passenger cars,
- the share of electric passenger cars and delivery vans in 2020.

The tables below show the influence of the most important uncertain factors on CO2 emissions, electricity demand and deployment of biofuels.

Table 3.3 *Uncertain factors CO2 emissions traffic and transport*

[Mton CO_2]	Uncertainty range deviation 5-95%		
Description uncertain factor	Lower value	Upper value	Variant
Economic growth, growth of dispensable income RR09	-0.5	0.5	
Economic growth, growth of dispensable income TRANSTOOLS	-1.0	1.0	
Population size, volume number of households	-1.1	1.1	
Basic emission factors delivery vans and lorries	-1.0	1.0	
Distribution of mileage across various types of road (road traffic)	-1.0	1.0	
Efficiency improvement lorries	0.0	0.3	
Oil prices	0.8	-0.7	0, V
Ratio first generation and second generation biofuels in 2020	-0.5	1.2	0, V
Difference between test and practical fuel consumption passenger cars V	0.0	0.5	0, V
Effect of CO_2 standardisation LD V	1.0	-1.1	V
Market penetration electric passenger cars and delivery vans	0.6	-1.0	V
Oil prices	0.5	-0.4	VV

9 Door het gebruik van een andere modelversie, een ander referentiescenario en een andere tariefstelling wijkt dit effect af van het effect zoals beschreven in de Memorie van Toelichting bij de wet Kilometerprijs.

[Mton CO_2] Description uncertain factor	Uncertainty range deviation 5-95% Lower value	Upper value	Variant
Effect of CO_2 standardisation LD VV	1.6	-1.5	VV
Effect of kilometre price	1.0	-1.0	VV
Ratio first generation and second generation biofuels in 2020	-0.4	1.0	VV
Market penetration electric passenger cars and delivery vans	0.6	-1.3	VV
Difference between test and practical fuel consumption passenger cars VV	0.0	0.8	VV

Table 3.4 *Uncertain factors biofuels traffic and transport*

[PJ] Description uncertain factor	Uncertainty range deviation 5-95% Lower value	Upper value	Variant
Economic growth, growth of dispensable income RR09	-0.9	1.0	
Economic growth, growth of dispensable income TRANSTOOLS	-1.0	1.0	
Population size, volume number of households	-1.3	1.3	
Basic emission factors delivery vans and lorries	-1.0	1.0	
Distribution of mileage across various types of road (road traffic)	-1.0	1.0	
Efficiency improvement lorries	0.0	0.3	
Ratio first generation and second generation biofuels in 2020	-23.4	10.1	0, V
Oil prices	1.1	-0.8	0, V
Difference between test and practical fuel consumption passenger cars V	0.0	0.6	0, V
Effect of CO_2 standardisation LD V	1.3	-1.4	V
Market penetration electric passenger cars and delivery vans	0.8	-1.3	V
Ratio first generation and second generation biofuels in 2020	-20.8	8.9	VV
Oil prices	0.6	-0.5	VV
Effect of CO_2 standardisation LD VV	2.0	-1.8	VV
Effect of kilometre price	1.0	-1.0	VV
Market penetration electric passenger cars and delivery vans	0.8	-1.7	VV
Difference between test and practical fuel consumption passenger cars VV	0.0	1.0	VV

Table 3.5 *Uncertain factors Electricity demand traffic and transport*

[PJ_e] Description uncertain factor	Uncertainty range deviation 5-95% Lower value	Upper value	Variant
Market penetration electric passenger cars and delivery vans	-3.3	4.8	0, V
Market penetration electric passenger cars and delivery vans	-3.3	5.7	VV

Bunkering

In the Netherlands much bunker fuel is sold to inland shipping, sea shipping and aviation. The energy use that is linked to selling these tax free fuels is not attributed to inland use. The CO_2 emissions resulting from bunker use are not ascribed to the Netherlands under Kyoto either.

The prognosis for the sales of bunker fuels is directly related to the volume prognoses for passenger transport at Schiphol Airport and goods transport via the port of Rotterdam. The volume prognoses for ocean shipping have been calculated with the TRANSTOOL model (TNO, 2009). The volume prognoses for aviation were derived from the calculations of the ACCM model (SEO and Significance, 2008). The agreements that were made in the framework of the Alders table have been taken into account[10].

As airplanes usually refuel before departure, there is a good correlation between the number of flight movements at Schiphol and fuel sales. Ocean ships have less correlation between bunkering and activities. As Rotterdam offers relatively cheap bunker fuels (partly because of its favourable position in relation to the surplus on the Russian market and local refining) ocean ships stock up a relatively large share of bunker fuel. However, competition is growing and the Rotterdam bunker fuels may become financially less attractive because of the sulphur demands enforced by IMO (International Maritime Organisation). Therefore the prognoses for ocean shipping bunkers sales in the Netherlands are uncertain.

3.4 Households

Introduction

Gas use and electricity use in households show different developments. The gas use for heating and warm tap water is decreasing. This is the result of continual improvement of the insulation grade and improved efficiency of boilers in existing dwellings. Due to these improvements and the milder winters the gas demand per dwelling has decreased significantly. But the number of dwellings has increased. The energetic demands for these new dwellings are much higher, though, which limits the effect of this increase in gas use. In total the climate corrected gas use of households has decreased from 362 to 311 PJ between 1990 and 2008.

Contrary to the decrease in gas use in households, the electricity demand is increasing due to electric appliances and lighting. Appliances that use much electricity, such as washing machines and refrigerators, underwent major efficiency improvements in the last ten years. However, this effect was compensated by the strong increase of both the number and the operating lifetime of appliances. These are mainly white goods, lighting and ICT equipment. On top of that a number of new appliances have emerged that show a growing penetration rate, for example the rise of the game computers. The final electricity use of households has therefore increased from 59 PJ_e in 1990 to 89 PJe in 2008.

The increase in electricity use and the decreasing gas demand result in a more or less unchanged primary energy use between 1990 and 2008, i.e. around 550 PJ primary.

Main developments 2005-2020

According to the most recent CBS prognosis the number of households will continue to grow until 2040, but the growth will be less strong than in the last decades. In 2020 the number of households in the Netherlands increased to 7.9 million, according to CBS. In some instances there are several households living in one dwelling, which is why the projection estimates the number of dwellings at 7.7 million. Due to the more limited growth of the number of households, the number of new-build houses will also grow less strongly, decreasing from 67 thousand annually in 2005 to 57 thousand annually in 2020. In the same period the household size will decrease from 2.3 to 2.1 persons per household.

[10] The Alders Table is a consultation on the future of the airports of Lelystad, Eindhoven and Schiphol and their environment.

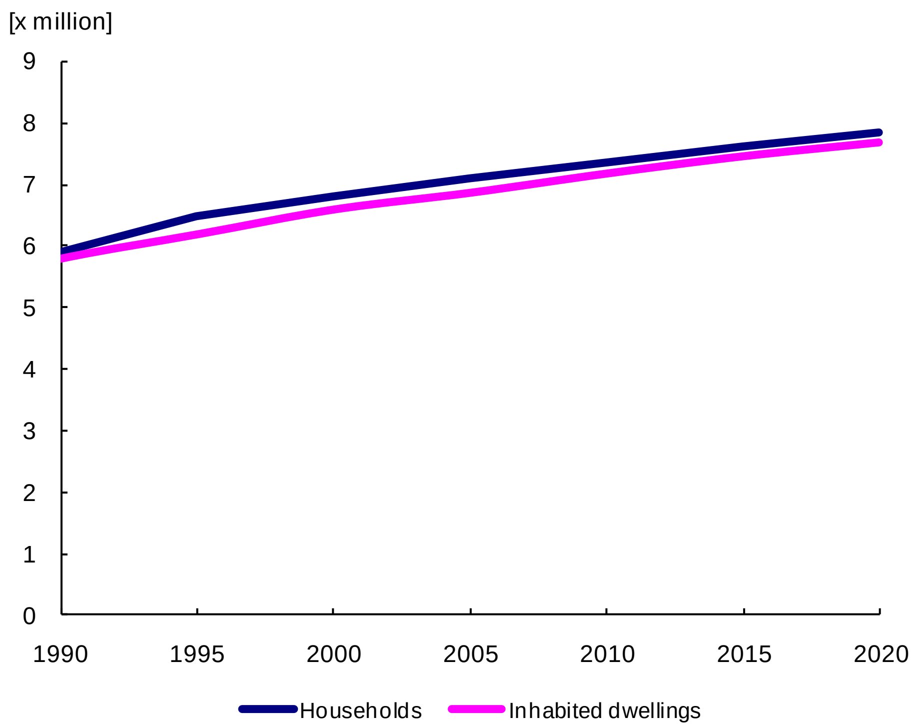

Figure 3.9 *Number of households and dwellings*

The existing housing stock in the Netherlands is becoming more energy efficient in the period 2005-2020. In 2020, more than 70% of the total glass surface in dwellings will consist of Low-E glass and around 80% of the roof surface will be insulated through autonomous development. The share of insulated floor surface will also grow. Exterior wall insulation is more difficult to install and will hardly be applied in existing dwellings, but cavity wall insulation will increase. The remaining potential for saving measures is decreasing and will become more difficult to deploy. By 2020, the potential for high efficiency boilers will be almost entirely deployed. The increasing penetration of measures will also result in many G and F label dwellings having improved to E level or better by 2020. The number of A label dwellings is increasing strongly because of new-build dwellings (see Figure 3.11).

In agreement with KNMI scenarios (The Royal Netherlands Meteorological Institute) it has been assumed that the average temperature in the Netherlands is rising due to climate change. Between 2005 and 2020 the number of heating degree days decreases with 7%. This influences the energy use especially in cases where space heating plays an important role.

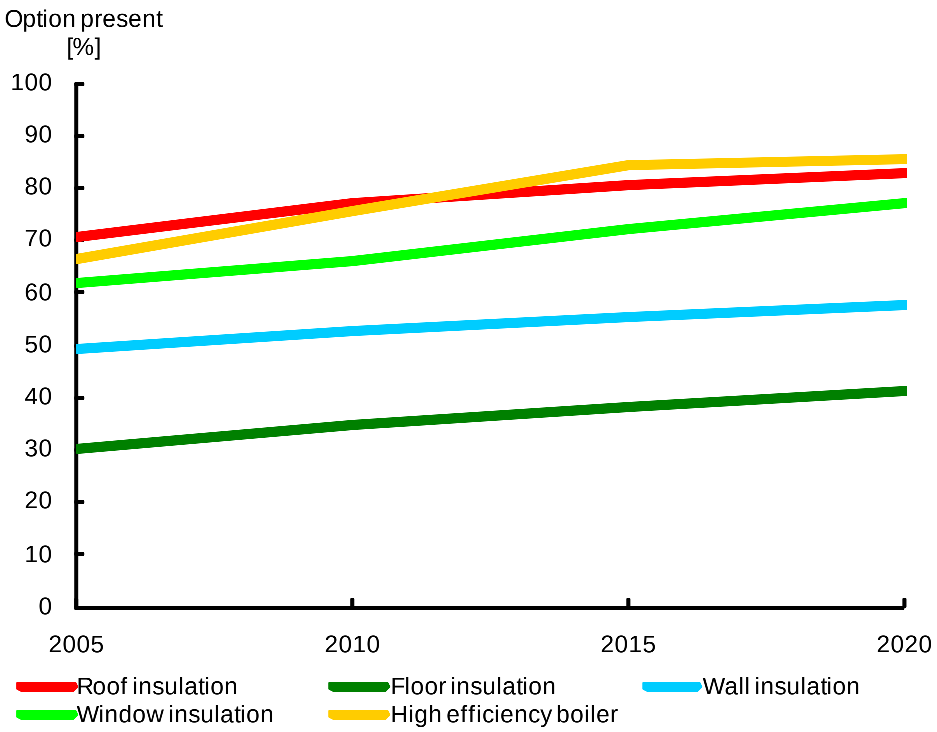

Figure 3.10 *Autonomous development share of dwellings with insulated surface construction parts, and dwellings with high efficiency boiler 2005-2020*

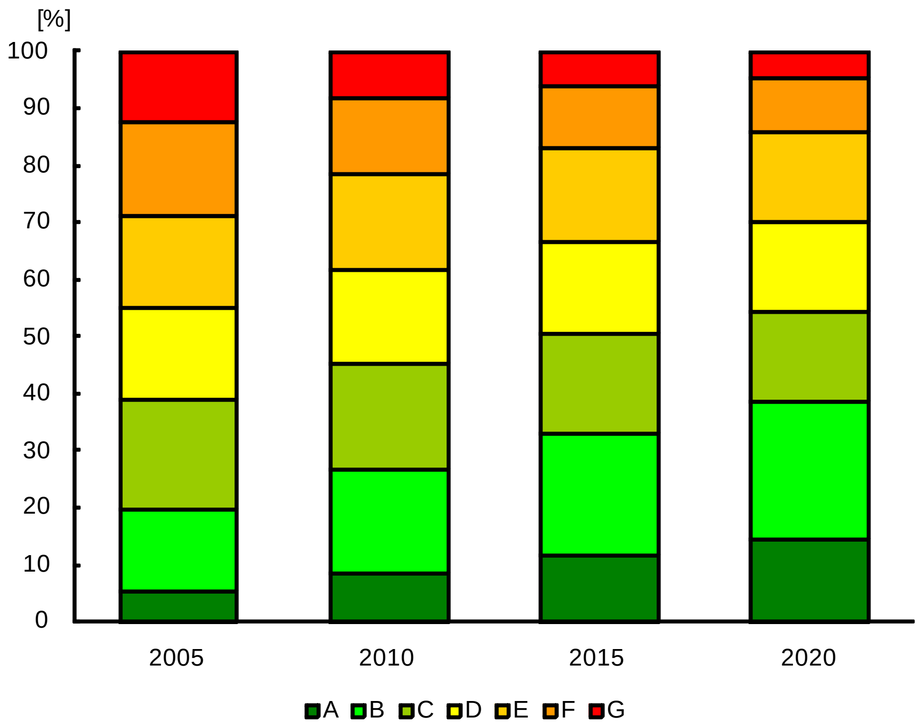

Figure 3.11 *Autonomous development energy labels dwellings 2005-2020*

Heat demand is determined by the desired comfort level, the occupation degree of a dwelling and the degree of insulation. Because of the increasing insulation measures the heat demand of dwellings built before 1995 will decrease from 37 GJ annually to 31 GJ annually in 2020. The efficiency of the heating installation determines the amount of natural gas that is needed for the dwelling. The average efficiency of heating installations will continue to rise. Due to replacement of heating boilers 86% of all dwellings will have a HR-107 boiler in 2020. The gas use of a dwelling built before 1995 decreases from an average use of 1542 m^3 in 2005 to 1320 m^3 natural gas annually in 2020.

In 2020, new-build dwellings will be built with an Energy Performance Coefficient (EPC) of 0.8 without any tightening of standards, i.e. with an energy use that is comparable to the current new-build dwellings. Because of the assumed temperature rise the gas use will decrease slightly from 6657 m^3 in 2010 to 617 m^3 in 2020 per new-build dwelling.

The electricity use of households for appliances and lighting has increased in the past. In the variant without Clean and Efficient policy only a slight increase in electricity use is anticipated until 2020. The largest users in 2005 are lighting and white goods, followed by audio-video-ICT equipment and televisions. Televisions and audi-video-ICT equipment are expected to gain a larger share in the electricity use of households in 2020. The same applies to ventilation systems and warm water equipment, which are expected to be among the large users in 2020.

Policy developments

There is a large diversity in policy instruments aimed at energy saving in households. It is the combination of various measures that yields effect. Obligations and covenants provide the basis. Moreover, subsidies and knowledge transfer are increasing workability.

The EPC is the main –obligatory- instrument for new-build dwellings. The variant with fixed policy assumes an EPC of 0.8 as a starting point. The variant with intended policy tightens the EPC to 0.6 in 2011 and to 0.4 in 2015. Eventually, dwellings must be built energy neutral as of 2020. Additional policy instruments such as the spring agreement, very energy efficient and innovative construction projects in excellent areas, subsidies for pilot projects and supporting facilities from the Compas programme (Energy awareness in living and working) are important for enhancing the support and (practical) knowledge of construction parties.

To realise energy savings in existing private properties and private rental houses, the ‘More with Less’ Covenant was closed with energy companies, the installation branch and the building sector. These parties set up a joint programme to support homeowners in realising saving measures. Participation of homeowners is entirely voluntary. This makes the effect of the covenant uncertain. At first it will mainly be frontrunners in sustainability who volunteer to participate in the More with Less covenant. This group is estimated to amount to 30% of the households[11]. Due to circumstances not all frontrunners will join the programme. This projection assumes that 10% of all owners/residents will participate in the “more with Less’ covenant after moving. This means that about 230 thousand dwelling will be 20% more efficient in 2020. This assumption is highly uncertain and in the uncertainty analysis it was taken into account that there is the option that many more private dwellings (up to a maximum of more than 8000 thousand) can be reached.

As private landlords benefit only to a limited extent from the saved energy cost resulting from investments in saving measures and because no covenant has been closed with these parties, the projection assumes that private landlords will not implement the 'More with Less' covenant. The uncertainty analysis did take the participation of private landlords into account.

A covenant of social landlords specifies which contribution housing corporations must supply to the 'More with Less' target. The umbrella organisation Aedes promised that corporations will invest an additional 2.5 billion euro in energy saving in 2020. The covenant that was closed on a national level has only partly been translated into local agreements with individual corporations.

[11] See for example: Hal, J.D.M. van, A.A.M. Postel, B. Dulski (2008), *Draaien aan Knoppen, Onderzoek naar het creëren van business opportunities bij het MKB in het kader van het terugdringen van het energieverbruik van woningen van eigenaar-bewoners*, Nyenrode Business University, Breukelen.

Therefore it is rather unclear whether corporations actually realise the extent of the large effort required from them or if they will arrange sufficient facilities and financial mean to realise the target in the covenant. This projection therefore assumes an additional investment in energy saving of 1.25 billion euro, which is 50% of the promised investment budget. The uncertainty analysis does take into account the possibility that corporations will observe the full effort as promised.

Investments in energy saving by housing corporations are facilitated by adjustments in the dwelling valuation system, which enables corporations to increase the rent for energy efficient dwellings. Moreover, 277 million euro is available through the Energy Investment Deduction scheme until 2010, which can be used by corporations to improve their existing housing stock. This means that the investment costs of corporations up to and including 2011 will be about 11% lower and that more savings will be realised with the assumed 1.25 billion euro of additional investments.

In addition to covenants there are also financial instruments for existing dwellings. The labour costs that are required for installing insulation (excluding insulating glass) are subject to the lower VAT rate (6% instead of 19%). The material costs are also subject to this lower rate if they constitute less than 50% of the total cost. There is a subsidy for Low-E glass as well as a temporary subsidy scheme for solar boilers and heat pumps until the end of 2011. The chapter on renewable energy addresses the subsidies on solar panels.

To remove or lower financial barriers there are also various small-scale facilitating programmes.
- Until 31 December 2010 a 200 euro subsidy is available for obtaining tailored advice.
- The Dutch Green Funds Scheme enables cheaper borrowing of money for investments in energy saving.
- Until 31 December 2010 private homeowners can use the energy saving credit which lowers the interest rate of a loan.

The *Compass, Energy-awareness in living and working* programme is a coordinating programme of Agentschap NL offering knowledge, methods and instruments to professional target groups such as local authorities, corporations, building supervisors and professionals in construction.

In the Netherlands there is no minimum performance requirement for appliances. Some national policy focuses on informing and stimulating energy efficient purchase and user behaviour, for example through energy labels for appliances. The current policy aimed at stimulating energy efficient appliances is mainly implemented by the European Union. The European Ecodesign guideline is a mandatory policy instrument that sets requirements for the maximum capacity for a product group. The Guideline for Energy Labels introduces energy labels for certain appliances. The authors of the Guideline expect that this will be an incentive for energy efficient purchase behaviour. The energy labels will probably be adjusted in 2010/2011. More energy efficient classes will be added (better than A) and more appliances will get a mandatory label. The Reference projection looks at the combined effect of label adjustment and the Ecodesign guideline. The policy variant with fixed policy includes only the statutory Ecodesign requirements; the policy variant with intended policy also includes the Ecodesign requirements that are proposed but not yet statutory.

Results

The variants with Clean and Efficient Policy show a decreasing thermal use (heat demand) resulting from insulation and climate change. This heat demand will have to be met by heating installations. As the share of high efficiency boilers increases, the average efficiency of these installations also increases. As a result gas demand decreases more rapidly than heat demand, dropping from 311 PJ in 2008 to 258 PJ in case of fixed policy and 255 PJ in case of intended policy.

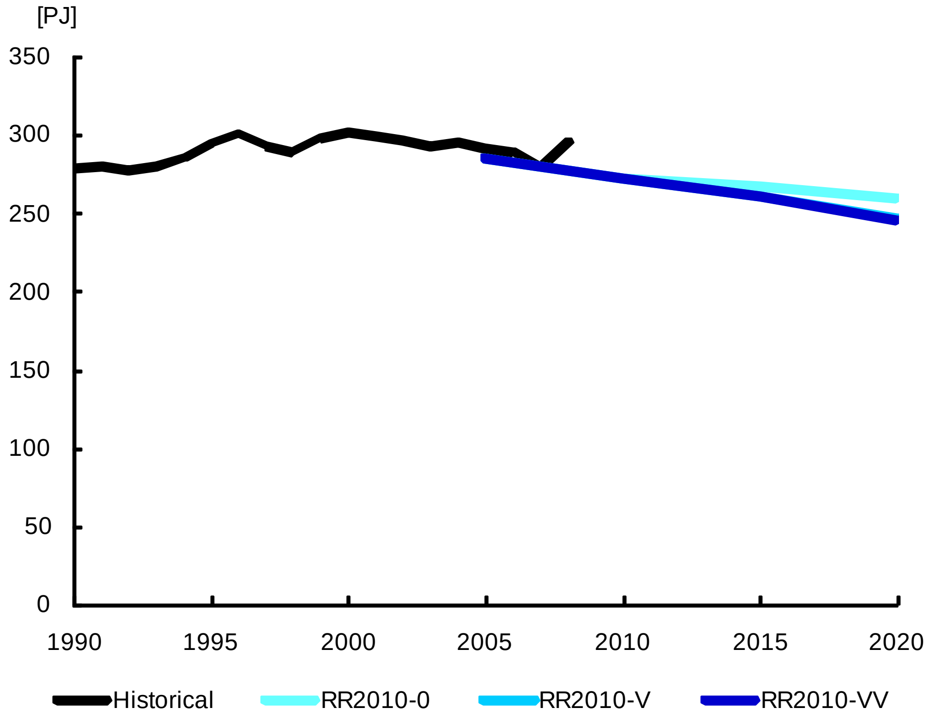

Figure 3.12 *Final thermal use households*

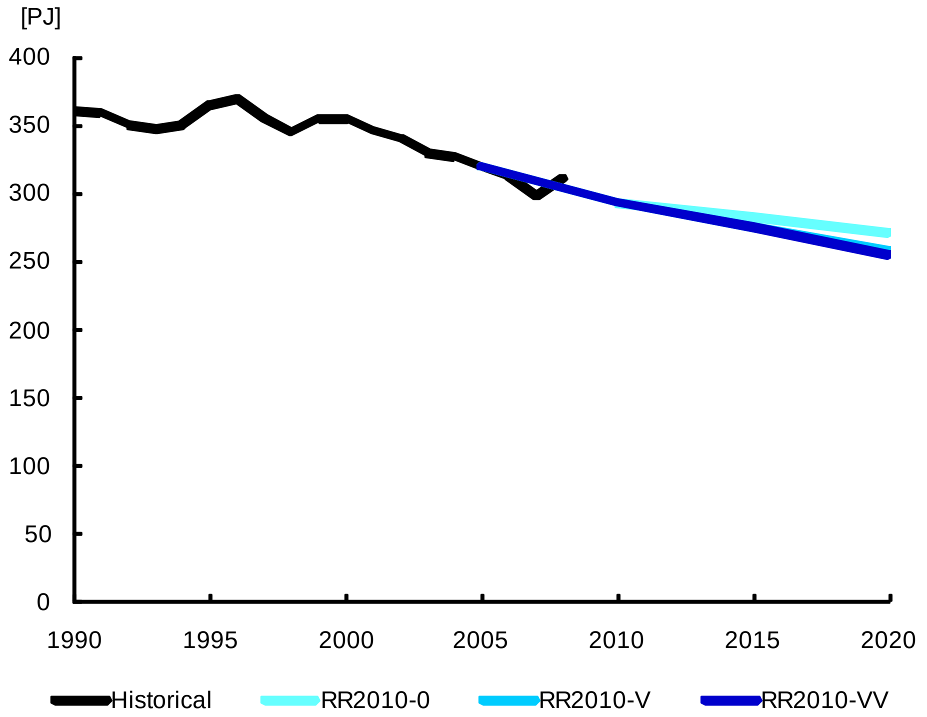

Figure 3.13 *Gas use households*[12]

Under fixed policy a slight increase in electricity use of households is expected until 2020. Under intended policy it is expected that the electricity use will start decreasing as of 2010. A de-

12 The historical gas use data of CBS are based on the average gas use per dwelling as published in the HOME survey. This panel study resulted in a relatively low consumption in 2007 due to a very warm winter and a large correction for degree days.

crease in domestic electricity use means a trend break with the historical development of electricity demand. This is the result of standardisation through the Ecodesign guideline and energy labelling.

In 2020 the electricity demand of households without Clean and Efficient policy will amount to 99 PJ_e. Under fixed and intended policy the electricity demand will be lower in 2020, i.e. 89 PJ_e and 87 PJ_e. The total effect of fixed and intended policy on appliances is thus expected to be 12 PJ_e in 2020. Three quarters of this saving in electricity demand in 2020 is the result of the standards for appliances and labels following from the current Ecodesign guideline. The other effect is the result of standardisation of Ecodesign, which is expected to be established in the coming years and due to adjustment of the labelling method.

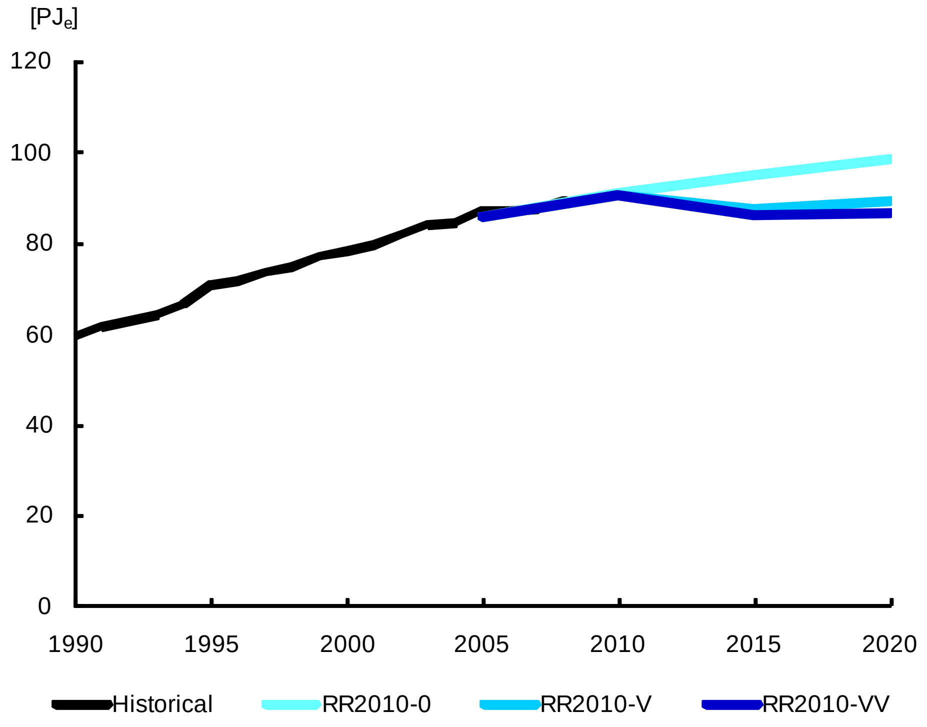

Figure 3.14 *Final electricity use households1990-2020.*

Due to the previously described autonomous developments there is a significant drop in primary energy use from 543 PJ in 2005 to 520 PJ in 2020. Without Clean and Efficient policy the historical contradiction between decreasing gas use and increasing electricity use will continue to exist in the future. The decrease in gas use is more limited than in previous decades, because the unused saving potential becomes smaller and it becomes increasingly difficult to realise additional savings. The increase in electricity use is also levelling off. This is due to the fact that possession and use of appliances do increase between 2005 and 2020, but to a lesser extent than in previous decades. On top of that the efficiency of appliances is expected to improve further.

Table 3.6 *Summarising overview table: Energy use households in 2020?*

[PJ]	No Clean and Efficient policy	Fixed policy	Intended policy
Electricity use	271	258	255
Gas use	99	89	87
Primary use	520	478	459

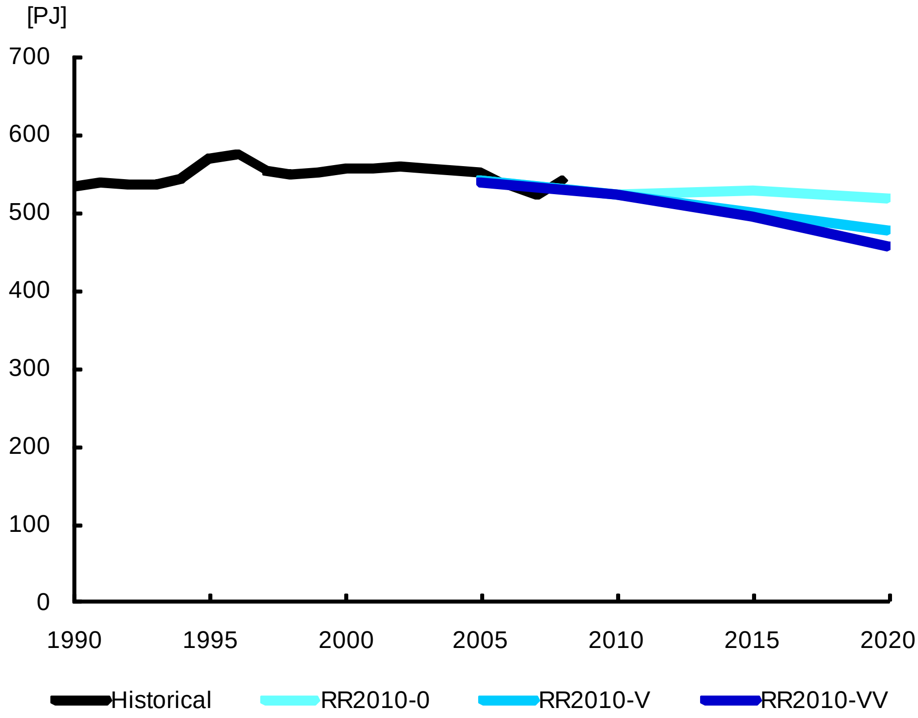

Figure 3.15 *Primary energy use households*

CO_2 emission

The CO_2 emissions of households have dropped from 21.4 Mton in 1990 to 18.1 Mton in 2008. Without Clean and Efficient policy the CO_2 emissions will decrease further to 15.7 Mton in 2020. With intended policy the CO_2 emission amounts to 14.5 Mton in 2020. The policy effect on the direct emission is only the result of gas savings. The saving in electricity also influences the indirect CO_2 emission in the energy sector. This will be discussed elsewhere in this projection.

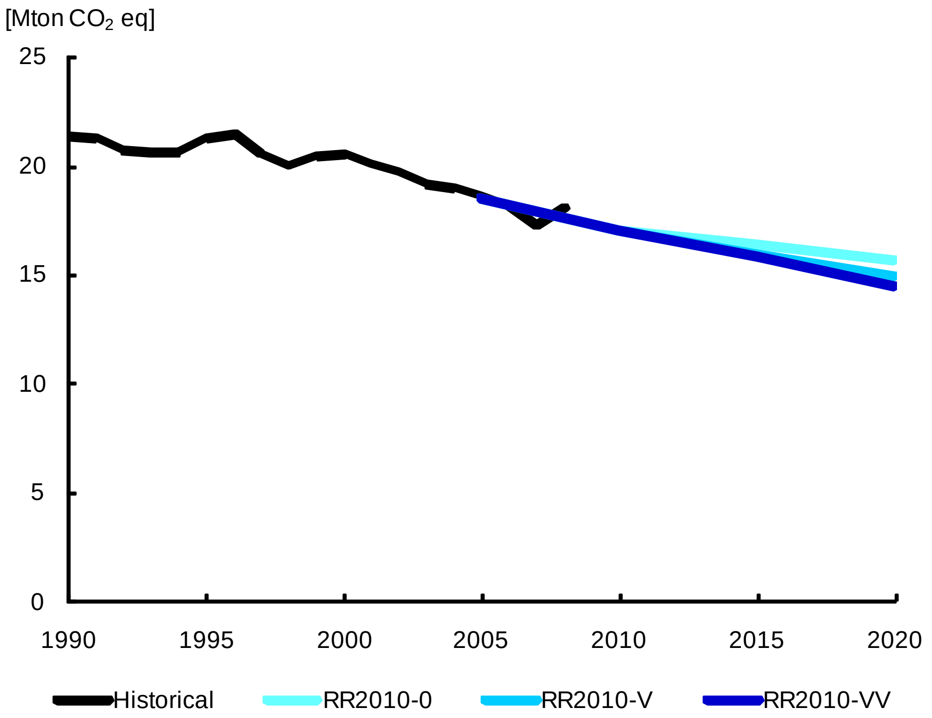

Figure 3.16 *CO_2 emissions households*

Uncertain factors

The following uncertain factors play a role in determining the direct CO_2 emission in households and/or final electric use:

- Effect of the 'More with Less' Covenant ('Meer met Minder'). The More with Less Covenant aims to develop a market for energy saving in the built environment. To get such a market going a sufficiently large group of frontrunners must be mobilised. In the projection it is assumed that the market will be limited to 10% of the target group in owner residents. This is an insufficiently critical mass to establish a growing market. (Van Hal et al. 2008). The upper bandwidth in the uncertainty analysis is assumed to be subjected to a snowball effect, resulting in the number of participants increasing gradually to 60% of the target group in 2020. As for corporations; if they spend the full amount of 2.5 billion of additional investments, the effect will be twice as large as assumed. Even the assumption that private landlords will not participate in the More with Less programme may prove to be false. On the other hand, the effect of More with Less may also be smaller than assumed.
- Population growth and growth housing stock. A generic uncertainty in the policy effects on energy use in the built environment is the growth of the Dutch population, which also partly determines the growth of the number of households. The number of households, in turn, determines the penetration rate of appliances and lighting, together with the average possession of appliances and lighting per household. To estimate the development of the housing stock and the pace of new constructions and demolition, the projections of the CBS prognoses and the Primos 2007 projections were assumed. Especially the pace of new constructions is subject to uncertainty. A faster or a slower pace of new constructions may influence the gas use and the saving effect of the energy performance standard of new constructions.
- Energy prices. Deviations in gas price will have a limited effect on the choice of saving measures in households.
- Behaviour. Changes in lifestyle such as decreasing the number of showers taken, adjusting the thermostat and use of appliances can have a large impact on domestic electricity use.
- Development of electrical appliances. The introduction of currently unknown (electrical) appliances may influence the energy use. The development of household incomes determines the possession of appliances and involves a degree of uncertainty.

- Climate factor. In the projection it is assumed that the equable temperature rise of the past will continue until 2020. It could however also be the case that the rise lags behind or even accelerates compared to the historical trend.
- Basic data. The model instruments used are calibrated based on statistics. Measuring errors or other uncertainties in these data therefore also influence the estimates for 2020.
- Elaboration of intended policy. The exact elaboration of intended policy is also uncertain. The effects of future EPC tightening and the Ecodesign guidelines strongly depend on the exact elaboration.

The tables below show the influence of the most important uncertain factors on CO_2 emissions, electricity demand and renewable heat.

Table 3.7 *Uncertain factors CO_2 emission Households*

[Mton CO_2]	Uncertainty range deviation 5-95%		
Description uncertain factor	Lower value	Upper value	Variant
Gas price	0.2	-0.2	
Lifestyle/behaviour	-0.6	0.6	
Climate development	-0.2	0.2	
Basic data	-0.8	0.8	
Development of housing stock, new-build dwellings and demolition pace	0.5	-0.5	0, V
Policy effect More with Less Owner-occupied sector	0.0	-0.4	V, VV
Policy effect More with Less Social housing sector	0.3	-0.6	V, VV
Policy effect More with Less Private Rented sector	0.0	-0.1	V, VV
Tightened EPC Development of housing stock, new-build dwellings and demolition pace	-0.1	0.6	VV

Table 3.8 *Uncertain factors electricity demand households*

[PJ_e]	Uncertainty range deviation 5-95%		
Description uncertain factor	Lower value	Upper value	Variant
Population growth: Number of households may turn out higher or lower	-6.3	6.3	
Statistics: Use/hh/yr may have been higher or lower	-1.9	1.9	
Income development: Possession of individual appliances may have been higher or lower	-1.7	1.7	
Lifestyle/behaviour: Possession of individual appliances may have been higher or lower	-1.7	1.7	
Established Ecodesign effect in V scenario	2.4	-2.4	V, VV
Established Ecodesign effect in V scenario	0.8	-0.8	VV

Table 3.9 *Uncertain factors renewable heating households*

[PJ]	Uncertainty range deviation 5-95%		
Description uncertain factor	Lower value	Upper value	Variant
Development of housing stock, new-build dwellings and demolition pace	-2.0	2.0	
Uncertain share of renewable heating options	-1.5	1.5	

Box 3.3 *Target range More with Less*

The More with Less Covenant signed in 2008 aims at: *"[..] realising additional building and installation related energy savings in existing dwellings and other buildings of at least 100 PJ in*

2020."[13] The Reference projection assumes a policy effect of More with Less of 23 PJ with a bandwidth of 12 to 44 PJ. The target of 100 PJ is thus not realised in the projection. The assumptions in this effect estimate are described in Sections 3.4 and 3.5. Figure 3.17 shows the target range of the More with Less covenant divided into target groups.

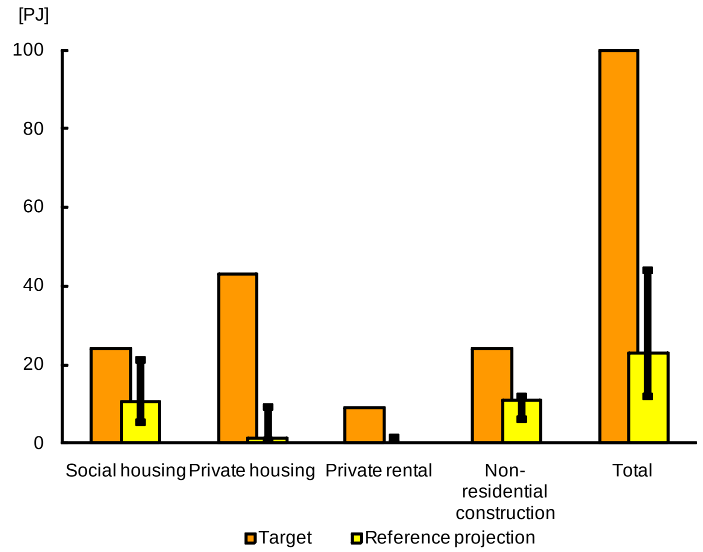

Figure 3.17 *Target range More with Less covenant*

In the explanation of the covenant the target of 100 PJ has been translated into the improvement of at least 2.4 million dwellings and buildings with 20 to 30%.[14] The upper limit of the bandwidth in the Reference projection assumes that 2.1 million dwellings and thousands of non residential buildings with be improved by a minimum of 30% (in the social rented sector even by averagely 45%); nevertheless the effect is 'only' 44 PJ. The intended number of dwellings and buildings to be improved thus turns out to be insufficient for realising the savings target.

The More with Less target is based on a feasibility study conducted by McKinsey, which resulted in a potential of 100 PJ. This study assumed a wide range of saving measure, including renewable energy and CHP (23 PJ), insulation and installations (62 PJ) and electrical appliances (14 PJ). Electrical appliances are outside the scope of the covenant. Some measures are realised in the Reference projection as an effect of other policy. Examples include renewable energy and CHP (policy effect 7 PJ) that result from the SDE subsidy, the subsidies for renewable heating and the SDE surplus. Another example is the building related measures that become mandatory through Ecodesign. Energy efficient pumps, ventilators, tap water and lighting (policy effect 21 PJ).

62 PJ of the 100 PJ in the McKinsey study involves insulation, heating and ventilation. The policy effect of 12 to 44 PJ assumed in the projection can only be compared to the latter. The fact that the upper value of the bandwidth of 62 is not realised is because McKinsey based its estimate on the technically feasible potential, which requires the improvement of much more than 2.4 million buildings. The lower value of the bandwidth has a smaller policy effect, because the projection assumes limited participation in the covenant. The covenant is too noncommittal for the target groups and financial incentives turn out to be insufficient to tempt dwelling and building owners into investments in energy saving on a large scale.

[13] Covenant Energy Saving existing buildings 'More with Less' ('Meer met Minder'), http://www.vrom.nl/Docs/bouwen_en_wonen/20080123_ConvenantMmM.pdf.
[14] More with Less, The National Energy Saving Plan for the built environment, http://www.vrom.nl/Docs/bouwen_en_wonen/20080122_MeermetMinder.pdf.

3.5 Trade, Services and Government

Introduction

The tertiary sector consists of trade, services and government (TSG). This sector has the non residential buildings that determine the built environment together with dwellings. The primary energy use of this sector amounted to 15% of total energy use in the Netherlands in 2008. The built environment accounts for almost one third.

About 64% of the energy use of TSG is used by the commercial sectors (trade and hotel and catering industry, banking and insurance, business services) and the remaining 36% is used by the non profit sector (public administration, nursing homes, hospitals, education, sports and leisure).

The largest share of the energy use is dedicated to space heating and electric appliances. Cooling will also become increasingly important. The sector mainly uses natural gas and electricity and a small share of heat from district heating and oil products. A part of the electricity demand is covered by decentralised CHP that is installed in the sector. Moreover, environmental services such as waste water treatment produce their own gas (fermentation gas, green gas).

The climate corrected gas use rose between 1990 and 2008 from 153 PJ to 193 PJ. The electricity demand in utility rose much faster because of increased cooling and nearly doubled from 69 PJ_e in 1990 to 117 PJ_e in 2008.

Main (volume) developments

Next to energy saving policy the development of the number of employees in the commercial services sector and its corresponding building area has a large influence in the total energy use. The number of employees is dictated by the expected economic and demographic developments.

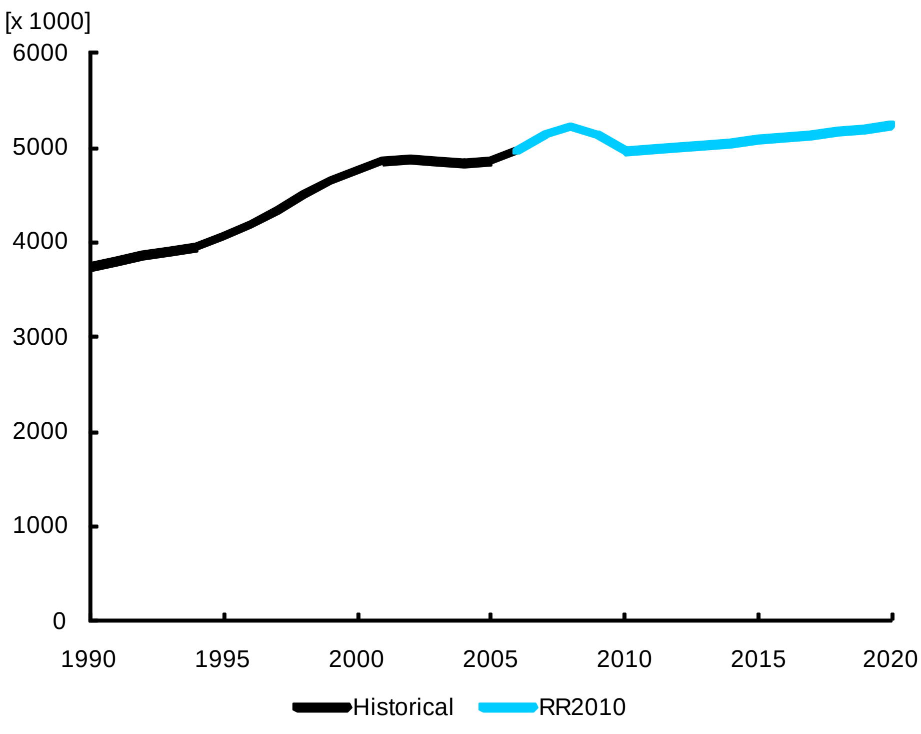

Figure 3.17 *Development of labour volume in FTE in the TSG sector*

An increasingly larger percentage of employees in the commercial sector are working in office buildings.

The non profit services sector is influenced by other factors: The number of residents in care residences, the type and number of treatments in hospitals and the number of students in education. Treatments in hospital are related to the population prognosis in which ageing plays an important role. The population prognosis also determines the number of students in education.

Policy developments
The following policy plays a role in TSG:

EPC tightening
EPC is an important instrument for new buildings. Without Clean and Efficient policy the current EPC standards for commercial and industrial buildings apply as of 1 January 2009. The variant with intended policy assumes that by 1 January 2015 a 50% improved energy performance will have been realised by the market (compared to the requirements of 2007) and that energy neutral construction will take place as of 2020.

More with Less covenant
The More with Less covenant was closed with energy companies, the installation branch and construction parties to realise energy savings in existing buildings. More with Less focuses on about 24 PJ saving in utility in 2020. The 2011 target is about 4 PJ. The approach gives priority to education, the social service sector, offices and corporate halls first. In 2009 pilot projects were established that will be scaled up to a programmatic approach. There is an important role for energy directors, i.e. advisors of installation, energy and construction companies who offer advice on energy saving measures and support the realisation. The Reference projection assumes that the penetration rate of saving measures that are profitable in the indicated sectors will increase as a result. This is the starting point in the variant with intended policy.

Energy Investment Deduction (EIA)
All profit sectors are assumed to have an 11% investment cost decrease for all building related energy saving measures resulting from EIA (based on the current energy list of EIA); this is not the case for non profit sectors.

Education subsidy
165 million euro of subsidy is available in the framework of the crisis package, to be used for energy saving and improvement of ventilation systems in education. This has been included in the variant with fixed policy.

Ecodesign
In the framework of the Ecodesign guideline, the EU lays down demands for energy use of appliances and products that are sold. As a result, only high efficiency boilers are allowed for replacing old boilers as of 2011 and as of 2013 energy efficient pumps are obligatory in cooling and heating installations. Moreover, as of 2015 only energy efficient ventilators will be installed and the same applies to energy efficient lighting as of 2017. Ecodesign will have little effect on office equipment, because the Energy star requirements are met by 95% of the market already.

Sustainable procurement
Sustainable procurement by the government is not explicitly included in the projection. Sustainable procurement can involve the purchase of green electricity, renting or buying office build-

ings and buying appliances. In the projection it is assumed that this does not have any additional effect compared to the policy measures in the intended policy variant such as More with Less and Ecodesign.

Long Term Agreements
The government has closed Long Term Agreements with Higher vocational education and universities, with university medical centres, supermarkets and with banks and insurers. Those LTAs date back to before the working programme Clean and Efficient of 2007 and are therefore part of the policy variant without Clean and Efficient policy.

Results
In TSG there is much interaction between heat demand, electricity demand and natural gas deployment, among other things because of the internal heat load and the deployment of electricity in climate control.

Heat demand
Without Clean and Efficient policy heat demand will increase only slightly from 153 PJ in 2008 to 154 PJ in 2020. The rising heat demand is adjusted to a nearly flat trend.
The rising heat demand caused by growth of the sector will be compensated by a decrease in degree days and savings resulting from the demolition and replacement of buildings. In intended Clean and Efficient policy the heat demand in 2020 is 4 PJ lower due to post insulation as an effect of More with Less.

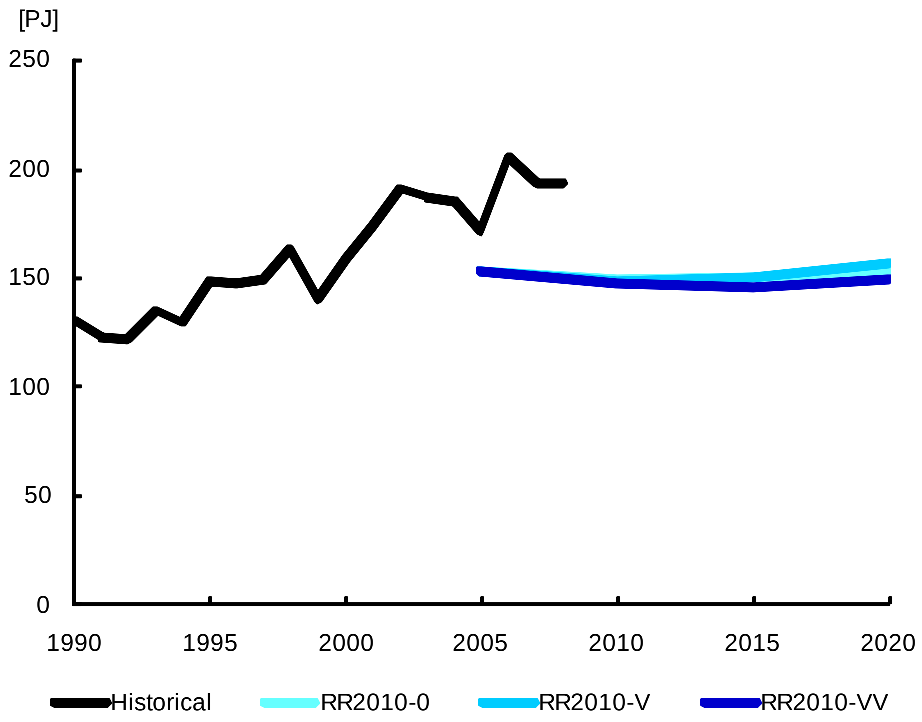

Figure 3.18 *Final thermal use TSG*

Natural gas use
Without Clean and Efficient policy the trend of increasing gas demand is adjusted to decreasing gas demand. The gas use decreases from 177 PJ in 2005 to 144 PJ in 2020, which is the result of saving measures, a decrease in the number of degree days and a relatively slower growth of the

number of employees compared to the past. On top of that there is a shift from gas appliances to electric appliances (e.g. an electric heat pump instead of a high efficiency boiler in new-build houses).

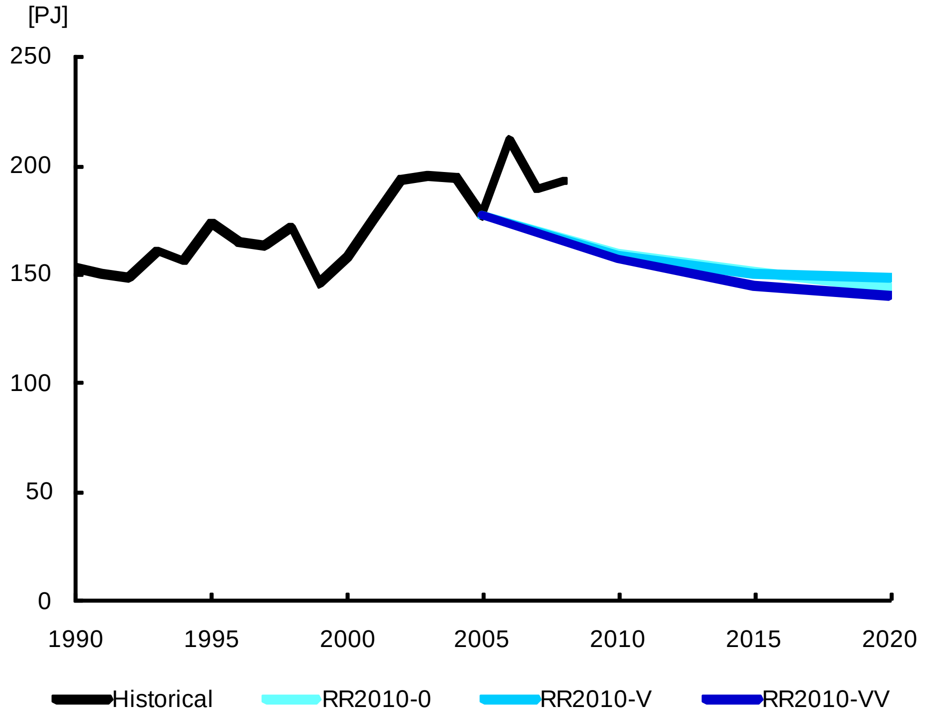

Figure 3.19 *Gas use TSG*

Under fixed policy gas demand is barely lower than without Clean and Efficient policy. Under intended policy gas demand is 3 PJ lower. The additional saving in gas demand of 11 PJ resulting from More with Less will be compensated by increased gas demand because of the Ecodesign effects. Ecodesign will lead to more efficient installations with lower electricity demand, but also decrease the internal heat load and thus increase the heat demand for space heating and cause an increase in gas use of about 6 PJ. The crisis measures offering subsidy for energy saving in education have only led to a limited gas saving effect of 0.5 PJ. The effect of EPC tightening in 2015 amounts to 0.5 PJ in the reference year 2020 because of the limited timeframe between construction application and delivery of the new building. Moreover gas use for CHP increases because in intended policy the SDE-charge makes CHP more attractive and there is saving in gas deployment because of the deployment of green gas from VFG digestion and waste water treatment that caters for own energy needs. On balance both developments result in an additional gas use of 3 PJ compared to the variant without Clean and Efficient policy.

Final electricity use

From a historical perspective electricity demand increases much more rapidly than gas use. The electricity demand in the TSG sector will continue to increase without Clean and Efficient policy, rising from 199 PJ_e in 2005[15] to 137 PJ_e in 2020. The main causes are the growth of the number of employees in TSG, the increase of the number of cooling degree days, more new dwellings with building cooling systems, growth in ICT and the previously mentioned shift from gas to electric appliances. Fixed and intended policy level off the increase, which is mainly

[15] This is the calculated value for 2005. It offers a better basis for illustrating the growth than the historical series that have been adjusted at a late stage.

caused by Ecodesign. With intended policy the electricity demand is therefore 11 PJ_e lower than without Clean and Efficient policy.

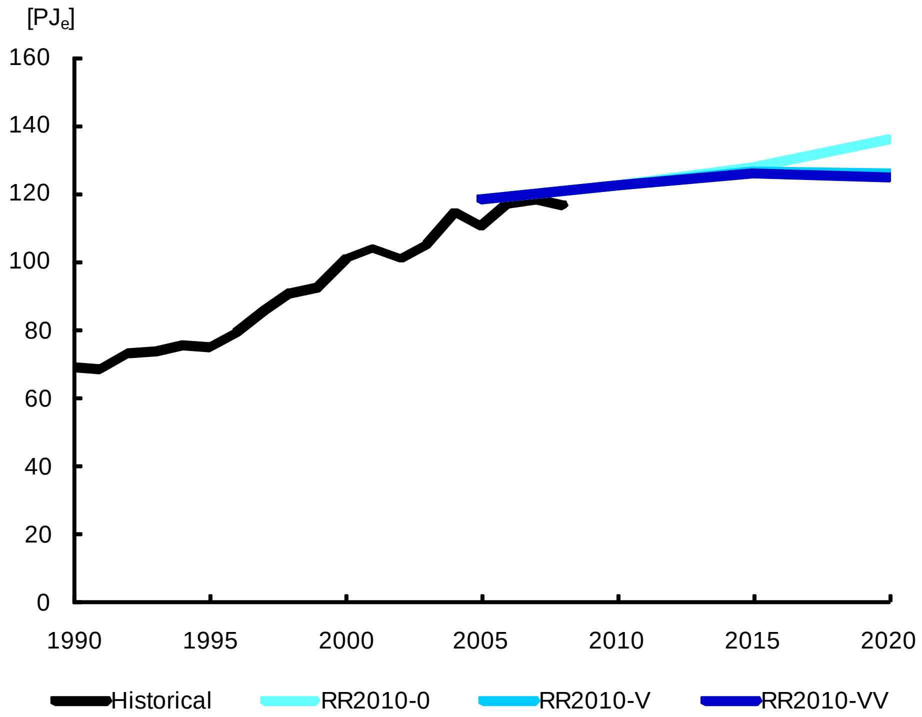

Figure 3.20 *Final electricity use TSG*

Primary energy use
Without Clean and Efficient policy the primary energy use increases from 460 PJ in 2005 to 479 PJ in 2020. With intended policy the primary energy use in 2020 decreases to 424 PJ.

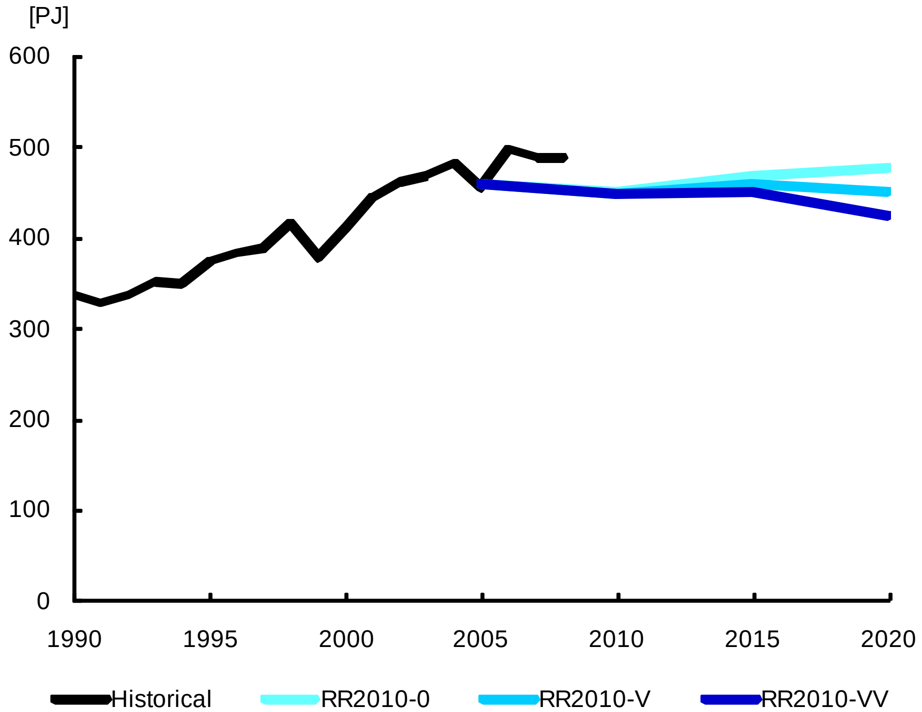

Figure 3.21 *Primary energy use TSG*

The crisis measures entailing subsidy for energy saving in education has only a limited effect. The effect of the tightening of the EPC standard in 2015 is barely visible in reference year 2020 due to the time span between construction application and completion of new buildings. The SDE surplus on electricity makes CHP more attractive, resulting in 2 PJ saving. The total effect of fixed and intended policy is a saving of 33 PJ primary; 11 PJ from More with Less and 19 PJ from Ecodesign.

CO_2 emission

The direct emission of TSG increased from 9.9 Mton to 11.3 Mton between 1990 and 2008. Without Clean and Efficient policy the direct CO_2 emission decreases from 10.2 Mton in 2005 to 8.3 Mton in 2020. With intended policy the direct CO_2 emission amounts to 7.9 Mton in 2020. The policy effect on the direct emission is limited because the decrease of the gas price is limited.

Uncertain factors

The following uncertain factors play a role in the determination of the direct CO_2 emissions and the electricity demand of TSG:

- Statistics The uncertainties in the historical data of TSG are large, because this sector is not observed separately by CBS in the energy statistics. The natural gas use and electricity use of the services sector is determined by deducting the use of the other sectors from the total national use. All uncertainties in the use of the other sectors are therefore manifest themselves in the use of the services sector. The historical trend is not flowing, but fanciful in shape, even after correction for fluctuations in temperature. The average deviation of statistics compared to the trend line in the period 1990-2005 is 8.5%.

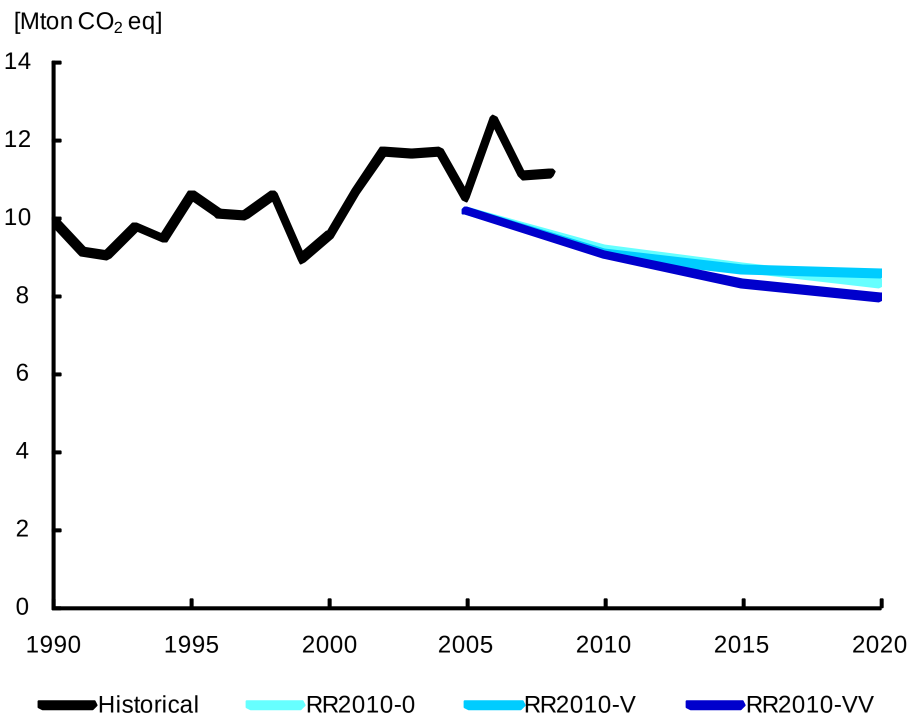

Figure 3.22 *CO_2 emission TSG*

- Growth non profit sectors. These are exogenic data such as number of students in various types of education, patients in healthcare, number of employees in TSG. These data were obtained from external sources and are scenario data, which can deviate from reality.
- Economic growth. If the economic growth between 2010-2020 is not 1.7% annually, but 0.9% or 2.5% annually, this will also decrease or increase the growth of TSG. A smaller of larger growth of the sector also implies decreased or increased gas and electricity use.
- Replacement pace buildings. It has become evident that the replacement pace of buildings is an important factor for the development of gas use. Demolition implies new buildings, replacing relatively poorly insulated buildings by buildings that meet the EPC standard valid at the time of completion. Literature has shown that demolition of office buildings in the past years varies from 0.1% to 0.5% annually. The projection assumes a demolition pace of 0.5% annually for all types of buildings. In the bandwidth calculations range from 0.1% to 0.8% annually.
- Climate factor. The development of the number of heating and cooling degree days is a prognosis provided by the Royal Netherlands Meteorological Institute (KNMI). The future temperature development may deviate from the temperature development assumed in the calculations. The bandwidth includes 50% of the effect of this climate factor.
- Policy effects of More with Less and Ecodesign have been given a bandwidth.

The tables below show the influence of the most important uncertain factors on CO2 emissions and electricity demand.

Table 3.10 *Uncertain factors CO_2 emission trade, services and government*

[Mton CO_2]	Uncertainty range deviation 5-95%		
Description uncertain factor	Lower value	Upper value	Variant
Economic growth, growth non profit sectors	-0.2	0.2	
Replacement pace buildings.	0.3	-0.2	
Statistics	-0.8	0.8	
Climate development	-0.2	0.2	
CHP TSG: Economic growth, choice of location companies and distribution of growth over activities	-0.1	0.1	
CHP TSG: Fuel prices	-0.1	0.0	
CHP TSG: CO_2 prices	-0.1	0.0	
CHP TSG: Cost development and barriers CHP	-0.1	0.1	
Policy Established Ecodesign	-0.2	0.2	V, VV
Policy: EPA office and social service sector	0.3	-0.1	VV
Policy: Intended Ecodesign	-0.1	0.1	VV

Table 3.11 *Uncertain factors electricity demand trade, services and government*

[PJ_e]	Uncertainty range deviation 5-95%		
Description uncertain factor	Lower value	Upper value	Variant
Economic growth, growth non profit sectors	-10.2	10.2	
Statistics	-7.8	7.8	
Climate development	-1.9	1.9	
Policy: Established Ecodesign	2.8	-2.8	V, VV
Policy: Intended Ecodesign	0.8	-0.8	VV

3.6 Agriculture

Introduction

The primary energy use of agriculture in 2008 amounted to about 5% of total Dutch primary use. The energy intensive greenhouse horticulture is to a large extent responsible for this use. In 2008 the total CO2 emission of agriculture was 7.8 Mton.

Greenhouse horticulture is in the middle of intensification and scaling up. The physical production per hectare has more than doubled since 1980. The number of greenhouse horticulture farms is decreasing rapidly, whereas the greenhouse horticulture area is growing slightly. Due to the increasing use of gas engine CHP, the developments in the electricity market are increasingly important for the sector from a financial point of view.

The starting point for the assumed developments in agriculture is the perspectives study conducted by LEI (2009). LEI has mapped the results based on the starting points of the Reference projection (economic growth, energy prices). These adjusted results on hectares, among other things, is the basis of the Reference projection.

The glass area increases from 10,540 hectares in 2005 to 11,080 hectares in 2020 (LEI, 2010). The cut flowers and potted plants area increases. The area of greenhouse vegetables, on the other hand, is decreasing. In the period 2011-2020 the average growth of the added value in agriculture is 1.5% annually.

Policy

The energy policy for agriculture encompasses a large number of initiatives. The Clean and Efficient Agriculture Covenant of 2008 addresses the targets of the working programme Clean and Efficient. Agreements with less energy intensive agricultural sectors are established in the annual working programmes.

Part of the intended policy is dedicated to establishing a CO_2 sector system for greenhouse horticulture. This system requires an emission ceiling that also covers CO_2 emissions of CHP. If the sector ceiling is exceeded, this must be compensated by purchasing JI/CDM allowances. The price incentive within the sector system is expected to match the incentive of the CO_2 price in the European emission trading system (ETS), i.e. 20 €/tonne in 2020 in the projection. It is assumed that the price of JI/CDM allowances will grow towards the price of CO_2 emission allowances in the ETS. In time provisions will probably be made for settlements with the sector in case the emissions are lower than the sector ceiling. The projection assumes that the price incentive will be passed on to individual companies. The exact set-up of the sector system is not yet known at this moment.

A limited number of large greenhouse horticultural businesses, with a joint emission of 1.5 Mton CO_2eq in 2008, is currently participating in the ETS.

The government and the greenhouse horticulture industry are working together on the energy transition in greenhouse horticulture in the programme Greenhouse as energy source. Much effort is put in energy saving (resulting from different cultivation methods, as in 'the new cultivation concept') and in innovation. To stimulate semi-closed greenhouses, geothermal heat and other innovative energy systems in greenhouse horticulture a subsidy scheme for Market introduction of energy innovations (MEI) was set up. This subsidy scheme reimburses 40% of the investment amount. The MEI scheme will be operative until 2020 under fixed and intended policy.

Innovative energy systems will only be implemented on a large scale if they can compete with heat supply from CHP. Whether or not this will succeed depends on technical developments and the energy prices.

The Reference projection assumes that CHP will remain an attractive option for greenhouse horticulture industry; the CHP capacity, excluding renewable CHP, will increase to 3600 MW_e under fixed policy and 3300 MW_e under intended policy. Storing CHP heat in heat buffers enables the greenhouse horticulture industry to respond in a flexible manner to the electricity prices.

In 2007, the first greenhouse horticulture business started using geothermal heat for heating a tomato greenhouse. Drilling for heat in deep layers of the earth requires high investments. A guarantee scheme for geothermal heat protecting entrepreneurs from misdrilling is part of the intended policy. The greenhouse horticulture are that is heated by geothermal heat is increasing to 800 hectares in 2020[16] under intended policy, whereas under fixed policy the area will amount to 200 hectares.

(Semi-)closed cultivation is an innovative way of producing renewable heat and (simultaneously) cooling the greenhouse. It enables a higher production per hectare. The working programme Clean and Efficient aims at 700 hectares of (semi) closed greenhouses in 2011 and a share of 25 of the area in 2020. Up to now the results of the semi-closed greenhouses have only partly met the expectations. Effort is made to accelerate the implementation by means of a long-term programme. The technical development of this greenhouse concept is uncertain. Under fixed policy the area of closed greenhouses will arrive at 800 hectares and under intended policy this will be somewhat lower at 700 hectares, because geothermal heat is more attractive here.

Results[17]

As more heat is produced with gas engines, the natural gas use in greenhouse horticulture rises quickly. Heat produced by CHP is cheaper than heat produced with a boiler. Therefore there is less incentive for CHP owners to lower their final heat demand. The increase in CHP use does accelerate the sectoral and national energy saving pace.

However, this increase is unfavourable for the national greenhouse gas balance, despite the fact that the CO_2 emissions of CHP gas engines are lower than in case of separate generation of electricity and heat. This is due to the fact that the CO_2 emission and methane emissions of the sector are increasing rapidly, whereas the decrease in CO_2 emission is taking place in the electricity sector, which is covered by the ETS system. In 2008 the Dutch cabinet decided to book the European emission reduction target for the ETS sector as result, regardless of the actual emissions. The CO_2 settlement scheme for greenhouse horticulture can solve this problem, because it compensates for any exceeding of the sector ceiling by purchasing JI/CDM credits.

The Clean and Efficient Agriculture Covenant established an emission reduction target for greenhouse horticulture in 2020 of at least 3.3 Mton CO_2 compared to 1990. The definition of emission reduction as agreed in the covenant values all generated electricity with an avoided CO_2 emission reduction of 480 kg/MWh. Due to the large deployment of CHP in 2008, the covenant's emission reduction target for 2020 was realised immediately.

Deploying CHP in greenhouse horticulture has a large effect on the development of fossil fuel use and the CO_2 emissions in agriculture. The variant with intended policy assumes less fuel use for CHP as a result of an additional realised area with alternative greenhouse concepts and less favourable market conditions for CHP.

---

[16] Based on most recent information this seems rather optimistic. The uncertainty bandwidth has taken this into account.

[17] The historical series of agriculture were adjusted after the calculations had already been completed. The graphs show the new series for history, but other values have been used as the starting point for the calculations. In a number of figures this has led to a bad link between history and calculations.

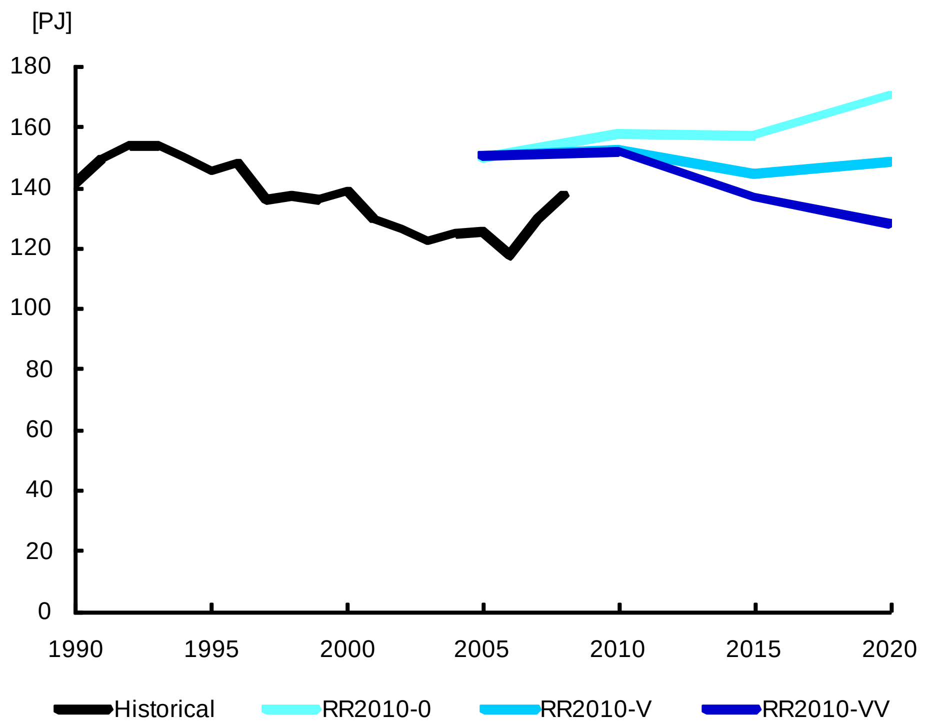

Figure 3.23 *Fossil energy use in agriculture*

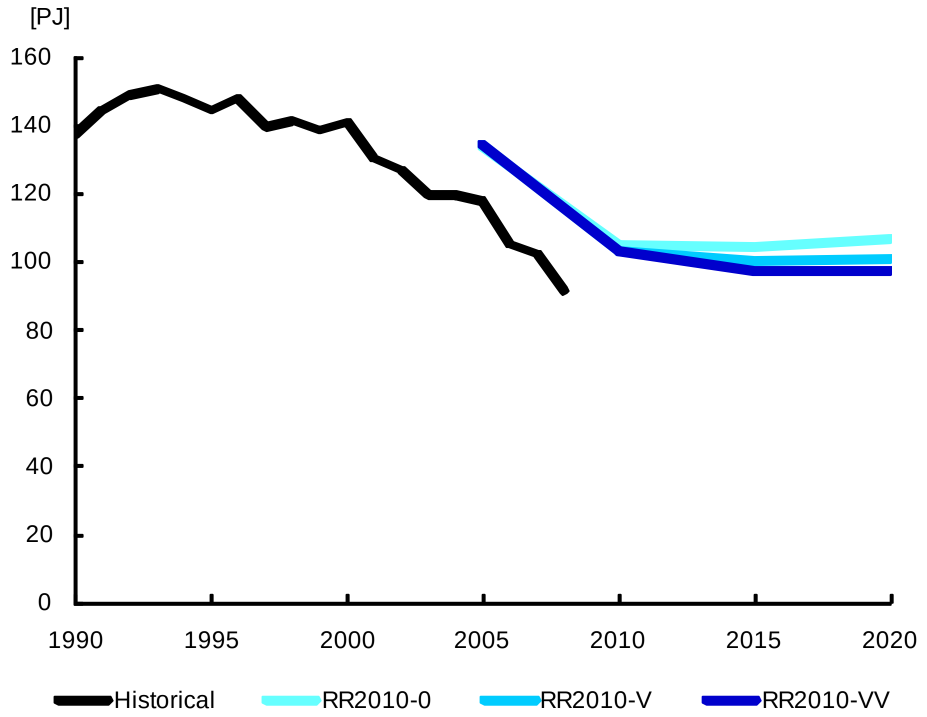

Figure 3.24 *Final thermal energy use agriculture*

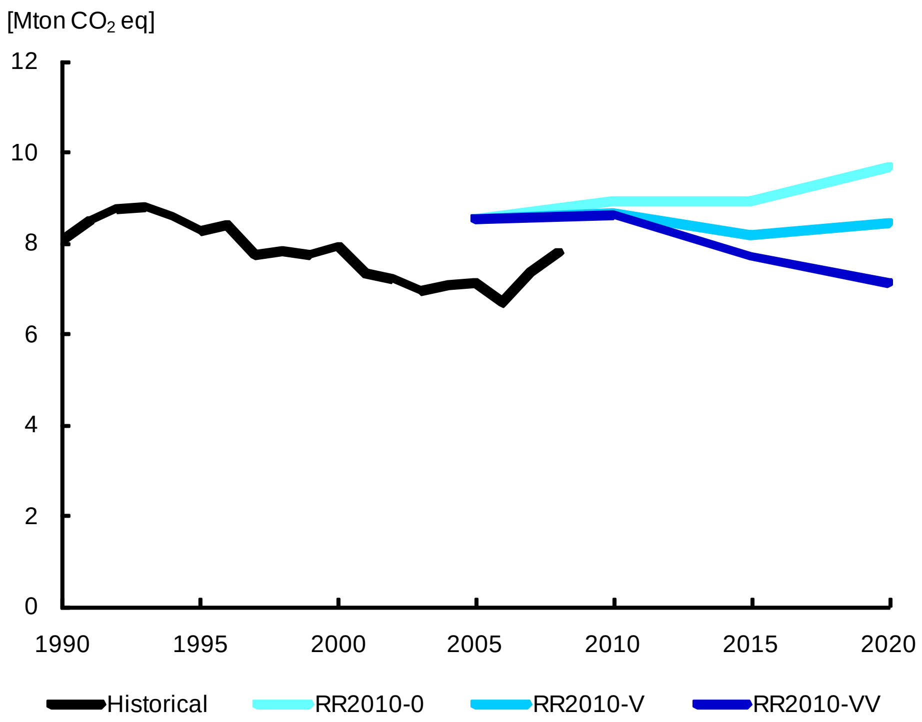

Figure 3.25 *Development of CO_2 emissions in agriculture*

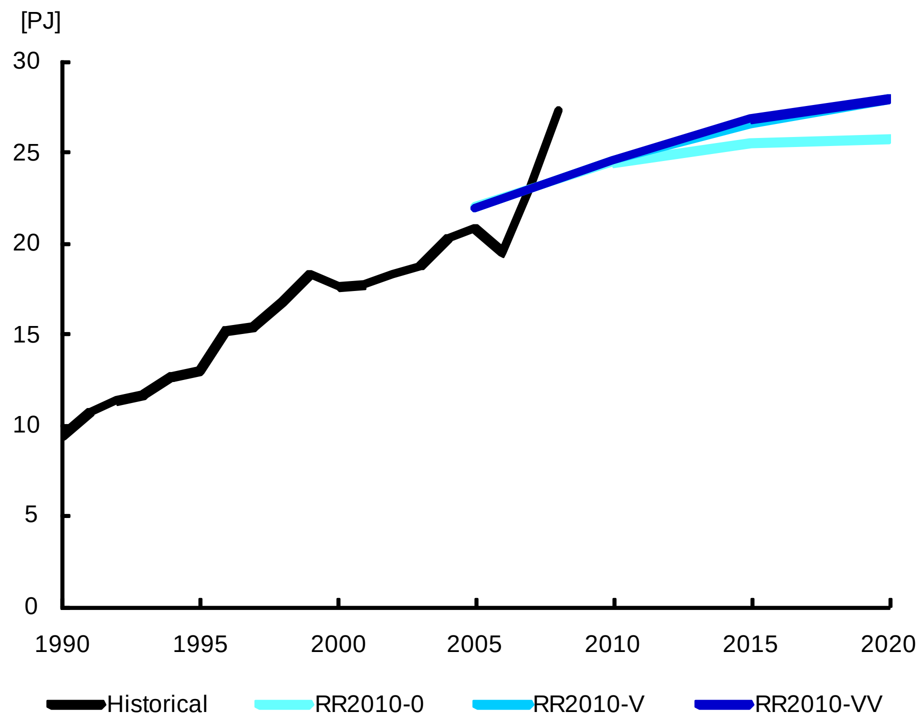

Figure 3.26 *Final electrical consumption agriculture*

The increase in final electricity demand is caused by an increase in illuminated cultivation, mechanisation and automation. The use of new innovative greenhouse systems also leads to a higher electricity use because of the use of heat pumps, pumps and air conditioning systems.

Uncertain factors

The main uncertain factors in agriculture are the fuel prices, which have a major influence on the use of CHP. Moreover, the costs and potential of saving measures are not well known. Another uncertain factor is to what extent innovative greenhouse systems will be successful. The small number of businesses that can conduct heat drillings is a limiting factor for the deployment of geothermal energy. The tables below show the influence of the most important uncertain factors on CO_2 emissions, electricity demand and renewable heat.

Table 3.12 *Uncertain factors CO_2 emission agriculture*

[Mton CO_2]	Uncertainty range deviation 5-95%		
Description uncertain factor	Lower value	Upper value	Variant
Economic growth, area growth and distribution into activities	-0.1	0.1	
Fuel prices	-0.1	0.1	
CO_2 prices	0.0	0.0	
Statistics	-0.1	0.1	
Cost and potential of saving measures	-0.1	0.1	
Deployment of alternative greenhouse concept	0.4	-0.8	
CHP agriculture and horticulture Economic growth, area growth and distribution into activities	-0.4	0.7	
CHP agriculture and horticulture Fuel prices	0.2	-1.4	
CHP agriculture and horticulture CO_2 prices	-0.4	0.4	
CHP agriculture and horticulture Cost development, deployment strategy and barriers CHP	-0.4	1.1	
Effectiveness energy policy	0.0	0.0	V, VV
VV Policy: Guarantee facility geothermal heat	0.4	0.0	VV
VV Policy: Effectiveness of other policy agriculture	0.1	-0.2	VV

Table 3.13 *Uncertain factors renewable heat agriculture*

[PJ]	Uncertainty range deviation 5-95%		
Description uncertain factor	Lower value	Upper value	Variant
Deployment of alternative greenhouse concepts	-6.2	13.1	
VV Policy: Guarantee facility geothermal heat	-6.8	0.2	VV
VV Policy: Effectiveness of other policy agriculture	0.0	1.8	VV

Table 3.14 *Uncertain factors electricity demand agriculture*

[PJ_e]	Uncertainty range deviation 5-95%		
Description uncertain factor	Lower value	Upper value	Variant
Economic growth, area growth and distribution into activities	-1.3	2.6	
Fuel prices	-1.6	3.9	
CO_2 prices	0.8	-1.0	
Statistics	-1.3	1.3	
Cost and potential of saving measures	-1.3	2.6	
Deployment of alternative greenhouse concepts	-1.7	3.9	
VV Policy: Guarantee facility geothermal heat	-0.3	0.0	VV
VV Policy: Effectiveness of other policy agriculture	-1.0	1.0	VV

4. Energy supply

4.1 Electricity production

Electricity demand in the Netherlands

In 2008 the final domestic electricity demand in the Netherlands amounted to 120 TWh. Under fixed Clean and Efficient policy the electricity demand in 2020 rises to 131 TWh; under intended policy it amounts to 130 TWh. The average annual growth in the period 2009-2020 is thus 0.7% annually. This slow growing pace is caused by the economic shrinkage in 2009 and 2010 and a moderate economic growth in the period 2011-2020.

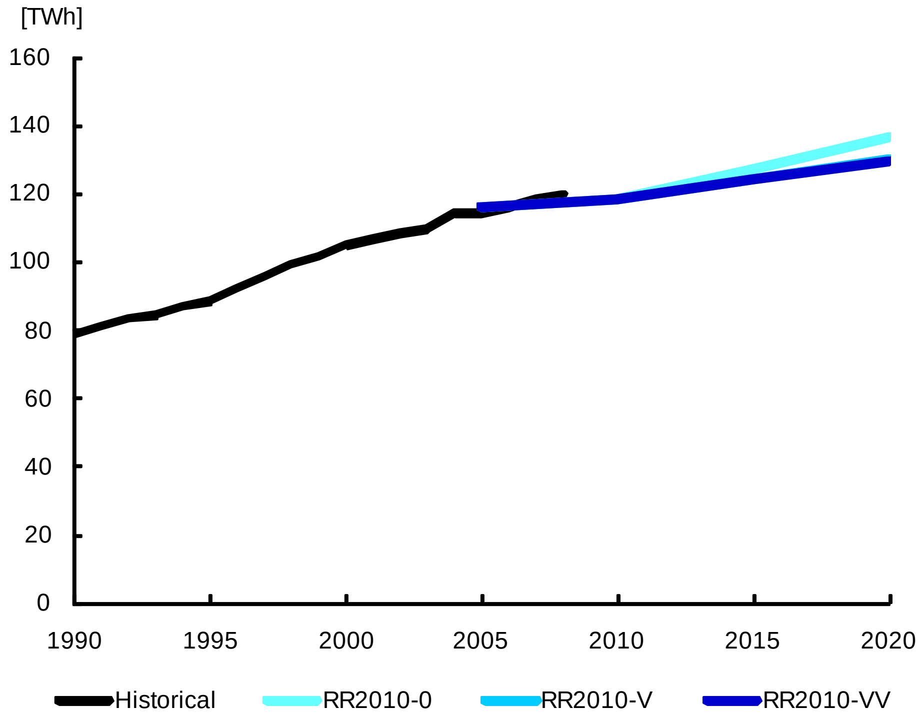

Figure 4.1 *Final electricity demand Netherlands*

Developments in the electricity market of Northwest Europe[18]

The developments in the Netherlands cannot be isolated from developments in neighbouring countries. After all the electricity market is a European market. The projection of the production capacity in the Northwest European electricity market is largely based on the EU baseline 'Trends to 2030' scenario (EC, 2008)[19], including some corrections made by ECN for recent developments such as the suspended phasing out of nuclear power plants in Germany and Belgium.

[18] This description of the developments of the Northwest European Electricity market agrees with and is largely based on previous ECN studies (Daniels and van der Maas, 2009; Seebregts et al, 2009; Seebregts et al, 2010).

[19] ECN has used this information in previous studies; see e.g. ECN-E-08-044 (Özdemir et al, 2008) for the period until 2020 with regard to new plants in Germany, and ECN-E-08-026 (Seebregts & Daniels, 2008) for specific information about the development until 2030 in Germany. Next to these sources the following documents were also consulted: the RWE Facts & Figures (RWE, 2009), and UCTE forecasts (UCTE, 2009). It should be noted that the UCTE forecasts deviate from the EU Trends to 2030 baseline. Traditionally, UCTE assumes high numbers with regard to production capacity and electricity demand.

Table 4.1 provides an overview of the development of the net additional capacity in the Netherlands and countries with which interconnections exist or are planned. The Netherlands clearly shows a trend towards much new production capacity. The growth is relatively larger than in other member states. Generally, the growth in GW is relatively larger than in TWh demand: The average number of operating hours is decreasing. This is partly caused by the fact that a renewable GW yields less TWh than conventional capacity and partly due to catching up after years of relatively few new-build plants in Northwest Europe ('boom & bust' cycle).

Table 4.1 *Growth installed production capacity Northwest Europe*[20]

	Additional compared to 2005			Additional compared to 2005			Growth demand compared to 2005	
	2020 [GW]	2025 [GW]	2030 [GW]	2020 [%]	2025 [%]	2030 [%]	2020 [%]	2030 [%]
NL[21]	12.2	14.2	16.1	61	72	81	34	41
DLD[22]	28.1	32.7	29.2	23	27	24	13	16
B	5.3	6.6	6.9	35	43	45	25	31
FR	5.0	0.2	1.9	4	0	2	15	18
NO	12.6	15.2	18.0	42	51	61		
UK	5.4	12.5	18.0	6	14	20	14	18
DK	-0.8	0.0	0.2	-6	0	1	13	16

Interconnections Additional increase

Apart from price differences, physical interconnections with foreign electricity markets also determine the import and export of electricity. There have been electricity connections with Belgium, France and Germany for a long time already. In 2013 the connection with Germany will be expanded (100-2000 MW); since 2008 the connection with Norway (700) is fully operational and in 2011 the connection with the United Kingdom will enter into operation (1000 MW).

Switch of Netherlands to being an exporting country is robust

Germany, a neighbouring country with much interconnection, is an important country to the Netherlands. Although the Netherlands is currently still a net importer of German electricity, the new Reference projection confirms once again that by 2012 and afterwards the switch of the Netherlands towards being an exporter of electricity is rather robust.

The same conclusion was drawn by other ECN studies (Özdemir et al, 2008; Seebregts & Daniels, 2008; ECN/PBL, 2009, 2009b). The Netherlands has a competitive advantage because of its coastal locations offering plenty of cooling water options and relatively cheap supply costs for coal. This advantage translates into the current boom in new construction plans in the Netherlands (see Table 4.2.), including the plans of German origin (E.ON, RWE). Moreover, the German park has a higher average CO_2 emission factor, which makes it more sensitive to fluctuations in the CO_2 price.

This projection also takes into account the decision of the German government to postpone the phase-out of nuclear power plants (CDU/CSU/FDP, 2009). Keeping the German nuclear power plants in operation and at the same time decreasing investments in new fossil generation capacity in Germany has cushioned the Dutch export to Germany. In the new projections the import in 2020 amounts to 16 and 19 TWh for RR2010-V and RR2010-VV respectively. If the German

[20] Conventional and renewable in Northwest European countries, 2020-2030 (EC, 2008).

[21] ECN uses other higher values for the Netherlands than this EU Baseline of 2008. In 2020 the number of GW increased to 37 (RR2010V) and 42 GW (RR2010VV).

[22] In Germany several plans for new coal-fired plants in Germany were postponed or even cancelled (early 2010). ECN has already processed this information and the postponed phase-out of nuclear power plants in the Reference projection. .

nuclear power plants would be phased out for the largest part before 2020, this would lead to 6 TWh of additional export to Germany.

Production park

By the end of 2008 there was about 25 GW of installed capacity in the Netherlands. Until 2020 this will increase to about 35.6 GW in case of fixed policy and nearly 42 GW in case of intended policy. The growth is largest in the period 2009-2015, which is due to the construction of new gas and coal-fired power plants. In the period 2015-2020 those power plants that are less efficient will be decommissioned. The difference between installed capacity between the variants with fixed and intended policy arises mostly from the expansion of renewable electricity, most of which additional wind capacity (see also Section 4.3).

The future fuel prices and the CO_2 price are very influential factors, both for investments in new production capacity and for the operational deployment of this capacity. These prices were described in Section 2.4. The development of production capacity and the electricity demand of neighbouring countries of the Netherlands in the Northwest European electricity market also determine the competitive relations.

Overview new construction plans the Netherlands

RR2010-V and RR2010-VV projections are based on assumptions of about 10 GW of new coal and gas-fired power plants up to and including 2016; these are the confirmed plans of those plants that have just entered into operation (Sloe plant), are already under construction or about to be constructed. This is lower than the total amount of the new construction plans reported to TenneT (TenneT, 2009; 2009b and various press and media messages), which is over 30 GW up to and including 2020 (Seebregts et al., 2009; Daniëls and van der Maas, 2009)[23].

3.5 GWe of new coal-fired plants, 6.5 GWe new gas-fired plants

In the period up to and including 2013 about 3500 MW of new coal-fired power plants will be built, with a conversion efficiency of 45 to 46%. Currently there are plans for about 6000 MW_e of new gas-fired plants either already under construction or planned for the near future, most of which CCGT (Combined Cycle Gas Turbine) with a conversion efficiency of 58 to 59%.

Second nuclear power plant Borssele

Due to the uncertainty in the decision making process and the current Dutch Cabinet's position. Additional nuclear energy was not included in the projection[24]. The energy company Delta plans on building a second nuclear power plant in the Sloe area. This 'Borssele-2' plant, with a capacity of 1600 to 2500 MW, will be three to five times larger than the existing nuclear power plant (492 MW_e)[25]. According to the expectations of Delta[26] this plant will enter into operation in 2018.

[23] In fact, a notification sent to TenneT does not mean that the plant will actually be built. In the end a construction permit must be obtained and a decision about starting the construction must be made. Market conditions and prospects at the time of making a final investment decision may lead to postponement or even withdrawal of the plan.

[24] A separate ECN study for the Dutch Ministry of Economic Affairs and the Environment addresses the role of more nuclear energy in the Netherlands after 2020 (Seebregts et al., ECN-E--10-033, March 2010).

[25] EPZ (2009). Press release. In 2008 the net capacity was 492 MW_e. The net capacity varies every year. In 2008 it was high as a result of an on average cold year. Due to on average colder cooling water the net efficiency is higher.

[26] Delta (2009): *Startnotitie MilieuEffectrapport Tweede Kerncentrale Borssele - Het gefaseerd bouwen en vervolgens bedrijven van een nucleaire elektriciteitscentrale met een vermogen van maximaal 2500 MWe,* June 2009. Internet: http://www.delta.nl/over_DELTA/kernenergie/startnotitie_tweede_kerncentrale/.

Table 4.2 *New construction plans central capacity ('electricity plants'), 2008-2020*

Company	Location	Capacity [MW_e]	In operation	Type	Electrical efficiency (net)	Status
Assumed to be actually new construction in projections						
Gas-fired						
Delta	Sloe area (Sloe plant)	870	2009	CCGT	58%	Meanwhile taken into production
Electrabel	Flevo plant	870	2009	CCGT	59%	Nearly in operation
Enecogen	Rijnmond	840	2011	CCGT	58%	Under construction
RWE/Essent	Moerdijk	400	End of 2011	CCGT, CHP	58% [4)]	Decree 28-5-2008
RWE/Essent	Maasbracht (Maasbracht-C)	+635	2011	Maasbracht-B becomes CCGT	58% [5)]	Contracts May 2008
Intergen [3)]	Rijnmond	420	2010	CCGT	58%	Under construction
Vattenfall/ Nuon [1)]	Eemshaven (Magnum)	1300	2012	STEG	56%	Under construction
Corus	IJmuiden	525	2013	Blast furnace gas, boilers and CHP	n.a.	Start-up memorandum 16-10-2008
	Total	**5859**				
In addition to old WLO-GEHP		4464	(WLO-GEHP already included Sloe plant)			
Coal-fired						
E.ON	Maasvlakte (MPP-3)	1070	2012	Pulverised coal	46% [2)]	Under construction
Electrabel	Maasvlakte	800	2012	Pulverised coal	46%	Under construction
RWE	Eemshaven	1600	2013	Pulverised coal	46%	Construction started
	Total	**3470**				
Business plans but not included in the Reference projection						
Gas-fired						
Advanced Power (Eemsmond Energie)	Eemshaven	Max. 1300	2013	CCGT	Min. 57%	MER July 2009
Electrabel	Bergum	454	2014	n.a.	n.a.	Reported via TenneT
NAM	Schoonebeek	130	2011	Gas, CCGT (CHP n.a.)		Reported via TenneT
Vattenfall/ Nuon	Amsterdam, Hemweg	max. 550	n.a.	CCGT, possibly CHP	Min. 57%	MER February 2009
Vattenfall/	Diemen	max. 550 $_e$,	n.a.	CCGT, CHP	Min. 57% (80% total)	Start-up memorandum 11-4-2008

Company	Location	Capacity [MW_e]	In operation	Type	Electrical efficiency (net)	Status
Nuon		(250 MW_{th})				
Unknown	Maasvlakte	600	2011	Gas	n.a.	Reported via TenneT
InterGen	Moerdijk	900	2013	Gas, CCGT (2 units)	58-59%	Start-up memorandum September 2009)
Coal-fired						
RWE/Essent	Geertruidenberg	800	n.a.	Pulverised coal	46%	Plan postponed
RWE/Essent/Shell	South-west Netherlands	1000 MW	n.a.	IGCC	46%	Feasibility study (meanwhile adjusted)
C.GEN	Europoort	400-450	2012	IGCC	46%	Start-up memorandum 25-9-2008
C.GEN	Sloe area	800-900	n.a.	IGCC	46%	Start-up memorandum January 2010
Delta	Sloe area	max. 2500	2018	Nuclear power plant		Start-up memorandum 25 June 2009

Notes Table 2.1:

1) Conversion efficiency highly depends on the fuel mix. Preference alternative sketches input of 60% coal/biomass (720 MW, efficiency 45%) and 40% natural gas (480 MW, efficiency 54%). At 100% natural gas input the efficiency is lower than the approximately 58% of the other CCGTs because the Magnum CCGTs are designed for syngas instead of natural gas. Nuon postponed the decision about a multi-fuel gasification plant to 2009. The construction of the natural gas-fired CCGT (1400 MW) will be started. It will possibly be fitted with a coal/biomass gasification plant at a later stage.
2) At 30% biomass input, the efficiency is 1%-point lower (45%). For the moment biomass co-firing is not assumed (no SDE scheme yet).
3) Construction started in January 2008 (Press releases Intergen and Oxxio, 2007). Meanwhile named 'Maastroom Energie'.
4) MER. Full load hours 7000 (expectation as a start/stop unit) and 8300 (worst case with regard to emissions, then base load unit). The decree (dated 29 May 2008) states that the CCGT is primarily intended as a peak load unit and that it will mostly be turned off at night time.
5) Press release Essent 29 May 2008; previously MER 56% with natural gas; possibly bio-oil boiler; in that case about 52% averagely (740 MW gas, 160 MW bio-oil). Old unit was 37% (and 640 MW). Pressent, number 4, November 2008: 58,8%.
6) If the unit is realised it will replace the conventional Hemweg-7 unit in time. Heat supply, district heating is probably one of the options. Nuon plans early phase-out of older units in the Amsterdam and Utrecht regions in the next 8-10 years.
7) Intended as additional CHP unit for district heating.
8) Start-up memorandum mentions coal, pet cokes (max. about 25%, natural gas and clean biomass (max. about 25%). Concept will be capture ready, in time enabling 85% capture of CO_2 from coal, pet cokes or biomass.
9) The Reference projection RR-GE of 2005 (WLO-GDP, 2006) assumed 2400 MW (4000 MW) of new coal-fired plants and older coal-fired plants were not removed. The only new assumed gas-fired plant was the Sloe plant. The rest of the increase in gas capacity consisted of decentralised CHP.
10) The net efficiencies mentioned are based, among other things, on Seebregts & Daniëls (2008).

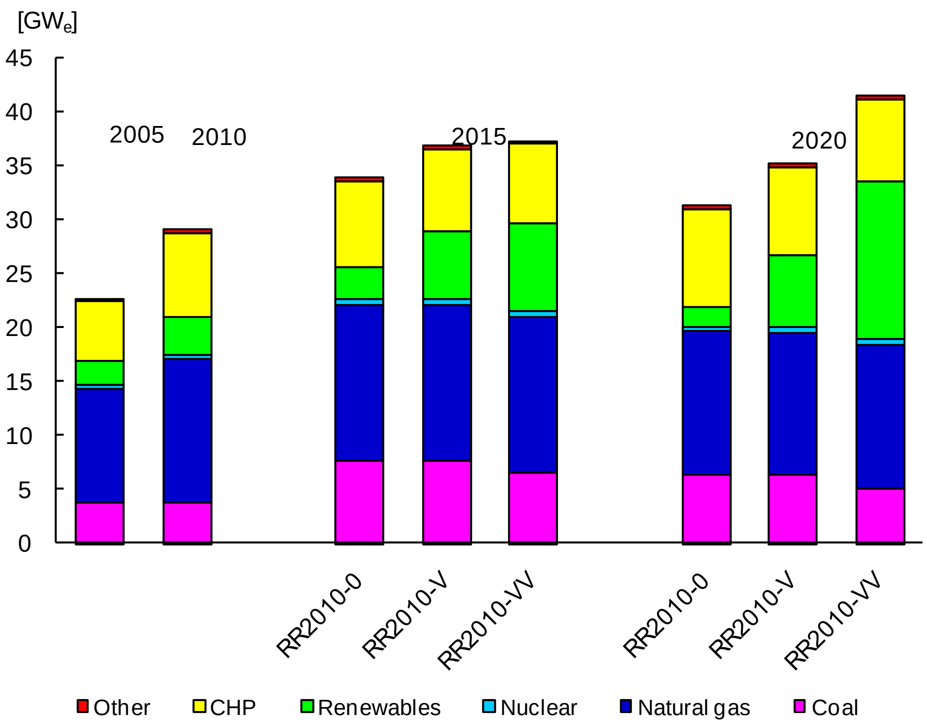

Figure 4.2 *Installed capacity in the Netherlands*

Policy overview

The main Clean and Efficient policy instruments for the electricity production are the SDE scheme (see Section 4.3), the energy sector covenant (Van Dril, 2009) and the subsidy for CO_2 capture.

CO_2 capture

The European Commission has allocated 180 million euro from the European Economic Recovery Plan to the demonstration project planned by the Rotterdam Climate Initiative[27]. Part of the project consists of using CO_2 capture in two new coal-fired plants of E.On and Electrabel. The aim is to capture 1.1 million tons of CO_2 by the end of 2015 and to store it in a depleted gas field 25 kilometres off the coast. The projection assumes that this demonstration project will be conducted.

Another demonstration project may be conducted in the Northern part of the Netherlands, near the planned Magnum plant of Vattenfall/Nuon. The Magnum plant was intended to be a coal gasifier and CCGT, but for now only 3 CCGT units will be realised. The projection assumes that this CCS project will not be conducted[28].

At a CO_2 price of 20 €/ton it is not likely that CO_2 capture will also be deployed on a large scale in other new plants before 2020. The costs are too high at the moment. Moreover, the technology has not been sufficiently developed to capture CO_2 efficiently and to guarantee reliable operation.

[27] RCI (2009): *CO_2 Capture, Transport and Storage in Rotterdam – Report 2009*, Rotterdam Climate Initiative, DCMR, Schiedam, September 2009.

[28] At the end of last year, but even today, there is no solid commitment to sufficient subsidy for the parties that must realise the second demo. Moreover, the subsidy is insufficient to yield a positive decision by the market parties. Additional CCS has been included in the uncertainty analysis.

Production mix and fuel use

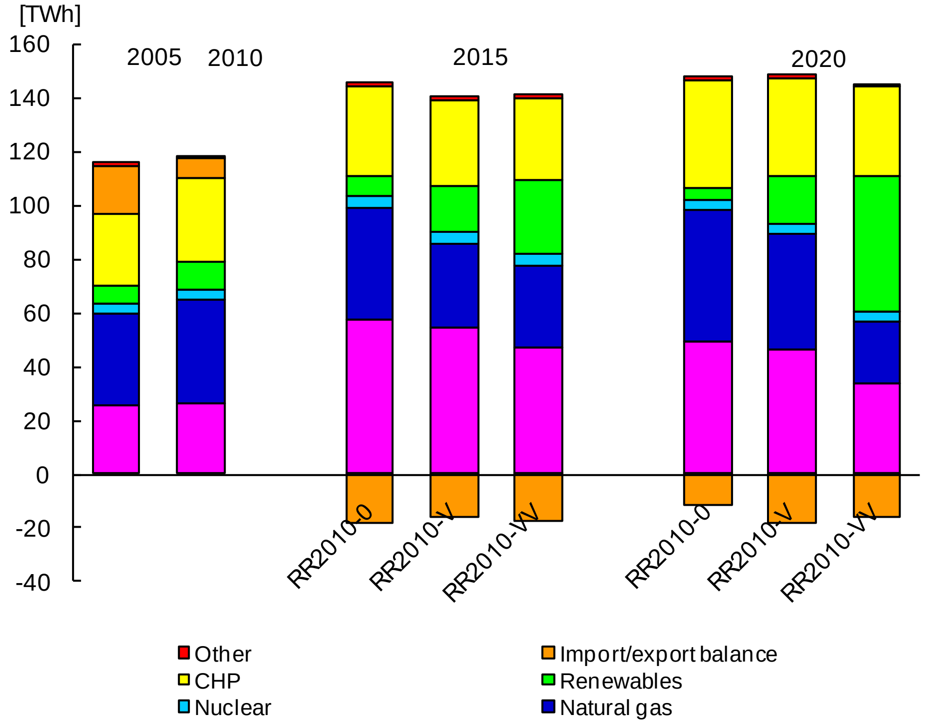

Figure 4.3 *Production mix, distributed into nuclear, coal, gas and renewable*

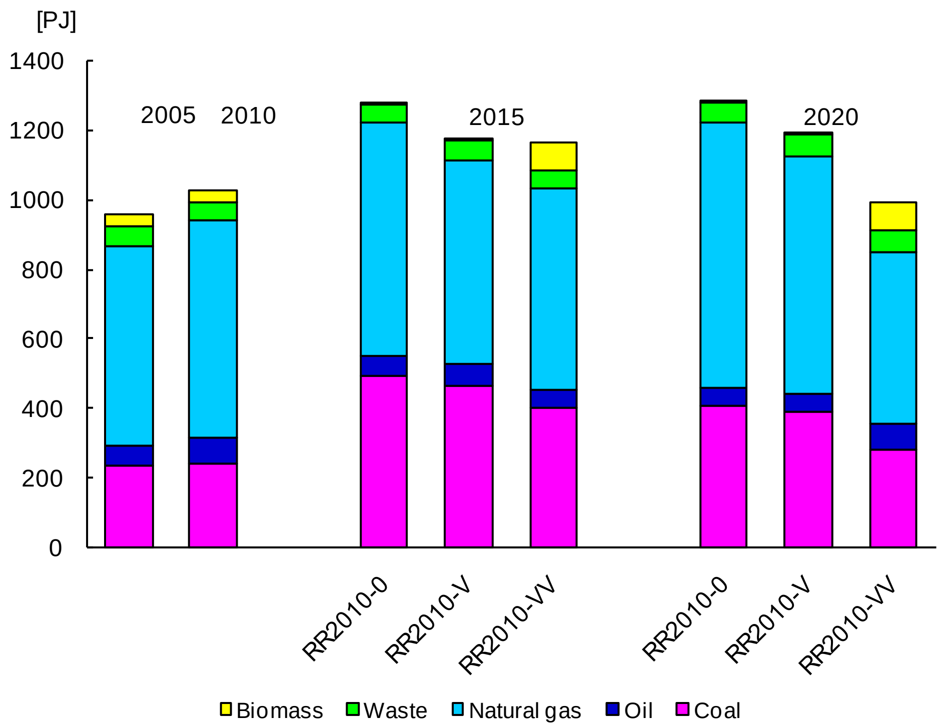

Figure 4.4 *Fuel use in the Dutch electricity production*

Import and export of electricity

Due to substantial construction of new plants the Netherlands is swiftly changing from importing to exporting country.[29] [30] [31] This change has been considered to be highly likely by ECN and TenneT since 2007. The combination of sufficiently high CO_2 prices and the additional new plants makes this change a robust one, as explained earlier. Even the political decision to postpone the phase out of nuclear plants in Germany and Belgium hardly affects the export balance to Germany. The net export in 2020 under fixed and intended policy is 19 TWh and 16 TWh.

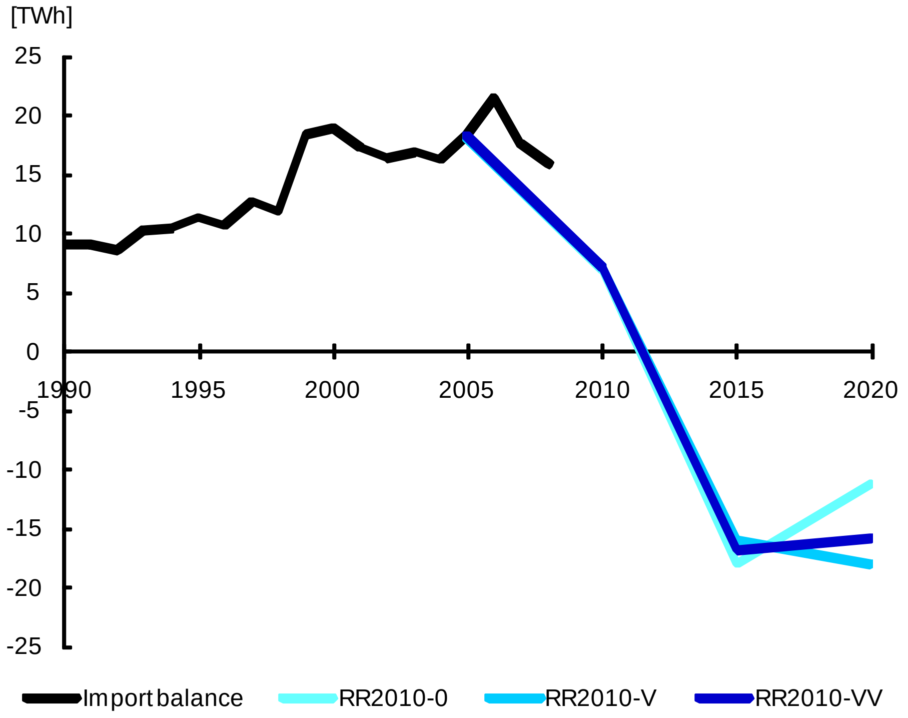

Figure 4.5 *Import/export balance Netherlands*

CO_2 emissions

The CO_2 emissions of electricity plants rise to 57 Mton (RR2010-V) and decrease to 40 Mton (RR2010-VV) in 2020. The increase in CO_2 emission is mainly caused by the new coal-fired plants and to a lesser extent by the new and efficient gas-fired plants.

Under intended policy the CO_2 emissions are 20 Mton lower than under fixed policy because the share of renewable electricity production is much larger (see also Section 4.3). The larger availability of wind energy lowers especially the deployment of (new) gas-fired plants and CHP , and the same applies to a lesser extent to the oldest coal-fired plants. Moreover, a larger share of biomass co-firing (20% on energy basis) in coal-fired plants also lowers the coal deployment. A relatively small share of the additional renewable production does not lead to a decrease in emissions in the Netherlands, but results in additional electricity export[32].

---

[29] Daniëls, B.W., C.W.M. van der Maas, et al. (2009): of ECN/PBL (2009): *Actualisatie Referentieramingen Energie en Emissies 2008-2020*, ECN/PBL, ECN-E-09-10, Petten/Bilthoven, August 2009. See also: http://www.ecn.nl/nl/units/ps/themas/energie-in-de-toekomst/referentieramingen-2008-2020/.

[30] TenneT (2009). *Monitoring Leveringszekerheid 2008-2024*, OBR 09-176, TenneT, Arnhem, http://www.tennet.org/images/176_rapport_Monitoring_Leveringszekerheid_2008-2024_NL_tcm41-18181.pdf (available since August 2009).

[31] EZ (2009): http://www.ez.nl/pv_obj_cache/pv_obj_id_86C88036DE95072E77A2F09A02788FC572A30000.

[32] As the electricity sector is covered by the European Emission Trade System, the Dutch transition towards being a net exporter and the consequences for the CO_2 emissions do not affect the national greenhouse gas targets for the year 2020 (see Chapter 7).

Box 4.1 *Integration of large-scale wind energy deployment*

The policy variant RR-2010-VV contains a large amount of wind energy capacity in 2020, i.e. about 11 gigawatt. A number of studies commissioned by the Dutch Ministry of Economic Affairs specifically address the integration of such a quantity of wind energy and the possible consequences for conventional plants (see ECN, 2009; KEMA, 2010; D-cision, 2010).

ECN concludes that, within the context of the new Reference projection, there will not be large integration problems in 2020. An issue that may arise is that in off-peak hours, periods of low electricity demand (including export demand) may occur as a result of which not all production capacity with lower variable costs (such as wind energy, waste incineration plants, must-run CHP, nuclear en coal-fired plants) can be deployed. This may possible result in plants having to lower their capacity, whereas normally they have many operating hours, such as coal and nuclear power plants.

Based on merit of order considerations and calculations for the new Reference projection and the study 'Kernenergie & brandstofmix' (ECN, 2010) it turns out that the new coal-fired plants (and any new coal-fired plants) do not suffer much from the so-called 'surplus of generation capacity'. According to expectations, the available wind capacity will not have to be lowered or switched off due to the low variable costs and the SDE subsidies in these situations.

The most important effect is the large reduction in operating hours of older and more recent gas-fired plants, the oldest coal-fired plants and a limited role for decentralise CHP. The newly built coal-fired plants and coal-fired plants from the 1990s are hardly or not at all affected in terms of decreased operating hours.

If these off-peak situations lead to significantly fewer operating hours for new conventional plants, this constitutes mainly a problem for the producer and investor, not for the government. Such a volume risk (less production than planned) is considered to be a standard business risk.

(ECN, 2009) sketches six types of solutions in case problems would arise at higher volumes of wind energy. These solutions are:
1. Larger flexibility of electricity demand
2. More interconnections with abroad and corresponding market regulations
3. Electricity storage
4. More flexibility of the other production capacity
5. Improved flexibility and predictability of the intermittent production capacity itself
6. Smart Grids Combined with these intelligent grids, electric vehicles could also play a role.

The extent to which these solutions can contribute by 2020 is mentioned in (D-cision, 2010), based on a synthesis of various recent studies.

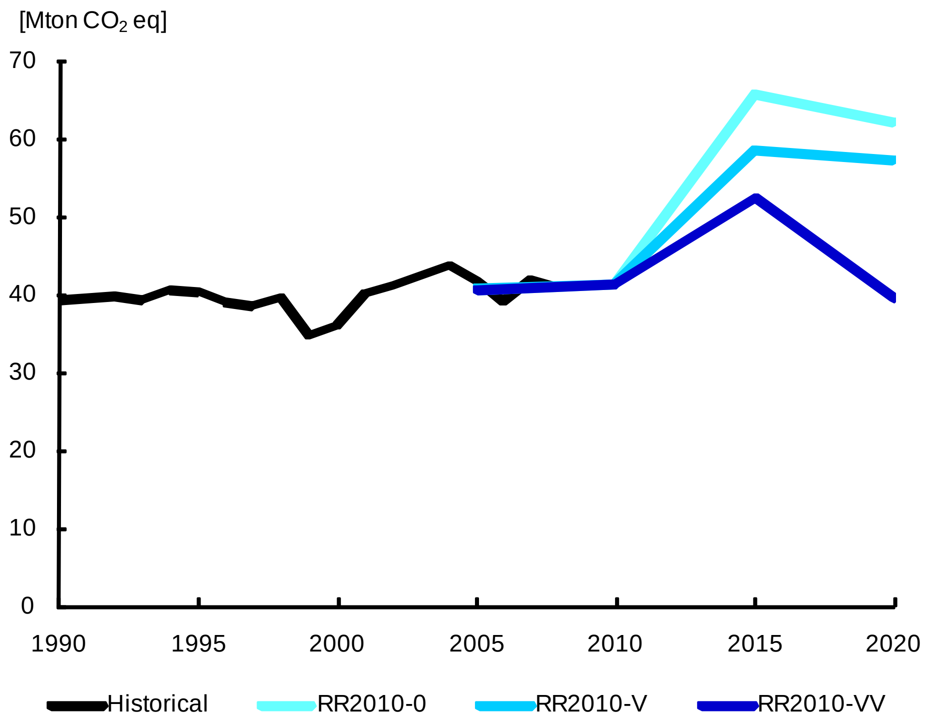

Figure 4.6 *CO_2 emissions electricity plants*

Conversion efficiencies new plants and park average

Due to new coal and gas-fired plants and closing or only partially using the existing less efficient coal and gas capacity the average conversion efficiency of the production park will improve, see Table 4.4. Due to the larger share of renewables, the average reference efficiency in RR-2010-VV is lower than in RR-2010-V. Because of the new CCGTs the production in RR-2010-VV is lower than in RR-2010-V.

Table 4.3 *Net average electrical conversion efficiencies*

Type of installation	2008 [%]	2020 [%]
Existing coal, average	39	About 40
New coal (modern pulverised coal)	n.a.	45-46
Existing gas, average	45	
New gas (CCGT)	n.a.	58-59
Gas 2020, average (for comparison with ‘Existing gas’, average, in 2008)		V: 50.5 VV: 47.8
Average park (‘ex production’)	43.7	V: 46.6 VV: 45.7

Electricity prices wholesale market

Next to an intermediate projection of the price trajectory of the RR2010-V policy variant, high and low price trajectories have also been calculated based on other fuel prices and CO_2 prices. The price trajectory of RR2010-VV is almost identical to the trajectory of RR-2010-V Especially the height of the CO_2 price and the fuel prices have a major effect on the average wholesale market price. The new gas-fired plants, which will enter into operation between 2009 and 2012, have a mitigating effect, especially on the peak prices. The peak prices increase to about 70 €/MWh in 2020. New efficient coal-fired plants and a CO_2 price of 20€/ton keep the off-peak prices below 54/MWh. The average (baseload) electricity market price in 2020 is about 62 MWh.

Box 4.2 Comparison projection prices 2010-2013 with forward prices

Current forward prices for the wholesale market will deviate from the scenario prices in the next years. Forward prices are currently lower. This is due to the fact that the scenario prices are based on higher fuel prices and CO_2 prices than the current forwards for fuel prices. This is especially true for the quotations of natural gas prices and CO_2 prices. Another aspect of recent forward quotations is that the Dutch prices are the lowest compared to Germany, Belgium and even France. This is probably due to the fact that the new plants meanwhile realised (Sloe plant, new Flevo plant) and the additional capacity that will enter into operation in the next three years.

Uncertain factors

The uncertain factors that are relevant for the large-scale electricity production are indicated in the table below. The uncertain factors for CHP production and renewable electricity production are explained in Sections 4.2 and 4.3. Many uncertainties in Electricity generation have a discrete character: Whether or not a new plant or interconnection is realised.

The uncertain factors relating to electricity demand in the end user sectors are described in Chapter 3. The uncertainty ranges for final electricity demand are set at 124 to 137 TWh under fixed policy and 123 to 136 TWh under intended policy.

Table 4.4 *Uncertain factors CO_2 emissions large-scale electricity generation*

[Mton CO_2]	Uncertainty range deviation 5-95%		
Description uncertain factor	Lower value	Upper value	Variant
CO_2 price low/high	-3.7	2.8	
Interconnection with DL – 5000 MW + 500 MW	-0.3	0.3	
Ratio natural gas price / coal price	-8.0	2.0	
Own CHP Corus cancelled	0.0	1.6	
Interconnection DK	-1.0	0.0	
Magnum will be IGCC instead of CCGT	0.0	2.7	
Additional coal capacity between 2013 and 2020	0.0	5.2	
Additional CCS: RWE plant in North-NL deploys CCS	-1.4	0.0	V, VV

Explanation of uncertainties:

- Natural gas/coal price ratio. Determines the fuel use and also import and export from/with abroad. Higher natural gas prices may increase national CO_2 emissions because the use of Dutch coal-fired plants becomes more attractive, and also leads to more (coal-based) electricity from Germany. In that case the increase in emissions takes place in Germany[33].
- Additional/new interconnection, Germany: +1000 MW with Germany (TenneT, 2009b). This means net lower export and less production in the Netherlands. (Uncertain factor has meanwhile become more certain)
- Additional/new interconnection, Denmark. The Cobra connection with Denmark has not been included in the medium term projections, but there is an estimated 50% chance that it will be constructed. This connection will be 600-700 MW and be ready by 2016. A net import is expected through this connection. The connection is also important for the integration of wind energy in Northwest Europe.

[33] The net effet cannot be predicted, which is why separate calculations were conducted. However, these calculations do not include an absolute rise in coal prices (compared to RR2020-V/RR2010-VV) but the gas prices increase much less. Such a fuel price scenario agrees with the most recent IEA WEO 2009 scenario. This has not been calculated separately.

- If plans for new plants will proceed (3 separate uncertainties). These uncertainties have been modelled with a discrete distribution of probability.
- The new CHP plant of Corus is cancelled (chance of 25%). The CO_2 effect is calculated compared to the flaring off of blast furnace gas.
- Vattenfall/Nuon decides to built a coal gasification installation for Magnum (CCGT will be IGCC, offering the option of additional biomass co-firing) 25% chance for + 2.7 Mton.
- In the period 2013-2020 one or more of the other plans for new coal-fired plants will proceed (see Table 4.1). These are the coal gasification units in Rotterdam (RCI, 2009) among others. A maximum of 1000 MW of additional coal is assumed.

4.2 Decentralised CHP

Introduction

In 2008 the total installed decentralised CHP capacity was 7000 MW_e in total, most of which in industry and greenhouse horticulture. Use of cogeneration (CHP) saves energy and has lower CO_2 emissions compared to separate generation of electricity and heat. Due to an increasing share of renewable electricity and improved efficiencies in electricity generation, the energy saving and emission reduction of CHP plants compared to the central park decrease over time

Drivers

In all policy variants the strong increase of coal and gas-fired capacity has a lowering effect on the electricity prices. Moreover, the uncertainty about the development of the fuel and electricity prices constitute an important barrier for investing in CHP. The variant without Clean and Efficient policy has higher electricity prices than the variant with intended policy, which is partly because the intended policy leads to lower electricity demand and a higher share of renewable electricity. This is a side effect of Clean and Efficient's additional renewable electricity aim. The additional electricity supply leads to lower electricity prices and a less favourable investment climate for CHP. The negative effect on CO_2 emissions and use of fossil fuels is much smaller though than the additional reduction from renewable energy.

High efficiency CHP installations that operate under the ETS will only have free emission allowances for the production of heat; emission allowances will have to be bought for the electricity production. CHP installations outside ETS need not buy emission allowances and thus have a relative advantage. This leads to higher emissions in the non ETS sector. Under intended policy, CHP installation in greenhouse horticulture do receive an equivalent price incentive by means of a CO_2 sector system.

Next to the production of steam and warm water, CHP can also be used for direct underfiring. As there is little experience with underfiring, directly underfired CHP is only used on a small scale until 2020.

Policy

In the SDE scheme there will be a tender for natural gas-fired CCGTs (the so-called ‘safety net scheme’) with a minimal capacity of 150 MW_e. The scheme will not be open anymore after the third trade period of the EU ETS in 2013. Due to the limited time for the opening, the limited number of suitable locations for large CHP and the high cost per installation there will only be a limited number of CHP that can profit from the scheme. These may be installations that would also have been built without this scheme. Therefore the effect of the scheme is highly uncertain.

Results
Under fixed policy the decentralised CHP capacity grows to 8400 MW_e in 2020. In industry, only limited additional capacity is realised. Since 2005, the use of gas engines in greenhouse horticulture has been increasing strongly. In the projection the growth comes to a standstill around 2010 due to satiety. A strongly decreasing steam demand in refineries, resulting from the deployment of desulphurisation techniques, leads to decreasing CHP deployment in refineries. There are few major changes in the services sector.

CHP that does not respond to price incentives from the electricity market will be considered 'must-run' CHP here. These may be installations that are unable to respond from a technical point of view, but they may also entail situations in which operators are unable or unwilling to deploy their installations in a flexible manner. Under intended policy the capacity of must-run CHP in 2020 is 3,700 MW_e. The main contributions to decentralised must run CHP capacity are produced by district heating installations, co-digestion installations and CHP in industry and refineries.

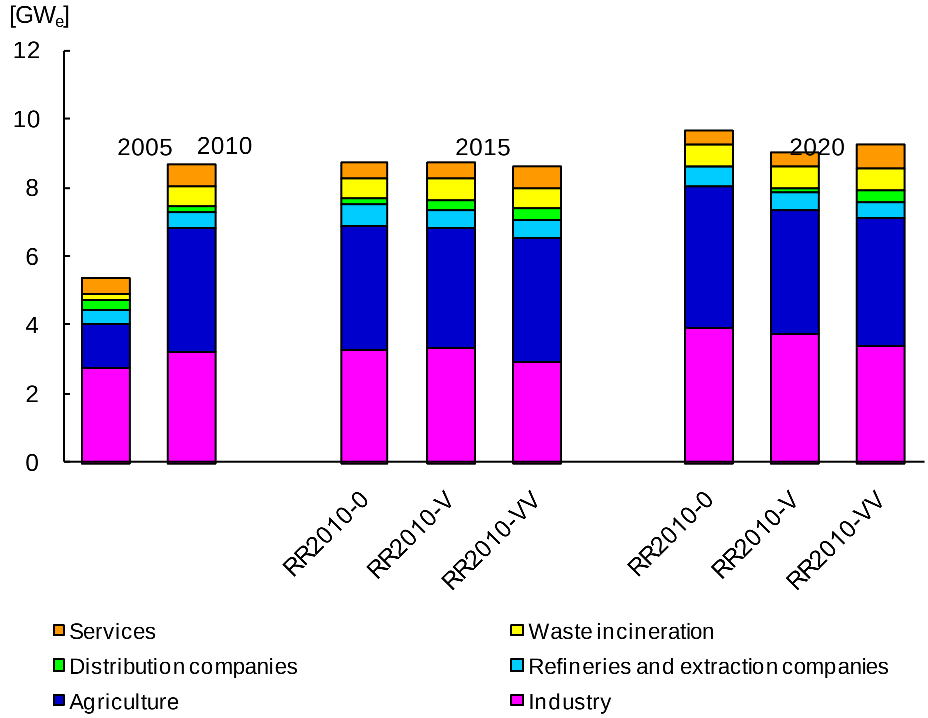

Figure 4.7 *CHP capacity, including renewable CHP*

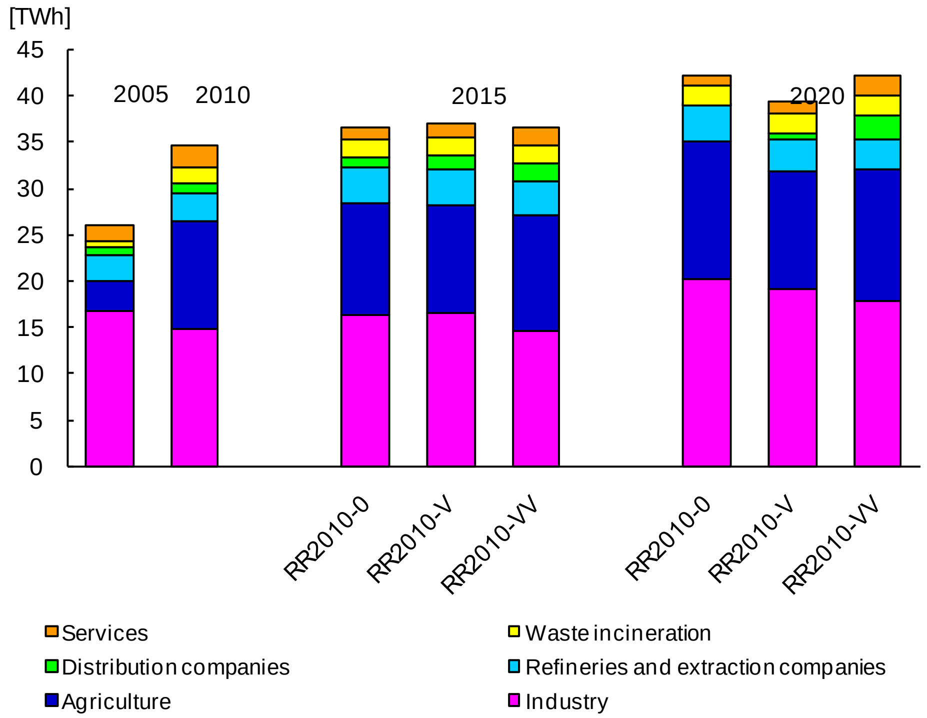

Figure 4.8 *CHP electricity production, including renewable CHP*

Uncertain factors

Main uncertain factors for the capacity and deployment of CHP are the fuel and CO_2 prices. Many companies have the ability to produce heat with a boiler instead of CHP if this is financially more attractive. All uncertainties included in Table 4.5 relate to the effects that increased or decreased deployment of CHP have on the entire electricity generation park.

Table 4.5 *Uncertain factors CO_2 emission reduction decentralised CHP*

[Mton CO_2]	Uncertainty range deviation 5-95%		
Description uncertain factor	Lower value	Upper value	Variant
CHP agriculture: Economic growth, area growth and distribution into activities	-0.1	0.1	
CHP agriculture: Fuel prices	0.0	-0.2	
CHP agriculture: CO_2 prices	-0.1	0.1	
CHP Land: Cost development, deployment strategy and barriers CHP	-0.1	0.2	
CHP Industry: Economic growth, choice of location companies and distribution of growth over activities	-0.3	0.3	
CHP Industry: Fuel prices	-0.6	0.1	
CHP Industry: CO_2 prices	-0.5	0.1	
CHP Industry: Cost development and barriers CHP	-0.3	0.3	
CHP refineries: Economic growth, choice of location companies and distribution of growth over activities	-0.1	0.1	
CHP refineries: Fuel prices	-0.2	0.0	
CHP refineries: CO_2 prices	-0.1	0.0	
CHP refineries: Cost development and barriers CHP	-0.1	0.1	

4.3 Renewable energy

Policy targets and instruments

Most of the options for renewable energy are not (yet) profitable without financial support. This means that the share of renewable energy that can be realised in 2020 highly depends on policy.

There are various targets for renewable energy. In 2007, the Balkenende IV cabinet adopted a national target of 20% renewable energy in 2020 based on avoided primary energy. The European Renewable Energy Directive of January 2008 sets the Dutch target at 14%, based on the end user calculation method. The European target cannot be easily translated into a target based on the national substitution calculation method, but the national target of 20% is more ambitious than the European target for the Netherlands. The target for the share of renewable energy in the electricity production in 2010 is 9%. There is no official target for 2020, but there is an indicative value of about 55 TWh. Onshore wind has a target of 4000 MW (in production or by tender) in 2012, subsequently growing further. Offshore wind has a target for 2020 of 6000 MW installed capacity.

IN 2008 the SDE scheme was introduced as a policy measure to incentivise renewable electricity and green gas, replacing the MEP scheme that was previously in place. In the MEP scheme producers of renewable energy received a fixed subsidy, which sometimes led to too much incentivisation. In the SDE scheme this is prevented by annually adjusting the subsidy to the realised energy prices. The budget of MEP scheme also turned out to be difficult to manage because of its 'open end character'. This is why the SDE scheme has budget ceilings. A third difference is the annual variation in technologies that are entitled to receiving subsidy. Contrary to the MEP, the current SDE scheme does not subsidise co-firing of biomass in coal-fired plants and combustion of vegetable oils (such as palm oil). The fixed policy follows this stipulation. In the intended policy variant, however, the SDE does support combustion of vegetable oils and co-firing of biomass in coal-fired plants.

The MEP ordinances are maintained in all policy variants. Under fixed policy the subsidy for renewable electricity through MEP and SDE are financed by the public funds. Until 2020, MEP and SDE have a shared fixed budget of about 1 billion euro annually: the additional funds that are released from the MEP are transferred to the SDE scheme. Thus the cumulative MEP/SDE budget for the period 2009-2020 amounts to about € 11 billion. This includes additional finance for 500 MW of offshore wind, as decided in the additional policy agreement of March 2009. The projection assumes that MEP funds released in the future can slowly be diverted to the SDE scheme to realise a gradual and targeted growth of capacity.

Box 4.3 *Policy starting points SDE*

In its study of early 2009 (BS-09-009), which was used for the so-called Easter letter of April 2009, ECN projected the required SDE budget needed up to and including 2020 to realise 35% renewable electricity, which amounts to 55 TWh in view of the projected electricity demand of that time. The starting points were a normative growth path ("Each cabinet period twice a doubling of new capacity) and incentivisation through the SDE scheme. The growth path was tested for technical options and potentials. Whether or not the financing structure via the SDE scheme was sufficiently attractive to pull the investments out of the market in time has not been tested.

The Reference projection uses the same growth path of SDE finance as a starting point, but it does test whether or not the market is able to install additional capacity fast enough with incentivisation from the SDE scheme. In contrast with the study of early 2009, the variant with intended policy assumes that the SDE scheme will be financed more widely and robustly by means of a surcharge on the electricity tariff. The projection shows that 55 TWh of renewable electricity is feasible this way, but is also shows that the chances of not realising this target are also large. The projection arrives at a middle value of 52 TWh in 2020 with an uncertainty bandwidth that is wider at the bottom than at the top.

The study of early 2009 showed that with the assumed electricity prices of that time about 2.6 billion euros of SDE budget would be required to realise the 55 TWh of renewable electricity. However, the study did not examine whether a budget reservation alone, running up to 2.6 billion euro in 2006, would provide sufficient incentive for realising 55 TWh renewable electricity. A comparison of these two studies cannot yield the conclusion that it is not necessary to make the SDE scheme broader and more robust to realise the 55 TWh renewable electricity target; neither should the conclusion be the opposite.

Under intended policy it is assumed that the financing is no longer arranged through the public funds, but by means of a surcharge on the electricity or gas bill. This applies to the SDE ordinances as of 2013. Moreover, the budget will be higher and more robust than in case of fixed policy. This will allow for more growth in renewable electricity and result in a larger role for more expensive technologies. Biomass co-firing is also supported. The joint MEP and SDE budget amounts to about €3.6 billion in 2020 under intended policy.

Green gas that is stimulated by the SDE scheme or is profitable without (additional) subsidy has been included in the projection. Until 2020 the projections include only green gas from digestion; it does not include green gas from gasification. Green gas from biomass gasification is assumed to have passed the demonstration and pilot stages by 2020, but the additional support needed for implementation (e.g. innovation subsidies) will not be available or only to a limited extent.

Box 4.4 *SDE and EEG: A comparison of premium and tariff systems*

In the Netherlands, renewable electricity is stimulated through the SDE scheme, which provides subsidies to compensate for the gap between production costs and electricity price. Germany has a renewable energy law named EEG. Under the EEG law producers receive an allowance for the total production cost. In the Netherlands a producer must sell its own electricity on the electricity market. This may constitute both an opportunity for and a threat to the profitability of the project. In Germany producers need not bother about the electricity market, which makes it easier to finance a project for renewable electricity. It does increase the balancing costs for other parties in the electricity sector.

In the variant with intended policy it is assumed that the broader and more robust SDE scheme in which (excluding solar PV) the budget ceilings are not a limiting factor, similar to the EEG. In this variant, the SDE scheme is no longer financed by public funds, but by means of a surcharge on the electricity bill, the same way EEG is financed. In the SDE scheme, the ex-post calculation of the tariff based on realised electricity prices can in fact lead to a guaranteed feed-in tariff. This also bears a strong resemblance to the EEG, apart from the maximised subsidy in the SDE scheme in case of extremely low electricity prices.

Looking at the outlines, a feed-in tariff system (EEG) does not differ essentially from the feed-in premium system (SDE) in view of the potential growth in the production of renewable electricity. The cost of balancing and grid integration are distributed somewhat differently in the electricity sector in these two systems. As these costs will barely burden the producers of renewable electricity in a feed-in tariff system, small producers with little to no experience in the electricity market will be the ones benefiting most from the feed-in tariff system.

Results

Figure 4.9 illustrates the production of renewable energy (based on avoided primary energy) for various policy variants. Without Clean and Efficient policy, the share of renewable energy decreases from 3.4% in 2008 to 2.6% in 2020 (2.1%-3.1%) Under fixed policy, the share will increase to 6.3% (5.5%-7.1%) in 2020 and to 15.5% under fixed and intended policy. In absolute terms the quantity of avoided primary energy in 2020 amounts to 190-240 PJ under fixed policy and 440-510 under intended policy.

According to the European calculation method (based on end use) the share of renewable energy in 2020 will amount to 14.5% under intended policy with a bandwidth of 12-15%.

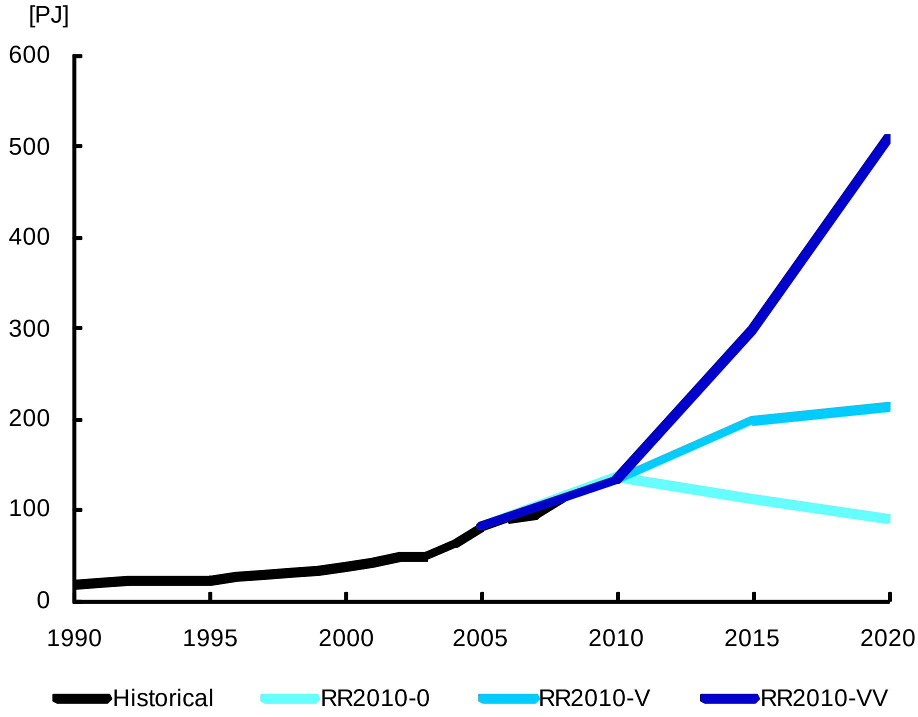

Figure 4.9 *Avoided primary energy through renewables*

As the share of renewable energy in total energy use increases, the contribution of renewable electricity to the total amount of renewable energy also increases. In the variant without Clean and Efficient policy the contribution of renewable electricity to renewable energy amounts to 28%; in the variant with fixed policy 59%; and in the variant with intended policy 76%. In the latter variant, the remaining share is covered by green gas (5%), biofuels (7%) and renewable heating and cooling (12%). By 2020 the SDE scheme for renewable electricity and green gas will support approximately 80% of the renewable energy production in the Netherlands. The second most important tool in view of volume is the obligation to blend biofuels.

The production of renewable electricity in TWh/year is provided in Figure 4.10. Based on the lowest cost options, the production will gradually increase to 15.2% in 2015 under fixed policy. After that the growth stagnates and the share of renewable electricity even decreases slightly to 13.8% in 2020[34]. The SDE budgets reserved for 2010 to 2020, including MEP release, are insufficient to realise the long term targets of the Dutch cabinet. In the projection it is assumed that the available financial means will first be dedicated to technologies with a specific objective, i.e. onshore wind and offshore wind. Onshore wind can grow to 4000 MW and offshore wind can increase to 1750 MW in 2020.

Under intended policy nearly all categories grow more rapidly due to the larger subsidies from the SDE scheme. Especially onshore wind grows faster and the SDE is also opened up for biomass co-firing.

[34] There is a slight increase in TWh.

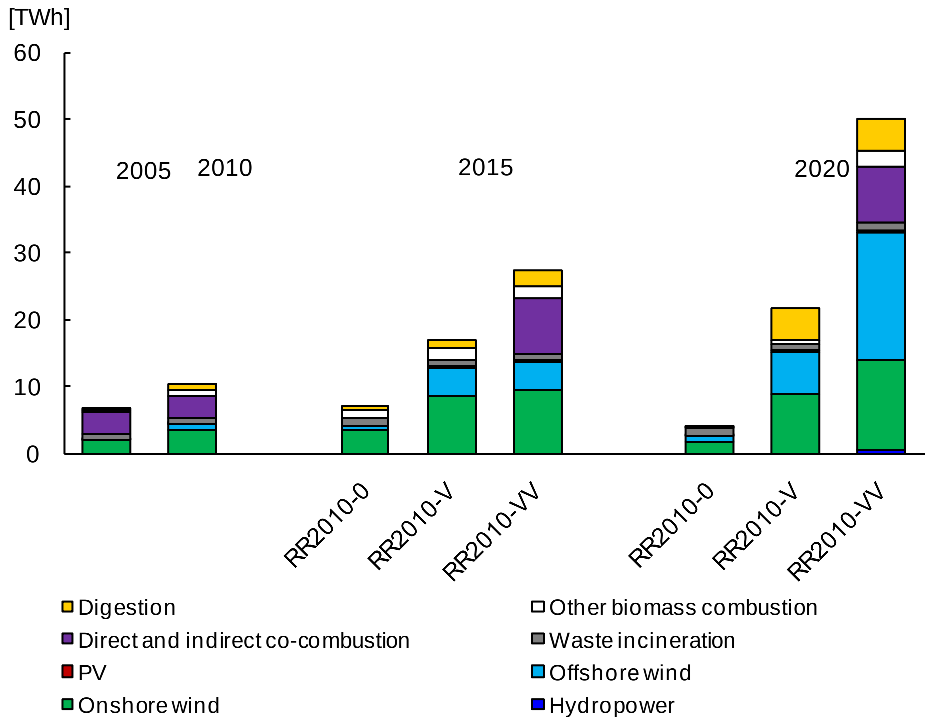

Figure 4.10 *Electricity production from renewable sources*

The amount of green gas from digestion amounts to about 1 PJ in 2020 under fixed policy and 24 PJ under intended policy, excluding the deployment of locally produced green gas in electricity production. Owners of digestion plants can either upgrade the biogas to natural gas quality or use it in a gas engine for electricity production. A broader and more robust SDE scheme will basically reimburse the unprofitable gap of both options. In the projection it is assumed that the routes will be stimulated to the same extent, resulting in an approximately equal distribution between electricity production and green gas production of natural gas quality.

Biofuels

The projection of the share of biofuels in transport fuels of both fixed and intended policy are based on the starting point that the European target of 10% renewable energy is realised. Without Clean and Efficient policy the old obligation of a share of 5.75% applies. Second generation biofuels (including biofuels from biomass residual flows) count double for the European target. Projections for 2020 indicate that the required 10% consists of 7%-point first generation biofuels and 1.5%-point second generation biofuels. Biodiesel will take up about two third of the biomass market (in energy content) and bio-ethanol about one third. Although electricity and green gas can also contribute to the target, their contribution is assumed minimal in the projection.

Renewable heating/cooling

Renewable heating and cooling will make a substantial contribution to the renewable energy target in 2020. The total of 510 PJ avoided primary energy in the intended policy variant can be distributed into 400 PJ renewable electricity, 35 PJ biofuels and about 75 PJ renewable heating and green gas. Renewable heating is supported to a limited extent through the useful heat calculation in the SDE scheme. Green gas from manure digestion is also the effect of the SDE scheme. Moreover, deployment of renewable heating or cooling is stimulated by policy in other sectors. For example in the built environment by the temporary subsidy scheme for renewable heating in existing dwellings and by tightening the EPC standard in new dwellings and commercial and industrial buildings. In greenhouse horticulture, the geothermal energy drilling guarantee and subsidy from the MEI scheme stimulate geothermal energy. The MEI scheme also incentivises renewable heat/cold storage in greenhouse horticulture.

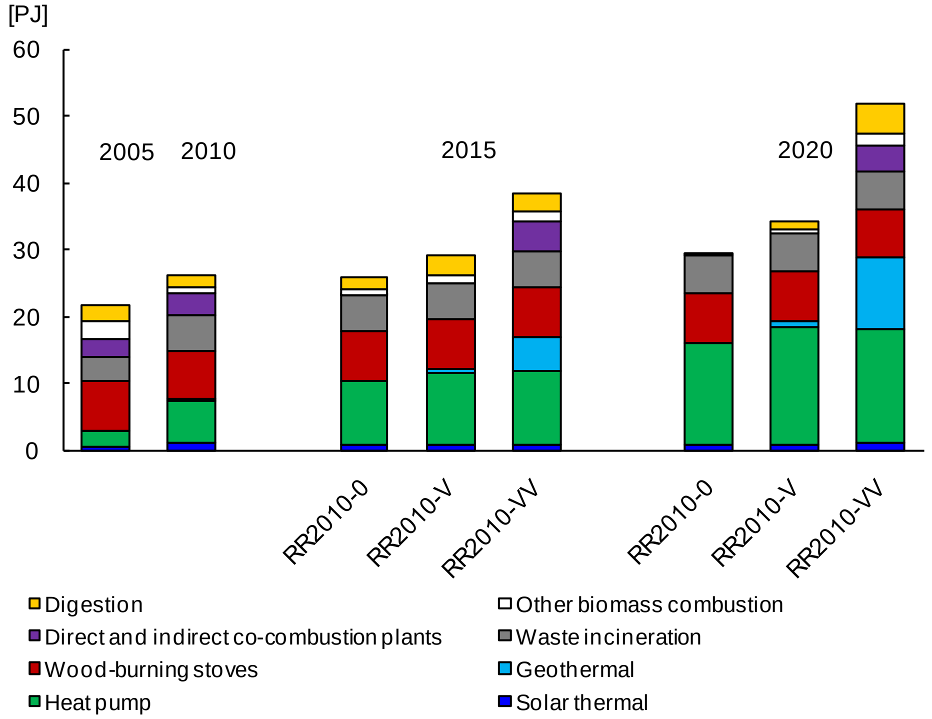

Figure 4.11 *Heat production from renewables*

Table 4.6 provides an overview of the various options and sectors to the 75 PJ avoided primary energy through renewable heating and cooling and green gas under intended policy.

Table 4.6 *Renewable heating in case of implementation of intended policy*

	Avoided primary []PJ]	Households	TSG	Agriculture	Industry	Other
Solar boilers	1.4	1.0	0.4	0	0	0
Heat pumps and heat/cold storage	19.2	1.2	15.5	2.6	0	0
Geothermal energy	10.7	0.0	0.0	10.7	0	0
Waste incineration	5.7	0	0	0	0	5.7
Direct/indirect co-firing	1.6	0	0	0	0	1.6
Biomass combustion small scale	2.0	0	0	0	0	2.0
Wood-burning stoves	7.4	6.8	0	0	0.6	0
Digestion	27.4	0	0.4	26.5	0.6	0
Green gas from gasification	0					0
Total	75	9.0	16.3	39.8	0.6	9.3

Uncertain factors

Tables 4.7 and 4.8 summarise the uncertain factors. For most uncertainties under intended policy it must be said that the chance that realisations are smaller than projected is larger than the chance that realisations are larger than projected. This is due to the fact that the projection assumes a share of renewable energy that is only feasible if there are no delays, for example due to social resistance, permit procedure or lack of construction capacity. The asymmetric uncertainty band shows a large risk of delays.

Table 4.7 *Uncertain factors renewable electricity*

[PJ_e] Description uncertain factor	Uncertainty range deviation 5-95% Lower value	 Upper value	 Variant
Cost decrease sustainable technologies	-2.2	0.7	V
MEP release, co-firing uncertainty	-6.8	10.1	V
Green gas, successful pilots	0.0	-6.1	V
Development period offshore wind parks	-3.2	2.9	V
Potential onshore wind	-1.8	2.5	V
Distribution SDE ordinances in biomass category (effect manure co-digestion: +320 GWh to -480 GWh)	-0.4	0.4	V
Electricity price (effect manure co-digestion: -136 GWh +640 GWh)	-0.8	1.2	V
Deployment of manure for co-digestion	-5.8	0.0	VV
Potential for bio-energy plants (independent biomass plants < 50 MW_e)	0.0	5.8	VV
Social and institutional potential for onshore wind	-15.8	0.0	VV
Development pace offshore wind	-20.5	0.0	VV
Development pace solar PV	0.0	0.7	VV
Hydropower	-1.8	0.0	VV
Biomass co-firing (on energy basis) percentage of production from coal-fired plants	-8.1	8.1	VV

Table 4.8 *Uncertain factors renewable heat central*

[PJ] Description uncertain factor	Uncertainty range deviation 5-95% Lower value	 Upper value	 Variant
Green gas, successful pilots	0.0	5.9	V
CHP ratio for renewable heat from electricity plants	-0.2	0.2	V
Deployment of heat in manure installations (uncertainty CHP ratio)	0.4	0.0	VV
Deployment of heat in bio-energy plant (incl. manure installations) – uncertainty in CHP ratio	-0.9	0.9	VV
Green gas	-15.8	6.3	VV

4.4 Refineries

Introduction

Over de last years refineries invested heavily in desulphurisation to comply with strict standards for the sulphur content of petrol and diesel. Moreover, an old cracking plant was closed down and the capacity was slightly expanded. A gas pipe came into operation to transport the CO_2 from the refineries to greenhouse horticulture.

Driving forces

Partly because of the export options via the Dutch rivers and the Port of Rotterdam, Dutch refineries have a much larger production capacity than required for Dutch oil product use. In addition to domestic use, the sales on the German market and the bunkering of heavy residual products by sea-going vessels are relevant to the production volume.

At an (expected) economic growth of 1.7% the variant with fixed policy until 2020 does not anticipate any expansion (or only limited expansion) of the Dutch production capacity. In the variant with intended policy, there is no need for capacity expansion in Western Europe for a long period, and some smaller refineries will even be closed down. There is s slight net decrease in capacity. This is caused by the fact that passenger cars and delivery vans are becoming increasingly efficient due to European regulations and because the share of biofuels increases. Therefore the European petroleum sales decrease and the diesel sales stay more or less the same. In the variant without Clean and Efficient policy vehicles are hardly becoming more efficient and it is assumed that the oil demand and the refining production will increase further in the future.

Beside demand for oil products, demands with regard to the sulphur content of these products also have a large impact on the energy use and CO_2 emissions of refineries. This will be further discussed under the heading ‘policy’.

Policy
The main policy developments bear upon the allowed SO_2 emissions of refineries en the maximum sulphur content of the supplied fuels. This policy has important consequences for the CO_2 emissions: deeper desulphurisation of oil products requires much additional energy.

The refineries agreed with the Dutch government that their SO_2 emissions in 2010 and subsequent years will not exceed 16 kton. This agreement has been recorded in individual permits. Moreover, it has been agreed that refining oil will no longer be used as fuel.

The EU imposes increasingly strict requirements on the sulphur content of petroleum and diesel. As of 1 January 2005, the sulphur content of petroleum and diesel is not allowed to exceed 50 ppm, and as of 1 January 2009 this is 10 pp. The standard for diesel with different applications than road transport (so-called red diesel) was tightened from 2000 ppm to 1000 ppm in 2008, and will be further tightened to 20 ppm in 2010/2011. In Germany, an important market for domestic fuel oil, the maximum sulphur content will be lowered to 50 ppm in view of the specifications of modern oil-fired central heating.

The standards for the sulphur content of sea shipping fuels will also be continuously tightened in the period 2020-2020. This was recorded in Annex IV of the Marpol Treaty on 9 October 2008. Table 4.9 provides an overview.

Table 4.9 *Maximum allowed sulphur content of fuel oil for sea-going vessels*

	Global [%]	SECA’s* [%]
Current 2008	4.50	1.50
1 July 2010		1.00
1 Jan. 2012	3.50	
1 Jan. 2015		0.10
1 Jan. 2020**	0.50	

* SECA = SO_x Emission Control Area (Baltic and North Sea/the Channel).
** Evaluation in 2018. If this turns out negative, the implementation date will be postponed from 2020 to 2025.

Results
The energy use of refineries is indicated in Figure 4.12.

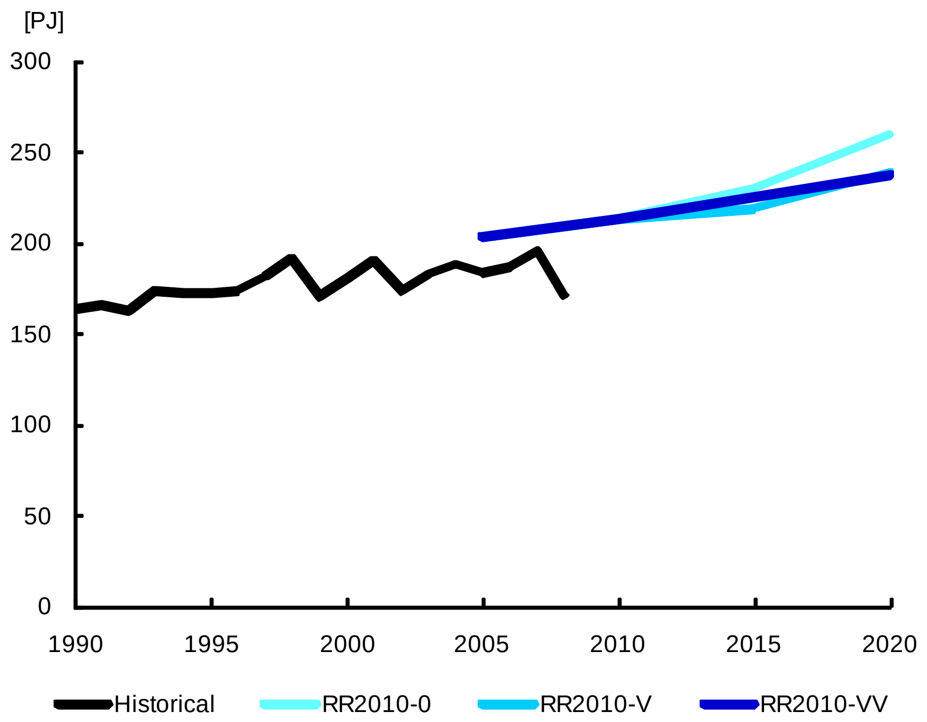

Figure 4.12 *Energy consumption refineries*

Figure 4.12 illustrates that the energy consumption of refineries will increase slowly in the coming years. It is true that the efficiency of the refining process is improving, but on the other hand the crude oil is becoming heavier, quality demand are becoming increasingly strict and the product range is shifting towards more costly products such as diesel and kerosene. The period 2015-2020 shows an accelerated increase in energy use, because by 2020 the sea shipping fuel will have to be drastically desulphurised (see Table 4.2). Part of the heavy fuel oil in the figure will have a much lower sulphur content in time. In 2020 the largest share will even resemble low quality diesel. To make desulphurisation feasible[35], but also to make 'diesel' from heavy oil, the sector will have to do some heavy investing until then.

The CO2 emission of refineries is indicated in Figure 4.4. As there is little to no shift in the fuel mix for own energy use, the CO_2 emissions are following almost the same trend as the energy use, except for the annual storage of 0.28 Mton CO_2 in the period 2011 until 2014 and 0.4 Mton in the subsequent period[36].

[35] The additional amount of sulphur released during desulphurisation of bunker oil can have a significant effect on the market for sulphur.

[36] The CO_2 figures were not corrected for CO_2 supply to greenhouse horticulture (currently 0.30 Mton is supplied annually, saving about 0.17 Mton emissions in gas-firing and 0.15 Mton from the soft drinks industry. In fact, deduction of the supply to greenhouse horticulture from refinery emissions is prohibited by the emission trade system.

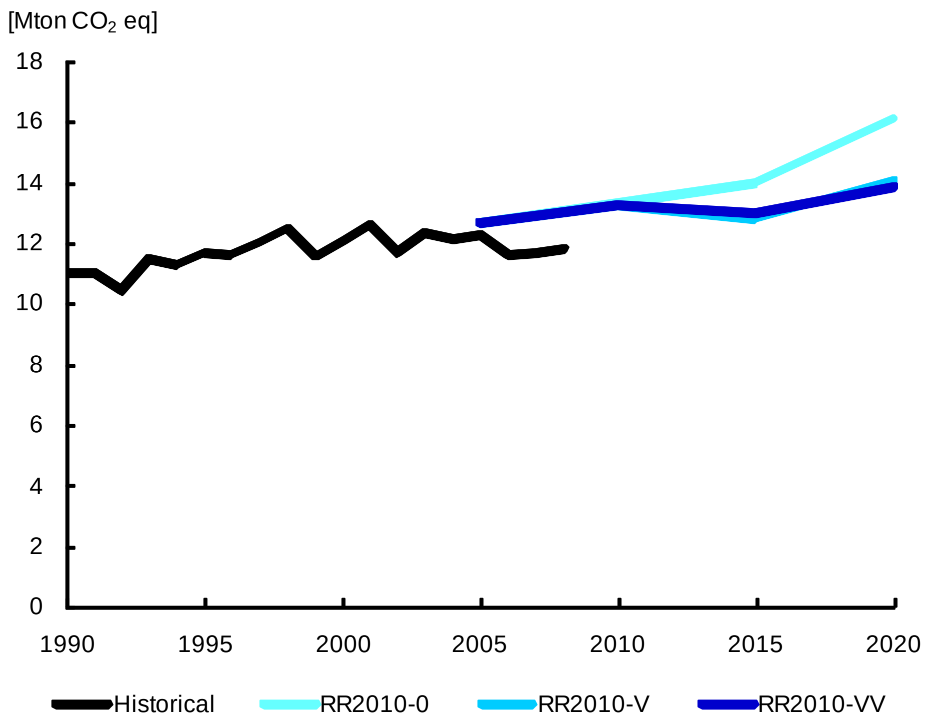

Figure 4.13 *CO_2 emission in the policy variants*

Uncertainties

The uncertainties are indicated in Table 4.10. The main uncertainties will be briefly discussed here.

- Sulphur standards for sea shipping. The projection assumes that 2/3rd of the heavy bunker oil in will be desulphurised in the refineries to meet the standard and that part of the fuel (about 25%) for sea-going vessels will continue to have the high sulphur content. These vessels will have to take on-board measures to desulphurise the exhaust gas of the engines. For large vessels this may be a cheaper option than buying clean fuel. It is unclear to what extent this option will be selected.
- Economic growth and capacity: To assess the effect of the uncertainty in economic growth on the CO_2 emissions it has been assumed that the refining throughput correlates in a linear way to the Gross National Product. The influence of the market for oil products and the extent of investment in new capacity or disposal of capacity are also taken into account.
- Energy prices. In principle, these have a limited effect on the throughput and hence on the CO_2 emissions.
- CO_2 price. The projection assumes a CO_2 price of 20 euro/tonne. This will lead to limited energy saving. The bandwidth is 10-40 €/tonne[37].

Table 4.10 *Uncertain factors CO_2 emission refineries*

[Mton CO_2] Description uncertain factor	Uncertainty range deviation 5-95% Lower value	Upper value	Variant
CHP: Economic growth, choice of location companies and distribution of growth over activities	-0.3	0.3	
CHP: Fuel prices	-0.5	0.1	
CHP: CO_2 prices	-0.4	0.1	
CHP: Cost development and barriers CHP	-0.3	0.3	
Similar maintenance	0.2	-1.0	

[37] It is assumed that CO_2 storage becomes profitable at 50 euro/tonne (1 Mton per year).

Shift in share of various products oil market	-0.8	0.8
Tightening product quality	-3.0	0.8
Investing in secondary capacity	-3.0	1.0
Investing in primary capacity	-1.5	1.5
Fuel deployment RF	0.0	0.5
Product distribution and feedstock quality, Statistics	-0.5	0.5
Product distribution and feedstock quality, Future	-1.5	1.5
Characteristics production processes	-1.5	1.5
Effect of different CO_2 price	0.1	-1.8
Effect of different energy price	0.4	-0.4
CHP production	-0.4	0.4
Economic uncertainty	-1.5	1.5

Table 411 *Uncertain factors electricity demand refineries*

[PJ_e]	Uncertainty range deviation 5-95%		
Description uncertain factor	Lower value	Upper value	Variant
Similar maintenance	0.2	-0.8	
Shift in share of various products oil market	-0.6	0.6	
Tightening product quality	-2.5	0.5	
Investing in secondary capacity	-2.4	0.8	
Investing in primary capacity	-1.2	1.2	
Fuel deployment RF	0.0	0.4	
Product distribution and feedstock quality, Statistics	-0.4	0.4	
Product distribution and feedstock quality, Future	-1.2	1.2	
Characteristics production processes	-1.2	1.2	
Effect of different CO_2 price	0.1	-0.1	
Effect of different energy price	0.3	-0.3	
Economic uncertainty	-1.2	1.2	

5. Other greenhouse gases

5.1 Introduction

Other greenhouse gases is a collective term for the emission of methane (CH_4), nitrous oxide and the so-called F-gases (HFKs, PFC's and SF_6).The emission of other greenhouse gases occurs mainly in agriculture, industry and at landfills. The share of other greenhouse gases in the total greenhouse gas emission amounted to over 15% in 2008. The main emissions were CH_4 (17 Mton) and N_2O (12 Mton). The emission of F gases amounted to over 2 Mton.

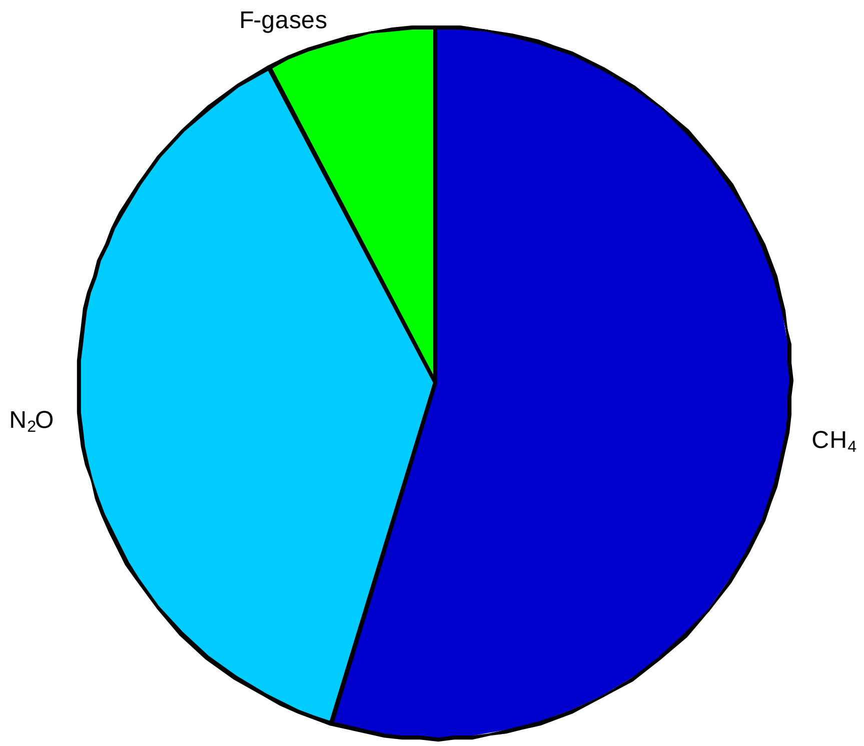

Figure 5.1 Distribution *other greenhouse gases, 2008*

The projected total Dutch emission of other greenhouse gases amounts to about 27 Mton CO_2 equivalents in 2020 (see Table 5.1.) both in the variant with fixed policy and in the variant with fixed and intended policy. The difference between both policy variants is less than 1 Mton. Without Clean and Efficient policy the emission of other greenhouse gases would have amounted to about 32 Mton. Especially the reduction of N_2O emission in nitric acid contributed to this policy effect (see Section 5.3).

Table 5.1 *Detailed overview of the other GHG emissions (Mton CO_2-eq) in 2007 and 2020*

Source	Substance (group)	2007	2020 RR2010-V	2020 RR2010-VV
Agriculture	CH_4	9	8.9	8.4
	N_2O	9.5	8.6	8.8
Waste disposal	CH_4	5.4	1.97	1.97
Industry	N_2O	4.8	1.09	1.09
of which Nitric acid production		*4.3*	*0.55*	*0.55*
of which Caprolactam production		*0.5*	*0.54*	*0.54*
Industry	HFCs	1.7	2.2	1.9
	PFCs	0.4	0.4	0.4
	SF_6	0.2	0.2	0.2
Traffic	N_2O	0.4	0.4	0.4
Energy sector	CH_4	0.8	0.5	0.5
Gas engines in CHP plants	CH_4	0.8	1.1	1.31
of which Greenhouse horticulture		*0.63*	*1.0*	*1.0*
of which Other sectors		*0.12*	*0.1*	*0.1*
Other sources	CH_4	1.1	1.0	1.0
Other sources	N_2O	0.9	0.9	0.9
TOTAL per substance (group)	*CH_4*	*17*	*13.5*	*13.14*
	N_2O	*15.6*	*11*	*11.2*
	F gases	*2.2*	*2.8*	*2.5*
TOTAL Other greenhouse gases		*34.8*	*27.3*	*26.8*

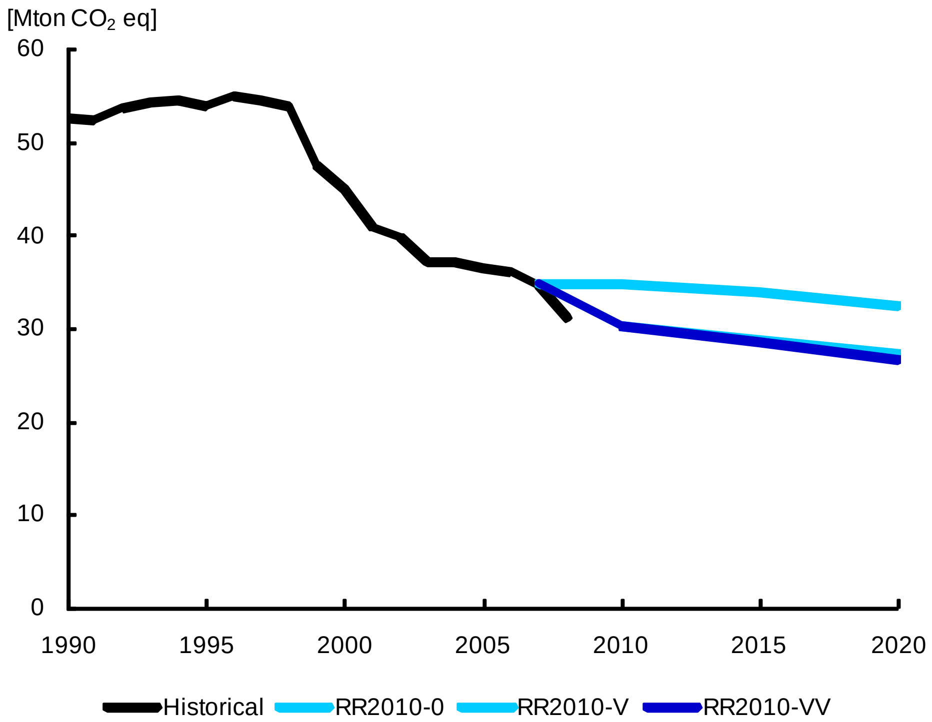

Figure 5.2 *Development of total emission of other greenhouse gases in the Netherlands*

5.2 Agriculture

Introduction

Agriculture emitted 9.0 Mton CO_2 equivalent methane (CH_4) in 2008 and 9.3 Mton CO_2 equivalent nitrous oxide (N_2O). These emissions do not include the energy related emissions of other greenhouse gases from agriculture (see Section 6.4)[38]. The share of agriculture in the total emissions of other greenhouse gases in the Netherlands amounted to over 50%. Methane arises from rumen digestion by livestock (especially cattle) and during manure storage. Nitrous oxide arises mostly after nitrogen administration to the soil (fertilizer or manure); soil processes convert part of the nitrogen into nitrous oxides. Nitrous oxides are also created more indirectly. Part of the nitrogen washes into the ground and surface water after which nitrous oxide is produced in conversion processes. Moreover, the part of the nitrogen that evaporates returns to the ground as ammonia and is then converted into nitrous oxide. Nitrous oxide is also produced during storage of (in particular solid) manure.

Volume developments

The volume and composition of the livestock is shaped by policy developments, technical developments and market developments. Despite the termination of the milk quota (and possibly the animal rights) and the assumption that all manure that is produced can have a destination (partly after manure processing), the number of animals in 2020 will decrease in this projection (especially the pigs and poultry and the cattle for meat production) or more or less stabilise (dairy cattle and laying birds). The development of the livestock until 2020 is mainly the result of market developments. Off-take rates will lower as a result of the liberalisation of the global trade, whereas cattle breeders do face costs for manure sale/processing and low emission housing (as a result of the manure and ammonia policy) (for more details see Paragraph 6.4 and Silvis et al, 2009).

Policy developments

- There isn‘t any law and regulation aimed at reducing other greenhouse gases in agriculture; policy focuses on subsidising R&D, practical experiments and environmental investments.
- The Covenant Clean and Efficient Agriculture (2008) aims to reduce other greenhouse gases by 4.0 to 6.0 Mton CO_2 equivalents annually in 2020 compared to 1990. This implies a maximal emission in 2020 of 16.1 to 18.1 Mton CO_2 eq.
- For now the effect of policy is limited to investments in installations for (co)digestion of manure influenced by the Renewable Energy Subsidy Scheme. This scheme supports a specific agreement in the Covenant for renewable energy from co-digestion: Cattle farms aim to generate 1,500 million m^3 natural gas equivalents of biogas from manure co-digestion in 2020. The biogas can subsequently be deployed for renewable electricity production or used as Green gas. Next to a reduction of CO_2 emissions resulting from avoided use of fossil fuels (see Chapter 4.3 on Renewable energy), it will also result in a reduction of CH_4 emission during manure storage (because the manure is shorter in storage). In co-digestion other feedstocks such as maize or crop residues are added to the manure to increase the energy yield. As a result of this addition, co-digestion increases the amount of nitrogen and phosphate in animal manure (digestate) and the tension in the manure market increases.
- The effects of other measures are mostly too uncertain (research, development) or have already been included in the projections (more or less implicitly).
- Precision manuring is a supportive measure for manure policy, enabling better realisation of user standards. The effect of user standards is already included in the Reference projection (see Section 6.4).
  - Cattle feed adjustments can contribute to lowering (or limiting the strong increase of) manure production and thus also constitute a supporting measure for manure policy. The Reference projection assumes that as a result of manure policy for dairy cattle there

[38] For example, methane emissions arising from energy generation (by means of combustion of natural gas or biogas obtained from co-digestion of manure in a CHP plant) are not included here. They are included in Section 6.4.

could be limited cattle feed adjustments. The ration adjustments assumed in the projection also have the side-effect of limiting the increase of CH_4 emission per cow (i.e. 7% instead of 10%). More far-reaching cattle feed adjustments are possible, but according to expectations these will not be implemented without additional policy[39].

- Manure separation is also considered a promising measure by manure policy. In the Reference projection it is assumed that manure processing will become successful and that manure that cannot be placed in the Netherlands (unprocessed) can find a destination through export, incineration or processing into manure products (by means of manure separation). (see section 6.4) In the projection it is assumed that in 2020 more than 10% of the produced manure is processed into manure products, mostly by means of manure separation. This means a fourfold increase of the current level of manure processing, but it constitutes less than half of the target laid down in the covenant (25% manure separation).

Development emission methane and nitrous oxide until 2020

In the variant without Clean and Efficient policy and in the variant with fixed policy the projection of the emission of nitrous oxide and methane from agriculture amounts to 17.5 Mton in 2020.

Under fixed policy the emission of CH_4 by agriculture lowers from 9.0 to 8.9 Mton CO_2 eq. between 2007 and 2020 (Van Schijndel and v.d. Sluis, 2010). The (net) decrease is caused by:

- Co-digestion of about 5% of the manure, creating about 350 mln m^3 natural gas equivalents of biogas (-0.1 Mton CO_2 eq.) This does not take into account the methane slip from the production of electricity from biogas by means of CHP (see Section 5.3),
- A larger number of dairy cattle (+0.1 Mton CO_2 eq.),
- A smaller pig, cattle and young stock (-0.55 Mton CO_2 eq.),
- A higher emission per animal in case of cattle, mainly resulting from higher milk production per cow (+0.55 Mton CO_2 eq.); cattle feed adjustments compensate partly (-0.1 Mton CO_2 eq.).

Under fixed policy the emission of N_2O by agriculture lowers from 9.0 to 8.9 Mton CO_2 eq. between 2007 and 2020 (van Schijndel and v.d. Sluis, 2010). The (net) decrease is caused by:

- A lower administration of manure to the soil due to tightened gas standards for manuring (-0.5 Mton CO_2 eq. Nitrous oxide) and less grazing (-0.1 Mton CO_2 eq. Nitrous oxide),
- A lower emission of NH3 resulting in a lower indirect emission of nitrous oxide after deposition of NH3 (-0.1 Mton CO_2 eq.).

[39] Drastic adjustmens in feed are needed to realise the agreed target of the sector in 2020: about 5% less CH_4 emission per cow. In the next years about 6 million euros will be invested in a research programme on ‘low emission feeds.

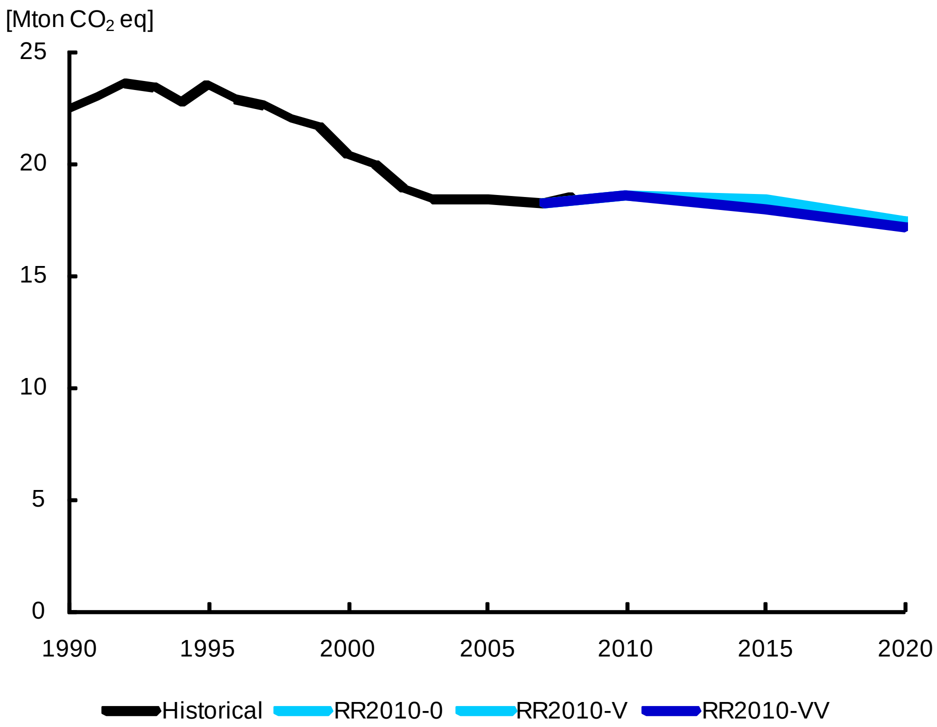

Figure 5.3 *Development emission of other greenhouse gases in agriculture*

In the variant with intended Clean and Efficient policy, the emission amounts to 17.2 Mton CO_2 eq. in 2020. Due to the increase in co-digestion in this variant (from 5% to about 25% of the produced manure, creating about 1900 mln m^3 natural gas equivalents of biogas), the methane emissions in 2020 decreases with 0.5 Mton CO_2 eq. in 2020. The emission of nitrous oxides increases by 0.2 Mton, though. This increase corresponds with the digestate that results from co-digestion and can be used as fertilizer. By adding co-substrate this fertilizer contains more nitrogen and phosphate. As a result the total volume of manure that cannot be directly put to use is increasing, which means that more manure must be processed by means of manure separation. Part of the processed manure will find a destination in Dutch agriculture. It is assumed that the manure products resulting from manure processing involve an evaporation of N_2O (and NH3) that is comparable to the evaporation of animal manure (due to lack of better data). (For more details, see Chapter 6, Section 4).

Uncertainties emission other greenhouse gases 2020

The total bandwidth in the projected emission of other greenhouse gases from agriculture under fixed policy amounts to 11.6 to 25.2 Mton CO_2 eq. in 2020 and is largely determined by the monitoring uncertainty of particularly N_2O emission. This is the uncertainty in the calculation methods for current (and historical) emissions. Next to monitoring uncertainty, the bandwidth encompasses uncertainties with regard to future expectations of volume developments or the extent to which measures are implemented. (see Table 5.1).

Table 5.2 *Uncertainties about other greenhouse gases agriculture*

Substance	[Mton $CO_{2\ eq.}$] Description uncertain factor	Uncertainty range deviation 5-95% Lower value	Upper value	Variant
N_2O	Monitoring uncertainty other N_2O	-0.6	0.6	
N_2O	Economic uncertainty about N_2O	-0.1	0.1	
N_2O	Number of animals	-0.3	0.2	
N_2O	Ration	-0.1	0.1	
N_2O	Sales manure surplus (excl. effect co-digestion)	-0.3	0.3	
N_2O	Artificial fertilizer	-0.1	0.1	
N_2O	Monitoring N_2O	6.5	-6.5	
N_2O	Co digestion VV	-0.1	0.0	VV
CH4	Monitoring uncertainty other CH4	-0.5	0.5	
CH4	Number of animals (derogation policy and development manure digestion)	-0.5	0.4	
CH4	Ration	-0.2	0.2	
CH4	Monitoring CH4	-2.3	2.3	
CH4	Co-digestion V	0.1	-0.1	V
CH4	Co-digestion VV	0.3	0.0	VV

One main uncertainty in the projection bears upon developments in numbers of animals.

- The pig population may be up to 10% smaller than currently assumed in the projection if costs for manure processing and/or environmental measures are too high.
- The dairy stock may end up 5% smaller in 2020 if the EU ceases to grant derogation of EU Nitrates Directive after 2013.
- The dairy stock may also be larger in 2020 than currently assumed in the projection. This seems to be a less than likely development for pigs, given the expected market developments, combined with the cost of manure sales/processing and low emission housing, but it is not entirely ruled out. The number of dairy cattle may turn out higher if the Netherlands manages to produce more milk than currently assumed, thanks to its strong competitive position. In case of a dairy stock increase of 6% the total manure production will remain just below the manure production ceiling. As the manure production ceiling has not (yet) been instrumented, exceedings are not inconceivable: this causes a possible *additional uncertainty*. Only a system of animal rights can restrict the growth of the livestock. (More details can be found in section 6.4).

Important uncertainties in the effect of environmental measures in the projection affect the extent to which:

- co-digestion becomes successful and manure is actually briefly in storage,
- cattle breeders adjust feed such that the emission of methane per cow lowers,
- the evaporation of N_2O from processed manure in manuring is truly comparable to animal manure; intermediate results of experiments at lab scale prove that this is true (alterra),
- The emission op NH3 is reduced and grazing is decreasing due to an increase in permanent stabling (see also Section 6.4).

5.3 Other greenhouse gases non agriculture

This section discusses the process related emission of other greenhouse gases in all sectors except agriculture and the energy related emission of other greenhouse gases from various sectors including agriculture. The previous section addressed only the other greenhouse gases from agriculture that are directly related to cattle breeding and arable farming, excluding energy use.

Methane
The non agricultural (i.e. non cattle breeding) related methane emission (CH_4) stems from landfills, the energy sector and from gas engine in CHP plants. There are a few other small sources, too. In 2007, the non agriculture related methane emission was about 8 Mton. In 2020 the emission in all three policy variants (i.e. no Clean and Efficient policy, foxed policy and intended policy) amounted to about 5 Mton. The emission development is mainly influenced by the decrease in landfill emission. Methane from landfills arises from the biological decomposition of the organic substance. This process may take tens of years. Since 1990 the amount of dumped waste has decreased significantly from about 14 Mton to about 2 Mton in 2007. It is expected that the amount of dumped waste will stabilise at 2 Mton in 2020, but the amount of carbon will decrease significantly. The emission of methane is estimated at about 2 Mton CO_2 equivalents in 2020. There are only slight differences between the policy variants of the other sources. This way the differences in deployment of CHP (see Chapter 4.2.) do affect the emission, but the emission of gas engines (methane slip) in CHP fluctuate around 1 Mton CO_2 equivalents in all variants.

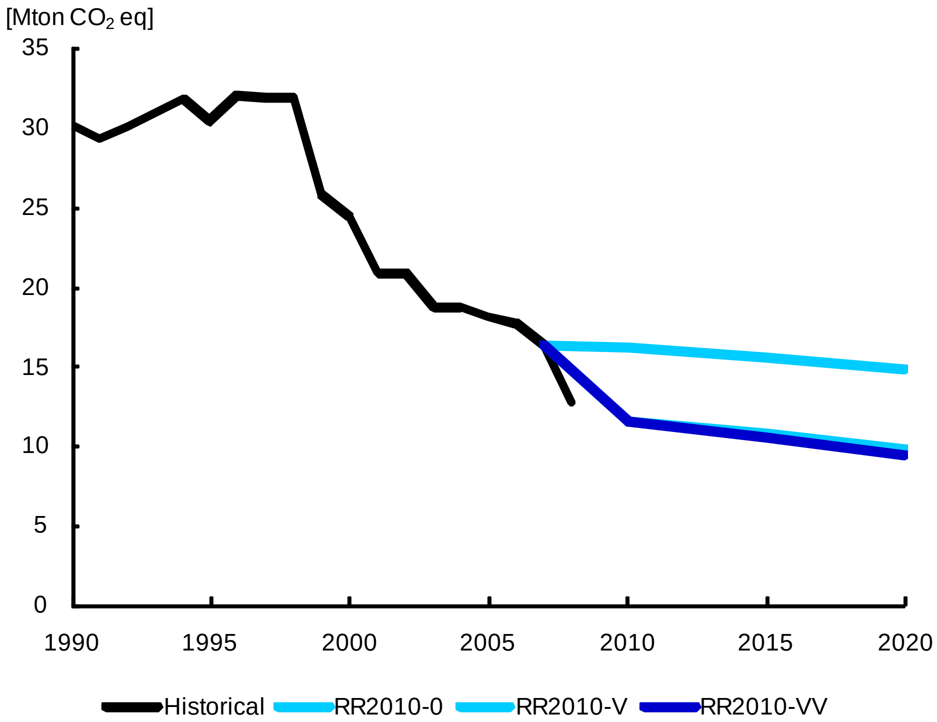

Figure 5.4 *Development emission of other greenhouse gases non agriculture*

Nitrous oxide
Nitrous oxide (N2O) mainly arises in industry during the production of nitric acid and caprolactam, and to a lesser extent as an indirect emission from combustion processes. In addition, the traffic sector also makes a slight contribution to Dutch N_2O emissions by using three-way catalysts in petrol cars. In 2007 this contribution was about 3%. Waste water treatment plants also contribute about 3% to the N_2O emission. In 2007 the N_2O emission was about 6 Mton CO_2 eq. In 2020 this emission will decrease to about 2 Mton, both in the variant with fixed policy and in the variant with intended policy. Without Clean and Efficient policy the emission would have amounted to over 7 Mton. The reduction of approximately 5 Mton results from reduction measures in the nitric acid plants in 2007.

F gases
The emission of F gases (HFCs, PFCs, SF_6) has various sources such as cooling (stationary and car air-conditioning), production of primary aluminium, the semiconductor industry, the produc-

tion and the user phase of double glazing. In 2007 the emission of F gases amounted to about 2 Mton CO_2 eq and in 2020 it will have increased to nearly 3 Mton CO_2 eq, both in the variant without Clean and Efficient Policy and in the variant with fixed policy. In the variant with intended policy the emission from stationary cooling decreases with 0.3 Mton by stimulating the transition from HFCs to natural coolants.

Uncertain factors
The total bandwidth of the projected emission of other greenhouse gases in the other sectors under fixed policy amounts to 7.6 to 10 Mton CO_2 eq in 2020. As in agriculture, the uncertainty in the projection of the other greenhouse gases of other sectors is mainly determined by monitoring uncertainty (see Table 5.3).

Table 5.3 *Uncertainties other greenhouse gases other sectors*

[Mton CO_2 eq.]			Uncertainty range deviation 5-95%	
Sector	Sub-stance	Description uncertain factor	Lower value	Upper value
Industry	N_2O	Monitoring uncertainty nitric acid	-0.1	0.1
Industry	N_2O	Monitoring uncertainty Caprolactam	-0.2	0.2
Traffic and transport	N_2O	Uncertainty N_2O traffic and transport	-0.3	0.4
Industry	CH4	Monitoring uncertainty transport and distribution natural gas	-0.2	0.2
Industry	CH4	Monitoring uncertainty CHP gas engines	-0.6	0.6
Industry	CH4	Economic uncertainty CHP gas engines	-0.1	0.1
Waste	CH4	Monitoring uncertainty landfills	-0.7	0.7
Waste	CH4	Monitoring uncertainty Waste water treatment plants	-0.1	0.1
Traffic and transport	F gas	Monitoring uncertainty mobile a/c	-0.1	0.1
Industry	F gas	Repacking HFCs	-0.1	0.1
Industry	F gas	Monitoring uncertainty PFC and SF6 semiconductors	-0.1	0.1
Industry	F gas	Monitoring uncertainty stationary a/c IND	-0.2	0.2
Industry	F gas	Use: Other (foams, aerosols, etc)	-0.1	0.1
Industry	F gas	Monitoring uncertainty other F gas	-0.1	0.1
Industry	F gas	Monitoring uncertainty SF6	-0.1	0.1
TSG	F gas	Monitoring uncertainty stationary a/c TSG	-0.5	0.5

6. Air polluting substances

6.1 Nitric oxides (NO_x)

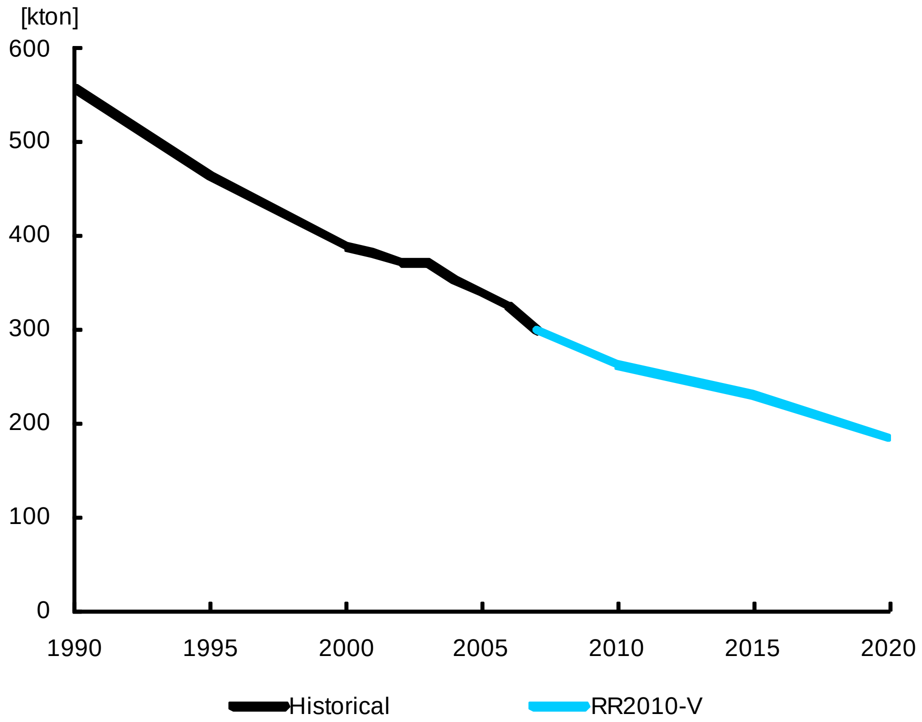

Figure 6.1 *Development of NO_x emission Netherlands total*

The NO_x emission continues to decrease between 2020 and 2020, see Figure 6.1. The NO_x emission of traffic dominates the national total amount. Moreover, industry and the energy sector contribute significantly to the total NO_x emission in the Netherlands.

6.1.1 Stationary sources

Development emission of nitric oxides (NO_x) stationary sources

Based on fixed policy, the decrease of the NO_x emission of stationary sources will continue in the coming years (Figure 6.2). The decree on emission regulation mid-sized combustion plants (BEMS) of December 2009 has also been taken into account. This new BEMS legislation will show its effect between 2015 and 2020 and gas engines will also have to comply with more strict emission standards. (VROM, 2009). After 2020 the emission will more or less stabilise. Replacing the old installations with new ones that have lower emissions will more or less compensate for the increase in fuel consumption.

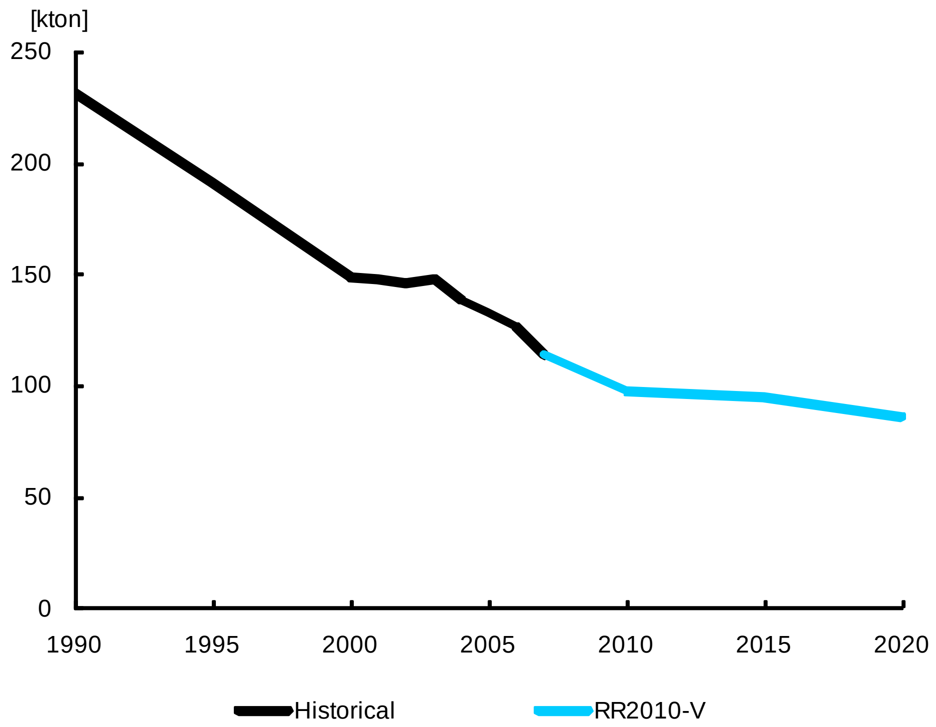

Figure 6.2 *Development of the NO_x emission of stationary sources*

Table 6.1 presents the emissions of various sectors. The following developments can be noted with regard to specific emissions of installations:

- In 2005 it was still assumed that the emission requirement of 80 g/GJ for new gas engines of the Gothenburg protocol would apply. Eventually this standard was not implemented in the Netherlands. In the mean time BEMS legislation has been implemented instead. At about 28 g/GJ for engines larger than 2.5 PMth, this standard is more strict than the Gothenburg protocol. Smaller engines and biogas engines must comply with the new BEMS standard of about 95 g/GJ. A major difference, moreover, is that the standards will enter into force for existing installations before 2020.
- As indicated elsewhere in this report, the number of gas engines in greenhouse horticulture has increased significantly in the last 5 years. Most of these engines are equipped with flue gas cleaning to enable using the released CO_2 as CO_2 fertilizer in the gas. Despite the fact that the cost is relatively low, flue gas cleaning is often switched off if CO_2 fertilization is not needed (Dueck, 2008). Therefore the standard emission of this type of engine has been increased. As these engines are covered by BEMS legislation, this adjustment is no longer visible in 2020. Due to this adjustment (a higher emission without BEMS) the effect of the BEMS legislation is increasing. In 2020 it amounts to about 7.5 kton, with about 6 kton in greenhouse horticulture.
- The inventory of the NO_x emission of the new high efficiency central heating boiler shows a favourable development. The emissions are significantly lower than the Dutch emission requirement. Due to these lower emissions the emissions of households are lower than in earlier calculations (Gastec, 2007).

Table 6.1 *Development of the NOx emission of stationary sources per sector*

NO_x emission in [kton]	1990	2000	2005	2008	2010	2015	2020
Industry	78.7	34.0	34.2	30.1	26.4	28.5	30.6
Refineries	18.8	10.3	9.1	8.6	7.0	6.0	5.8
Energy sector	85.0	55.6	46.2	30.2	31.7	34.3	32.7
Waste treatment	7.1	4.5	3.8	3.8	2.9	2.8	2.7
Agriculture	9.8	13.1	12.3	12.5	12.1	9.9	3.9
Households	20.3	18.4	15.2	13.0	9.9	7.1	5.8
TSG and construction	11.8	12.7	11.7	13.1	8.1	6.5	5.0
Total	232.0	148.6	132.5	111.3	98.2	95.2	86.4

The NO_x trade system, which entered into operation mid 2005 for installations with a capacity of more than 20 MW_{th} (unless exempted) and installations with high process emissions, deserves special attention. Since its implementation in 2005 there has been a surplus of emission allowances (NEA, 2008). The amount of allowances will be lowered step by step in the course of time. For 2010 the maximum emission of incineration installations has been set at 40 g/GJ fuel. This is the performance standard rate (PSR). Process emissions have a reduction target. In 2008 the average incineration emission amounted to about 44 gr/GJ. This is already lower than the PSR of 2009 of 46 g/GJ, but higher than the PSR of 2010. Around 2013 the PSR will be gradually tightened to 37 g/GJ. In the period 2010[40]-2013 the emission allowances could for the first time obtain a trading value that corresponds to the costs of additional emission reduction.

Table 6.2 shows the dist5ibution of emissions in 2020 under fixed policy. About 80% of the emission is covered by the NO_x emission trade system. This percentage is higher than today because the reduction of BEMS occurs in smaller installations. Here. the emissions of incineration installations under the trade system was established by multiplying the fuel use with the PSR of 37 g/GJ. The process emission was established by multiplying the historical emission with the physical growth and the reduction target for process emission in the trade system.

Table 6.2 *Development NO_x emission and emission trade*

NO_x emission in [kton]	2020
Small sources	19.1
Trade incineration emissions	54.1
Trade process emissions	13.3
Total trade	67.3
Total	86.4

Suppose the trade system is in balance in 2012 (the demand of companies with too high emissions are exactly compensated by companies that have surplus emission allowances and sell them), this may lead to another surplus in 2013. It seems likely that the maximum allowed emission is realised in 2012 by adjusting the installations. The reduction of the NO_x emission will mainly be realised through investments and there will only be substantial variable costs in a very limited number of instances. Once the installation has been adjusted it will remain at the

40 In the various years it is possible to save about 5% of the emission allowances for (or borrow from) a subsequent year. The surplus of 2008, via 2009, can thus be used to cover a deficit in 2010. It may also be the case that businesses will buy additional allowances in 2011 anyway to use them in 2011. As a result a trade market could arise in 2010 with a certain equilibrium between supply and demand. The explanation of the legislation for the emission trade system states: “As a result of this mechanism, the emission curbing measures that contribute in the most cost-effective manner to realising the total emission target will be taken”. This mechanism could enter into operation as of 2010 (temporary, see text below). The underlying aim of the system, i.e. to realise ambitious reduction targets for NOx in 2020, is realised quite successfully in terms of pace. Partly because of the pressure of the trade system, but also due to local policy addressing for example NOx removal in coal-fired plants, the NOx emissions of the energy and industrial sector have decreased rapidly and significantly.

lower level and not have a higher emission if the emission allowance price decreases significantly.

A large number of electricity plants will be built between 2013 and 2020. Given the environmental requirements for these new installations the emission will be far below the PSR. As a result the electricity sector is expected to have a surplus of emission allowances in 2020 of about 3 to 5 kton. If the PSR is not further tightened after 2013 there will hardly be a market for the surplus of allowances among the existing installations in 2013. Assuming maximum purchase by existing, expanded and new businesses, the unmarketable surplus is expected to amount to 0 to 1 kton. It is more likely that businesses will have lower emissions in time (because of renovations). A surplus of 2 to 3 kton is therefore more likely. Refer to the discussion of uncertainties with regard to the emission estimate for 2020.

Uncertainties NOx

Table 6.3 illustrates the economic uncertainty in the NO_x emission.

2 kton of the industrial uncertainty is in process emissions; 3.5 in larger incineration installations and 0.5 kton in smaller installations. In the electricity sector the difference is mainly due to the 20% lower electricity demand. In waste treatment there is little difference between the scenarios of GE and RC. Therefore the difference between UR-GE and GE has been included. In agriculture and TSG construction the difference is not only caused by the economic development but also by the deployment of CHP installations (gas engines).

Based on economic development alone, the total uncertainty of the emissions in 2020 is about 15% (13 kton). This is based on the assumption that the higher economic growth will occur proportionally in all sectors. If these uncertainties were not related then it would amount to over 7% (6.5 kton[41]). Although the 7% is currently not the case, it does indicate that the effect of different economic development of specific industries on the emission is smaller than the effect of a smaller or larger economic growth in the Netherlands.

Table 6.3 *Uncertainty in the NO_x emission in 2020*

[kton NO_x] Description uncertain factor	Uncertainty range deviation 5-95% Lower value	Upper value	Comment
Economic growth refineries	-0.5	1.0	Economic uncertainty
Fuel prices refineries	-0.2	0.2	
Allowance trading refineries	0.2	2.5	
Economic growth agriculture	-0.6	1.2	Economic uncertainty
Emission factors agriculture	-0.8	0.8	
Fuel prices agriculture	-0.1	0.1	
Gas engine deployment agriculture	-0.4	0.4	
Economic growth industry	-2.3	1.8	Economic uncertainty
Emission factors industry	-0.8	1.1	
Fuel prices industry	-0.9	0.9	
Gas engine deployment industry	0.0	0.0	
Allowance trading industry	-4.1	5.4	
Surplus emission allowances industry	-2.0	0.0	
Economic growth households	-0.1	0.2	Economic uncertainty
Emission factors households	-1.1	3.3	
Fuel prices households	-0.1	0.1	
Economic growth Trade, Services, Government	-0.1	0.4	Economic uncertainty

[41] This is determined by means of a quadrates method: quadrate independent uncertainties, add them and then take their square root.

[kton NO_x]	Uncertainty range deviation 5-95%		
Description uncertain factor	Lower value	Upper value	Comment
Emission factors Trade, Services, Government	-1.2	2.5	
Fuel prices TSG	-0.1	0.1	
Economic growth waste-processing industry	-0.1	0.2	Economic uncertainty
Allowance trading waste-processing industry	-0.3	0.3	
Economic growth power plants	-1.9	2.2	Economic uncertainty
Emission factors power plants	-0.1	0.1	
Fuel prices power plants	-1.2	1.2	
Gas engine deployment power plants	0.0	0.0	
Allowance trading power plants	-5.9	1.8	
Surplus allowances power plants	-5.0	0.0	

Other uncertainties

The other uncertainties encompass the uncertainties in the used emission factors for calculating the emissions of certain installations from the fuel use. These factors may be higher or lower than currently assumed. Moreover, the effect of energy prices has been examined and a number of more specific uncertainties have been included regarding the effects of the NO_x trading system and small-scale CHP.

Emission factors. About 19 kton of the NO_x emission of stationary sources will be outside the NO_x emission trading system in 2020. To determine the uncertainty of this emission each type of installation was examined to establish how much higher or lower the used emission factor may be. This emission calculation was subsequently conducted with these other factors and the possible deviation in the emission was determined per type of installation. After that the total uncertainty of emissions being higher or lower was established per sector. The main uncertainties are linked to gas engines: is the emission close to the maximum standard or is it importantly lower. In households the main uncertainties involve the actual emissions of central heating boilers. For new central heating boilers (high efficiency boilers), these are on average significantly lower than the emission standard, but the question remains how these development will evolve. The emission of gas heaters for local heating in this sector, for which there are no emission standards, is still a source of uncertainty.

Energy prices. The effect of different energy prices was derived from the uncertainty in the CO_2 emission that is linked to the energy prices for the various sectors. In the electricity sector this is mainly about the difference between the coal and gas prices. Here the average CO_2 effect is used and it is assumed that it has the same direction as in the other sectors. There may be some shifts in large-scale CHP. As these occur mainly in the NOx emission trading system, they were not included here. What is more, in the basic calculation the actual emission may (partly) occur in a different sector than indicated here due to emission trading. As higher or lower prices in all sectors are taking effect simultaneously, the total was established here by means of addition.

Volume gas engine park. There is significant movement in the volume of these installations. Moreover, the small engines and the biogas engines have relatively high emissions. An additional uncertainty percentage of 35% of the capacity is used here. A decreasing capacity leads to emission reductions ranging from 30% to 50%. The 35% used here is derived from the maximal changes in gas engine deployment between 2010 and 2020, taking into account the lifetime and age structure of the park. The introduction of BEMS and the subsequent lower gas engine emissions have significantly reduced the uncertainty here. It is assumed that the effect may work both ways.

Emission trading system. The emission trading system causes three uncertainties. First of all, a sector may emit more or less than the allowances it acquires. In that case the allowances must be purchased from other sectors. Based on the data from the trade system an uncertainty percentage of 15% is assumed. A second uncertainty encompasses the surplus of allowances from the electricity sector arising from building new electricity plants. As the trade balance is involved, the effect of the total emission is obviously nil.
A third uncertainty also pertains to the construction of new electricity plants. As indicated the expectation is that a surplus of allowances will arise. This might be 0 kton but it can also amount to 5 kton (double the expected value of 2 to 3 kton). A surplus could also arise in the process emissions in the industry.

Overall picture
Remarkably, the margins upwards and downwards are about the same. The expected surplus of emission allowances will lower, which is more or less compensated by the effects of a higher economic growth and higher emission factors in the upward margin.

As part of the uncertainty in the emission trading system is lost between the various sectors, the total uncertainty is smaller than one would conclude from the sectors. The calculated value of 86 kton NO_x emission from stationary sources in the scenario with fixed policy has a margin of 78 to 95 kton. To determine the total emission (and margin) the transport sector including mobile equipment must also be included.

6.1.2 Traffic and transport

The traffic and transport sector is the main source of NO_x emissions in the Netherlands. The emissions of sea shipping are not attributed to the Member States in view of the national emission ceilings (NEC) enforced by the EU. Even without considering sea shipping, the sector traffic and transport is the main source of NOx emissions in the Netherlands. Due to the increasingly strict emission standards for new engines of mainly road vehicles, but also of mobile equipment, ships and diesel engines for example, the NO_x emissions of the sector have decreased strongly since 1990.

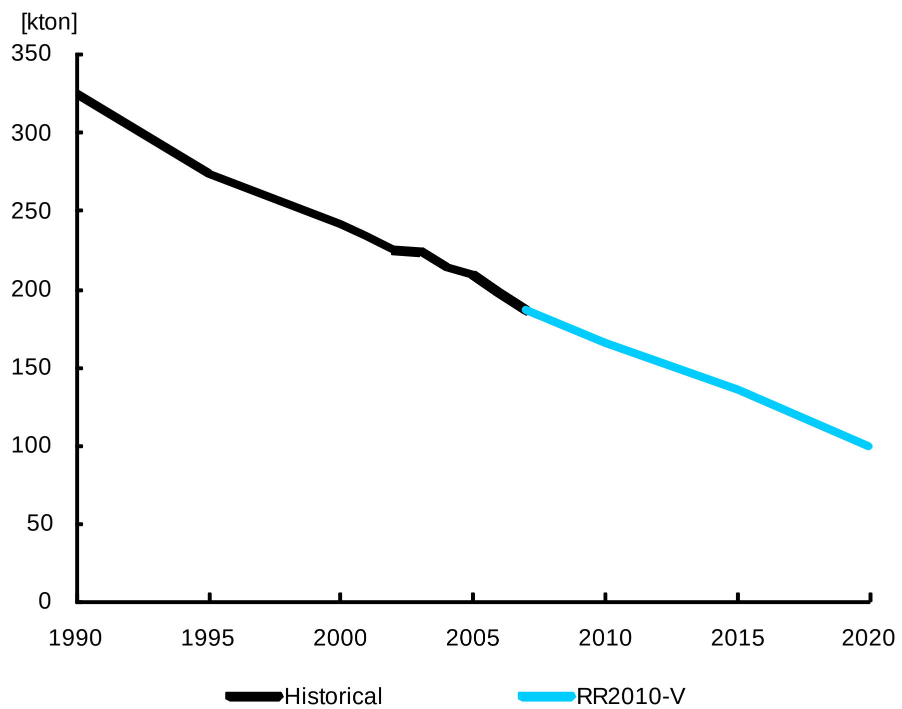

Figure 6.3 *Development of NO_x emissions in traffic and transport*

Volume developments

A description of the latest growth prognoses for passenger and freight transport in the Netherlands can be found in Section 3.3. Next to the prognoses for the growth of traffic and transport in the Netherlands, new prognoses were also established for the composition of the passenger car, delivery van and lorry fleet. The prognoses for the volume and composition of the passenger car fleet are calculated with the passenger car market model Dynamo, version 2.1 (MuConsult, 2008). The volume of the passenger car fleet in the Netherlands amounts to about 8.5 million in 2020, with a share of diesel cars of 19%. The share of diesel cars is limited by the new system for taxes on passenger cars and motorcycles and the European CO_2 standardisation, which will both result in a decreasing share of diesel cars in sales of new cars.

The new prognoses for the composition and the use of the delivery van and lorry fleet have been derived from new series of traffic performances derived from the mileages of the Stichting Nationale Autopas (NAP) by Statistics Netherlands last year. On average the lorry fleet is slightly older in the new projections, which results in higher NOx emissions (see also Hoen et al, 2010, to be published).

Policy developments

Over the last years various policy instruments were implemented that influence the NO_x emission projections for traffic and transport. These include:

- Euro-6 emission standards: In 2007 the EU agreed upon the implementation of the Euro-6 emission standard for passenger cars and delivery vans as of September 2014. Compared to Euro-5 the NO_x emission standards for diesel cars are lowered by about 55%.
- Tax Plan 2008: the increase in the tax on diesel fuel from the Tax Plan 2008 results in a slight decrease in diesel use and thus a slight decrease in NO_x emissions.
- Euro-6 emission standards: Within the EU agreement was reached about the tightening of the NO_x and PM10 emission standards for heavy road traffic late 2008. These Euro-6 emission standards enter into operation for new types of vehicles as of 2013 and for all newly sold cars as of 2014.
- IMO legislation sea shipping: Within the framework of IMO, agreements were made about tightening the NO_x emission standards for sea-going vessels in the autumn of 2008. The emission standard for new engines will be lowered with about 20% as of 2011.
- Walstroom Schiphol: In the Schiphol Air Traffic Decree 2008 it was established that as of 2010 at least 60% of the handling areas at Schiphol must be equipped with a power connection and preconditioned air. This will reduce the deployment of Auxiliary Units and Ground Power Units and their corresponding emissions.

New insights

The NO_x emission factors for Euro-3, -4 and -5 lorries and tractors have been adjusted upwards significantly in the new projections. New measurements of TNO to Euro-5 lorries show that in practise NO_2 emissions on city roads are up to a factor 3 higher than allowed by the European emission standard for these lorries (Ligterink et al., 2009). At higher driving speeds the difference between emission standard and emissions in practise becomes smaller, but it is only on motorways that the NO_x emissions approach the standards. These new insights lead to substantial adjustments of the NOx emission projections, especially in 2010 (+ 12 kton) and 2015 (+15 kton), because the majority of the lorry fleet consists of Euro-3, -4 and -5 lorries in these years. In 2020 the increase is about 5 kton.

The new projections also include new insights that are processed in the distribution of mileage of road traffic in three types of roads distinguished by the emission calculations (city roads, motorways and other roads). Goudappel Coffeng derived new divisions for the Emission registration based on the national traffic model combined with the license plate research and accidents statistics (Van den Brink et al., 2010). The new road types for delivery vans and tractors deviate mostly with regard to city roads, compared to the previously used divisions: The number of inner city kilometres has (nearly) halved to the benefit of the country roads (delivery vans) and motorways (delivery vans and tractors). As the emission levels of road vehicles on motorways are lower than on city roads, the new divisions result in lower emissions in 2010 (-6 kton), 2015 (-5 kton) and 2020 (-2 kton).

The new emission projections for mobile equipment, finally, were calculated with the EMMA model that was developed by TNO last year to be used for the Emission registration (Hulskotte and Verbeek, 2009). Previously only the emissions of diesel equipment was calculated, but the new model also distinguishes petrol and LPG equipment. The NO_x emissions of LPG equipment is currently estimated at about 3 kton. As LPG equipment is not regulated by the European emission legislation for mobile equipment, these emissions will increase in the projections until about 4 kton in 2020. Adding the LPG equipment thus leads to an increase in the NO_x emission projections. In total, the projected NO_x emissions for mobile equipment in 2020 are about 4 kton higher than in UR-GE.

Results
The NO_x emission projection for traffic and transport on 2020 amounts to 99 kton, which is 2 kton higher compared to the previous projection (Daniëls and Van der Maas, 2009). This increase is mainly due to the increased NO_x emission factors for freight traffic and the increase in NO_x emissions of mobile equipment. The effect of lower traffic volumes and new road type divisions, both leading to a decrease in emissions, is thus fully compensated.

The NO_x emission projections for 2010 and 2015 are 166 and 135 kton and are thus 10 kton and 14 kton higher compared to the previous projection. This is mainly the consequence of the increased NO_x emission factors for freight traffic.

The NO_x emission projection for sea shipping amounts to 110 kton in 2010 and 90 kton in 2020. The new projections are substantially lower than the UR-GE projections of 126 kton and 125 kton. This decrease is largely the result of the new growth prognoses for sea shipping.

Target range 2010
The NO_x emission ceiling for traffic and transport amounts to 158 kton in 2010. The new emission prognosis for 2010 is higher.

Uncertain factors
The emission prognoses for air-polluting substances by traffic and transport are based on a large number of basic data obtained from a variety of sources. The uncertainties surrounding these basic data are often not (well) known. This makes it more difficult to name and quantify most of the uncertain factors in the prognoses. Nevertheless, based on expert judgement, an estimate was made of the main uncertain factors in the NO_x emission projections and how they affect the projections. The monitoring uncertainty of NO_x emissions for traffic and transport has roughly been estimated at +/- 25%, thus constituting the main uncertain factor in the emission projections. Other main uncertain factors are the effectiveness of the Euro-6 and Euro-VI emission standards, the economic development and the development of the oil price.

The bandwidth of the NO_x emission projection for traffic and transport in 2020 is estimated at -22/+36 kton. Without monitoring uncertainty the bandwidth is -8/+22 kton.

6.2 Sulphur dioxides (SO_2)

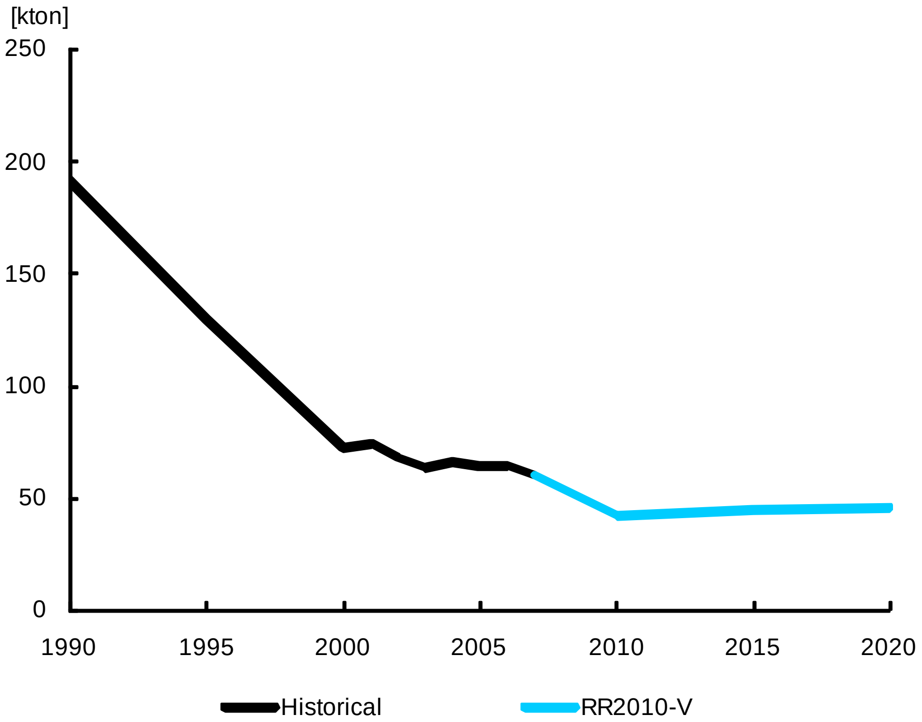

Figure 6.4 *Development of SO2 emission Netherlands total*

The SO_2 emission increases by several kilotons between 2010 and 2020, rising from 42 to 45 kton SO_2 (Figure 6.1). The contribution of the industry, the refineries and the energy sector together account for more than 90% of the SO2 emission in the Netherlands.

Development of emission of sulphur dioxides (SO_2) stationary sources
The development of the SO_2 emission of stationary sources is indicated in Figure 6.5. The emission decreased significantly towards 2000, but after that there has been little change for a long time. In recent years the emission is decreasing again due to measures in coal-fired plants, the transition of refineries to gas-firing instead of (a small part) oil and decreasing sulphur content of oil products. As for government policy, the SO_2 covenant with the electricity sector plays an important role, as does the agreement to enter a maximum emission of 16 kton in the permits for refineries divided over various companies.

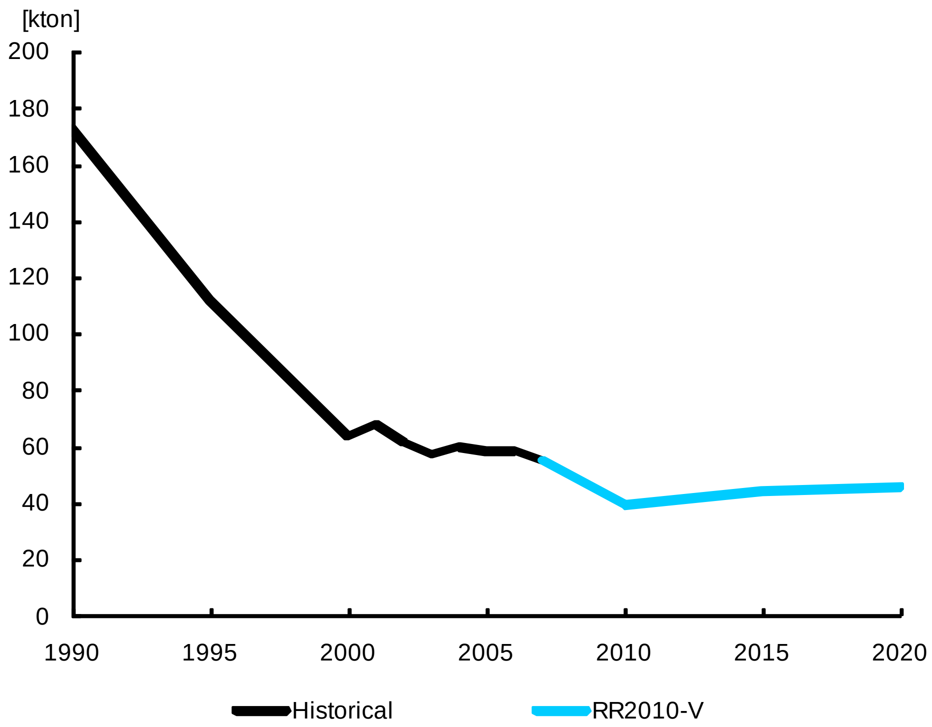

Figure 6.5 *The development of the SO_2 emission of stationary sources*

The SO_2 emissions of the various sectors are listed in Table 6.4. Relevant developments include:

- The development of process emissions of the industry is assumed to be equal to the physical growth of the sector. The development of the emission of the sector over the past years has been examined, though. For example, the emission for the base metal industry in the last few years was 0.4 kton lower. Moreover, in several situations it is assumed that the emission will increase less rapidly than a linear relation with the physical production would imply.
- Several years ago an agreement was made with refineries that they would stop burning heavy fuel oil, aiming at 2020 emissions not being higher than in case of gas-firing. A further agreement was made about limiting the maximum emission to 16 kton in 2010 and subsequent years and establishing the emission per company in the permit. If refineries would stop burning oil and keep their installations in the BAT (Best Available Technique) range of the IPCC guideline, then the emission would be significantly lower than in 2005. To comply with the new sulphur demands for sea-going vessels, the Dutch refineries will have to make large investments in additional secondary production capacity and desulphurisation installations before 2020. As this will lead to higher energy use and additional desulphurisation capacity (with corresponding process emissions) this might put pressure on the 16 kton agreement.
- A covenant was closed with the electricity sector to reduce the SO_2 emission in the period 2010 to 2019 to 13.5 kton. The covenant does not include the year 2020 because European agreements that still need to be worked out will possible demand a lower emission. In 2010 the emission in these scenario calculations is well below the agreed ceiling. This is due to the fact that the sector has already taken various measures over the last years to reduce the SO_2 emission. On balance this leaves ample space to work out new construction plans and still remain below the emission ceiling of 2019.
- In households and TSG the emission lowers because the sulphur content of the domestic fuel oil decreases from 0.2% to 0.1%.

Table 6.4 *The development of the SO_2 emission of stationary sources per sector*

SO_2 emission in [kton]	1990	2000	2005	2008	2010	2015	2020
Industry	51.1	13.4	14.9	14.3	13.6	15.0	16.7
Refineries	67.1	33.1	32.2	25.7	15.0	15.0	14.8
Energy sector	45.6	15.1	9.9	6.3	10.1	13.5	13.5
Waste processing	4.6	0.2	0.2	0.2	0.2	0.2	0.2
Agriculture	1.0	0.1	0.4	0.1	0.0	0.0	0.0
Households	1.1	0.5	0.5	0.5	0.3	0.3	0.3
TSG and construction	2.7	1.3	0.5	0.6	0.3	0.3	0.3
Total	232.0	63.7	58.6	47.7	39.4	44.3	45.7

Uncertainties SO_2 emissions

The uncertainties surrounding SO_2 emissions were assessed in view of the effect of a lower economic development. Moreover, the main other uncertainties per sector are mapped. In two sectors (energy sector and refineries) there is an emission agreement between government and the sector that significantly decreases the uncertainty. Moreover, the process emissions play an important role in the industry. As a result, aspects such as energy price or CO_2 price only have limited influence on the uncertainties in the SO_2 emissions, which is why they have not been further quantified. Although it is obvious that new government policy can further reduce the emissions, this is not included in the uncertainty analysis. The SO_2 emissions of transport are discussed elsewhere in this report.

Economic uncertainty

The total uncertainty with regard to the 2020 emissions, based on the economic developments alone, results in an emission that is about 6% lower or 4% higher. If there is no correlation between the uncertainties, then the emission would be less than 4%, but this is not the case when considering a complete scenario image with lower growth.

Table 6.5 *Economic and other uncertainties in the SO_2 emission in 2020*

[kton SO_2]	Uncertainty range deviation 5-95%		
Description uncertain factor	Lower value	Upper value	Comment
Economic growth refineries	-1.3	1.2	Economic uncertainty
Other uncertainties refineries	-2.0	0.5	
Other uncertainties agriculture	0.0	0.1	
Economic uncertainty industry	-0.9	0.7	Economic uncertainty
Other uncertainties industry	-2.5	3.0	
Other uncertainties households	-0.1	0.1	
Other uncertainties, trade, services, government	-0.1	0.1	
Economic uncertainty power plants	-0.7	0.0	Economic uncertainty
Other uncertainties power plants	-1.5	1.5	

Other uncertainties

The non economic uncertainties are explained below. Attention is paid to the largest factor influencing uncertainty.

- The industrial emission results mainly from process emissions of the chemical industry and the heavy metal industry. The emission increases over time. As can be seen in statistics, the emission can change significantly between two years. The upper limit was established by looking at the difference between historical emissions and the calculated emission in 2020. The lower limit was established by assuming a slight reduction compared to historical emissions. The 16.7 kton emission will then be in the range of 14.2 - 19.7 kton. No assumptions were made about conceivable new policy for further reducing these emissions.

- A ceiling of 16 kton was agreed upon with the refinery sector. Looking at the emissions, about 3 kton may be emitted by flaring. In 2020 the refineries will reduce about 1500 kton of SO_2 emissions with desulphurisation installations (i.e. remove 750 kton sulphur from the oil annually). This amounts to nearly 1 kton SO_2 per refinery per day. Imagine a failure taking place at the end of the year; this would cause an emission of 0.5% that cannot be compensated for in that same year. To preserve flexibility in operational management the refineries will aim at staying about 10% below the ceiling. As the 2020 emission is mainly linked to processes rather than to fuels (heavy fuel oil is no longer used) the flexibility is more limited than it is today. Emissions can no longer be balanced by deploying own fuels. This is why a higher lower limit of 2 kton is assumed.
- The SO_2 emission of the electricity sector is limited by a covenant to 13.5 kton in 2019. This end date was selected in view of new, currently unknown, SO2 ceilings for 2020 that may require a different agreement. Formally, there is no agreement for 2020, but it is reasonable to assume that the emission will develop along the same line (no major changes in type of coal or used reduction technology assumed between 2019 and 2020). The ceiling may be exceeded but this must be compensated for in the subsequent two years until the exceeding is not higher than 0.5 kton after three years. In a certain year the emission thus may exceed the covenant value (by even more than the mentioned 0.5 kton). Looking at the fluctuation in coal deployment in the last years this may amount to as much as 10%. In other words: if the coal deployment in 2020 is low or high, this may result in a 10% difference in emission, or in a round figure 1.5 kton higher or lower.
- The uncertainty in emissions of the other three sectors, i.e. waste processing, TSG and construction and households, is estimated at 0.1 kton. Waste processing involves a combination of uncertainty about emission factors and uncertainty about waste input. The other two sectors involve uncertainty about the volume of domestic fuel oil use compared to gas use. Despite the fact that agriculture does not have any visible SO_2 emission in the scenario image, within the used rounded figures, a margin of 0.1 kton upwards is still assumed based on the conceivable deployment of sulphurous fuels.

Traffic and transport

In traffic and transport, sea shipping is by far the largest emitter with a share of over 90%. Sea shipping emissions are not ascribed to the Netherlands under the NEC guideline. The share of traffic and transport in the Dutch NEC emission was significantly lower at 8% in 2008. The SO_2 emission is decreasing further as a result of the continuous tightening of the maximum allowed sulphur content of fuels in traffic and transport.

The 2020 SO_2 emission projection for traffic and transport amounts to 0.3 kton. The bandwidth for this projection is about +/- 15% (+/- 0,1 kton). The SO_2 projection for 2010 amounts to 2.6 kton.

The SO_2 emissions from sea shipping are projected at about 34 kton in 2010. Due to tightened sulphur standards for the SECA on the North Sea, which was agreed upon in October 2008 in the framework of IMO, the SO_2 emission projection for 2020 is significantly lower: according to estimates the 2020 emissions amount to about 4 kton.

Target range 2010

The SO_2 sector ceiling for traffic and transport amounts to 4 kton in 2010. It looks as though the NEC sector target will be realised.

6.3 Volatile organic compounds (NMVOC)

6.3.1 Netherlands total

Introduction

NMVOC (volatile organic compounds, excluding methane) are emitted by all sectors. Traffic and industry held the largest shares in 2008 at 28% and 24%, followed by households (20%) and TSG and construction (18%). The share of refineries, the energy sector and agriculture in NMVOC emissions is significantly smaller.

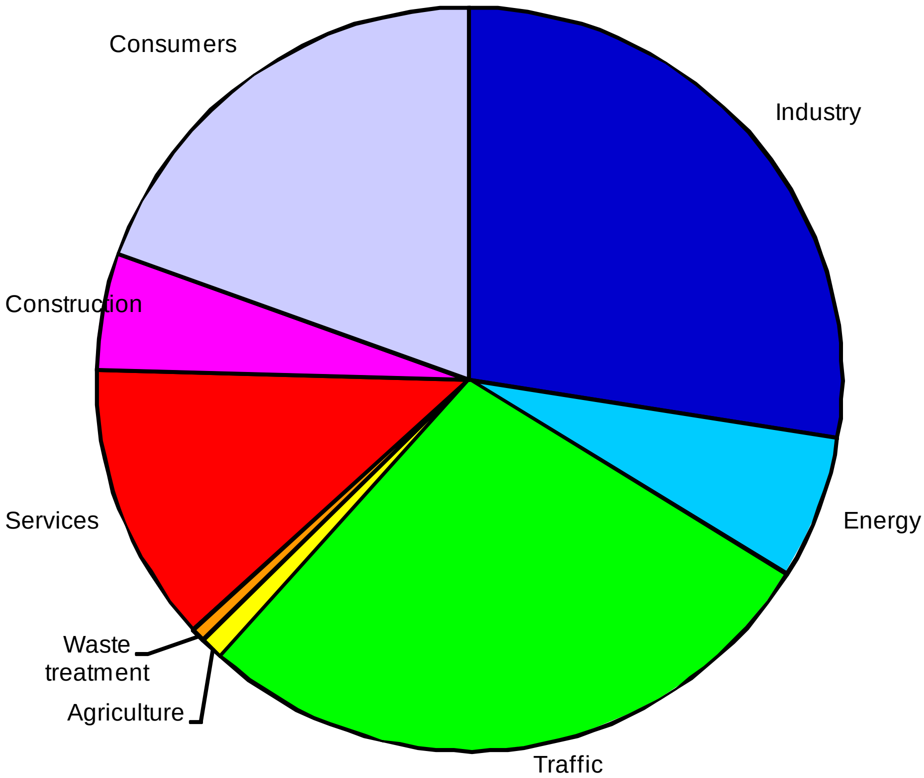

Figure 6.6 *Share in total NMVOC emissions in 2007 per sector*

In traffic NMVOC emissions are mainly released in petrol use. In industry and refineries NMVOC arises as a process emission in the production and storage of hydrocarbons and as a combustion emission in fuel use. In households, TSG and construction, the NMVOC containing products such as paint, glue and cosmetics are the main sources of emission.

Results

The NMVOC emission in 2008 amounted to 159 kton and will have decreased to 144 kton in 2010. Especially the emissions from traffic and the energy sector are decreasing. Between 2010 and 2020 the NMVOC emissions will increase again to 149 kton. The emissions of traffic and the energy sector will continue to decrease between 2010 and 2020, which is counteracted by an increase in emissions from all other sectors. The consumer emissions increase strongest. The decreasing emissions from traffic result in a decrease in the share of traffic in the total NMVOC emissions from 29% in 2008 to 17% in 2020. Not only the industry will have a larger share than traffic (26%); the same holds for consumers (27%) and TSG and construction (21%).

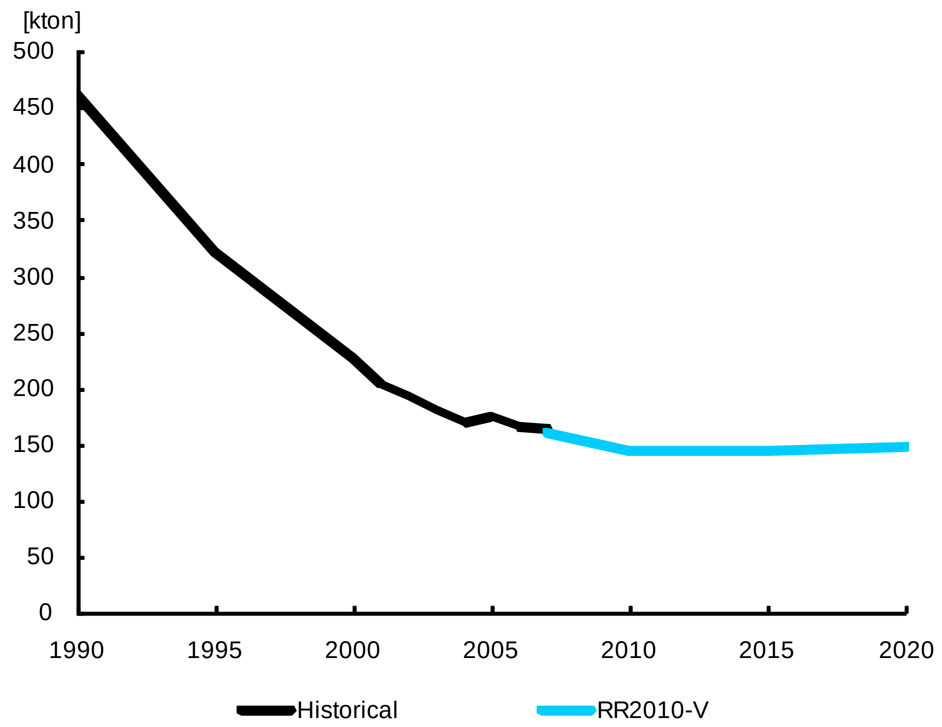

Figure 6.7 *Development of NMVOC emission in the Netherlands 1990-2020*

Uncertain factors

The projected emissions of NMVOC for 2020 have a 90% reliability interval of 132 to 168 kton. The main uncertainties are monitoring uncertainty and uncertainties related to economic developments. Without monitoring uncertainty the 90% reliability interval amounts is 137-162 kton.

Table 6.6 *Uncertainties Volatile organic compounds*

[kton NMVOC] Description uncertain factor	Uncertainty range deviation 5-95% Lower value	Upper value
Economic growth traffic and transport	-1.0	1.1
Population size traffic and transport	-1.0	1.0
Oil price traffic and transport	-1.1	1.1
Monitoring uncertainty traffic and transport	-7.6	7.6
Economic uncertainty Refineries	-0.7	1.4
Monitoring uncertainty Refineries	-2.0	2.0
Agriculture other, economic uncertainty	-0.1	0.2
Economic uncertainty Food and Stimulants	-0.4	0.6
Economic uncertainty Chemical industry	-0.9	0.5
Economic uncertainty Printing industry	-0.1	0.1
Economic uncertainty Base metal industry	-0.3	0.3
Economic uncertainty Metalectro	-0.6	0.6
Economic uncertainty Rubber & Plastic industry	-0.2	0.2
Economic uncertainty Wood industry	0.0	0.0
Economic uncertainty Other industry	-0.2	0.4
Economic uncertainty Construction materials	-0.1	0.1
Monitoring uncertainty Food & Stimulants	-1.8	1.8
Monitoring uncertainty Chemical industry	-2.1	2.1

[kton NMVOC] Description uncertain factor	Uncertainty range deviation 5-95% Lower value	Upper value
Monitoring uncertainty Printing industry	-0.3	0.3
Monitoring uncertainty Base metal industry	-3.1	3.1
Monitoring uncertainty Metalectro	-0.8	0.8
Monitoring uncertainty Rubber & Plastic industry	-0.5	0.5
Monitoring uncertainty Wood industry	-0.1	0.1
Monitoring uncertainty Other industry	-2.7	2.7
Monitoring uncertainty Construction materials	-0.5	0.5
Economic uncertainty Paint	-0.8	0.8
Economic uncertainty Cosmetics	-2.4	2.4
Economic uncertainty Hearths	-0.1	0.2
Economic uncertainty Other	-2.0	2.0
Demographical uncertainty Paint	-0.2	0.2
Demographical uncertainty Cosmetics	-0.5	0.5
Uncertainty in monitoring value paint	-1.0	1.0
Uncertainty in monitoring value cosmetics	-3.8	3.8
Uncertainty in other monitoring values	-6.1	6.1
Economic uncertainty Car respraying shops	-0.1	0.3
Economic uncertainty Other TSG	-0.2	0.6
Economic uncertainty Construction	-0.5	1.0
Economic uncertainty Storage and Handling Dry bulk	-0.9	0.9
Uncertainty in monitoring value Car respraying shops	-1.0	1.0
Uncertainty in monitoring value construction sector (mainly paint)	-1.6	1.6
Uncertainty in other monitoring values	-2.9	2.9
Monitoring uncertainty Storage and handling Dry bulk	-2.6	2.6
Economic uncertainty Waste disposal	-0.1	0.1
Monitoring uncertainty Waste disposal	-0.6	0.0
Economic uncertainty Energy generation	-0.2	0.3
Economic uncertainty Extraction & distribution Energy	-1.2	1.2
Monitoring uncertainty Energy generation	-1.0	1.0
Monitoring uncertainty Extraction & distribution Energy	-3.0	3.0

6.3.2 Industry, energy sector, refineries and waste processing

Introduction

The industry (incl. waste disposal), refineries and the energy sector held a share of 24, 5 and 4% in total NMVOC emissions in the Netherlands in 2006.

Nearly all industrial sectors have NMVOC emissions. NMVOC arises as process emission in various industrial processes and as combustion emission in the use of fuels. A significant share of the emission results from the use of NMVOC containing products such as paint, ink, cleaning and degreasing agents.

In refineries NMVOC is emitted in the production and storage and handling of petroleum products. In the energy sector the extraction and transport of natural gas is the main source of NMVOC emissions.

Relevant developments up to and including 2020

In 2009 and 2010 the production in the industry will decrease due to the credit crisis. The industry is more severely affected by the credit crisis than other sectors. This is especially true for the chemical industry, the metal industry and refineries. Between 2010 and 2020 the growth of the industry is more or less similar to the growth of the economy. The growth of the chemical industry is considerably higher, whereas the growth of the food and stimulants industry and the refineries is lower.

No new policy developments are to be reported since 2007. The measures of the 'National Reduction Plan NMVOC' are still taking effect in this projection.

Results
The NMVOC emissions from industry (including waste processing) amounted to 38 kton in 2008. Industrial activities are decreasing due to the credit crisis and the NMVOC emissions will decrease to 36 kton in 2010. After 2010 the NMVOC emissions from industry will rise again and in 2020 they will amount to 38 kton according to expectations. The development of NMVOC emissions from refineries shows a similar picture. There is a decrease from 8 kton in 2008 to 7 kton in 2010. After that the emission rises again to 8 kton in 2020. The energy sector emitted 8 kton NMVOC in 2008. This emission will decrease in the coming years to 6 kton in 2010 and 4 kton in 2020.

Uncertain factors
The main uncertainties for the NMVOC emissions from the industry, refineries and the energy sector are the monitoring uncertainty and the economic uncertainty. A monitoring uncertainty bandwidth of -25 - +25% is assumed for the chemical industry, the printing industry, the refineries and the energy sector; for the other industries a bandwidth of -50% - +50% is assumed and for other industrial subsectors -30 - +30%. The economic uncertainty for single subsectors follows the bandwidths used for NOx and SO2.

The 95% reliability interval of the NMVOC emissions from the industry (including waste processing) amounts to 31-43 kton. For refineries this bandwidth is 6-11 kton and for the energy sector it amounts to 1-8 kton.

6.3.3 Traffic and transport
The contribution of the sectors traffic and transport to the NMVOC emissions in the Netherlands amounted to about 28% in 2008. The emissions from sea shipping are not included in that number because they are not covered by the NEC agreements. Due to increasingly tighter emission standards for combustion engines and foe evaporation of fuel from road vehicles the NMVOC emissions from traffic and transport have been reduced significantly between 1990 and 2008.

The NMVOC emission projections for traffic and transport amount to 34 kton in 2010 and 25 kton in 2020. The decrease in NMVOC emissions between 2010 and 2020 are mainly the result of the Dutch car fleet that is becoming increasingly clean due to European emission standards for road traffic. The emissions of the inland shipping fleet and the mobile equipment are also increasing as a result of European emission legislation.

Uncertain factors
The bandwidth for the NMVOC emission projection for 2020 amounts to about +/- 8 kton (17-33 kton), +/- 6 kton as a result of monitoring uncertainty. The remaining bandwidth results from uncertainties about the economic and demographical developments, the oil price development and the effectiveness of the European source policy for road traffic, inland shipping and mobile equipment.

6.3.4 Households, TSG and agriculture

Introduction

The households held a share of 20% in total NMVOC emissions in the Netherlands in 2008. In households NMVOC emissions mainly arise from the use of cosmetics, other toiletry products, paint, car products and cleaning agents and from firing hearths and wood-burning stoves.

The services sector (TSG) and construction held an 18% share in the total NMVOC emissions in 2008. In the services sector emissions are released by a large number of sources. The storage and handling businesses are taking up an important share in NMVOC emissions. These are released in storage and handling of VOC containing products. Filling stations and car respraying shops also emit NMVOC. The use of cleaning agents also provides an important contribution. In construction the emission is mainly caused by use of paint.

Agriculture emits relatively little NMVOC (1%). This emission is mainly caused by incomplete combustion.

Relevant developments until 2020

NMVOC emissions from households are for the largest part caused by luxury products such as cosmetics and other toiletry products and paint. The luxury product expenditure is increasing more rapidly than the average expenditure of households. The use of hearths and wood-burning stoves, on the other hand, is increasing less rapidly. Volume developments in the services sector, construction and agriculture are described in Section 2.3.

Results

Between 2008 and 2010 the NMVOC emissions of households are increasing from 32 kton to 33 kton, despite the credit crisis. After 2010 the NMVOC emissions from households will continue to increase to 40 kton. Due to this relatively large increase, the share of households in the total NMVOC emissions will increase from 20% to 27%.

The NMVOC emissions from the services sector (TSG) and construction decrease slightly from 28 to 27 kton between 2008 and 2010. After 2020 the NMVOC emissions in the services sector will start rising again to 31 kton in 2020. The emissions from construction in 2020 will be at about the same level as in 2008. The share of the services sector and construction in the total NMVOC emissions will also increase from 17% to 21% between 2008 and 2020.

The NMVOC emissions from agriculture hardly change in the period 2008-2020.

Uncertain factors

The main uncertainty for estimating the NMVOC emissions of households, the services sector, construction and agriculture is the monitoring uncertainty. Depending on the emission source it ranges from 20 to 30%. It is higher for hearths and wood-burning stoves: 50%. Next to monitoring uncertainties economic uncertainties also play a role. Uncertainties related to population growth are also important for the NMVOC emissions of households.

The 95% reliability interval for NMVOC emissions of households ranges from 32 to 49 kton. For the services sector and construction together the interval ranges from 27 to 36 kton and for agriculture it ranges from 1.5 to 1.8 kton.

6.4 Ammonia (NH3)

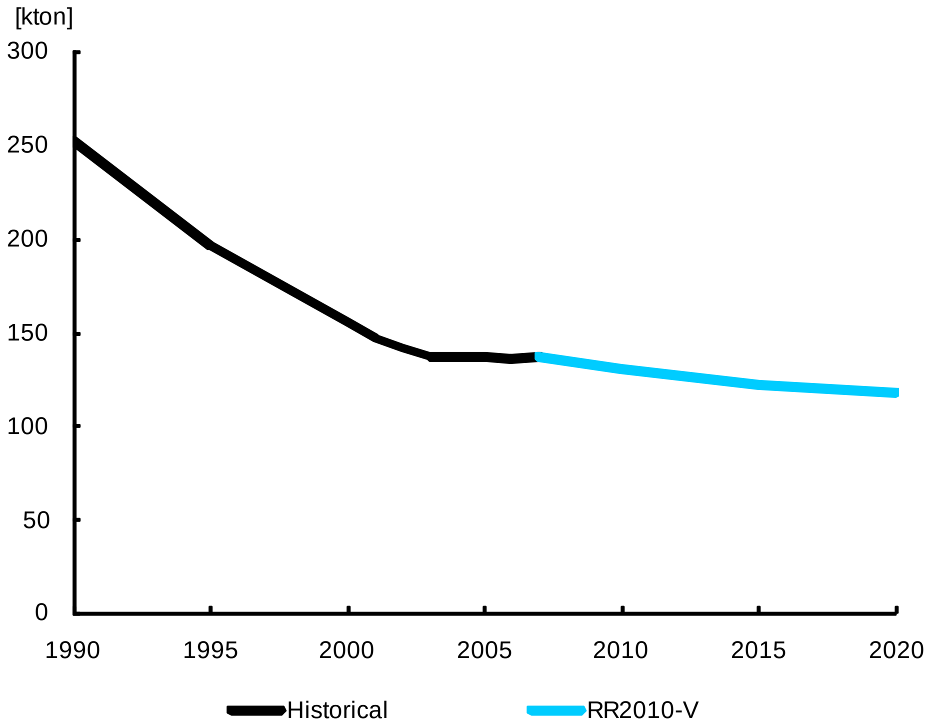

Figure 6.8 *Development of NH3 emission Netherlands total*

Agriculture has by far the largest share (about 90% in 2007) in the Dutch NH3 emission. It arises mainly from animal manure. The emissions of horses and ponies of riding stables and private persons (over 2 kton) are not attributed to agriculture but to the services sector. As for the other sectors: households has the largest share at 6%. The sources are mainly perspiration and animal manure. The ammonia emission of traffic, a contribution of about 2% to the total Dutch emission, is caused by the three-way catalyst in petrol cars. The emission in industry (2% of the total emission) is mainly released in the production of ammonia.

The total projected emission of ammonia for 2020 is 118 kton in 2020 (Table 6.7), with a share of 102 kton from agriculture.

Uncertainties

The bandwidth in the total NH3 emission in 2020 amounts to 101-137 kton NH3, which is largely determined by the monitoring uncertainty. This is the uncertainty in the calculation method for current (and historical) NH3 emissions. The other part of the bandwidth (i.e. without monitoring uncertainty) encompasses uncertainties with regard to future expectations of volume developments The uncertainties with regard to the NH3 emission of agriculture is elaborated in Section 6.4.2.

Table 6.7 *Uncertain factors NH_3 emission*

Sector	[kton NH_3] Uncertain factor	Uncertainty range deviation 5-95% Lower value	 Upper value
Traffic	Oil price	-0.1	0.1
Traffic	Monitoring uncertainty	-1.2	2.5
Agriculture	Number of animals (derogation policy and development manure processing)	-7.0	3.4
Agriculture	Ration	-1.0	1.0

Sector	[kton NH_3]	Uncertainty range deviation 5-95%	
	Uncertain factor	Lower value	Upper value
Agriculture	Sales manure surplus	-3.3	3.2
Agriculture	Co-digestion	-1.7	5.4
Agriculture	Artificial fertilizer	-0.5	0.5
Agriculture	Housing	0.0	0.9
Agriculture	Use	0.0	1.1
Agriculture	Monitoring uncertainty agriculture	-16.3	16.3
Industry	Economic uncertainty Chemical industry	-0.1	0.1
Industry	Monitoring uncertainty Food & Stimulants	-0.1	0.1
Industry	Monitoring uncertainty Chemical industry	-0.3	0.3
Industry	Monitoring uncertainty Construction materials	-0.1	0.1
Households	Uncertainty Population volume	-0.3	0.3
Households	Monitoring uncertainty Consumers	-2.7	2.7
Trade, Services, government	Uncertainty Population volume	-0.1	0.1
Trade, Services, government	Monitoring uncertainty TSG	-0.8	0.8
Waste processing	Monitoring uncertainty Waste disposal	-0.1	0.1

As the emission of agriculture holds by far the largest share in total emissions and the emission of other sectors is not subject to much change, this section will focus on further elaboration of the projected ammonia emissions of agriculture.

6.4.2 Agriculture

Introduction

Agriculture emitted about 121 kton ammonia (NH_3) in 2007, which was a share of almost 90% in the total ammonia emission in the Netherlands. The emission of 2007 is almost 20 kton less than in 2000 (CLO, 2009).

Ammonia arises mainly from animal manure. Emission sources are stables, manure storage outside the stable, grazing the cattle and manure spreading. NH_3 is also released in the use of nitrogen fertilizer. In 2007, stables, storage and manuring with animal manure, grazing and artificial fertilizer contribute 50%, 34%, 6% and 10% to the total ammonia emission from agriculture. Of all the different animal categories dairy cattle and pigs provide the largest contributions of 40% and 30%.

Future developments in the NH_3 emissions in agriculture are on the one hand related to the developments in the volume and composition of the livestock (volume developments) and on the other hand on the policy-induced measures that are taken by the sector to lower the emission (further).

Volume developments until 2020

The livestock of dairy and laying poultry is estimated to be a few percent higher in 2020 compared to 2007. In the projection it is assumed that the dairy cattle sector will realise a 15% higher milk production in 2020. A productivity increase of 1% annually can be realised with a number of dairy cattle that is at the same level as today. The volume of the young livestock, however, will decrease with about 15%. The number of pigs and meat poultry also decreases with about 10% and 5%. Cattle for meat production shows a decrease in number of animals of about 40%, except for veal calves which shows numbers that stay at the level of 2007 Silvis et al, 2009).

The milk quotas and manure and ammonia policy restrict the growth of the livestock until 2015[42]. The projection takes into account that the milk quotas expire as of 1 April 2015 and the intention to abolish the system of animal rights in factory farming in 2015. The manure production ceiling of the Netherlands, as agreed with the European Commission[43], cannot stop the growth of the livestock as this is not instrumented at business level.

Nevertheless, the projection assumes that the livestock will not grow strongly between 2015 and 2020. The reason is that the development of the livestock until 2020 is mainly the consequence of trade policy and market developments. Sales prices are expected to drop as a result of liberalising world trade whereas dairy farmers do face the cost of manure sales/treatment and low emission housing (as a result of manure and ammonia policy).

In 2020 the total manure production (for phosphate) is about 5% below the manure production ceiling of 2002. In practise the manure that cannot be immediately places still manages to find a destination up to now. It is expected that the future will not be different. The difference with the future is that currently there is still policy in place that restricts the livestock and hence also manure production (as the system of animal rights). Should this system be terminated, the livestock may grow and lead to more pressure on the manure market. In that case the manure sales prices will increase and the sensitivity to fraud will increase in the implementation and enforcement of manure policy.

This projection assumes that the manure that cannot be directly placed in the Netherlands (in unprocessed form) may find a destination via export, incineration or processing into manure products. In the projection for 2020 the same amount of (unprocessed) animal manure is exported abroad (about 10%) and incinerated (about 5%) as today. About 10% of the produced manure will be processed into manure products, mostly via manure separation. This is a fourfold increase compared to the current level of manure processing.

Due to further tightening of the manure policy (to comply with the Nitrate directive) more manure will enter the market that needs to be processed. Higher export of unprocessed slurry is less obvious due to high transport costs (Hoogeveen et al, 2010).
The projection assumes that the cost of manure processing will lower compared to the current level. Nevertheless, some companies are facing such high costs for processing and sales of manure (including storage and transport) that they are no longer competitive. Their market share will (partly) be taken over by more efficient companies, which means that the scale-up in agriculture persists.

- Due to tightened manure policy. dairy farms that have their own land to deposit the manure will face higher costs to dispose of the manure surpluses at company level or to prevent this by adjusting the feed. It is expected that this sector will continue to be competitive at the global market due to increased productivity and scaling-up.
- Pig farms usually have a less favourable competitive position than dairy farms because the cost of manure transport and processing weighs more heavily than in dairy farms. This is partly due to the fact that they have no ground or insufficient ground to deposit the manure and partly because of the lower added value per unit of manure production of this sector.
- Laying hen farms usually have little to no own ground to deposit the manure on either. Nevertheless the cost of manure processing weighs less heavily on their competitive position

[42] The total milk production in the Netherlands has stayed at more or less the same level in the last 20 years due to the European milk quote. However, the total amount of milk was produced by an increasingly lower number of dairy cows because the milk production per cow increased in the same period.

[43] The production of animal manure may not exceed the level of 2002 (= 172 mln kg P and 384 kg N in annex 1 belonging to the derogation request of 2005). In 2009, the historical range was recalculated due to a change in method; as a result the manure production for 2002 amounted to 173 mln kg P and 410 kg N 9CBS , 2009). Especially for N this is an increase of almost 7%; it is not know whether this will lead to a revision of the manure production ceiling stated in the Annex.

than in pig farms. The reason for this is that the type of manure processing used (incineration) is much cheaper.

Policy developments until 2020

The projection takes into account the consequences of the following policy:

- Following the Ammonia Emissions Decree for Livestock Housing (stb 2005, No. 675) in 2020 all pigs and chickens will be housed in low-emission stables that also meet the welfare demands entering into force on 2013 (Pigs decree, 1998) and 2012 (Decree on Laying hens, 2002). Due to an increase in permanent stabling, part of the dairy cattle (about 30%) will also be housed in low-emission stables (Hoogeveen et al, 2010). Various policy actions are planned to incentivise far-reaching emission reduction measures in dairy stables (VROM, Actieplan ammoniak en veehouderij, 2009).
- Environmental policy for the local environment (ammonia, odour, particulate matter)[44] results in additional measures for expanding and new pig and poultry farms. It is expected that about one third of the pigs and poultry in 2020 will be in stables with for example (combi) air scrubbers (based on MNP, 2008). Combi air scrubbers purify the stable air from ammonia, particulate matter and odour. Instead of opting for further reductions of NH3, poultry farms can also opt for aviary housing with manure drying. They will need to take additional measures for addressing the particulate matter (see Section 6.5). Subsidy schemes for combi air scrubbers and for particulate matter measures in companies with (local) bottlenecks help limit the additional cost for those companies.
- The prohibition on incorporating of manure in two working passes (as of 2008) will result in on average lower emission techniques being used for manuring farmland in 2020.
- Prohibition of the use of the [trailing shoe] on sand (as of 2012) prevents farmers from using this technique more in the future.
- The Renewable Energy Subsidy scheme incentivises co-digestion of animal manure. In co-digestion other feedstocks such as maize or crop residues are added to the manure to increase the energy yield. Due to this addition co-digestion increases the amount of nitrogen and phosphate in animal manure (digestate) and the tension on the manure market increases. Therefore extra manure processing is needed to arrange a destination for all manure.

Development ammonia emission until 2020

The emission of NH_3 from agriculture under fixed policy decreases with 19 kton from 121 kton to 102 kton NH_3 between 2007 and 2020 (Hoogeveen et al, 2010). The reductions are mainly realised in housing (-10 kton NH_3) and manure use (-8 kton NH3).

The (net) decrease of the NH_3 emission in housing of 10 kton is caused by:

- Implementation of low-emission stables for pigs (-6 kton) and poultry (-3 kton); additional emission reducing measures include combi air scrubbers at pig farms (about -2 kton) and poultry farms (-0.5 kton).
- Implementation of low-emission stables as a result of the Decree on housing for permanently stabled dairy cattle (-1 kton).
- An increase of the amount of manure per cow (+3 kton) as a result of the assumed increase in milk production per cow. No changes anticipated in the other animal categories.
- A smaller pig and beef cattle (resp. -2 and -1 kton); the smaller young livestock compensates for the emission because of the larger number of milk cows (0.4 kton).

The (net) decrease of the NH_3 emission in manure use of 8 kton is caused by:

- Use of low emission manuring techniques as a result of the prohibition of manuring in two working passes on farmland as of 2008 (-5.5 kton).

[44] I.e. “Beleidslijn IPPC-omgevingstoetsing” (2007), Natura 2000, the Odour Nuisance and Livestock Farming Act (2006) and the Air Quality Act 2007.

- Decreased use of unprocessed manure as a result of tightened nitrogen and phosphate standards (-5.5 kton).
- Additional use of processed animal manure (+3 kton): The contribution to the use of processed animal manure as a result of added feedstocks in co-digestion of manure is about 1 kton (van Schijndel en v.d. Sluis, 2010).

Uncertainties ammonia emission 2020

The total bandwidth in the NH3 emission if agriculture amounts to 85 to 120 kton in 2020 and is partly determined by monitoring uncertainty. That is the uncertainty in the calculation method for the current (and historic) NH3 emission[45].

The other part of the bandwidth encompasses uncertainties about future expectations with regard to for example volume developments or degree of implementation of measures, and amounts to 95 to 110 kton NH3.

An important uncertainty in the projection relates to developments in animal numbers.

- If manure processing does not evolve (i.e. the cost price doesn't lower) and/or the additional cost of additional housing measures are too high, the pig population will be about 10% smaller than currently assumed in the projection.
- If derogation of the Nitrate directive is no longer granted by the EU after 2013, the dairy stock (and pig population) will be about 5% smaller than currently assumed in the projection.
- Given the expected market developments, combined with the cost of manure sales/processing and low-emission housing, it seems less likely that the pig population will be much larger than currently assumed, but it is not ruled out. The diary stock may turn out much larger if the Netherlands, thanks to its strong competitive position, manages to produce more milk than currently assumed. At an additional growth of 6% of the number of dairy cow (and an increase in productivity of over 1% annually) the total milk production in will be about 22% higher than in 2007 instead of the currently assumed 15%. This may be an *additional uncertainty*. This uncertainty has not been quantified in the Reference projection. Only a system of animal rights can restrain the growth of the livestock.

Main uncertainties in the effect of environmental policy measures in the projection are related to the extent to which:

- The sector is taking additional measures (e.g. implementation of combi air scrubbers) combined with the extent to which the internal balancing at company level will be used.
- Various low-emission manuring techniques are uses and their effectiveness.
- The evaporation of NH3 and N_2O from processed manure are actually comparable to those of animal manure; intermediate results of experiments at lab scale demonstrate that this is actually the case (Alterra, 2009).

[45] Please note: A new method is being developed to calculate ammonia emissions (Alterra, 2009). The difference between the current method and the new method is currently being calculated for the statistical year 2008. Moreover, there are a number of monitoring uncertainties that cannot be adequately quantified at the moment, but which do indicate higher emissions. There may be a case of underestimating emissions from crop ripening (MB, 2008), in manuring (because in practise possibly fewer low emission techniques are used to spread manure) and from dairy cattle barns.

Box 6.1 *Development ammonia emission until 2010 and 2015*

The number of pigs and poultry is slightly higher in 2010 than in 2007, i.e. the same level as 2008, decreasing to the average of the levels of 2010 and 2020 in the period 2010-2015. The number of dairy cattle increases with about 5% between 2007 and 2010, due to the annual expansion of the milk quotas. This level is maintained until 2015, afterwards decreasing to the level of 2020.
The total manure production (for phosphate) in 2007 was several percentages below the manure production ceiling for phosphate of 2002. In 2008, and in 2010, the manure production was several percentages higher than the manure production ceiling. In 2015 the manure production will be near the manure production ceiling again. [46]

Between 2007 ad 2010 the emission of NH_3 from agriculture under fixed policy decreases with about 5 kton from 121 to 116 kton. The (net) decrease of the NH3 emission is caused by:
Use of low emission manuring techniques as a result of the prohibition of manuring in two working passes on farmland as of 2008 (-5 kton).

A decrease in emissions from stables of 1 kton. This is the net effect of a larger number of low-emission stables for pigs and poultry *(-2 kton*), a slightly increased livestock *(+2 kton*, *half of which dairy cattle*) and a slightly lower manure production *(-1 kton*).

Delaying the implementation of the Housing Decree to 2013 results in half of all stables being low-emission in 2010. This includes the (low-emission) battery cage systems in 2008. These systems must be replaced by welfare friendly systems, which have a relatively higher ammonia emission, before 2012. In the projection it has been assumed that the largest part of the replacement will take place in 2011 (i.e. after 2010).

Additional use of animal manure (+1 kton) resulting from added feedstocks in so-digestion of manure.

Between 2010 and 2015 the emission of NH3 from agriculture under fixed policy decreases with about 10 kton from 116 to 106 kton. The (net) decrease of the NH3 emission is mainly caused by:
Continued implementation of low-emission stables (-8 kton).

Decreased use of unprocessed manure as a result of tightened nitrogen and deployment standards (-6 kton).

Additional use of processed animal manure (+ 4 kton); the contribution of processed animal manure resulting from added feedstocks in co-digestion of manure amounts to about *1 kton.*

6.5 Particulate matter

6.5.1 Introduction

Particulate matter arises from combustion processes in various sectors and as a so-called process emission in various activities, among others in industry, agriculture (stables) and TSG (storage and handling of dry bulk). In 2007 the emission of particulate matter amounted to 34 kton. Substantial contributions to the particulate matter emissions came from traffic and transport, agriculture and the industry (Figure 6.8). These sectors are discussed in the next sections.

[46] The comparison is indicative due to uncertainty about a possible revision of the manure production ceilings mentioned in the derogation request of Annex 1.

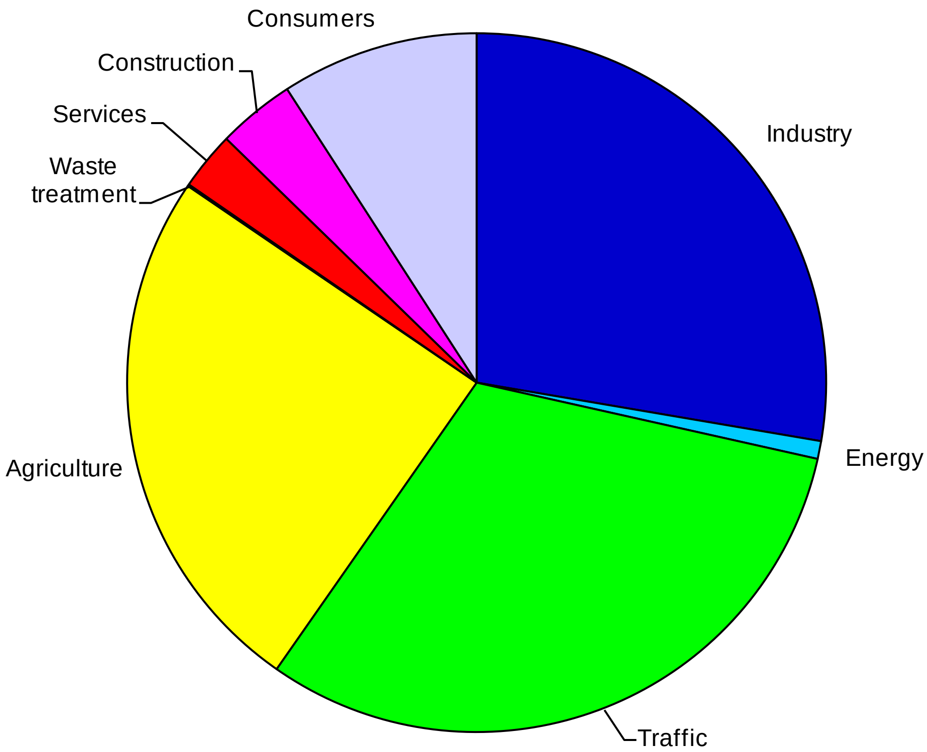

Figure 6.9 *Distribution of PM_{10} emissions according to sector, 2007*

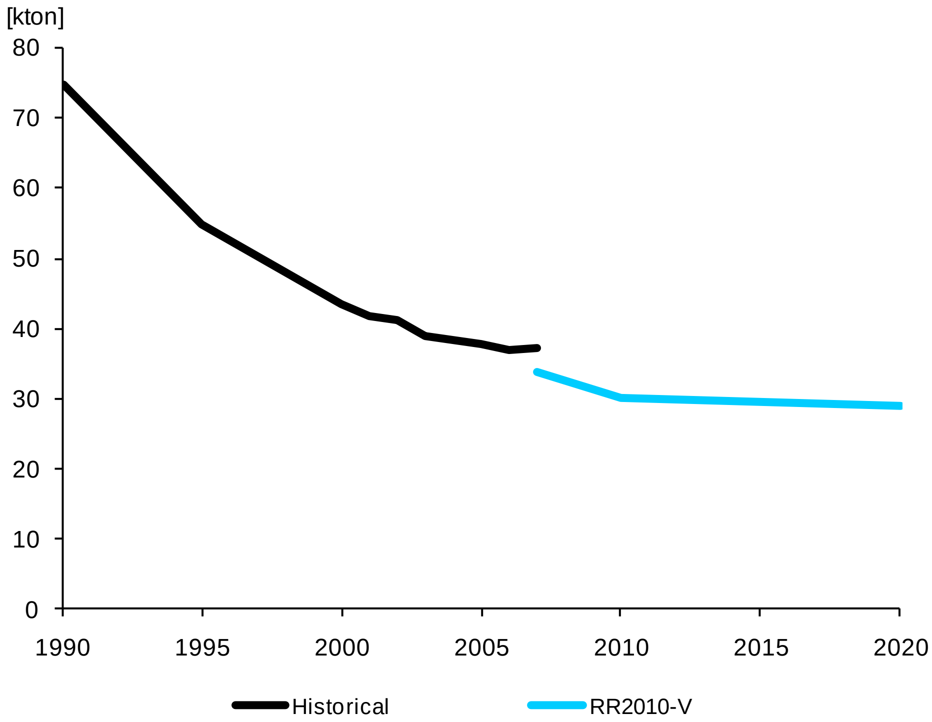

Figure 6.10 *Development of PM10 emission Netherlands total*

The total projected PM10 emissions in 2020 amount to 29 kton at an uncertainty bandwidth of 25 to 35 kton.

The emission of $PM_{2.5}$ has been derived from the development of the PM10 emission and will not be discussed separately. In 2007 the emission of $PM_{2.5}$ amounted to 18 kton. The projected emission in 2020 amounts to about 13 kton.

6.5.2 Traffic and transport

The PM10 emissions of traffic and transport amounted to about 15 kton in 2007, 7 kton of which emitted by sea shipping. The sector thus accounted for about 40% of the total PM10 emissions in the Netherlands. The PM10 emissions caused by abrasion of tyres , brakes, road surface and overhead wires amounted to about 2.5 kton in 2007. The remaining part of the PM10 emissions stems from combustion engines.

The PM10 emission projections for traffic and transport amounted to about 16 kton and 10 kton for the reference years 2010 and 2020. The contribution of sea shipping is about 7 kton and 4 kton respectively. The PM10 emissions of other traffic (NEC categories) in 2010 and 2020 is projected at about 9 kton and 6 kton. About 2.l6 kton and 2.9 kton of these emissions are caused by abrasion processes. The remaining part stems from combustion engines.

In roads traffic the abrasion emissions will become the dominant source of PM10 emissions in the future. The share of abrasion in the total PM10 emissions of road traffic amounted to about 30% in 2005. In the emission projections of 2020 this share has increased to over 70%.

The decrease in PM10 emissions in traffic and transport is mainly the result of the European emission standards for road traffic. As of 2012 all new passenger cars and delivery vans will be equipped with a wall flow filters, for example. The Euro-VI emission standards for lorries, which will enter into operation as of 2014, also result in further decreasing PM10 emissions in lorry traffic. The PM10 emissions of the inland shipping fleet and the mobile equipment are also decreasing as a result of European emission legislation.

The PM10 emissions of sea shipping increase slightly between 2007 and 2010. As a result of high fuel prices in 2008, various shipping companies lowered the cruising speed of their sea-going vessels to reduce the fuel use. The decrease in fuel use also resulted in lower PM10 emissions. As the oil prices in the projections are lower than in 2008, the decrease in cruising speed has not been included in the prognoses. Therefore a slight increase of PM10 emissions from sea shipping can be observed between 2008 and 2010. After 2010 there is a relatively large decrease in PM10 emissions from sea shipping. This is mainly caused by the far-reaching tightening of the sulphur standards for SECA on the North Sea, which was included in agreements in the IMO in October 2008. The lowering of the sulphur content of sea shipping fuels also leads to lower PM10 emissions.

The bandwidth of the PM10 emission projection for traffic and transport (excluding sea shipping) in 2020 is estimated at -2.5/+4 kton. Without monitoring uncertainty the bandwidth is -1.5/+3 kton. The main uncertain factor in the PM10 emission projections is the volume of the abrasion emissions from tyres, brakes and road surface. Relatively little empirical research has been conducted on this source of emissions, which renders the volume of PM10 abrasion emissions somewhat uncertain (the bandwidth is estimated at -50%/+100%. Other uncertain factors that affect the bandwidth of the PM10 emission projections for traffic and transport are the oil price developments, the demographical and economic developments and the effectiveness of the Euro-VI emission standards for lorries.

Table 6.8 *Uncertainties in PM10 emissions from traffic*

Uncertainties Particulate Matter Traffic [kt]	Uncertainty range deviation 5-95%	
Description uncertain factor	Lower value	Upper value
Economic growth	-0.2	0.3
Population	-0.2	0.2
Oil price	-0.3	0.3
Effectiveness of Euro-V and Euro-VI LD	-0.2	0.4

Effectiveness Euro-VI HD	-0.1	0.2
Abrasion emissions	-1.5	2.9
Monitoring uncertainty	-2.4	2.4

6.5.3 Agriculture

Introduction

Agriculture emitted about 6 kton PM10 in 2007, which was a share of almost 20% in the total particulate matter emission in the Netherlands[47].

The main source of PM10 emissions in agriculture are skin, manure, feed and litter particles that are blown into the outside air along with the ventilation airflow from the stables. Of all the different animal categories, dairy cattle, pigs and poultry take up respectively 15, 27 and 57% of the total stable emissions from agriculture (in 2007) (CLO, 2009).

Future developments in the PM10 emissions in agriculture are on the one hand related to the developments in the volume and composition of the livestock (volume developments) and on the other hand on the policy-induced measures that are taken by the sector to lower the emission (further). The volume and composition of the livestock results from policy developments, technical developments and market developments (see Section 6.4).

Volume developments until 2020

In 2020 dairy cattle and laying hens will increase the livestock volume by several percentages compared to 2007. The number of pigs and meat poultry, however, will decrease with about 10% and 5%. The young livestock volume will also decrease by about 15%. Cattle for meat production shows a decrease in number of animals of about 50%, except for veal calves, which shows numbers that stay at the level of 2007 (Silvis et al, 2009).

Policy developments until 2020

This section focuses mainly on the developments in environmental policy that make companies take measures for lowering the PM10 emissions. Adverse side-effects of other environmental policy measures will also be discussed here. The projection takes into account the consequences of the following policy:

- The Air Quality Act of 2007 adopted boundary values for particulate matter concentrations that must be complied with throughout the Netherlands. Cattle farms will be faced with these boundary values if they expand or want to establish a new farm. The law therefore results in additional measures (caused by scaling up). It is expected that about one third of the pigs and poultry in 2020 will be in stables with for example (combi) air scrubbers (based on MNP, 2008; van Zeijts et al). Combi air scrubbers purify the stable air from ammonia, particulate matter and odour. Poultry farms can also opt for different particulate matter measures such as oil mist systems.
- Subsidies are deployed as a means to solve the particulate matter bottlenecks that occur mainly in poultry farming by 2011 at the latest. Next to a subsidy scheme for combi air scrubbers (see Section 6.4) that was made available by the Government and the provinces, an NSL subsidy was also made available for implementing measures to combat particulate matter bottlenecks in 2010 and 2011. This also includes measure other than combi air scrubbers. Combi air scrubbers can be deployed at poultry farms, but they are relatively expensive due to the need for frequent cleaning of the air scrubber and the high energy use. More cost-effective methods have meanwhile become available, but only an alternative such as oil mist in stables (causing the particles to precipitate) can result in similar emission reductions. The subsidy schemes can help limit the additional cost for companies. The effect of the subsidies

[47] This emission is about 3 kton lower than the emission figure published last year for 2007 (CLO, 2009) due to the use of new emission factors that have become available as a result of measurements at the end of 2009 (Van Schijndel and van der Sluis, 2010).

will not be significant in the near term because existing poultry farmers are not obliged to take any particulate matter measures. Only in case of expansion or establishing of a new farm can new demands be imposed by the permit granting body.
- The tightened requirements for animal welfare that will enter into force as of 2012 (prohibition of battery cages) will lead to a shift towards free range systems with higher PM10 emissions.

Development of particulate matter emission until 2020
The emission of PM10 from agriculture under fixed policy increases with 0.6 kton between 2007 and 2010, i.e. from 6.1 to 6.7 kton PM10. There is a slight increase of 0.8 kton in poultry and 0.1 kton in cattle whereas pig stables have a 0.3 kton decrease.

This decrease in PM10- emission is caused by:
- A smaller pig stock (-0.14 kton) and a larger poultry stock (+0.16 kton).
- Transition from battery cages to free range systems (+0.85 kton).
- Implementation of additional emission curbing measures such as combi air scrubbers for pigs (-0.15 kton) and poultry (-0.25 kton).

Development of particulate matter emission until 2010 and 2015
The number of pigs and poultry is slightly higher in 2010 than in 2007, i.e. the same level as 2008, decreasing to the average of the levels of 2010 and 2020 in the period 2010-2015. The number of dairy cattle increases with about 5% between 2007 and 2010, due to the annual expansion of the milk quotas. This level is maintained until 2015, afterwards decreasing to the level of 2020.

Between 2007 and 2010 the emission of PM10 from agriculture under fixed policy increases with about 0.5 kton from 6.1 to 6.6 kton. The increase of the PM10 emission is caused by:
- A larger dairy stock (+0.2 kton), pig stock (+0.1 kton) and poultry stock (+0.1 kton).
- Transition from battery cages to free range systems (+0.14 kton).

The emission of PM10 from agriculture under fixed policy will increase with an additional 0.5 kton between 2010 and 2015, i.e. from 6.6 kton to 7.1 kton. This is caused by the ongoing transition from battery cages to free range systems combined with implementing additional emission curbing measures such as combi air scrubbers or oil mist.

Uncertainties particulate matter emission 2020
The total bandwidth in the PM10 emission of agriculture amounts to 3.9 to 13.4 kton in 2020. A major uncertainty in the projection encompasses the uncertainties related to future expectations about volume developments or the degree of implementation of measures and amounts to 6.6 to 7.1 kton PM10. On top of that there is also monitoring uncertainty[48].

Table 6.9 *Uncertainties PM10 emissions of agriculture*

Sector	Uncertainties Particulate Matter Agriculture [kt] Description uncertain factor	Uncertainty range deviation 5-95% Lower value	 Upper value
LT	Number of animals	-0.2	0.0
LT	Agriculture other, economic uncertainty	0.0	0.0
LT	Housing	0.0	0.4
LT	Monitoring PM_{10}	-3.4	3.4

48 The monitoring uncertainty of particulate matter emission resulting from working on farmland has not been included in this projection. It is a new source of emissions and the emissions will soon be published (CLO, 2009). The volume amounts to about 0.4 kton in 2007 and 0.5 kton in 2008.

6.5.4 Industry, Energy and Refineries

Introduction

In 2007 the sectors Industry, Energy and Refineries (IER) emitted 10.6 kton PM10, which is a share of 30% in total PM10 emissions in the Netherlands. Nearly all industrial sectors have PM10 emissions. PM10 arises as a process emission in various industrial processes such as combustion emission in firing of fuels. The emissions in the industry are dominated by the process emissions (about 75%).

Volume developments

The volume developments in the industry are a reflection of the economic development. Until 2010 the production volume decreases and between 2010 and 2020 the production volumes increase again due to the influence of the assumed moderate economic growth.

Policy developments

Successful emission curbing policy has lowered the PM10 emissions in these sectors with about 65% between 1990 and 2007. Agreements with the refineries about switching to oil-firing instead of gas-firing will further decrease the PM10 emissions in this sector.

In 2008 the Particulate Matter Action Plan was drafted. In this action plan the Dutch Ministry of Housing, Spatial Planning and the Environment, the Association of Netherlands Municipalities (VNG) and the Interprovincial Consultative Body (IPO) agreed on decreasing the emission of particulate matter by the industry. The aim of the action plan is to realise the PM10 sector ceiling: 11 kton in 2010, 10.5 kton in 2015 and 10 kton in 2020. This ceiling applies to all IER sectors and to the storage and handling of dry bulk. Key in this action plan is the use of best available techniques, such as fabric filters and similar techniques. The action plan aims to implement these techniques on a large scale. The proposals have meanwhile been included in the NER. As the action plan does not indicate which sectors are involved and how much reduction per sector must be realised, it has not been included in this projection as fixed policy.

Results and uncertainties

The projected emission of PM10 by the IER sectors amounts to 10.3 kton with a bandwidth of 7.7 to 11.7 kton in 2020. Uncertain factors are mainly the economic growth and the monitoring uncertainty. The emission of storage and handling of dry bulk amounts to 1.2 kton in 2020.

Table 6.10 *Uncertainty in PM10 emissions of IER sectors*

[kton]	Uncertainty range deviation 5-95%	
Description uncertain factor	Lower value	Upper value
Economic uncertainty Food and Stimulants	-0.2	0.3
Economic uncertainty Chemical industry	-0.1	0.1
Economic uncertainty Construction materials	0.0	0.0
Economic uncertainty Base metal industry	-0.1	0.1
Economic uncertainty Metalectro	-0.1	0.1
Economic uncertainty Other industry	0.0	0.1
Monitoring uncertainty Food & Stimulants	-1.5	1.5
Monitoring uncertainty Chemical industry	-0.4	0.4
Monitoring uncertainty Construction materials	-0.6	0.6
Monitoring uncertainty Base metal industry	-0.7	0.7
Monitoring uncertainty Metalectro	-0.3	0.3
Monitoring uncertainty Other industry	-0.5	0.5
Economic uncertainty Refineries	0.0	0.1
Monitoring uncertainty Refineries	-0.3	0.3
Economic uncertainty Energy generation	0.0	0.0
Monitoring uncertainty Energy generation	-0.1	0.1

7. Synthesis: Policy and objectives of climate and energy

7.1 Target range Clean and Efficient

Will the Clean and Efficient targets be realised?
Both fixed and intended policy are insufficient for realising the targets for greenhouse gases, renewable energy and energy saving. Figure 7.1 shows that the upper value of the uncertainty bandwidth is rather far away from the target values in all instances. Clean and Efficient policy does realise a clear trend break. If intended policy is implemented in addition to the fixed policy, the energy saving pace will increase from 0.7-1.2% annually to 1.1-1.6% annually and the share of renewable energy will increase from 2-3% to 13-16%. Compared to 1990 the emission reduction will increase from 11-18% to 17-24%.

Fixed and intended policy
Contrary to fixed policy, no formal decision has been made about intended policy. It is uncertain whether the next cabinet will adopt the policy intentions of the Balkenende IV cabinet.

Figure 7.1 shows that intended policy realises the largest increase in renewable energy. The largest share of energy saving can be ascribed to fixed policy and in the case of emission reduction compared to 1990 fixed and intended policy offer more or less similar contributions.

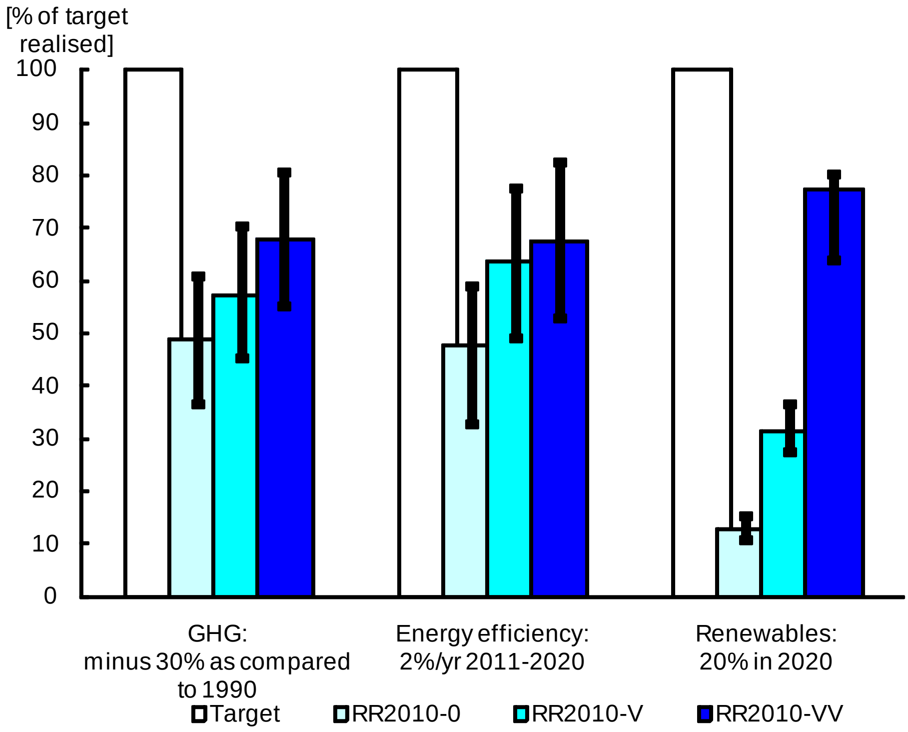

Figure 7.1 *Target range Clean and Efficient*

Role of ETS
In Figure 7.1 a fixed emission reduction for greenhouse gases under the ETS is booked in all policy variants. It is similar to the European reduction target. Section 7.1.1 explains why this decision was made and in what way the emission reduction is calculated. The differences between the reduction percentages realised in each of the three policy variants must be entirely ascribed to the physical emission reductions realised outside the ETS. It is true that Clean and Ef-

ficient policy realises physical emission reductions in the ETS sector, but these do not influence the target range and they are not visible in Figure 7.1. Further explanation is provided in Section 7.1.1. In this chapter the terms (physical) emission(s) or chimney emission(s) refer to actual emissions on Dutch territory and the term realisation is used for emission values that apply to the target.

7.1.1 Greenhouse gas emissions

Greenhouse gas emissions have a 30% decrease target in 2020 compared to 1990. Under fixed policy the realised reduction ranges from 14% to 21%. If intended policy is implemented as well, the reduction will range from 16% to 24%. The Dutch chimney emissions in the European CO_2 emission trading system are not included in these reductions.

Table 7.1 *Greenhouse gas emissions total, targets and realisation*

	No C&E policy	Fixed policy	Intended policy	Target range 2020
	Emission greenhouse gases (physical) 2020 [Mton CO_2 eq]			
ETS	130	116	97	
Non ETS	108	102	96	
Total	237	219	193	
	Realisation greenhouse gas emissions 2020 [Mton CO_2 eq]			
ETS	75	75	75	63
Non ETS	108	102	96	87
Total	183	177	171	150
	Policy deficit [Mton CO_2 eq]			
ETS	12	12	12	
Non ETS	21	15	9	
Total	33	27	21	

The European CO2 emission trading system in relation to the national CO2 emission

When establishing these reduction percentages, the physical emission reductions were used for the non ETS sector and the emission reduction booked by the Balkenende IV cabinet was used for the ETS sector. As there will no longer be emission ceilings for the ETS sector as of 2013, the Balkenende IV cabinet decided to book the Pan-European reduction percentage realised by the ETS for the emissions of the Dutch ETS sector. Therefore physical emissions (chimney emissions) of the Dutch ETS sector on Dutch territory do not play any role in establishing whether or not the national emission target of -30% will be realised. This will be further explained in Text box 7.1.

Box 7.1 *Targets and realisations greenhouse gas emission and the position of the ETS*

Part of the emission in the Netherlands is covered by the European emission trading system (ETS) At the same time there is also a national target for the reduction of the total greenhouse gas emissions of 30% between 1990 and 2020. This makes it rather difficult to assess if the national target will be realised. This text box will explain how ECN and PBL conduct this assessment.

Targets for ETS and non ETS as well

The Balkenende IV cabinet declared that the reduction target of 30% applies not only to the national greenhouse gas emission but also to the emission of the ETS and non ETS sectors individually. Based on a reduction of 30% in 2020 of the ETS and non ETS emissions compared to 1990, and taking into account the two corrections that are needed because 1) as of 2013 more emission activities will be covered by the ETS and 2) because some time ago the Cabinet decided that nitrous oxide from the sulphur acid industry should be included in the ETS (a so-called opt-in), the emission ceiling in 2020 will amount to 63 Mton for the ETS and 87 Mton for non ETS.

Reduction in ETS sector in the Netherlands are derived from the average reduction in the EU-ETS.
The EU implemented the ETS to enable large businesses (ETS sectors) to trade their emission allowances. In this system ETS actors must reduce their emissions with 21% between 2005 and 2020. In the ETS is not immediately clear in which countries emission reductions will actually take place. In view of the ETS, the Balkenende IV cabinet indicated that, compared to 2005, a 21% reduction will be booked for the emission covered by the ETS, regardless of whether the actual reduction is realised in the Netherlands. One exception is the emissions that will be covered by the ETS as of 2013. In 2013 the range of the ETS will be expanded with process emissions from the industry, among others. Moreover, in 2008 there was an opt-in for nitrous oxides from the sulphur acid industry. The EU states that the emissions that will be added to the ETS in 2013 must realise annual emission reductions of 1.74% in the period 2010-2020 compared to the emission of 2010. This decrease has also been applied to the average emission space attributed to the nitrous oxide opt-in. For this new emission under the ETS, resulting from scope expansion and by the opt-in, we apply this factor instead of the 21%. Given the above-mentioned calculation rules, the (accounting) ETS realisation amounts to 75 Mton in 2020.

Realisation of non-ETS
To establish the actual emission under non-ETS, the ETS and non-ETS shares have been determined per economic sector based on the ETS emission in 2008 as reported by the Dutch Emission Authority. In total 48% of the emission in 2008 is covered by the ETS. As for the expansion in 2013, the emissions of activities that will be covered by the ETS have been estimated. Including expansion, the ETS share in 2008 would amount to 53% of the Dutch emissions. The share of emissions not covered by ETS thus consists of 47% of the emission. As this share is an estimate based on the emissions of 2008, it may be that the actual realisation in the period 2013-2020 will deviate from this share due to developments in the sectors.

Emission ceilings for ETS and non-ETS possibly unstable
Due to three main uncertainties the division of the national emission ceiling of 150 Mton in ETS and non-ETS may change in the future. First of all the European Commission will not decide on the shift of emissions from non-ETS to ETS until the fall of 2010. Although this projection tries to anticipate that decision most accurately, some (minor) deviations may occur. Secondly, some changes may occur on the future in case of new op-tins and opt-outs. An opt-in is when the Netherlands volunteers to add certain emission sources to the ETS. It may also be that some emission sources are withdrawn from the ETS, which is called an opt-out. Thirdly, the ETS and non-ETS emission targets may change if it turns out that the relation between ETS and non-ETS starts deviating from the estimated shares due to structure and volume developments. At this moment it is still unclear how policymakers will react if the shares should shift.

Sectoral targets
The Dutch cabinet translated the national emission reduction target into emission reduction tasks per sector. These targets only apply to the non-ETS emissions. Figure 7.2 shows the targets per sector and the realised non-ETS emissions for the three policy variants in 2020: Without Clean and Efficient policy, (2) with fixed policy, and (3) with intended Clean and Efficient policy. Under intended policy, the targets of all sectors are in the uncertainty bandwidth, except for the built environment and the industry. This means that there is a chance that the target is realised, although that chance is lower than 50% in all cases.

Table 7.2 *Greenhouse gas emission per sector, non-ETS*

	Built environment	Industry/ energy	Traffic	Agriculture	OGHG agr./hort.	OGHG other	Total inland
Non-ETS target per sector [Mton CO_2 eq]							
	17.3	5.3	32.0	4.3[49]	16.6	8.4	
Non-ETS emissions per sector and upper/lower limit of projected emissions bandwidths for the policy variants [Mton CO_2 eq]							
No C&E policy							
Lower	22.4	8.7	38.3	6.5	10.6	8.1	100.2
Projection	23.7	9.3	40.1	7.8	17.5	9.3	107.7
Upper	25.0	9.7	43.4	8.7	24.2	10.6	115.9
Fixed policy							
Lower	21.4	8.3	34.5	5.4	10.6	7.9	94.2
Projection	23.2	9.0	36.9	6.8	17.5	9.2	102.5
Upper	24.2	9.4	40.3	7.6	24.2	10.4	110.1
Intended policy							
Lower	20.5	7.8	30.6	4.4	10.4	7.6	87.4
Projection	22.2	8.4	33.3	5.6	17.2	8.8	95.6
Upper	23.4	8.8	37.1	6.6	24.0	10.1	103.8

[49] On the occasion of presenting the Clean and Efficient Outlook to the Dutch Lower Chamber in April 2009, the ministry of the environment announced a change in the target of agriculture. This is due to the fact that the target of 4.3 Mton pays insufficient attention to the efforts of the sector with regard to CHP. This change has meanwhile taken place. The target has been adjusted to 6.8 Mton for the entire sector, including the ETS share. Without the ETS share, the target for agriculture amounts to 5.6 Mton. This figure does not take into account an opt-out of small CHP installations from the ETS. In case of an opt out, the non ETS target becomes higher than 5.6 Mton because CO_2 is transferred from the ETS space to the non ETS space. It is likely that in case of an opt out 0.8 Mton will be transferred from ETS to non ETS, setting the target at 6.4 Mton.

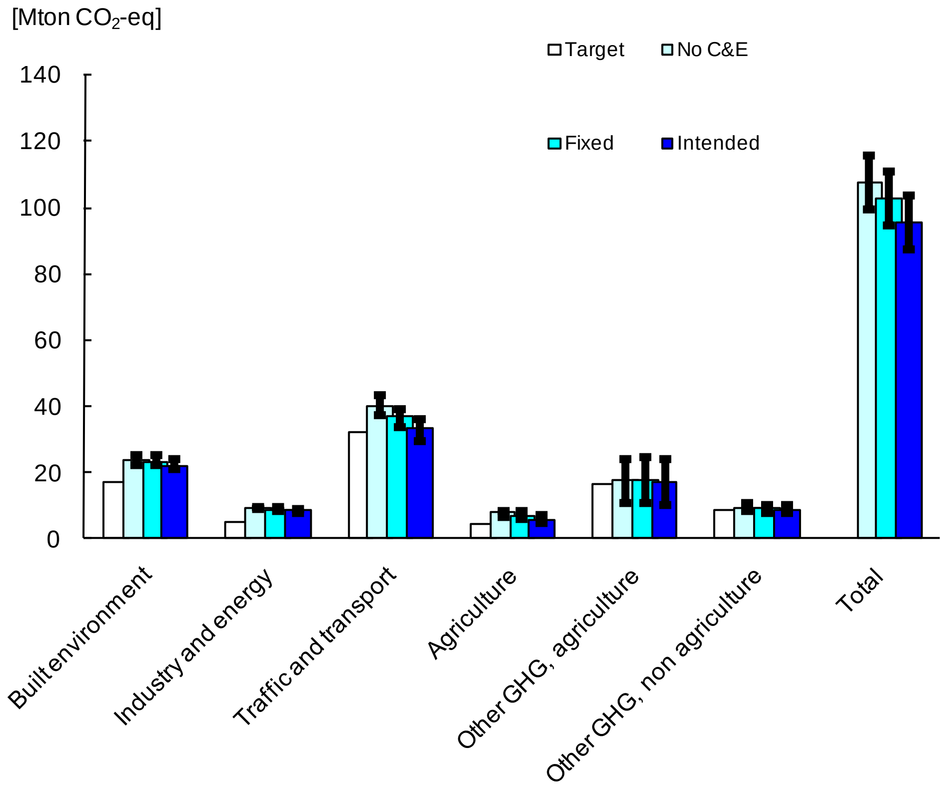

Figure 7.2 *Non-ETS emissions per sector*

7.1.2 Energy saving

The target for the energy saving rate is to annually increase the Dutch energy efficiency with on average 2% annually in the period 2011 to 2020. Without Clean and Efficient policy the average saving rate varies from 0.7% to 1.2% annually; under fixed policy 1.0% to 1.5% annually and without intended policy 1.1% to 1.6% annually. Textbox 7.2 explains the definition of the saving rate and describes which measures contribute to the saving pace and which ones don't.

Box 7.2 *A closer look at the Dutch energy saving target*

Clean and Efficient focuses on an energy saving rate of 2% annually as of 2011. This is an energy efficiency target that, according to the Protocol Monitoring Energy saving (PME) is defined as 'conducting the same activities or fulfilling the same functions at a lower energy use'. This means that the even when the target is reached the energy use may still rise if the activities increase more rapidly than the efficiency increases. The selection of activities that are used for comparison are laid down in the PME.

The energy saving target of Clean and Efficient only relates to the so-called energetic use, excluding the so-called feedstocks. These are fuels used as feedstock, for example petroleum for plastics or natural gas for artificial fertiliser. It is difficult to realise saving on feedstocks: One kg of product will always require minimally one kg of feedstock. The share of feedstock that does not end up in the product is usually released as an energy by-product, which is attributed to energetic use.

An energy saving target aiming at efficiency means that a lower energy use resulting from a lower activity level does not lead to a higher saving rate. The price per kilometre will lower the fuel use due to decreased car mileage but it will not result in additional energy saving. More efficient cars lead to lower fuel use per kilometre and hence also to additional energy saving.

Replacing coal-fired power plants with gas-fired plants, which have a higher efficiency, is not considered energy saving either. The PME considers electricity generation with different fuels as different activities. Replacing old coal-fired power plants with new more efficient coal-fired plants does contribute to the energy saving.

Saving rate per sector

Figure 7.3 shows the energy saving rate for the policy variants for the Netherlands and per sector. In most sectors, Clean and Efficient Policy leads to an increase in the saving rate. Especially households and transport show a large increase. Strikingly the Clean and Efficient policy lowers the saving rate in agriculture and the energy companies. This is due to the fact that renewable energy is ousting energy saving techniques (see Text box on Conflicting targets).

The national energy saving target is not translated into sectoral targets. Therefore the energy saving rate of the individual sectors does not make clear if the national 2% will be realised: one sector is able to realise a higher rate than the other. The rate of energy companies is defined in another way than the rate of other sectors and can therefore not be compared.

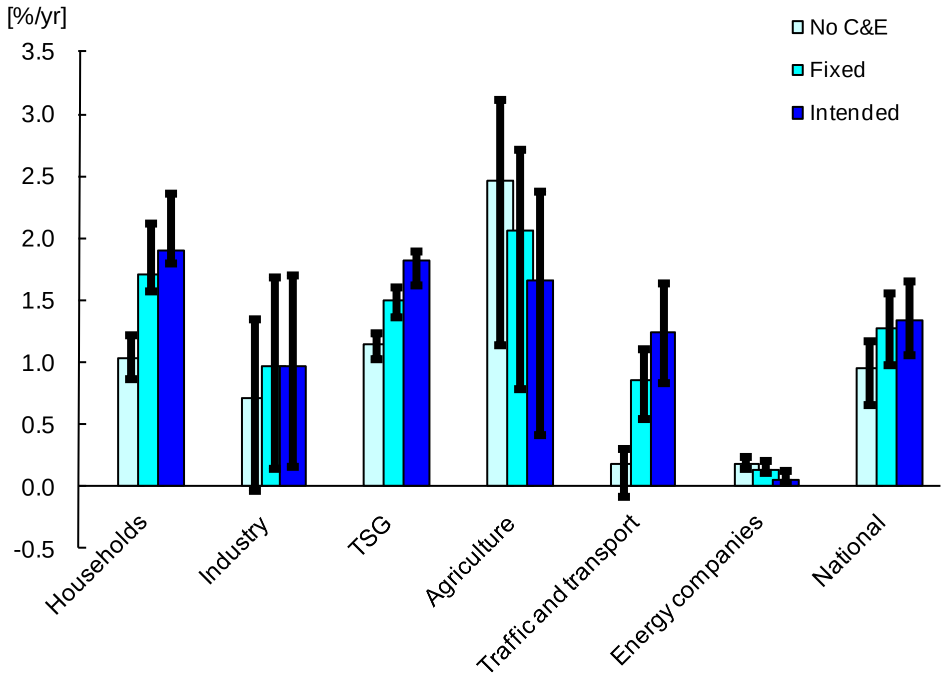

Figure 7.3 *Energy saving rate per sector*

Table 7.3 *Saving rate per sector*

	[%/year]	Households	Industry	TSG	Agriculture	Transport	National
RR2010-0	Fuel demand	0.65	0.30	0.95	0.69	0.19	0.46
	Electricity demand	0.39	0.11	0.22	0.64	0.00	0.18
	CHP	0.00	0.31	-0.02	1.15		0.14
	Energy companies						0.18
	Total	1.04	0.72	1.15	2.48	0.19	0.96
RR2010-V	Fuel demand	0.89	0.49	0.96	0.81	0.85	0.68
	Electricity demand	0.83	0.27	0.57	0.66	0.00	0.36
	CHP	0.00	0.22	-0.02	0.61		0.09
	Energy companies						0.14

	Total	1.72	0.98	1.50	2.08	0.85	1.28
RR2010-VV	Fuel demand	0.93	0.50	1.20	0.98	1.25	0.82
	Electricity demand	0.98	0.27	0.60	0.68	0.00	0.41
	CHP	0.00	0.21	0.02	0.01		0.07
	Energy companies						0.06
	Total	1.91	0.98	1.82	1.67	1.25	1.35

Box 7.3 *Conflicting targets I: Renewable energy and energy saving*

In a limited number of cases the three targets of Clean and Efficient seem to be in each other's way. This is mainly the case with energy saving and renewable energy. Energy saving in one sector may also lead to a deterioration in another sector. Additional policy aimed at renewable energy or additional saving may lead to a slight deterioration for some energy-saving techniques.

In agriculture and in energy companies the energy saving rate under implementation of intended Clean and Efficient policy is lower than under fixed Clean and Efficient policy. In industry, the energy saving rate is still increasing, despite the drop in savings from CHP. This is caused by displacement: One measure is taken at the expense of another. Below the main displacement effects are listed.

Energy sector

The intended Clean and Efficient policy leads to a large increase in the production of renewable electricity and to lower electricity demand. This means that the electricity prices will be lower and that the power plants' production lowers slightly. A power plant does not supply electricity until the electricity yields more than the cost of generation. Mostly the new more efficient gas-fired plants have a lower production. Because the electricity generation becomes less efficient on average the energy saving rate decreases slightly.

Industry

Due to the increase in renewable electricity and the effect on the electricity price, CHP plants in the industry will lower production. The energy saving by CHP will also decrease slightly.

Greenhouse horticulture

In greenhouse horticulture CHP deployment is also decreasing. This has an additional reason: More geothermal heat and heat-cold storage. The demand for heat that can be filled by CHP is therefore smaller.

Net effect on emission reduction

The unfavourable displacement effects described in this box are much smaller than the favourable effect of additional renewable energy and the lower energy demand. The additional renewable energy and electricity saving lead to an emission reduction of about 33 Mton CO2. The negative effects of CHP and electricity plants add up to a maximum of 6 Mton.

The denominator effect

A larger share of renewable energy complicates the realisation of the saving target, but higher savings do facilitate realising the target for renewable energy. After all, the latter is defined as a percentage of the total energy use. In case of lower energy use (the denominator) less renewable energy is required (numerator) to realise the target.

Box 7.4 *Conflicting targets II: The role of ETS*

Due to the ETS emission reduction in the ETS sectors does not contribute to realising the GHG emission target. Measures in the ETS sectors can, however, help realise the other targets for renewable energy and energy saving. In these cases there is usually not a conflict between the targets. The situation is different for measures that lead to higher emissions in the non-ETS sectors and lower emissions in the ET sectors. An example is provided by a large share of the CHP in greenhouse horticulture and the built environment. In these cases the targets for greenhouse gas emissions and energy saving are conflicting.

More CHP normally leads to decreasing CO_2 emissions on balance: An increase of the emissions at the location and a larger decrease at the plants. However, for CHP outside the ETS the increase takes place outside the ETS, but the decrease takes place in the ETS. Within the ETS the emission space that becomes available is filled up again so there is no net decrease. The increase outside the ETS is not compensated and is therefore counterproductive for realising the emission target.

In the calculated policy variants more policy involves less CHP. That is unfavourable for the saving target. But the cases where the amount of CHP decreases outside the ETS are favourable for the emission target. It is important to note that it is the immediate result of the split between ETS and non-ETS emissions. CHP as such does offer the option to produce the same quantity of heat and electricity with lower emissions and less energy use.

7.1.3 Renewable energy

The national target for renewable energy amounts to 20% renewable energy in 2020. This target involves the avoided deployment of fossil fuels. Without Clean and Efficient policy, the share of renewable energy in 2020 ranges from 2 to 3 %, under fixed policy it amounts to 6 to 7% and including intended policy it varies from 13 to 16% (see Figure 7.1). Textbox 7.5 describes how the percentage of renewable energy is calculated.

Box 7.5 *The definition of renewable energy in the Netherlands according to the Dutch and European target*

Clean and Efficient focuses on a share of renewable energy of 20% in 2020 and the Netherlands also has to comply with the European target of 14%. Both percentages cannot be simply compared because their definitions differ.

The Dutch 20%

The Dutch target assumes the *substitution method*. The share of renewable energy is based on the amount of fossil fuel that is displaced by renewable energy. In the deployment or production of renewable energy a calculation needs to be made of the additional deployment of fossil fuels that would have been needed without the renewable energy. In the case of electricity his is done by looking at the average efficiency of fossil electricity plants. Under a typical conversion efficiency for electricity of 40%, 1 PJ of renewable electricity will displace 2.5 PJ of fossil fuel. Renewable heat displaces heat from fossil-fuelled boilers, thus 1 PJ of renewable heat at a common boiler efficiency of 90% avoids only 1.1 PJ of fossil fuel. In the substitution method the avoided fossil energy is divided by the total energy demand, including feedstocks, to determine the share of renewable energy.

The European 14%

The European target follows the final energy method. In this method the deployment of renewable energy (heat, electricity and biofuels) is divided by the added demand of heat, electricity and transport fuels, excluding feedstocks. Renewable heat and electricity have equal weight.

Effect of policy on both targets compared

In the Netherlands the largest share of the renewable energy consists of electricity, which has less weight in the European target than in the Dutch target. The projected 13-16% of implementing intended policy according to the Dutch definition is therefore somewhat lower in the European definition: 12-15%.

Sectoral division

The largest share of the renewable energy production occurs within the energy sector: Onshore wind, offshore wind and biomass co-firing. Outside the energy sector manure digestion and bio-fuels are relatively important. Except for biofuels, renewable heat options in the built environment and agriculture and the WIPs, almost all renewable energy results from the SDE scheme. Especially implementing intended policy will lead to much additional renewable energy, the main cause being the increase of the SDE budget. Under intended policy there is s slight decrease in biofuels in the transport sector because the total energy demand is lower here. A constant percentage will lead to a lower amount of biofuels.

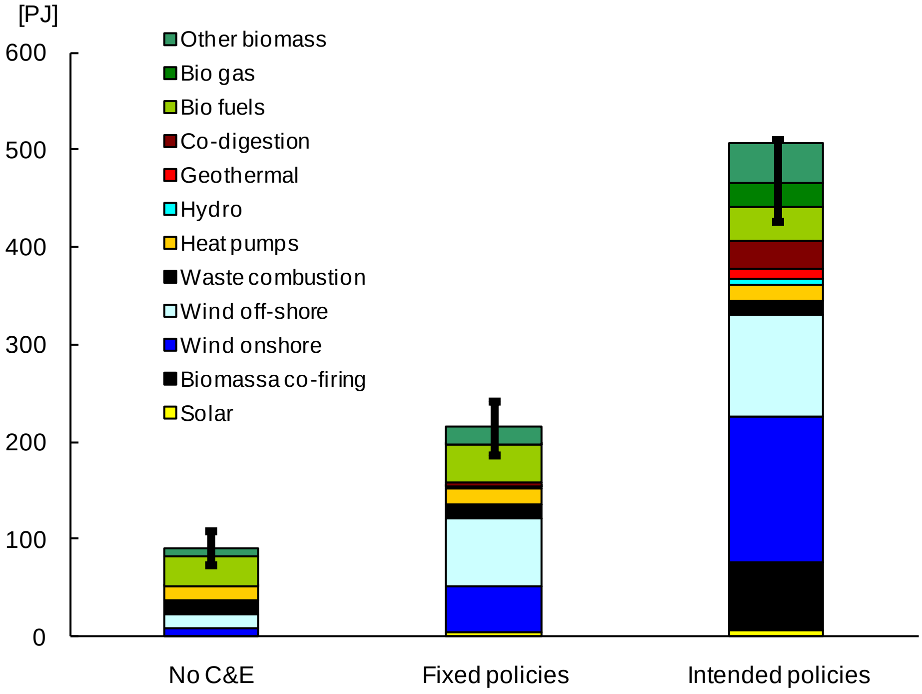

Figure 7.4 *Avoided primary energy by renewable energy, divided into type. Uncertainties in intended policy are mainly linked to the lower end.*

Under intended policy the uncertainty bandwidth is asymmetrical (Figure 7.4). Compared to the calculated projection value, the bandwidth is significantly concentrated at the lower end. This is a direct consequence of the starting point of the SDE scheme under intended policy: A budget that is enough to realise 55 TWh of renewable electricity. Exceedings of the 55 TWh are out of the question by definition. Due to possible setbacks such as delays in the spatial planning process procedures or bottlenecks with regard to granting of credit, there is a large chance that the amount of renewable energy will be lower than 55 TWh. The projected value assumes a realisation of 52 TWh in 2020. As described in Section 2.2, the bandwidth encompasses not only uncertainty in policy, but also the uncertainty in effects of the policy given a certain starting point. Whether or not the assumed budget really becomes available is therefore not part of the bandwidth.

The percentage of renewable energy has a less significant concentration at the lower end than in the case of the amount of avoided primary. This is due to the fact that in total energy use, the uncertainty also plays a role for the percentage.

7.2 EU targets

In addition to the national targets of Clean and Efficient for greenhouse gas emissions and renewable energy in 2020 the EU has also set targets. There are no European obligations for energy saving.

Greenhouse gas emissions outside the ETS

The only emissions that matter for the EU target are those of the non-ETS sectors. After all, the emission under the ETS are covered by a European emission ceiling that has not been translated to Member States. The Netherlands needs to achieve an emission reduction of 16% in the non-ETS sectors compared to 2005, which corresponds to a ceiling of 98 Mton in 2020. Taking into account the shifts in ETS phase 3, the ceiling for non ETS in 2020 is expected to amount to 99 Mton. This means that under fixed policy and a non-ETS realisation of 94-111 Mton the chances of realising the European target are less than 50%. When implementing intended policy with a non-ETS realisation of 87-104 Mton the chances of realising the European target are more than 50%.

Renewable energy

Renewable energy in the Netherlands must comply with the 14% EU target, measured as share in the demand for heat, transport fuels and electricity (see Text box 7.5).

When measuring in accordance with the European definition, the share of renewable energy without Clean and Efficient is about 4%, under fixed policy it amounts to about 7% and including intended policy the share is about 14.5% at a bandwidth of 12-15%. Implementing intended policy and particularly increasing the SDE budgets are thus necessary to realise the European target for renewable energy, but given the uncertainties there is no guarantee that the target will be reached.

7.3 Overview of policy effects

Total effects

Clean and Efficient policy has a large influence on the Dutch greenhouse gas emissions, the energy demand and the use of fossil fuels. Without Clean and Efficient the total energy demand, including renewable, amounts to about 3530 PJ in 2020. With fixed policy this is 130 PJ lower and with intended policy it is even 110 PJ less.

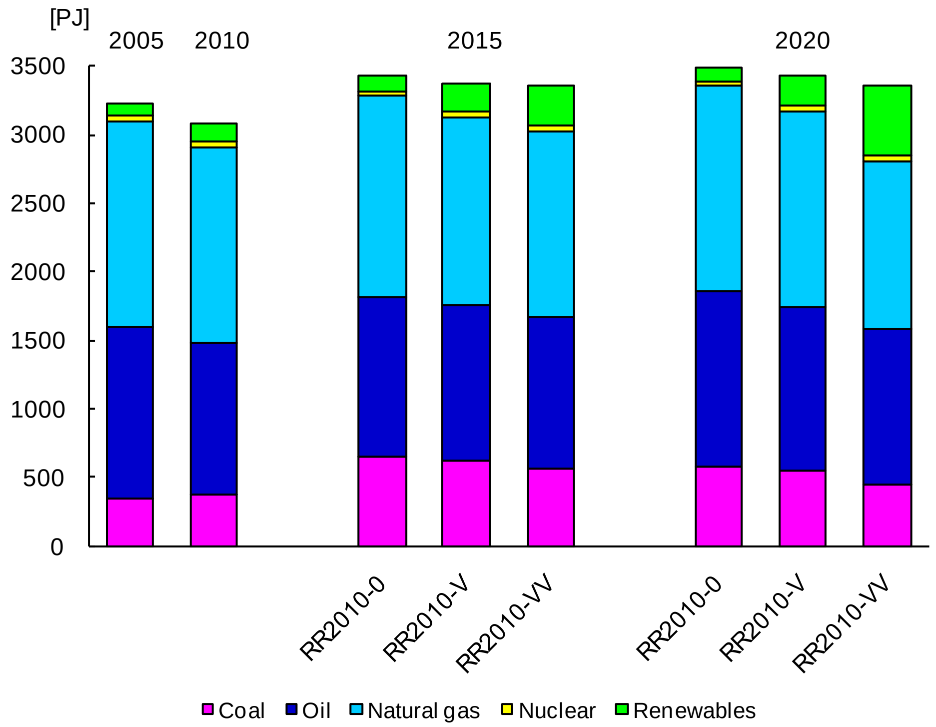

Figure 7.5 *Shares of energy carriers 2005-2020*

The projections show a decrease in energy use, which is partly caused by the recession. After 2010 there is a distinct increase in energy use. Particularly the use of coal increases significantly between 2020 and 2015 as a result of new electricity plants entering into operation.

As more policy is implemented the increase in energy use will drop and the contribution of renewable energy increases significantly: in 2020 the share will have increased fivefold with more than 500 PJ. As a result the total use of fossil fuels in 2020 under intended policy implementation is about 100 PJ lower than in 2010. The decrease in fossil energy use is largest for natural gas: The decrease of the electricity demand and the growth of renewable electricity results mostly in less electricity production from gas-fired plants. Implementing intended policy will also decrease the use of coal slightly as a result of biomass co-firing in coal-fired plants.

Without Clean and Efficient policy the use of fossil fuels amounts to about 3350 PJ in 2020. Under fixed policy, the use in 2020 is 180 PJ lower and in the case of intended policy it is another 360 PJ lower; in total 540 PJ. More than 100 PJ can be attributed to additional saving and about 420 PJ results from additional renewable energy.

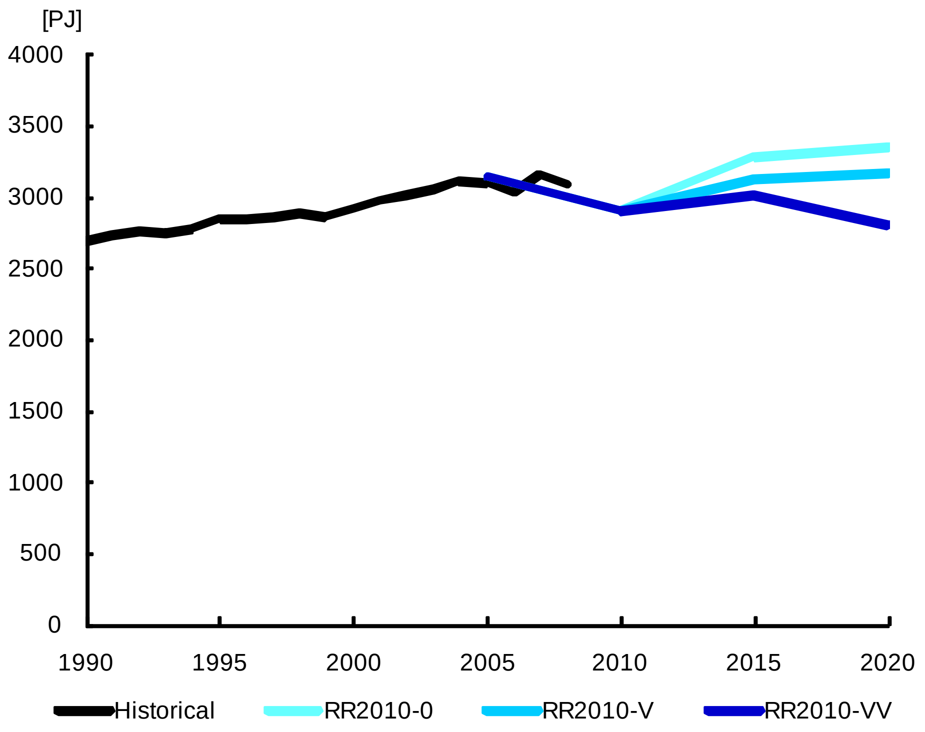

Figure 7.6 *User balance of fossil fuels*

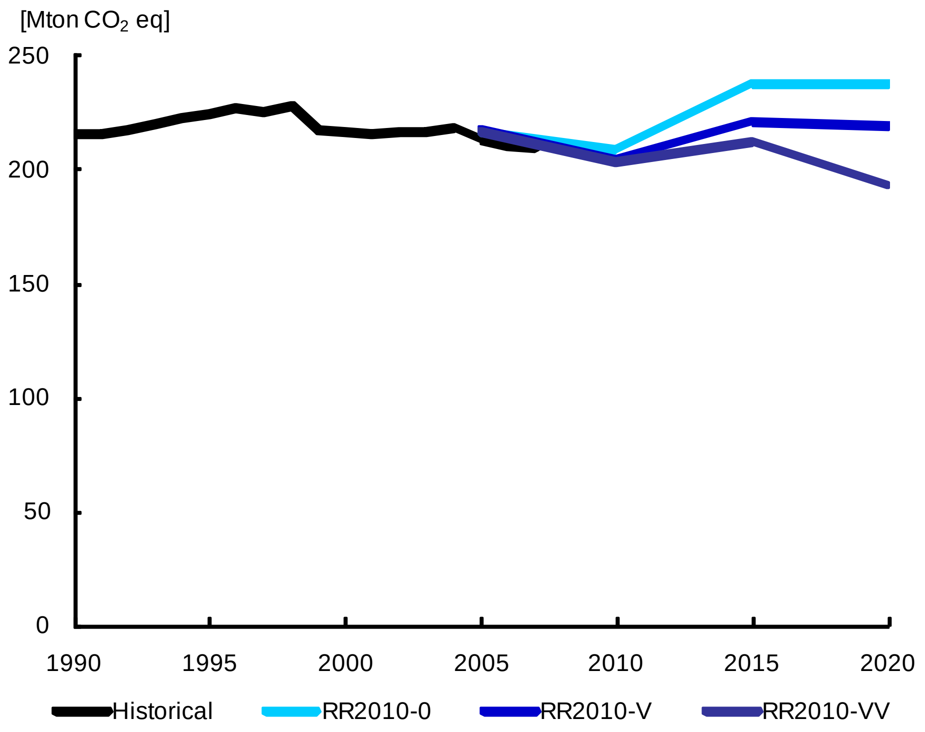

Figure 7.7 *Total greenhouse gas emissions*

The physical greenhouse gas emissions in 2020 will be lower under fixed policy, decreasing from 237 PJ (without Clean and Efficient policy) to 219 Mton. Under intended policy the emissions will be another 26 Mton lower at 193 Mton. In the period 2010-2020 the Netherlands is shifting from a net importer to being a net exporter. If the Netherlands would not be a net exporter in 2020, the greenhouse gas emissions would be about 9 Mton lower at about 184 Mton. As these emissions are covered by the ETS they do not affect the target.

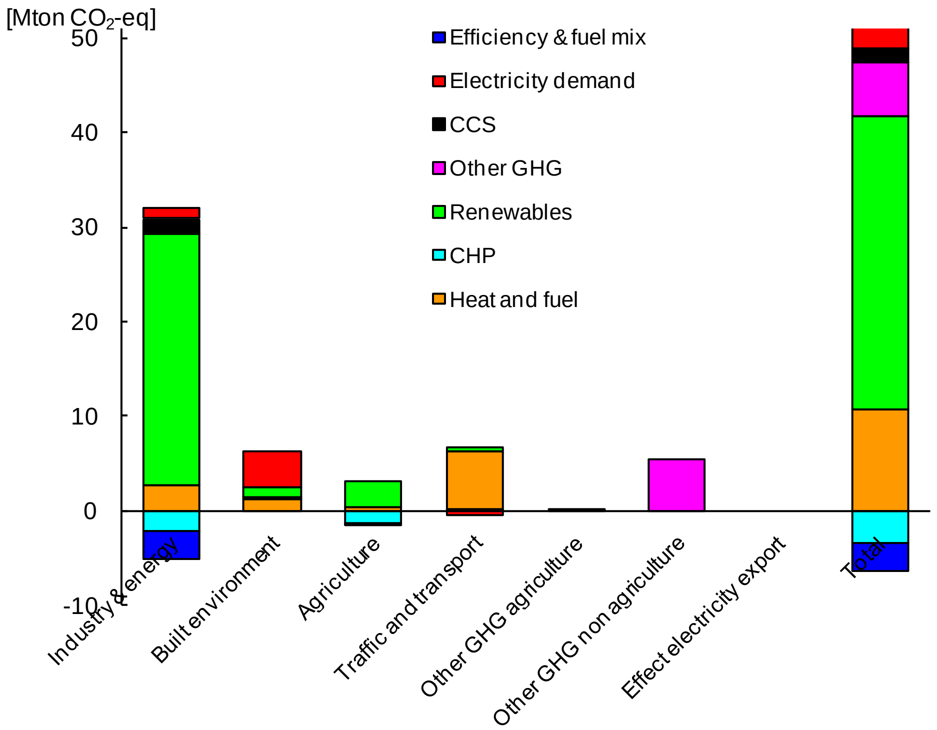

Figure 7.8 *Total effect Clean and Efficient policy*

Effects according to sector and category

Figure 7.9 shows which sectors and categories of measures contribute to the emission effects of fixed and intended Clean and Efficient policy. The emission effects are attributed to the sectors where the measures are taken. This is not always similar to the sectors where the emission affects actually occur. A clear example is CHP: It realises an emission reduction in the electricity generation but the emission on location even increase. In the case of electricity saving and renewable electricity there is no effect on the emissions on location; only elsewhere at the electricity plants. The figure does not show what the contribution to the target range or sectoral emission tasks is. One category of measures that does lower the local emissions is lowering the fuel demand, for example by means of building insulation, more efficient boilers, more efficient cars and road-pricing.

The large effect from the industry and energy sector is striking. It is mainly caused by the renewable energy production resulting from the SDE scheme.

A number of negative effects in the sectors industry/energy and agriculture also stand out. They are the result of less CHP in the industry and agriculture and an unfavourable effect on the emissions in electricity plants. Both are consequences of a lower electricity demand and additional renewable electricity production (see Box 7.3). The export of electricity also shows a negative entry. The lower electricity demand and the additional renewable electricity production do not only result in less generation of electricity from fossil fuels in the Netherlands. Part of the production is exported and will therefore lead to lower emissions abroad. The emission reduction that the Netherlands loses this way is the ‘export effect electricity’ in the figure.

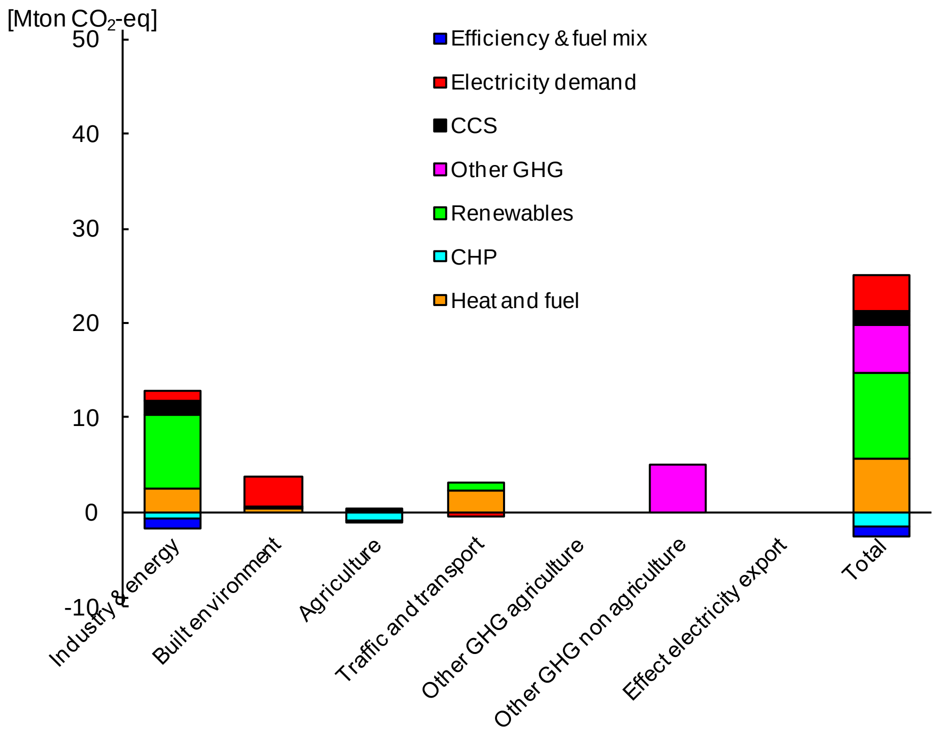

Figure 7.9 *Effects fixed Clean and Efficient policy*

Fixed and intended policy

The projection shows the realisations for fixed and intended policy as described in Section 2.1. The intended policy is still subject to political decision-making; the corresponding realisations are only valid under the assumption that the intended policy is actually implemented. The occurrence of the effects of intended policy are thus more uncertain than the effects of fixed policy, which is already being implemented. Figure 7.9 therefore shows the effects of fixed policy separately.

Policy effect to contribution emission target: What counts for what?

The effects of Clean and Efficient policy are considerable, but not all effects contribute to realising the emission targets. Of the total greenhouse gas emission reduction of 44 Mton under intended policy, only 12 Mton contributes to realising the targets: This is the part that occurs in sectors not covered by the ETS. The remaining 32 Mton occurs in the ETS sectors. The ETS share realises 75 Mton by definition due to its link to the European definitions (see Box 7.1). The 75 Mton are lower than the chimney emissions in the ETS, though: 116 Mton under fixed policy and 97 Mton under intended policy.

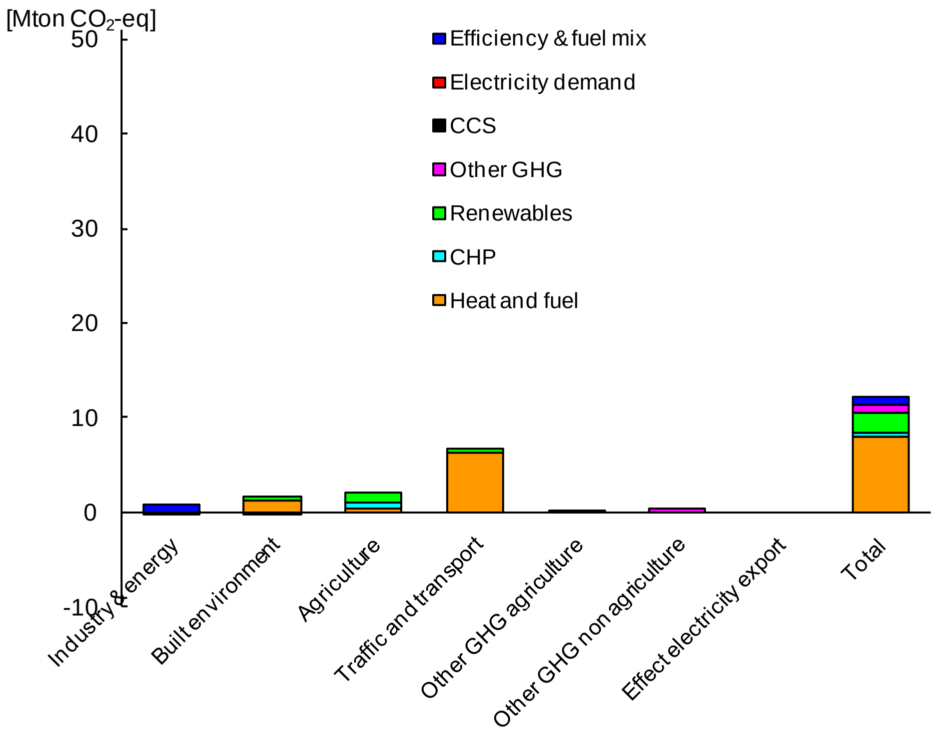

Figure 7.10 *Effects of Clean and Efficient policy in the non-ETS sectors*

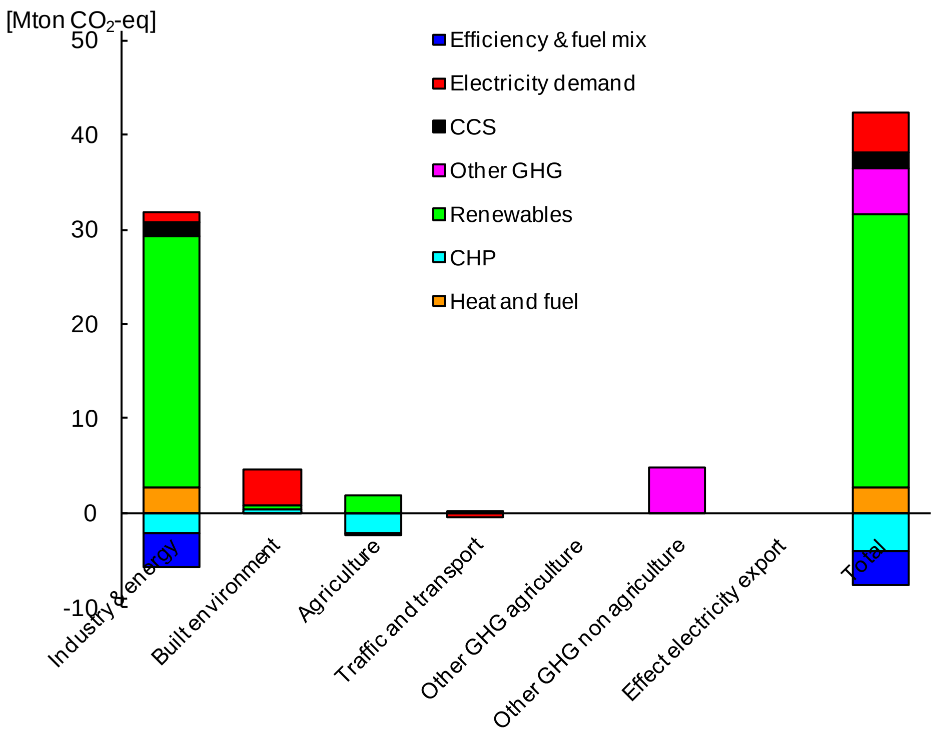

Figure 7.11 *Effects of Clean and Efficient policy in the ETS sectors*

Particularly the emission effects of the renewable energy realised by Clean and Efficient are largely covered by the ETS. 28 Mton of the over 31 Mton of reduction due to renewable energy under intended policy is covered by the ETS, whereas about 1.5 Mton is not covered by the ETS and contributes directly to realising the emission target. The emission reduction of green gas and biofuels is attributed to the sector using the energy. Biofuels in transport are thus entirely excluded from the ETS. The emission effects of green gas are attributed to various sectors in proportion to their natural gas use, resulting in half of them ending up outside the ETS.

The emission effects of energy savings are also covered by the ETS for the largest part. All emission effects of savings in electricity and the largest part of savings in heat in the industry are covered by the ETS.

The traffic sector takes up more than half of the emission reduction outside the ETS with about 7 Mton, resulting from lower fuel demand (more efficient cars, road-pricing). Part of this reduction is accompanied by a slight increase in the emissions in the ETS as a result of the increased number of electric vehicles. Agriculture contributes over 2 Mton and the built environment about 1.5 Mton.

Dutch and European policy
The projection allocates all European energy and climate policy after 2007 to the title Clean and Efficient policy. In those cases where Europe has already implemented policy, Dutch policy can usually supplement only little. European policy can play a role with regard to measures that are unfeasible or hard to realise with national policy. Examples include standards that would disrupt the internal market if they would apply to single Member States.

In a number of cases the boundary between Dutch and European policy is somewhat fuzzy: The European obligation with regard to biofuels in transport specifies in detail what needs to be accomplished, but leaves the required policy up to the Member States. The effects of Dutch and European policy are not always easy to separate. European vehicle standards and fiscal incentivisation of more efficient cars influence each other's effects, for example. The 6 Mton CO_2 eq emission reduction of N_2O in the sulphuric acid industry follows from the Dutch decision to subject this source to the ETS.

European policy with large effects includes the Ecodesign directive with an effect of about 4 Mton and the vehicle standard in the transport sector with an effect of 4 Mton. The Dutch policy measure with the most important effect is the SDE scheme, amounting to about 27 Mton.

7.4 Looking ahead to 2030

The effects of the Working Programme Clean and Efficient will continue after 2020. This section offers an overall view on the policy effects between 2020 and 2030 that follow from the policy implemented between 2010 and 2020. The development of other greenhouse gases after 2020 has not been mapped.

The picture after 2020
The picture for 2030 is based on the continued trends that are assumed for the period 2010-2020. There is a moderate growth in population and of the economy. Energy prices remain at more or less the same level; the CO_2 price continues to rise slowly to € 30 in 2030.

After 2020 further intensification of policy is not assumed, nor any new policy. The starting points remain the same. The projection does not assume any further tightening of standards or increases in subsidies. The effects of possible new options that follow from innovation trajectories have not been included either: It is uncertain which new options will follow from the innovation trajectories. Moreover, the deployment of these new options will often require new policy, which has not been assumed.

Outline of trends in emission
Based on these starting points and without Clean and Efficient policy the CO2 emissions increase slightly in the period 2020-2030. In case of implemented fixed and assumed Clean and

Efficient policy the CO_2 emissions decrease slightly. Without further intensification, Clean and Efficient policy does not lead to a distinct continued decrease of emissions after 2020, but it does prevent a slow increase in emissions after 2020 (Figure 7.12).

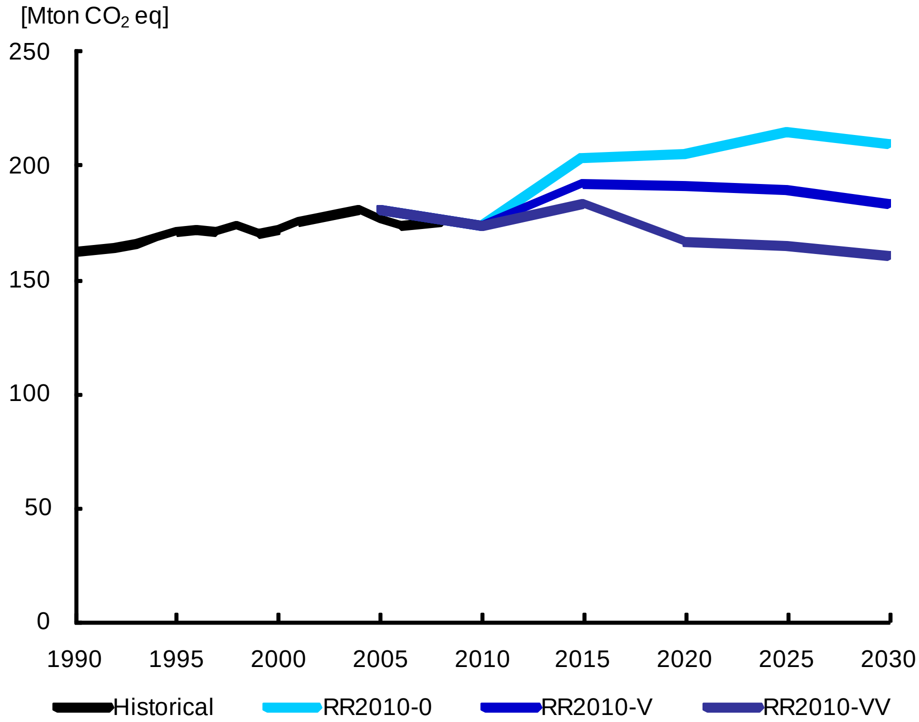

Figure 7.12 *Development of CO_2 emissions 1990-2030*

Where should more drastic reductions be realised?
In some cases, the policy as assumed for 2020 provides the basis for reductions after 2020. Figure 7.13 offers a picture of the effects of fixed and intended Clean and Efficient policy in 2030 compared to 2020. In the period 2020-2030 the total Clean and Efficient policy realises a reduction of about 10 Mton.

The reductions in the period 2020-2030 include lower fuel consumption in the transport sector, a lower electricity demand in the built environment and a lower electricity and fuel demand in the industry. Standards that were introduced or tightened before 2020 often play a role here. It is not until after 2020 that these standards take full effect. For example, the tightened CO_2 standard for cars will take effect after 2020 when the car fleet is renewed. The continuing growth of the share of electric vehicles plays a role in the transport sector.

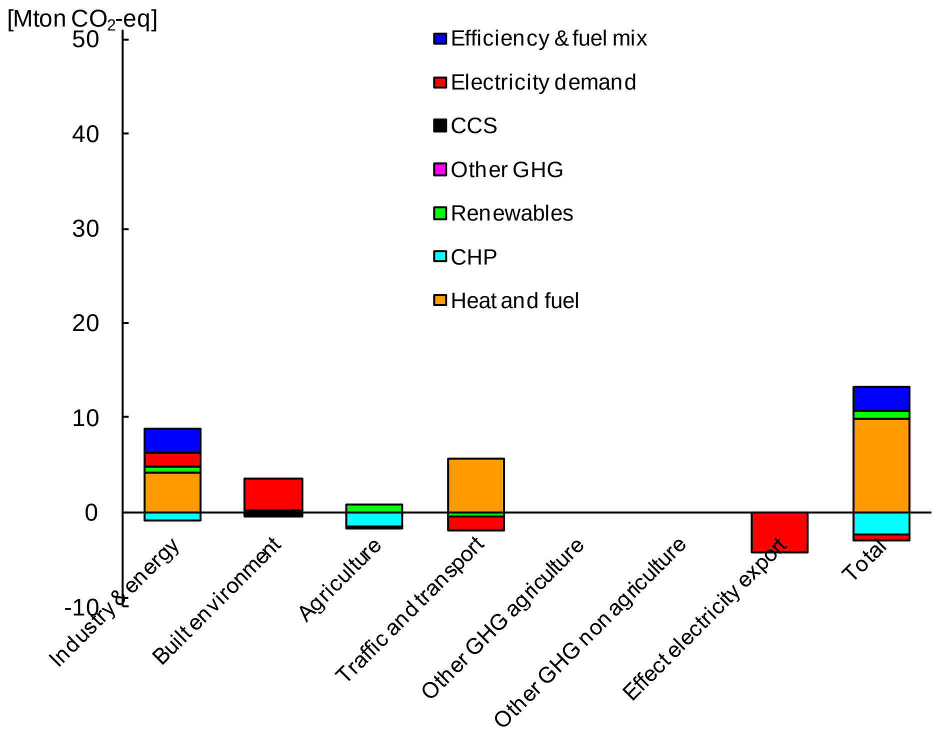

Figure 7.13 *Effects of Clean and Efficient policy in the period 2020-2030*

Cost of renewable energy

As for the support of renewable energy by means of the SDE scheme; after 2020 the same starting points apply as before 2020. Under fixed policy there is a fixed budget. As a result, the realisation of renewable energy still increases slightly between 2020 and 2030: The constant budget is sufficient for an increasing share of renewable energy because costs decrease in the course of time.

Implementing assumed policy does not increase the realisation of renewable energy appreciably after 2020. This is the result of the policy starting point of the SDE scheme: A fixed realisation of 55 TWh and an annual budget that must be sufficient. Between 2020 and 2030 the required budget decreases by half a billion euros to about 2.5. billion euros. The costs of most renewable energy options decrease significantly. In the case of offshore wind, for example, the budget is nearly halved but the production level stays the same. Renewable energy from biomass, however, faces increasing costs due to higher biomass prices.

References

Alterra (2009): Wageningen UR. Kunstmestvervangers onderzocht. Tussentijds rapport van het onderzoek in het kader van de pilot mineralenconcentraten.

Bakker, J.C., J.B. Campen, (2007): *Aardwarmte in de glastuinbouw: duurzame energie met grote besparingspotentie* (2007). Wageningen UR glastuinbouw.

Bersch, F., M. Skolnik (2008): *Biobrandstofproductie in Nederland Onderzoek naar huidige en geplande biobrandstofinstallaties in Nederland*. Milieudefensie, Amsterdam, 2008.

Brink, R.M.M. van den, Brederode, L.J.N. and Wagenaar, M. (2010) *Onderzoek naar de wegtype-verdeling en samenstelling van het wegverkeer.* RPB004/Bkr/0035, Goudappel Coffeng, Deventer.

Bunte, F (2009): *Ontwikkeling glasareaal 2020*. LEI, den Haag.

Bunte, F.H.J., Y. Dijkxhoorn (2009): *CO_2-emissiehandel in 2020: betekenis voor de Nederlandse glastuinbouw*. LEI Wageningen UR,Den Haag, 2009.

CBS (jaar): *Milieurekeningen*.

Dueck, Th. A., C.J. van Dijk, F. Kempes, T. van der Zalm (2008): *Emissies uit WKK-installaties in de glastuinbouw*. *Methaan, etheen en NO_x concentraties in rookgassen voor CO_2 dosering.* Nota 505 Wageningen UR Glastuinbouw, Wageningen, January 2008.

CE Delft (2009): *Milieudifferentiatie van de kilometerprijs. Effecten van verschillende milieudifferentiaties van de kilometerprijs voor vrachtauto's, bestelauto's en autobussen.* Publicatienummer 09.4896.50a, CE Delft, Delft.

CPB (2006): *Het groeipotentieel van de Nederlandse economie 2008; 2011*. CPB; Document 117.

CPB (2009): *Centraal Economische Plan 2009.* Centraal Planbureau, Den Haag.

CPB (2010*): De effecten van de olieprijs op lange termijn (in voorbereiding)*. Centraal Planbureau, Den Haag.

CPB (2010a), *Centraal Economische Plan 2010*. Centraal Planbureau, Den Haag.

CPB (2010b), *Economische Verkenning 2011-2015*. CPB-document 203, Centraal Planbureau, Den Haag.

CPB/MNP/RPB (2006): *Welvaart en leefomgeving, incl. achtergronddocument*. Centraal Planbureau/Milieu- en Natuurplanbureau/Ruimtelijk Planbureau, Den Haag/Bilthoven.

Dagblad van het Noorden (2004): *NAM onderzoekt herontwikkeling olieveld Schoonebeek.* Monday 26 April 2004.

Daniels, B.W., C.W.M. van der Maas et al. (2009): *Actualisatie referentieramingen Energie en emissies 2008-2020*. ECN-E--09-010, ECN/PBL, Petten, August 2009.

D-cision (2010): Rudi Hakvoort, Jos Meeuwsen, *Ontwikkeling van de brandstofmix van de Nederlandse elektriciteitsvoorziening - Analyse en synthese van recente studies*. D-cision B.V., Zwolle, March 2010.

Dijkgraaf, E., J.M. de Jong, M, Spijkerman, O. Tanis (2009): *Effectiviteit Convenanten Energiebeleid.* SEOR, Erasmus School of Economics, Erasmus Universiteit Rotterdam.

Duin, C. van (2009): *Bevolkingsprognose 2008–2050: naar 17,5 miljoen inwoners*. In: CBS, Bevolkingstrends, Statistisch kwartaalblad voor de demografie, jaargang 57, 1e kwartaal, pp. 15-22.

Duin, C. van, S. Loozen (2009): *Huishoudensprognose 2008–2050: uitkomsten*. In: CBS, Bevolkingstrends, Statistisch kwartaalblad voor de demografie, jaargang 57, 3e kwartaal, pp. 14-19.

Dril, A.W.N. van, H.E. Elzenga (coörd.) (2005): *Referentieramingen energie en emissies 2005-2020.* ECN-C--05-018, Petten/Bilthoven, March 2005.

Dril, A.W.N. van (coörd.) (2009): *Verkenning Schoon en Zuinig. Effecten op energiebesparing, hernieuwbare energie en uitstoot van broeikasgassen*. ECN, PBL, Petten/Bilthoven, April 2009.

ECN (2009): Seebregts, A.J., H.J.M. Snoep, J. van Deurzen, S.M. Lensink, A.J. van der Welle, W. Wetzels (2009): *Brandstofmix elektriciteit 2020: Inventarisatie, mogelijke problemen en oplossingsrichtingen*. ECN, Petten, ECN-E-09-046, December 2009.

ECN (2010): Seebregts, A.J., H.J.M. Snoep, J. van Deurzen, P. Lako, A.D. Poley, *Kernenergie & Brandstofmix - Effecten van nieuwe kerncentrales na 2020 in de kernenergiescenario's uit het Energierapport 2008*, ECN-E-10-033, March 2010.

Gastec (2007): *Inventarisatie van NO_x-emissiegegevens; Een inventarisatie van de NO_x-emissies van huishoudelijke centrale verwarmingstoestellen over de periode 2002 tot en met 2006.* VGI/319/LE, Gastec Technology B.V., Apeldoorn, June 2007.

Geilenkirchen, G.P. and Kieboom, S.K. (2010, in voorbereiding) *Milieueffecten planningsvarianten kilometerprijs ten behoeve van Referentieraming energie en emissies 2010-2020*. PBL-rapport XX, Planbureau voor de Leefomgeving, Den Haag/Bilthoven.

Gerdes, J., P.G.M. Boonekamp, H. Vreuls, M. Verdonk, J.W. Pouwelse (2009): *Energiebesparing in Nederland 1995-2007. Inclusief decompositie energieverbruikstrend*. ECN-E-09-040, August 2009.

Gijsen, A., A. J. Seebregts (2005): *Onzekerheden in de Referentieramingen.* Achtergrondrapport bij het rapport 'Referentieramingen Energie en Emissies 2005-2020' MNP Rapport 773001032/2005, MNP/ECN, Bilthoven/Petten 2004.

Hal, J.D.M. van, A.A.M. Postel, B. Dulski (2008): *Draaien aan Knoppen, Onderzoek naar het creëren van business-opportunities bij het MKB in het kader van het terugdringen van het energieverbruik van woningen van eigenaar-bewoners.* Nyenrode Business Universiteit, Breukelen.

Hers, J.S., W. Wetzels, A.J. Seebregts, A.J. van der Welle (2008): *Onrendabele top berekeningen voor nieuw WKK-vermogen 2008*. ECN-E-08-016, Petten, May 2008.

Hers, J.S., W. Wetzels, *Technische ondersteuning subsidieberekening SDE WKK 2010*, ECN-E--09-069, Petten, October 2009.

Het Bedrijfschap Horeca en Catering.

Hoogeveen M.W., H.H. Luesink en P.W. Blokland (2010 in prep): *Ammoniakemissie uit de landbouw in 2020 raming en onzekerheden.*

Hoen, A., Geilenkirchen, G.P., Kieboom, S.K. en C. Hanschke (2010 in prep): *Referentieraming energie en emissies 2010-2020. Achtergrondrapport verkeer en vervoer.* PBL-rapport XX, Planbureau voor de Leefomgeving, Den Haag/Bilthoven.

Huizinga, F., B. Smid (2004): *Vier Vergezichten: Productie, arbeid en sectorstructuur in vier scenario's tot 2040.* Centraal Planbureau, Den Haag.

Hulskotte, J.H.J. and Verbeek, R.P. (2009) *Emissiemodel mobiele machines gebaseerd op machineverkopen in combinatie met brandstof afzet (EMMA).* TNO-034-UT-2009-01782-RPT-ML, TNO Bouw en Ondergrond, Utrecht.

Jacobs Consultancy (2009): *Techno-economische parameters SDE, Ontwikkeling van 2009 naar 2010, STEG eenheden 250 MW_e.* Jacobs Consultancy, Leiden, Revisie A, 21 August 2009.

KaE (2010): *Jaarplan 2010, Programma Kas als Energiebron*. Zoetermeer, January 2010.

KEMA (2010): W. van der Veen, N. Moldovan, G. Stienstra, E. Benz, C. Hewicker, *Integratie van wind energie in het Nederlandse elektriciteitssysteem in de context van de Noordwest-Europese elektriciteitsmarkt.* KEMA, rapport 030920572-Consulting 10-0198, March 2010.

Lange, R. de, Verbeek, R., Passier, G. and Kattenwinkel, H. (2008) *Mogelijkheden tot CO_2 normering en brandstof differentiatie voor het vrachtverkeer.* TNO-rapport MON-RPT-033-DTS-2008-02646, TNO Industrie en Techniek, Delft.

Ligterink, N.E. and Bos, B. (2010) *CO_2-uitstoot van personenwagens in norm en praktijk - analyse van gegevens van zakelijke rijders*. TNO-rapport MON-RPT-2010-00114, TNO Industrie en Techniek, Delft.

Ligterink, N., Lange, R. de, Vermeulen, R. and Dekker, H. (2009) *On-road NO_x emissions of Euro-V trucks.* TNO-rapport MON-RPT-033-DTS-2009-03840. TNO Industrie en Techniek, Delft.

LNV (2008): *Convenant Schone en Zuinige Agrosectoren*. Ministerie van Landbouw, Natuur en Voedselkwaliteit.10 June 2008.

Ministerie van Verkeer en Waterstaat (2009) *Voortgangsrapportage 3 Anders Betalen voor Mobiliteit. Verslagperiode 1 januari 2009 - 30 juni 2009.* Bijlage bij Kamerstuk 2009-2010, 31305, nr. 154, Tweede Kamer, Den Haag.

Marel, J. van der, E. Goudappel, B. Ebbinge Wubben (2008): *Techno-economische parameters SDE WKK 2008*. Jacobs Consultancy, Leiden, March 2008.

MEE (2009): *Meerjarenafspraak Energie-efficientie ETS-ondernemingen (MEE)*. Den Haag, 2 October 2009.

MJA3 (2008): *MJA3, Meerjarenafspraak energie efficiëntie 2001-2020*. Definitieve versie 1 July 2008.

MNP (2008): Milieukundige en landschappelijke aspecten van megabedrijven in de intensieve veehouderij. MNP-publicatienummer 500139003. http://www.pbl.nl.

NEA (2009): *Nadere analyse NO_x-emissiegegevens 2005-2008.* Nederlandse Emissieautoriteit, Den Haag, May 2009.

MuConsult (2008) *DYNAMO 2.1: dynamic automobile market model. Technische eindrapportage.* Kenmerk RI09.002, MuConsult, Amersfoort.

OC&W (2010): *Uitbreiding data referentieraming*. Ontvangen per email.

PBL (2009): *Greenhouse Gas Emissions in the Netherlands 1990-2007; National Inventory Report 2009.* PBL report 500080012/ 2009, Netherlands Environmental Assessment Agency (PBL), Bilthoven, april 2009.

Rijksoverheid (2008): *Meerjarenafspraken energie-efficiency, Resultaten 2008*. September 2009.

RIVM: *Nationaal Kompas Volksgezondheid*.

Schijndel, M.W. van, S.M. van der Sluis (2010 in prep): *Achtergronddocument referentieraming emissies landbouw 2010 – 2020.*

Shell (2008): *Vergunningaanvraag Wet milieubeheer; Inrichting: Shell CO_2 Storage B.V. (SCS) - inrichting Barendrecht Ondergrondse CO_2-opslag (BRT-OCO).* Shell CO_2 Storage B.V., Assen, December 2008.

SEO en Significance (2008) *Actualisering ontwikkeling Schiphol 2020-2040 bij het huidige beleid. Eindrapport.* SEO Economisch Onderzoek, Amsterdam en Significance, Den Haag.

Silvis, H.J., C.J.A.M. de Bont, J.F.M. Helming, M.G.A. van Leeuwen, F. Bunte en J.C.M. van Meijl (2009): *De agrarische sector in Nederland naar 2020; Perspectieven en onzekerheden*. LEI, Den Haag, 2009.

Smit, P.X., N.J.A. van der Velden (2008): *Energiebenutting warmtekrachtkoppeling in de Nederlandse glastuinbouw*. LEI, den Haag, 2008.

Taskforce Verlichting (2008): *Groen licht voor energiebesparing*. Taskforce Verlichting, 26 May 2008.

TNO (2009): *Delfstoffen en aardwarmte in Nederland; Jaarverslag 2008; Een overzicht van opsporings- en winningsactiviteiten en van ondergrondse gasopslag*. www.nlog.nl, TNO Bouw en Ondergrond in opdracht van EZ, Utrecht, 2009.

TNO (2009): *Scenarioberekeningen goederenvervoer ten behoeve van emissieramingen*. TNO-034-DTM-2009-05057, TNO Mobiliteit en Logistiek, Delft.

Velden, N.J.A. van der (2008): *Effecten stijgende energieprijzen voor de Nederlandse glastuinbouw*. LEI, den Haag

Velden, N.J.A. van der, P. Smit (2009): *Energiemonitor van de Nederlandse glastuinbouw 2008*. LEI, Den Haag, 2009.

Velthof, G.L., C. van Bruggen, C.M. Groenestein, B.J. de Haan, M.W. Hoogeveen and J.F.M. Huijsmans (2009): *Methodiek voor berekening van ammoniakemissie uit de landbouw in Nederland.* Wageningen, Wettelijke Onderzoekstaken Natuur & Milieu,WOt-rapport 70.

Vreuls, H.H.J. (2006): *Nederlandse lijst van energiedragers en standaard CO_2-emissiefactoren*.

VROM (2007): *Nieuwe energie voor het klimaat- werkprogramma Schoon en Zuinig*, VROM 7421/September 2007.

VROM (2009)*: Houdende nieuwe regels voor de emissie van middelgrote stookinstallaties*. Besluit van 7 december 2009 (Besluit emissie-eisen middelgrote stookinstallaties milieubeheer). Staatsblad Jaargang 2009, no 547.

Websites

CBS (2009): *Bevolkingsprognose 2008-2020*. http://www.cbs.nl/NR/rdonlyres/EB986187-DFD1-4EBA-ABC2-E14A8E9B21B0/0/2009k1b15p15art.pdf

CBS: (2005): *De vraag naar ruimte voor economische activiteit tot 2040*. Bedrijfslocatiemonitor. http://www.cpb.nl/nl/pub/cpbreeksen/bijzonder/59/bijz59.pdf

CBS (2008): *Gezondheid en zorg in cijfers, 2008.* (Hoofdstuk 2). http://www.cbs.nl/NR/rdonlyres/516BE7D7-B35E-4CFA-BF66-9B48ADF6995F/0/2008c156pub.pdf

CBS Statline prognose Bevolking naar huishoudenspositie, 2009-2050.

CBS historische data Statline aantal leerlingen. http://statline.cbs.nl/StatWeb/publication/?VW=T&DM=SLNL&PA=37220&D1=0-3,6,11,62,71,102&D2=0&D3=40-57&HD=090604-0938&HDR=G1,G2&STB=T

CBS Arbeidsrekeningen. http://statline.cbs.nl/StatWeb/publication/?DM=SLNL&PA=7511NR&D1=3-4,18&D2=a&D3=21-39&HDR=T,G2&STB=G1&VW=T

CBS Groothandel en handelsbemiddeling; arbeid en financiën, 2000-2005. http://statline.cbs.nl/StatWeb/publication/default.aspx?DM=SLNL&PA=70080NED&D1=2&D2=a&D3=a&VW=T

CBS Groothandel en handelsbemiddeling; arbeids- en financiële gegevens. http://statline.cbs.nl/StatWeb/publication/default.aspx?DM=SLNL&PA=71841NED&D1=1&D2=0-2%2c6%2c10%2c14%2c20%2cl&D3=a&VW=T

CBS Statline prognose Bevolking naar huishoudenspositie, 2009-2050.

CBS historische data Statline Personen in institutionele huishoudens.

CBS Zorginstellingen; financiën, personeel, productie en capaciteit naar SBI http://statline.cbs.nl/StatWeb/publication/?VW=T&DM=SLNL&PA=71584NED&D1=95-130&D2=a&D3=l&HD=090424-1157&HDR=G2&STB=T,G1

CBS Ziekenhuizen; exploitatie, personeel en productie http://statline.cbs.nl/StatWeb/publication/?VW=T&DM=SLNL&PA=71346NED&D1=56-66&D2=a&D3=18-34&HD=090424-1154&HDR=G2&STB=T,G1

CBS Ziekenhuizen: exploitatie, personeel, capaciteit, patiënten en productie http://statline.cbs.nl/StatWeb/publication/?VW=T&DM=SLNL&PA=7107_96&D1=47-59&D2=a&D3=a&HD=090424-1156&HDR=G2&STB=T,G1

CBS Bedrijfsleven; arbeid en financiën, per branche, tijdreeks vanaf 1987 http://statline.cbs.nl/StatWeb/publication/?VW=T&DM=SLNL&PA=80067ned&D1=a&D2=1,8-10,16-24&D3=a&HD=100222-1416&HDR=T&STB=G1,G2

CBS Nationale rekeningen 2008; Arbeidsrekeningen

CLO (2009 en 2010): http://www.compendiumvoordeleefomgeving.nl/overhetclo/ (voorheen MNC, 2009).

College bouw ziekenhuisvoorzieningen (2001): *Uitvoeringstoets Onderzoek bouwbehoefte 2000-2012; Actueel beleid Gehandicaptenzorg en Verpleeg- en verzorgingshuizen.* http://www.bouwcollege.nl/Pdf/CBZ%20Website/Publicaties/Uitvoeringstoetsen/Verpleeghuizen/ut499.pdf

College bouw ziekenhuisvoorzieningen (2003): *Intern referentiekader, ombouw van verzorgingshuizen.* http://www.bouwcollege.nl/Pdf/CBZ%20Website/Publicaties/Uitvoeringstoetsen/Verzorgingshuizen/ut550.pdf

College bouw ziekenhuisvoorzieningen: *Privacy in verpleeghuizen, metafoor van de Nederlandse samenleving*. http://www.bouwcollege.nl/Pdf/Ontwerpaspecten/A%20posteriori%20-%20privacy%20in%20verpleeghuizen.pdf

Convenant Schone en Zuinige Agrosectoren (2008) http://www.senternovem.nl/mmfiles/LNVConvenant_tcm24-303178.pdf

EIB (jaar): *Vraag naar Kantoren tot 2015*. http://www.eib.nl/ShowPers.cfm?ID=280

OC&W Referentieraming Leerlingen 2008 http://www.minocw.nl/documenten/referentieraming_2008.pdf

OCAP (2007): *OCAP CO_2 project sneller succes dan verwacht. OCAP*. Persbericht, Schiedam, 12 februari 2007. http://www.ocap.nl/

SenterNovem website, 10 december 2009. http://www.SenterNovem.nl/taskforceverlichting/over_de_taskforce/index.asp

Shell (2009) Internet pagina: Waarom CO_2-opslag? Shell, Pernis, november 2009 http://www.shell.nl/home/content/nld/responsible_energy/CO_2_storage/why_barendrecht

Stade advies BV (2010): De zelfstandige oudere: heimwee naar het verzorgingshuis? http://www.stade-advies.nl/stadeadvies_nl/acf0a3478ab21873abcded7c772c4a45.php

VROM (2009): *Actieplan ammoniak en veehouderij*. http://www.infomil.nl/onderwerpen/klimaat-lucht/ammoniak/actieplan-ammoniak

Woonzorg (2010): http://www.zorghotelegbertsduin.nl/links.php?command=show_link&lnk_id=11

Appendix A Energy balances

Table A.1 *Energy balance 2008 corrected for climate*

	Households	Industry	Of which chem. ind.	Agri- and horticulture	Trade, services, government	Traffic	Total end use	Refineries	Electr. production	Natural gas and oil extraction	Total energy company	Total
Net consumption [PJ]	425	1250	838	138	341	562	2716	172	420	41	633	3349
coal	0	109	9	0	0	0	109	0	229	0	229	338
oil	4	585	544	5	2	556	1153	119	10	0	129	1281
of which biofuels	0	0	0	0	0	12	12	0	0	0	0	12
natural gas	311	328	172	132	192	0	964	49	417	32	498	1462
steam from nuclear energy	0	0	0	0	0	0	0	0	40	0	40	40
electricity	89	136	38	-10	114	6	336	1	-273	9	-262	73
heat	20	91	75	7	27	0	145	3	-5	0	-1	143
fermentation gas	0	1	0	3	5	0	9	0	1	0	1	10
Non energetic consumption [PJ]	0	626	524	1	1	3	632					632
coal	0	65	5	0	0	0	65					65
oil	0	479	437	1	1	3	484					484
natural gas	0	82	82	0	0	0	82					82
Extraction [PJ]	12	11	4	0	17	0	39	11	109	0	121	160
heat	12	10	4	0	12	0	34	11	98	0	110	143
of which renewables	2	0	0	0	6	0	8	0	0	0	0	8
of which biomass	9	3	0	0	6	0	18	0	57	0	57	75
electricity	0	0	0	0	5	0	6	0	11	0	11	16
of which renewables	0	0	0	0	5	0	5	0	11	0	11	16
Final electricity [PJ]	89	152	45	27	117	6	392	9	21	9	39	431
Primary energy consumption [PJ]	543	1398	867	123	488	583	3134				215	3349
CO_2 emission [kton]												
combustion	17.9	25.8	12.5	7.8	11.0	39.7	102.2	11.0	52.4	1.8	65.2	167.4
energetic process	0.0	5.1	3.4	0.0	0.0	0.0	5.1	0.8	0.0	0.0	0.8	5.9
other	0.1	2.0	0.3	0.0	0.1	0.0	2.2	0.0	0.0	0.1	0.1	2.3
CO_2 storage	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	18.1	32.8	16.1	7.8	11.2	39.7	109.5	11.8	52.4	1.9	66.1	175.6

Table A2 *Energy balance 2020 without new national and European policy since 2007*

	Households	Industry	Of which chem. ind.	Agri- and horticulture	Trade, services, government	Traffic	Total end use	Refineries	Electr. production	Natural gas and oil extraction	Total energy company	Total
Net consumption [PJ]	405	1082	689	150	309	547	2492	213	409	45	667	3159
coal	0	111	2	0	0	0	111	0	266	0	266	376
oil	3	443	397	0	0	541	987	133	3	0	136	1123
of which biofuels	0	0	0	0	0	27	27	0	0	0	0	27
natural gas	294	308	182	158	160	0	919	74	408	32	515	1434
steam from nuclear energy	0	0	0	0	0	0	0	0	43	0	43	43
electricity	91	122	34	-20	116	6	316	0	-285	11	-273	42
heat	16	97	75	4	29	0	145	6	-26	1	-19	127
fermentation gas	0	2	0	8	4	0	14	0	0	0	0	14
Non energetic consumption [PJ]	0	468	369	0	0	3	471					471
coal	0	63	2	0	0	0	63					63
oil	0	328	290	0	0	3	331					331
natural gas	0	77	77	0	0	0	77					77
Extraction [PJ]	9	9	5	0	7	0	25	16	101	1	118	144
heat	9	9	4	0	7	0	25	16	85	1	102	127
of which renewables	1	0	0	0	7	0	8	0	26	0	26	35
of which biomass	7	1	0	0	0	0	8	0	32	1	34	42
electricity	0	1	0	0	0	0	1	0	16	0	16	17
of which renewables	0	0	0	0	0	0	0	0	16	0	16	16
Final electricity [PJ]	91	142	44	24	122	6	386	11	19	11	42	428
Primary energy consumption [PJ]	525	1209	715	125	452	572	2883				276	3159
CO_2 emission [kton]												
combustion	16.9	26.5	12.1	8.9	9.1	37.5	99.0	11.9	52.3	1.9	66.1	165.1
energetic process	0.0	4.4	3.1	0.0	0.0	0.1	4.6	1.4	0.0	0.0	1.4	6.0
other	0.1	2.1	0.3	0.0	0.1	0.0	2.4	0.0	0.0	0.1	0.1	2.5
CO_2 storage	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	17.0	33.1	15.5	8.9	9.2	37.7	105.9	13.3	52.3	2.0	67.7	173.6

Table A.3 *Energy balance 2010 under fixed national and European policy*

	Households	Industry	Of which chem. ind.	Agri- and horticulture	Trade, services, government	Traffic	Total end use	Refineries	Electr. production	Natural gas and oil extraction	Total energy company	Total
Net consumption [PJ]	404	1082	689	149	308	547	2489	213	410	45	668	3157
coal	0	111	2	0	0	0	111	0	266	0	266	377
oil	3	443	397	0	0	541	987	133	3	0	136	1123
of which biofuels	0	0	0	0	0	19	19	0	0	0	0	19
natural gas	294	307	182	153	158	0	912	74	410	32	516	1429
steam from nuclear energy	0	0	0	0	0	0	0	0	43	0	43	43
electricity	91	122	34	-17	116	6	318	0	-286	11	-275	43
heat	16	97	75	5	29	0	146	6	-25	1	-18	128
fermentation gas	0	2	0	9	4	0	15	0	0	0	0	15
Non energetic consumption [PJ]	0	468	369	0	0	3	471					471
coal	0	63	2	0	0	0	63					63
oil	0	328	290	0	0	3	331					331
natural gas	0	77	77	0	0	0	77					77
Extraction [PJ]	9	9	5	1	7	0	26	16	102	1	119	146
heat	9	9	4	1	7	0	25	16	85	1	103	128
of which renewables	2	0	0	1	7	0	9	0	26	0	26	35
of which biomass	7	1	0	0	0	0	8	0	33	1	34	43
electricity	0	1	0	0	0	0	1	0	17	0	17	18
of which renewables	0	0	0	0	0	0	0	0	17	0	17	17
Final electricity [PJ]	91	142	44	25	123	6	386	11	19	11	42	428
Primary energy consumption [PJ]	523	1209	714	127	450	572	2882				275	3157
CO_2 emission [kton]												
combustion	16.9	26.5	12.1	8.7	9.0	38.1	99.2	11.9	52.4	1.9	66.2	165.4
energetic process	0.0	4.4	3.1	0.0	0.0	0.1	4.6	1.4	0.0	0.0	1.4	6.0
other	0.1	2.1	0.3	0.0	0.1	0.0	2.4	0.0	0.0	0.1	0.1	2.5
CO_2 storage	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	17.0	33.1	15.5	8.7	9.1	38.3	106.2	13.3	52.4	2.0	67.8	173.9

Table A.4 *Energy balance 2010 upon implementation of intended national and European policy*

	Households	Industry	Of which chem. ind.	Agri- and horticulture	Trade, services, government	Traffic	Total end use	Refineries	Electr. production	Natural gas and oil extraction	Total energy company	Total
Net consumption [PJ]	404	1082	689	149	306	545	2486	213	409	45	667	3153
coal	0	111	2	0	0	0	111	0	265	0	265	376
oil	3	443	397	0	0	540	986	133	3	0	136	1122
of which biofuels	0	0	0	0	0	19	19	0	0	0	0	19
natural gas	294	307	182	152	157	0	910	74	409	32	516	1426
steam from nuclear energy	0	0	0	0	0	0	0	0	43	0	43	43
electricity	91	122	34	-18	116	6	317	0	-285	11	-274	43
heat	16	97	75	6	29	0	148	6	-26	1	-18	129
fermentation gas	0	2	0	9	4	0	15	0	0	0	0	15
Non energetic consumption [PJ]	0	468	369	0	0	3	471					471
coal	0	63	2	0	0	0	63					63
oil	0	328	290	0	0	3	331					331
natural gas	0	77	77	0	0	0	77					77
Extraction [PJ]	9	9	5	2	7	0	28	16	102	1	119	147
heat	9	9	4	2	7	0	27	16	85	1	103	129
of which renewables	2	0	0	2	7	0	10	0	26	0	26	37
of which biomass	7	1	0	0	0	0	8	0	33	1	34	42
electricity	0	1	0	0	0	0	1	0	17	0	17	18
of which renewables	0	0	0	0	0	0	0	0	17	0	17	17
Final electricity [PJ]	91	142	44	25	123	6	386	11	19	11	41	427
Primary energy consumption [PJ]	523	1210	715	126	448	571	2878				275	3153
CO_2 emission [kton]												
combustion	16.9	26.5	12.1	8.6	8.9	38.1	99.0	11.9	52.3	1.9	66.1	165.1
energetic process	0.0	4.4	3.1	0.0	0.0	0.1	4.6	1.4	0.0	0.0	1.4	6.0
other	0.1	2.1	0.3	0.0	0.1	0.0	2.4	0.0	0.0	0.1	0.1	2.5
CO_2 storage	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	17.0	33.1	15.5	8.6	9.0	38.2	106.0	13.3	52.3	2.0	67.7	173.6

Table A.5 *Energy balance 2015 without new national and European policy since 2007*

	Households	Industry	Of which chem. ind.	Agri- and horticulture	Trade, services, government	Traffic	Total end use	Refineries	Electr. production	Natural gas and oil extraction	Total energy company	Total
Net consumption [PJ]	398	1183	751	150	308	564	2604	231	544	51	826	3430
coal	0	135	2	0	0	0	135	0	514	0	514	649
oil	3	487	439	0	0	558	1048	139	5	0	144	1192
of which biofuels	0	0	0	0	0	28	28	0	0	0	0	28
natural gas	283	343	200	157	151	0	935	75	419	40	534	1469
steam from nuclear energy	0	0	0	0	0	0	0	0	43	0	43	43
electricity	95	128	36	-20	124	6	333	3	-395	11	-381	-48
heat	17	88	73	4	30	0	139	13	-42	1	-28	111
fermentation gas	0	2	0	9	4	0	14	0	0	0	0	14
Non energetic consumption [PJ]	0	513	403	0	0	3	516					516
coal	0	72	2	0	0	0	72					72
oil	0	358	318	0	0	3	361					361
natural gas	0	82	82	0	0	0	82					82
Extraction [PJ]	9	10	5	0	11	0	30	21	76	1	98	128
heat	9	9	5	0	11	0	29	21	61	1	82	111
of which renewables	2	0	0	0	11	0	13	0	27	0	27	40
of which biomass	7	1	0	0	0	0	8	0	6	1	6	14
electricity	0	1	0	0	0	0	1	0	16	0	16	17
of which renewables	0	0	0	0	0	0	0	0	16	0	16	16
Final electricity [PJ]	95	155	49	26	128	6	410	11	23	15	49	459
Primary energy consumption [PJ]	530	1333	785	124	470	591	3048				381	3430
CO_2 emission [kton]												
combustion	16.3	30.9	13.6	8.9	8.6	38.8	103.5	11.7	76.0	2.3	90.1	193.5
energetic process	0.0	5.0	3.3	0.0	0.0	0.1	5.1	2.2	0.0	0.0	2.2	7.3
other	0.1	2.4	0.3	0.0	0.1	0.0	2.6	0.0	0.0	0.1	0.1	2.7
CO_2 storage	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	16.4	38.2	17.2	8.9	8.7	38.9	111.2	14.0	76.0	2.4	92.4	203.6

Table A.6 *Energy balance 2015 under fixed national and European policy*

	Households	Industry	Of which chem. ind.	Agri- and horticulture	Trade, services, government	Traffic	Total end use	Refineries	Electr. production	Natural gas and oil extraction	Total energy company	Total
Net consumption [PJ]	384	1177	744	151	308	550	2569	219	497	51	767	3336
coal	0	134	2	0	0	0	134	0	492	0	492	626
oil	3	481	433	0	0	540	1024	129	7	0	136	1160
Of which biofuels	0	0	0	0	0	29	29	0	0	0	0	29
natural gas	276	346	201	145	151	3	920	76	342	39	456	1377
steam from nuclear energy	0	0	0	0	0	0	0	0	43	0	43	43
electricity	88	126	35	-15	122	6	326	2	-349	11	-335	-9
heat	17	87	73	8	30	0	141	12	-37	2	-24	118
fermentation gas	0	4	0	14	5	0	23	0	0	0	0	23
Non energetic consumption [PJ]	0	510	400	0	0	3	513					513
coal	0	72	2	0	0	0	72					72
oil	0	356	317	0	0	3	359					359
natural gas	0	82	82	0	0	0	82					82
Extraction [PJ]	10	10	5	4	11	0	34	20	110	2	132	166
heat	9	9	5	4	11	0	33	20	63	2	85	118
of which renewables	2	0	0	4	11	0	16	0	27	0	27	44
of which biomass	7	1	0	0	0	0	8	0	8	2	10	18
electricity	1	1	0	0	0	0	2	0	47	0	47	48
of which renewables	1	0	0	0	0	0	1	0	47	0	47	47
Final electricity [PJ]	88	154	48	27	127	6	401	11	22	15	48	449
Primary energy consumption [PJ]	500	1317	774	132	461	575	2986				351	3336
CO_2 emission [kton]												
combustion	15.9	30.7	13.4	8.2	8.5	37.5	100.9	11.1	69.7	2.3	83.0	183.9
energetic process	0.0	5.0	3.3	0.0	0.0	0.1	5.1	2.1	0.0	0.0	2.1	7.2
other	0.1	2.4	0.3	0.0	0.1	0.0	2.6	0.0	0.0	0.1	0.1	2.7
CO_2 storage	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.4	-1.1	0.0	-1.5	-1.5
Total	16.0	38.0	17.0	8.2	8.7	37.6	108.6	12.8	68.6	2.4	83.8	192.3

Table A.7 *Energy balance 2015 upon implementation of intended national and European policy*

	Households	Industry	Of which chem. ind.	Agri- and horticulture	Trade, services, government	Traffic	Total end use	Refineries	Electr. production	Natural gas and oil extraction	Total energy company	Total
Net consumption [PJ]	382	1180	746	158	301	533	2554	225	493	51	770	3324
coal	0	134	2	0	0	0	134	0	428	0	428	562
oil	3	481	433	0	0	524	1008	129	7	0	137	1144
of which biofuels	0	0	0	0	0	28	28	0	0	0	0	28
natural gas	276	361	217	137	145	3	922	80	311	32	423	1345
steam from nuclear energy	0	0	0	0	0	0	0	0	43	0	43	43
electricity	86	124	33	-18	120	6	318	3	-341	11	-327	-9
heat	17	75	61	13	30	0	135	13	46	8	68	202
fermentation gas	0	5	0	26	6	0	38	0	0	0	0	38
Non energetic consumption [PJ]	0	510	400	0	0	3	513					513
coal	0	72	2	0	0	0	72					72
oil	0	356	317	0	0	3	359					359
natural gas	0	82	82	0	0	0	82					82
Extraction [PJ]	10	10	5	9	11	0	40	22	184	8	214	254
heat	9	9	5	9	11	0	38	22	134	8	164	202
of which renewables	2	0	0	9	11	0	22	0	27	0	27	49
of which biomass	7	1	0	0	0	0	8	0	79	8	88	96
electricity	1	1	0	0	0	0	2	0	50	0	50	52
of which renewables	1	0	0	0	0	0	1	0	50	0	50	51
Final electricity [PJ]	86	154	48	27	126	6	400	11	21	15	48	447
Primary energy consumption [PJ]	497	1325	781	135	452	559	2969				356	3324
CO_2 emission [kton]												
combustion	15.8	31.5	14.3	7.7	8.2	36.4	99.6	11.1	62.0	2.3	75.3	174.9
energetic process	0.0	4.9	3.3	0.0	0.0	0.1	5.0	2.3	0.0	0.0	2.3	7.4
other	0.1	2.4	0.3	0.0	0.1	0.0	2.6	0.0	0.0	0.1	0.1	2.7
CO_2 storage	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.4	-1.1	0.0	-1.5	-1.5
Total	15.9	38.8	17.8	7.7	8.3	36.5	107.3	13.0	60.9	2.4	76.3	183.5

Table A.8 *Energy balance 2020 without new national and European policy since 2007*

	Households	Industry	Of which chem. ind.	Agri- and horticulture	Trade, services, government	Traffic	Total end use	Refineries	Electr. production	Natural gas and oil extraction	Total energy company	Total
Net consumption [PJ]	390	1276	826	146	314	582	2708	260	511	47	818	3526
coal	0	136	2	0	0	0	136	0	443	0	443	579
oil	3	506	457	0	0	576	1084	194	34	0	228	1312
of which biofuels	0	0	0	0	0	29	29	0	0	0	0	29
natural gas	271	411	262	171	144	0	996	40	424	33	497	1493
steam from nuclear energy	0	0	0	0	0	0	0	0	43	0	43	43
electricity	99	136	36	-28	133	6	346	5	-394	15	-375	-29
heat	18	85	68	3	35	0	141	22	-39	0	-17	124
fermentation gas	0	2	0	0	3	0	5	0	0	0	0	5
Non energetic consumption [PJ]	0	558	440	0	0	3	561					561
coal	0	79	2	0	0	0	79					79
oil	0	390	350	0	0	3	393					393
natural gas	0	88	88	0	0	0	88					88
Extraction [PJ]	10	11	5	0	16	0	36	29	70	0	99	135
heat	10	9	5	0	16	0	35	29	60	0	89	124
of which renewables	2	0	0	0	16	0	18	0	30	0	30	48
of which biomass	7	1	0	0	0	0	8	0	0	0	0	8
electricity	0	1	0	0	0	0	1	0	10	0	10	11
of which renewables	0	0	0	0	0	0	0	0	10	0	10	10
Final electricity [PJ]	99	171	56	26	137	6	438	13	23	19	55	493
Primary energy consumption [PJ]	520	1435	866	112	479	611	3156				370	3526
CO_2 emission [kton]												
combustion	15.6	32.2	15.9	9.7	8.2	40.0	105.6	12.4	73.2	1.9	87.4	193.1
energetic process	0.0	5.2	3.6	0.0	0.0	0.1	5.4	3.7	0.0	0.0	3.7	9.1
other	0.1	2.6	0.3	0.0	0.1	0.0	2.9	0.0	0.0	0.1	0.1	3.0
CO_2 storage	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	15.7	40.1	19.8	9.7	8.3	40.1	113.9	16.1	73.2	2.0	91.2	205.1

Table A.9 *Energy balance 2020 under fixed national and European policy*

	Households	Industry	Of which chem. ind.	Agri- and horticulture	Trade, services, government	Traffic	Total end use	Refineries	Electr. production	Natural gas and oil extraction	Total energy company	Total
Net consumption [PJ]	368	1249	803	146	309	553	2625	238	483	47	768	3394
coal	0	133	2	0	0	0	133	0	426	0	426	559
oil	3	500	451	0	0	537	1040	161	33	0	194	1233
of which biofuels	0	0	0	0	0	39	39	0	0	0	0	39
natural gas	258	401	250	149	148	7	963	55	370	32	456	1419
steam from nuclear energy	0	0	0	0	0	0	0	0	43	0	43	43
electricity	89	133	34	-18	122	9	334	4	-360	15	-342	-8
heat	18	78	66	11	34	0	141	19	-28	1	-8	133
fermentation gas	0	5	0	4	5	0	14	0	0	0	0	14
Non energetic consumption [PJ]	0	549	432	0	0	3	552					552
coal	0	79	2	0	0	0	79					79
oil	0	385	344	0	0	3	388					388
natural gas	0	86	86	0	0	0	86					86
Extraction [PJ]	10	10	5	8	16	0	44	27	118	1	146	190
heat	10	9	4	8	16	0	43	27	62	1	90	133
of which renewables	2	0	0	8	16	0	26	0	30	0	30	56
of which biomass	7	1	0	0	0	0	8	0	2	1	3	12
electricity	1	1	0	0	0	0	2	0	56	0	56	57
of which renewables	1	0	0	0	0	0	1	0	56	0	56	56
Final electricity [PJ]	89	165	51	28	126	9	418	12	22	19	53	470
Primary energy consumption [PJ]	478	1394	835	125	451	582	3030				364	3394
CO_2 emission [kton]												
combustion	14.8	31.4	15.3	8.4	8.4	36.8	99.9	11.2	68.5	1.9	81.5	181.4
energetic process	0.0	5.2	3.5	0.0	0.0	0.1	5.3	3.3	0.0	0.0	3.3	8.6
other	0.1	2.6	0.3	0.0	0.1	0.0	2.9	0.0	0.0	0.1	0.1	3.0
CO_2 storage	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.4	-1.1	0.0	-1.5	-1.5
Total	15.0	39.2	19.0	8.4	8.6	36.9	108.1	14.1	67.4	1.9	83.4	191.5

Table A.10 *Energy balance 2020 upon implementation of intended national and European policy*

	Households	Industry	Of which chem. ind.	Agri- and horticulture	Trade, services, government	Traffic	Total end use	Refineries	Electr. production	Natural gas and oil extraction	Total energy company	Total
Net consumption [PJ]	363	1262	807	183	302	500	2610	238	388	47	673	3283
coal	0	133	2	0	0	0	133	0	315	0	315	448
oil	3	499	450	0	0	485	986	160	33	0	193	1179
of which biofuels	0	0	0	0	0	35	35	0	0	0	0	35
natural gas	255	437	284	128	140	6	966	55	192	8	255	1220
steam from nuclear energy	0	0	0	0	0	0	0	0	43	0	43	43
electricity	87	122	26	-23	117	10	313	4	-266	14	-247	65
heat	19	57	45	20	34	0	129	19	71	24	115	244
fermentation gas	0	15	0	58	10	0	83	0	0	0	0	83
Non energetic consumption [PJ]	0	549	432	0	0	3	553					553
coal	0	79	2	0	0	0	79					79
oil	0	385	344	0	0	3	388					388
natural gas	0	86	86	0	0	0	86					86
Extraction [PJ]	12	10	5	17	15	0	55	28	259	24	312	367
heat	10	9	4	17	15	0	52	28	140	24	192	244
of which renewables	3	0	0	17	15	0	35	0	30	0	30	65
of which biomass	7	1	0	0	0	0	8	0	80	24	105	113
electricity	2	1	0	0	0	0	3	0	119	0	119	122
of which renewables	2	0	0	0	0	0	2	0	119	0	119	121
Final electricity [PJ]	87	166	51	28	125	10	415	12	21	19	51	466
Primary energy consumption [PJ]	459	1390	838	158	424	526	2958				325	3283
CO_2 emission [kton]												
combustion	14.4	33.0	17.0	7.1	7.8	33.2	95.5	11.0	48.0	1.8	60.8	156.3
energetic process	0.0	5.2	3.4	0.0	0.0	0.1	5.3	3.3	0.0	0.0	3.3	8.6
other	0.1	2.6	0.3	0.0	0.1	0.0	2.9	0.0	0.0	0.1	0.1	3.0
CO_2 storage	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.4	-1.1	0.0	-1.5	-1.5
Total	14.5	40.8	20.7	7.1	7.9	33.3	103.7	13.9	46.9	1.9	62.7	166.4

Appendix B Overview policy measures Clean and Efficient

This appendix provides an overview of the policy measures covered by Clean and Efficient in the Reference projection and it shows which measures are part of fixed policy and of intended policy. In the Reference projection all new policy and adjustments of existing policy after 1 January 2007 are attributed to Clean and Efficient. The same applies to post 2007 European policy.

Fixed policy comprises all policy that had already passed the decision stage in October 2009. The starting points for fixed policy have been derived as much as possible from public records and involved departments were consulted if needed.

The intended Clean and Efficient policy comprises policy that had not passed the decision stage in October 2009 or policy that lacked concrete implementation and dimensions. The implementation has primarily been derived from the working programme Clean and Efficient and supplemented with other proposed measures with regard to energy and climate policy, such as surcharge on the electricity price to generate additional subsidy funds for renewable energy. In those cases where the intended policy was insufficiently concrete to allow for calculations, the departments indicated which dimensions the Reference projection should assume.

B.1 Traffic and transport

VO = Clean and Efficient – intended policy / VA = Clean and Efficient fixed policy
NG = Clean and Efficient – not instrumented
NL = Dutch policy
EU = European policy

Table B.1 *Traffic and transport policy*

Measure C&E and corresponding instruments	Instrument description[50]	Status and category
Alternative fuels **46. Higher deployment sustainable biofuels**		
Transport Biofuels Act	Obligation for fuel suppliers: Minimum share of 4.0% biofuels (based on energy content) for transport as of 2010.	VA - NL
Renewable Energy Directive	Target of at least 10% transport fuels from renewable sources in 2020 (biofuels, electricity or hydrogen, each with additional provisions such as sustainability criteria for biofuels). This must be instrumented at the national level (in NL planned for summer 2010; see under intended policy). **Note:** This more drastic target at EU level has not been included as fixed policy because the target has not yet been instrumented in the Netherlands. Because the Fuel Quality Directive (see below) is assumed to be fixed policy, a large part of the Directive will be realised without setting up a Dutch instrument for this guideline.	VA - EU
(Adjusted) Fuel Quality Directive (98/70/EC)	Demands fuel producers to realise a 6% greenhouse gas emission reduction between 2010 and 2020 (for example by deploying biofuels or preventing flaring). Moreover the Directive imposes sustainability criteria on biofuels. Moreover, after 2012 the EU can oblige its Member States to realise an additional 2 × 2% by means of other options in the fuel production chain such as CCS and CDM (these will probably be less relevant for the impact on the transport sector). **Assumptions for the projection – fixed policy:** The 6% demand with regard to fuel producers does not require further instruments at the national level and is therefore part of fixed policy.	VA - EU (+NL)
Intended policy	In line with the Renewable Energy Directive, the Netherlands must realise the minimum policy target of a 10% share. A scenario with policy target 20% was also examined for the Netherlands, but no subsequent action has been taken. **Assumptions for the projection – intended policy** For the projection it was assumed that the policy will focus on a 10% target for 2020 in which the instruments are assumed to be comparable with the current national policy (with double counting regulation for a number of (2nd generation) biofuels). A separate obligation for the minimal share of 2nd generation fuels will not be introduced. The sustainable use of hydrogen and electricity will also be included analogous to the Renewable Energy Directive, but its influence will be limited.	VO - NL
47. Tender for the introduction of innovative biofuels		
Tender scheme innovative biofuels	First tender completed. Follow-up is still unclear: this depends on the decision about biofuels that is expected spring 2010 (see 46 decision Biofuels) **Assumptions for the projection - intended policy** There will be no follow-up.	NG - NL

[50] Instrument description including target group/sub category, subsidy/fiscal/standards (incl. financial and sanctions/enforcement related details), implementing body and start date/phasing).

Measure C&E and corresponding instruments	Instrument description[50]	Status and category
48. Enhancement of alternative fuels		
Incentivising filling stations including natural gas and bio-ethanol.	1. Subsidy programme TAB (Alternative Fuels Filling Station programme) Outline: a. Subsidy programme established in collaboration with the provinces; provinces also make subsidy budget available; b. Owners of filling stations receive subsidy upon request when they open a filling station that offers natural gas/green gas, bio-ethanol (E85) or biodiesel (B30). c. The subsidy is distributed via a tender system, in which the subsidy amount (of the applicant) is the main tender criterion. d. Owners of filling stations are encouraged to offer the natural gas as green gas. Subsidy applicants that offer natural gas as green gas will eligible for subsidy sooner. It is assumed that 'biogas' will be used in the generating sector and can therefore not be booked under transport. e. To realise a network that covers the entire country, a limited number of filling stations per province are subsidised. f. The Dutch Ministry of Transport, Public Works and Water Management offers €2.5 mln subsidy. €1.0 mln is dedicated to realising the natural gas filling stations, €0.3 mln for conversion or newly built E85 filling stations and €0.3 mln for the conversion or newly built B30 filling stations. g. The fuels must be available at the filling stations before 1 September 2010. In 2009 a second subsidy round was opened by TAB. Provinces and several urban regions will provide contributions too, thus realising a subsidy ceiling of €4.3 mln (including the previous budget). **Assumptions for the projection - fixed policy:** The above-mentioned scheme with €4.3 mln budget. **Assumptions for the projection - intended policy** There will be no follow-up of this scheme and no additional budget. NB: This scheme has been included in the assessment of the future fuel mix. 2. MAIL, Market introduction driving on natural gas With regard to new natural gas filling stations that will be opened, the market (owners of large car fleets) will be approached to list (and stimulate) how (part of) the car fleet can switch to natural gas. NB: This scheme has been included in the assessment of the future fuel mix. 3. Fiscal greening See letter of the Ministry of Finance on natural gas and intended excise rebate on E85 (see amendment below) and the concept Tax plan. General comment: Tax plan 2008 and 2009 are part of fixed policy, whereas 2010 is part of intended policy.	VA - NL VA - NL VO - NL VA - NL VO – NL (Fiscal

Measure C&E and correspond-ing instruments	Instrument description[50]	Status and category
		greening – first announcement Tax Plan 2010)
Incentivising ‘electric driving’	An action plan for electric driving has been worked out by the Ministry of Transport, Public Works and Water Management and the Ministry of Economic Affairs, which was presented to the Lower Chamber on July 3rd 2009. Part of the Action plan consists of making € 65 mln available for incentivising electric driving (this budget is fixed policy, See action plan for distribution into subareas). Electric driving is also made fiscally attractive (see Section 2.1 of Fiscal greening letter), but this is considered intended policy. The action plan has included an indicative value of 200,000 electric vehicle equivalents. On top of this there are also local initiatives. **Assumptions for the projection - intended policy** No additional budget will become available.	VA & VO - NL
Pricing/volume policy **49. ABvM Paying differently for mobility**		
Pay as you drive	Pay as you drive is included in the projection as intended policy because the parliamentary decision about the shape, implementation and instruments has not been completed. **Assumptions for the projection - intended policy** • Introduction in 2011 for freight transport and 2012-2016 for passenger cars, delivery vans and auto buses; • Cost neutral conversion of the road tax (except for European minim tariff for lorries) and the (full) tax on passenger cars and motorcycles incorporated in the kilometre price. The run-down of the tax on passenger cars and motorcycles is finished in 2018. • CO_2 dependent tariff setting for passenger cars, tariff setting depending on weight for other vehicle categories. NB: The tariff setting used by ECN and PBL in the projection deviates from the Pay as you drive Bill, because the bill was not timely available for the projection.	VO - NL
50. Internalising external costs freight transport		
Revision Eurovignette directive	At the EU level options are explored to internalise external costs in freight traffic. The Netherlands will subsequently explore options for introduction in the Netherlands. **Assumptions for the projection - intended policy** No policy expected in the short term.	NG - EU/NL
Energy efficiency vehicles **51. EU standard CO_2 emission new passenger cars (possibly expanded with delivery vans).**		
EU standard CO_2 emission new vehicles	Standard of 130 grams CO_2 per kilometre (g/km) for newly sold cars (differentiated into weight class) as of 2015. In 2012-2014 this standards will already apply to 65%, 75% and 80% of all new cars. Electric vehicles,	VA - EU

Measure C&E and corresponding instruments	Instrument description[50]	Status and category
	plug-in hybrids and eco-innovations (energy saving measures not tested in the test drive, e.g. energy efficient air-conditioning) can lead to a reduction of up to 7 g/km. Fine swill be charged if the standard is exceeded. Until 2019 the fines for small exceedings will be small. Moreover, the aim is to realise an additional reduction of 10 g/km for new vehicles by means of additional measures in the areas of safety and biofuels (see regulations on rolling resistance below and fixed/intended policy biofuels). Current European legislation for the 2015 standard also mentions a 2020 target of 95 g CO_2/km. This target has not been instrumented and is therefore considered intended policy in the projection. **Assumptions for the projection - intended policy** The 95 g CO_2/km standard for 2020 will be introduced with a comparable utility curve as used for the current standard of 130 g CO_2/km. It is assumed that the fines linked to exceeding the standard will cause car manufacturers to adhere the standard as of 2020. Implementation by means of phased introduction (increasing shares) will not be needed and options for deductions will expire. Electric vehicles are counted as zero emission vehicles.	(instrumented elsewhere) VO - EU
Regulations for rolling resistance of tyres (incl. label system)	Regulations ((EC) no 661/2009) states requirements with regard to type approval concerning safety of vehicles. It arranges, for example, the introduction of energy saving tyres for passenger cars and delivery vans in 2012 (for new types of tyres; replacement market 2014) with a second stage in 2016 (for new types of tyres; replacement market 2018). The replacement market for truck tyres has two years respite (2016, 2020). The regulation also requires new cars to be equipped with a tyre pressure monitoring system and a Gear Shift Indicator as of 2012. Proposed regulation is currently submitted to introduce a labelling system for tyres (COM(2009) 348 final/2; 2008/0221 (COD)).	VA - EU VO - EU
EU standard CO_2 emission new delivery vans	An EU Communication of 2007 announced a CO_2 standard for new delivery vans for 2012 (175 g/km) and 2015 (160 g/km). **Assumptions for the projection - intended policy** A standard is implemented according to the same system as the CO_2 standard for passenger cars (based on utility curve and fines for exceedings). It is assumed that the announced standards will be implemented according to plan and not be further tightened. There will be no obligatory phased introduction and there will be no deductions. **Note:** The European Commission has meanwhile published a legislation proposal containing targets that deviate from previous communications. These targets were not included in the projection.	VO - EU
52. Innovation: Car of the future		
Sustainable procurement government	The government will introduce sustainable procurement for all its purchases, including its car fleet. As of 1 January 2010 the following criteria apply to sustainable procurement.	VA - NL
Pilot projects for Sustainable Mobility – Electric transport	Action plan to incentivise (pilot projects for) electric driving has been elaborated (details: see below under item 48).	VA & VO - NL

Measure C&E and corresponding instruments	Instrument description[50]	Status and category
Pilot projects for Sustainable Mobility - Hydrogen and Pilot Projects for Sustainable Mobility - Other	A similar trajectory will probably be created for hydrogen. In fall, the pilot project for driving on biogas/ higher blends of biofuels will launch an action plan. **Assumptions for the projection - intended policy** The hydrogen regulation will be launched in the fall of 2009. Concerns 5 mln from pilot projects sustainable mobility + contribution from means new gas.	VO/NG - NL
53. Research of further efficiency improvement freight transport		
Sustainable logistics programme	The Sustainable Logistics Programme (duration 2007-2012, €20 mln) focuses on business innovations with regard to CO_2 emission reduction rollout in sub branches. The PDL is an implementation programme that provides the basis of the sectoral agreement Sustainability in Mobility. Further quantification not available. **Assumptions for the projection - intended policy** No additional budget foreseen for the period after 2012.	VA - NL
54. Fiscal greening of mobility		
Excise duties on fuels	Tax Plan 2008/2009 (fixed policy) and tax plan 2010 (intended policy): Excise increase diesel/LPG as of 2008, measures for red diesel in accordance with tax plan 2008. Excise policy for alternative fuels (biofuels, CNG, exemption for hydrogen).	VA - NL
Energy labelling new passenger cars	Introduction of the energy label for passenger cars in the Netherlands based on relative fuel consumption. Another EC proposal may follow but the content of this proposal is unknown and therefore not included as intended policy.	VA - EU/NL
Differentiation in tax on passenger cars and motorcycles based on energy labels	Incl. tightening from Tax plan 2008.	VA - NL
Environmental differentiation (fine particles) tax on passenger cars and motor vehicles for diesel passenger cars.	In accordance with Tax plan 2008	VA - NL
Discount on tax on passenger cars and motorcycles for hybrid cars with label A or B.	Discount on tax on passenger cars and motor vehicles for hybrid cars with label A or B.	VA - NL
Exemption from tax on passenger cars and motorcycles for so-called zero emission vehicles (H_2 and EV)	In accordance with Tax plan 2008	VA - NL
CO_2 surcharge Tax on passenger	In accordance with Tax plan 2008	VA - NL

Measure C&E and corresponding instruments	Instrument description[50]	Status and category
cars and motorcycles for inefficient cars		
Lowering road tax for very efficient cars	In accordance with the Tax plan 2008 (50% regular tariff) and 2009 (25% regular tariff)	VA - NL
Increasing additional tax liability company cars to 25%	In accordance with Tax plan 2008	VA - NL
Lowering additional tax liability (very) efficient company cars	In accordance with the Tax plan 2008 914% for very efficient company cars) and 2009 (20% for very efficient company cars)	VA - NL
Shifting part of the tax on passenger cars and motorcycles to road tax (refuge)	In accordance with the Tax plan 2008 and 2009, 5% annual run-down of the tax on passenger cars and motor vehicles in the road tax between 2008 and 2012 (compared to the level of 2007). In 2013 the run-down will be 12.5%.	VA - NL
Basis for Tax on passenger cars and motorcycles switches from catalogue price to CO_2 emission	In accordance with Tax plan 2009	VA - NL
Other adjustments road tax	In accordance with the Tax plan 2009; cars on natural gas lowered to level petrol cars; increase for motor cycles, increase for EURO 0, I and II lorries	VA - NL
Plan 2010)	The Tax plan 2010 was included in the projections as intended policy, because the parliamentary decision-making process was not yet completed at the time of writing the projection. The Tax plan comprises the following measures, among others: • Increase in bonus for category efficient passenger cars in the tax on passenger cars and motorcycles; • Technical correction natural gas cars in the passenger cars in the tax on passenger cars and motorcycles • Abolishing the road tax for very efficient passenger cars; • Intensifying investment facilities for very efficient cars; • Granting exemption to zero emission cars in the tax on passenger cars and motorcycles • Lowering the additional tax liability for zero emission cars; • Incentivising Euro-6 diesel passenger cars in the tax on passenger cars and motorcycles; See letter on greening 2010 and draft Tax plan 2010 for details.	VO - NL
55. Innovation public transport buses		
Tender scheme innovative buses	A tender scheme in which 10 million euros were awarded to six projects (for different types of hybrid buses and buses on natural gas and hydrogen. Scheme is finished, evaluation will follow. **Assumptions for the projection - intended policy** In the projection we assume that there will be no follow-up.	VA - NL (but finished)

Measure C&E and corresponding instruments	Instrument description[50]	Status and category
Behaviour. **56. Information for changing behaviour traffic and transport**		
Eco-driving phase 1 -3	Stimulate more efficient driving behaviour by means of information campaigns and information services (through various channels). Concerns driving behaviour but also tyre pressure and efficient tyres.	OU - NL
Eco-driving phase 4	Recent extension. See progress report for details. **Assumptions for the projection - intended policy** No concrete intentions for subsequent phases.	VA - NL
'Voortvarend besparen' (Effective saving)	Target: 5% energy saving in 2007-2010 through behavioural change (largest part of this energy use is not attributed to the Netherlands)	VA - NL
57. Outline of new instruments to incentivise more efficient transport modalities		
General	Few changes expected for the short term. The EC has presented a white paper announcing intensification in the field of sustainable freight transport. **Assumptions for the projection - intended policy** No concrete policy.	NG - NL NG - EU
Incentivising bicycle use	Implementation often left to the local authorities. A proposal is currently being drafted. End of August secretary of state Huizinga will send a letter to the Dutch Lower Chamber to explain the policy efforts aimed at promoting cycling. Details still unknown. **Assumptions for the projection - intended policy** The letter will be sent to parliament end of August 2009. Concerns for instance 10 million expenditure by MP Atsma. In a way intensifies existing cycling policy (e.g. commuter traffic, which is already covered by policy, incl own targets)	VO - NL
58. Task force mobility management		
Reduction of (car) mileage during rush hour and drive back work related mobility or make it more efficient	Initiative aimed at 5% reduction of cars during rush hour. An amount of €40 million is available for implementing measures/advice of the task force mobility management. An additional €10 million is available from the action plan Railway for a mobility management project in SME (intended for individual advice for SME entrepreneurs). The largest part of the 40 million will be spent indirectly on for example a mobility broker, communication (conferences, leaflets, information meetings, websites, etcetera), and making a list of best practises. 30 million will be allocated to the various regions. They will spend it on a large number of small projects such as incentivising cycling, teleworking, etcetera. The other 10 million will be spent on centralised projects, e.g. 1.8 million for a knowledge centre for CLA negotiators, 0.8 million for a pilot with digital mobility in the Amsterdam region.	VA - NL
Other (relevant) policy **Miscellaneous - general**		
LTA Dutch Railways (NS) - share	Until now the following agreements were made in the framework of the LTA. These targets have already been	OU – NL

Measure C&E and corresponding instruments	Instrument description[50]	Status and category
of renewable electricity and target for efficiency improvement	realised or will be shortly: • 20% energy efficiency improvement in 2010 compared to 1997. • 5% sustainable procurement of traction energy in 2010. In the sectoral agreement for the Dutch Railways an absolute target has been included to reduce the CO_2 emission in 2020 with 20% compared to 1990. A follow-up LTA is currently discusses with the Dutch Railways. Making the CO_2 (which is more accurately measurable due to availability of data) target for 2020 more concrete implies a relative reduction of the emission per traveller's kilometre of 20% compared to 2008, assuming that the emission factor of electricity improves with 10% as a result of the sector becoming more sustainable (starting point is 15.4 bln kilometres today growing to 21.5 bln in 2020).	VA - NL (g/km in sectoral agreement) VO - NL Follow-up LTA
VAMIL/MIA scheme	Fiscal facility incentivising investments in sustainable transport for example. See: http://www.senternovem.nl/vamil_mia/english.asp For example: **Public charging point for electric vehicles or vessels** (Code: F 2041) Description: a. intended for: Charging batteries of vehicles and vessels that have an electric engine as main engine at the electricity grid or a fuel cell via a public electricity charging point at a parking place where the electricity take-up is immediately measured, b. consists of: A charging system, a measuring system (optionally) a payment system and (optionally) a plug recognition system. Explanation: Charging points that are not freely accessible are not eligible for environmental deduction and the voluntary depreciation on environmental investments The following amendments have been made in the framework of Clean and Efficient (fixed policy): On 26 June 2009 the Dutch Ministry of the Environment published an interim amendment to the schemes in the Staatscourant, allocating € 20 mln for this purpose. This has increased the financial benefits of the largest part of the capital equipment on the Environmental list (e.g. sustainable stables and electric vehicles). The largest part of the capital equipment has now received s fiscal benefit of 14% (depending on the additional costs compared to the conventional alternative). The remaining amount (€10 mln) will be used for the next interim amendment in the third quarter of 2009. The ministry of the Environment will use the Dutch national framework for temporarily granting limited financial support residing under the temporary European support framework for the economic crisis. As the criteria of the framework will be met, there is no need to report separately to Brussels.	OU - NL VA - NL
EIA-scheme	Fiscal facility incentivising investments in energy efficient transport for example. See: http://www.senternovem.nl/eia/	OU - NL
Policy for air quality		

Measure C&E and corresponding instruments	**Instrument description**[50]	**Status and category**
VERS scheme inland shipping	The subsidy scheme diesel engines for inland shipping is a scheme of the Ministry of the Environment. The scheme aims to reduce the NO_x emissions of inland shipping. The scheme is in operation since 2005. In 2009 the scheme will also be implemented, however, only retrofit installations are eligible for subsidy. This is due to the fact that CCR II engines are obligatory as a result of European legislation as of 1 July 2007.	VA - NL
IMO-regulation (International Maritime Organization) SECAs (SOx Emission Control Areas) and NO_x emissions sea shipping (agreement fall 2008)	Tightening the emission regulation for sea-going vessels: • Maximum sulphur content sea shipping fuel in SECAs (including the North Sea) will be lowered to 1.0% as of 2010 and to 0.1% as of 2015. • Tightening the NO_x emission standards for new and existing sea-going vessels.	VA
Budget Day (Prinsjesdag) package 2005 and measures from the tax plans 2008 and 2009	An overview can be found in Annex 1 of the National Collaboration programme Air Quality (NSL) measures 1-14.	VA - NL

Status:
OU = Old
VA = Clean and Efficient – fixed policy
VO = Clean and Efficient - intended policy / VA = Clean and Efficient fixed policy
NG = Clean and Efficient - not instrumented
Possibly all NG entries need to be specified with regard to their status. It is difficult to establish if it is fixed or intended policy if it has not been instrumented. An important distinction is whether concrete action is taken or whether it is planned for the future.
Category:
NL = Dutch policy
EU = European policy

B.2 Policy industry, energy and agriculture

Table B.2 *Policy industry, energy and agriculture*

Sub-sector	Policy instrument	C&E free	Fixed policy	Intended policy
General	VAMIL (voluntary depreciation of environmental investment)	Only limited share of the eligible capital equipment is energy related	Only limited share of the eligible capital equipment is energy related	Only limited share of the eligible capital equipment is energy related
General	EIA (Environmental Impact Assessment)	Yes	Yes, budget was increased	Yes, budget was increased
General	Expenditure of auction revenues ETS	No destination established	No destination established	No destination established
CHP	Subsidy heating infrastructure	None	None	Reservation 40 million
CHP	EIA (Environmental Impact Assessment)	Yes	Yes, budget was temporarily increased (2009-2010)	Yes, budget was temporarily increased (2009-2010)
CHP	Safety net scheme	No	No	Safety net scheme for large industrial CHP (natural gas fired CCGTs with a minimum capacity of 150 MW_e). The subsidy ceiling based on the scheme for 2010 amounts to 168 million euros The subsidy period is 12 years, but the scheme will not be open anymore after the third trade period of the EU ETS.
CHP	Congestion management	No	No	Not for CHP
CHP	Micro CHP	No policy		
Industry	MEE (Long-term Agreement Energy Efficiency ETS enterprises)	Not	Yes MEE Covenant was signed on 2 October 2009. Comparable to LTA-3. Companies commit themselves to a number of activities: Drafting an energy saving plan once every four years (when efficient measures are taken (TVT 5 years), which other saving options), annual monitoring (which measures taken, effect) and preparing pre-studies and route maps (long term). If	Yes MEE Covenant was signed on 2 October 2009. Comparable to LTA-3. Companies commit themselves to a number of activities: Drafting an energy saving plan once every four years (when efficient measures are taken (TVT 5 years), which other saving options), annual monitoring (which measures taken, effect) and preparing pre-studies and route maps (long term). If

Sub-sector	Policy instrument	C&E free	Fixed policy	Intended policy
			companies fail to meet their obligation (no plan or no implementation of plan) they will be expelled from the covenant (after a warning).	companies fail to meet their obligation (no plan or no implementation of plan) they will be expelled from the covenant (after a warning).
Industry	Benchmarking covenant	Expires in 2012, partly overruled by ETS already (some obligations can also be met by buying CO_2 allowances)	Succeeded by MEE	Succeeded by MEE
Industry	LTA-3	Not, LTA-2 has ended.	Yes Companies commit themselves to a number of activities: Drafting an energy saving plan once every four years (when efficient measures are taken (TVT 5 years), which other saving options), annual monitoring (which measures taken, effect) and preparing pre-studies and route maps (long term). If companies fail to meet their obligation (no plan or no implementation of plan) they will be expelled from the covenant (after a warning).	Yes Companies commit themselves to a number of activities: Drafting an energy saving plan once every four years (when efficient measures are taken (TVT 5 years), which other saving options), annual monitoring (which measures taken, effect) and preparing pre-studies and route maps (long term). If companies fail to meet their obligation (no plan or no implementation of plan) they will be expelled from the covenant (after a warning).
Industry	Environmental permit	Not for Bench mark and LTA-2 companies, only after 2012 when the BM and LTA-2 end	Not for MEE/LTA-3 companies	Not for MEE/LTA-3 companies
Industry	EIA (Environmental Impact Assessment)	Yes	Yes, temporarily increased	Yes, temporarily increased
Industry	VAMIL (voluntary depreciation of environmental investment)	Only limited share of the eligible capital equipment is energy related	Only limited share of the eligible capital equipment is energy related	Only limited share of the eligible capital equipment is energy related
Industry	ETS	20 €/ton CO_2	20 €/ton CO_2	20 €/ton CO_2
Industry	Ecodesign guideline	Not	Yes	Yes
Energy	Coal covenant	Expires in 2012	Expires in 2012	Expires in 2012
Energy	MEP (Environmental Quality of Electricity production)	Terminated, existing orders end before 2020	Terminated, existing orders end before 2020	Terminated, existing orders end before 2020
Energy	SDE	Not	Available budget is starting point About	Cf. Paasbrief (Easter letter): Budget

Sub-sector	Policy instrument	C&E free	Fixed policy	Intended policy
			1 billion euros	available for 35% renewable energy in 2020. Starting points include 6000 MW onshore wind Financing by surcharge on electricity tariff linked to the energy taxation brackets Starting point for SDE surcharge 50-50 division citizens and businesses, division over first 3 energy taxation brackets. Surcharge will apply to new orders as of 2013.
Energy	Obligatory biomass co-combustion	Not	Not	Not
Energy	Congestion management	No	No	Priority for renewables in case of transport scarcity
Energy	CCS	No	Small scale demo projects capture and storage realised	Large-scale demos operational in 2015
Agriculture	EIA (Environmental Impact Assessment)	Yes	Yes, temporarily increased	Yes, temporarily increased
Agriculture	MEP (Environmental Quality of Electricity production)	Terminated, existing orders end before 2020	Terminated, existing orders end before 2020	Terminated, existing orders end before 2020
Agriculture	SDE	Not	Available budget is starting point. About 1 billion euros	Cf. Paasbrief (Easter letter): Budget available for 35% renewable energy in 2020. Starting points include 6000 MW onshore wind Financing by surcharge on electricity tariff linked to the energy taxation brackets Starting point for SDE surcharge 50-50 division citizens and businesses, division over first 3 energy taxation brackets. Surcharge will apply to new orders as of 2013.
Agriculture	Transition scheme Subsidy scheme generation of renewable electricity in digestion installations.			
Agriculture	Covenant Agricultural sectors	Not	Yes Agricultural covenant closed on 10 July 2008.	Yes Agricultural covenant closed on 10 July 2008.
Agriculture	Programme for Sustainable Chains and			

Sub-sector	Policy instrument	C&E free	Fixed policy	Intended policy
	Energy saving			
Agriculture	LTA-3	Not, LTA-MJA2 has ended.	Yes Companies commit themselves to a number of activities: Drafting an energy saving plan once every four years (when efficient measures are taken (TVT 5 years), which other saving options), annual monitoring (which measures taken, effect) and preparing pre-studies and route maps (long term). If companies fail to meet their obligation (no plan or no implementation of plan) they will be expelled from the covenant (after a warning).	Yes Companies commit themselves to a number of activities: Drafting an energy saving plan once every four years (when efficient measures are taken (TVT 5 years), which other saving options), annual monitoring (which measures taken, effect) and preparing pre-studies and route maps (long term). If companies fail to meet their obligation (no plan or no implementation of plan) they will be expelled from the covenant (after a warning).
Agriculture	Covenant greenhouse horticulture and environment (GLAMI)	The GLAMI Covenant expires	The GLAMI Covenant expires	The GLAMI Covenant expires
Agriculture	Continue agreements greenhouse as energy source	Not	Yes	Yes
Agriculture	Growth area of (semi) closed greenhouse / subsidy scheme MEI (Market introduction of energy innovations)	Not	Yes, including acceleration programme for implementation of semi-closed greenhouses (Greenhouse as energy source) Assumed that MEI scheme will be continued at the same level until 2020	Yes, including acceleration programme for implementation of semi-closed greenhouses (Greenhouse as energy source) Assumed that MEI scheme will be continued at the same level until 2020
Agriculture	Energy networks scheme/clustering with greenhouse horticulture/heat maps	Not	Not	Yes, energy networks scheme to be tested by Brussels. Aimed at waste heat, CO_2 supply with minimally one of the involved parties being a greenhouse horticulture business. Budget 22.5 million euros during 3 years Assumption projection: Continuance of annual budget at the same level until 2020.
Agriculture	Greenhouse innovations and geothermal heat (MEI + Guarantee facility geothermal heat)	Not	MEI scheme assumed to be continued at the same level until 2020. Assumed that MEI scheme will be continued at the	MEI scheme and guarantee facility geothermal heat MEI scheme assumed to be continued at the same level until

Sub-sector	Policy instrument	C&E free	Fixed policy	Intended policy
			same level until 2020	2020. Guarantee facility yet to be tested by Brussels and is budget neutral when proceeding as planned. Possible taken over by market parties in time.
Agriculture	CO_2 sector system	Not	Not	How to fill in the CO_2 settlement system still needs to be established. Basis for emissions: Gas use plus settling heat supply, CO_2 supply CO_2 price incentive: To be based on ETS (for now 20€/tonne CO_2). Ceiling: Cf target Clean and Efficient. Exceeding of sector ceiling will be compensated by purchasing CO_2 allowances In time also a provision for the settlement of the sector's emissions below the ceiling Ministry of the environment is working on a different management of emissions.
Agriculture	Annual working programmes small sectors	Not	Yes Agreed in the agricultural covenant.	Yes Agreed in the agricultural covenant.
Agriculture	Innovation programme bio-based economy	Not	Yes Is part of the Innovation Agenda.	Yes Is part of the Innovation Agenda.
Agriculture	SBIR (Small Business Innovation Research programme)	In 2006 once-only SBIR tender	Yes	Yes
Agriculture	Green label greenhouse	Yes	Yes	Yes
Agriculture	IRE (Investment Scheme Energy Saving)	Yes	Yes	Yes
Agriculture	UKP (Unique Opportunities Scheme)	No	Yes, Unique opportunities scheme sustainable heating and cooling.	Yes, Unique opportunities scheme sustainable heating and cooling.
Agriculture	CO_2 supply	No	Yes	Yes
Agriculture	MIA (tax refund on environmental investment)	Only limited share of the eligible capital equipment is energy related	Only limited share of the eligible capital equipment is energy related	Only limited share of the eligible capital equipment is energy related
Agriculture	VAMIL (voluntary depreciation of environmental investment)	Only limited share of the eligible capital equipment is energy related	Only limited share of the eligible capital equipment is energy related	Only limited share of the eligible capital equipment is energy related

Sub-sector	Policy instrument	C&E free	Fixed policy	Intended policy
Agriculture	ETS	20 €/ton CO_2	20 €/ton CO_2	20 €/ton CO_2

B.3 Policy for the built environment

Table B.3 *Policy for the built environment*

Sub-sector	Policy instrument	Policy free	Fixed policy	Intended policy
Electricity	EU Ecodesign and adjustment of EU energy labels	n.a.	Adjustment of EU energy labels household appliances: dishwashers, washing machines, refrigerators, freezers, TVs, air-conditioners and ovens. Plus Ecodesign regulations for 9 product groups, established by the EC Households: Televisions, stand-by use, battery chargers, refrigerators and freezers, indiv. set-top boxes, lighting. Utility: Office lighting, stand-by use, electronic engines, circulators in buildings	In addition to fixed policy, Ecodesign requirements are also under preparation and study available: Central heating and warm tap water, PCs, copiers, scanners and printers, air-conditioners, ventilators, pumps, commercial refrigeration/freezer equipment, washing machines, dishwashers, dryers, complex set-top boxes and additional domestic lighting (i.e. halogen)
	SDE surcharge	n.a.	n.a.	Yes
General	Climate covenant with provinces and municipalities	n.a.	Flanking	Flanking, But more specific attention for enforcement of Environmental Protection Act in utility buildings[51]
	SLOK scheme (Stimulating Local Climate Initiatives)	n.a.	Flanking	Flanking
	Dutch National Heating Expertise Centre	n.a.	Flanking	Flanking
	Energy labelling	Flanking	Flanking	Flanking
	Innovation Agenda	n.a.	Flanking	Flanking
	Energy Tax	Yes, current pricing	Yes	Yes

[51] Research of energy saving measures (in case of electricity use of > 200.000 kWh/year and a gas use of > 75,000 m^3/year, all measures to be taken with a cost recovery period of 5 years (with electricity use of > 50,000 kWh/year and gas use of 25,000 m^3/year.

Sub-sector	Policy instrument	Policy free	Fixed policy	Intended policy
Construction new houses Dwellings and Utility	EPC (Energy Performance Coefficient) And Spring Agreement	Current EPC	Current EPC • Tightening still awaiting approval by Parliament • Spring Agreement no monitoring data yet	EPC tightening dwellings to 0.6 in 2011 and 0.4 in 2015 U construction tightened 50% in 2017 and Spring Agreement is supporting
	Role model The Dutch Government Buildings Agency	n.a.	n.a. No monitoring data yet	The Government Buildings Agency is building below the 25% standard. (is about 20% of the public administration sector)
Existing buildings Utility	Widening EIA (Energy Investment Tax Deduction)	EIA was already in place before Clean and Efficient policy The EIA effect amounts to about 11% It includes High efficiency glazing, insulation, lighting and control systems, Ventilation with heat recovery, heat pumps, heating boiler, solar boiler and hot and cold storage. [52]	On 1 January 2008 the new energy performance advice (EPA) was added to the Energy list as a new measure and as of 1 January 2009 the EIA will be extended with a bonus measure. A bonus will be supplied if the minimum of Label B is realised or in case of a label improvement of at least 2 label steps. Thus, post-insulation combined with other improvements to installations becomes more attractive.	Same as under fixed policy.
	More with less Covenant	n.a.	Advice and process management Starts in 2009. Only Education receives 165 mln subsidy from crisis package for ventilation and energy saving until 2011.	Same as fixed policy, but in addition to education also focused on healthcare and offices. All building related measures (insulation, lighting and installations) with a payback time of less than 5 years are applied more often in these sectors.
	Sustainable procurement government	n.a.	n.a. No monitoring data yet	
Existing dwellings. Private property	More with Less Covenant	n.a.	When dwellings change owners, 10% of these dwellings with label C or lower will save 20% energy.	Same as under fixed policy.

[52] The investment amount reported for these building related energy investments amounted to M€ 40 in 2006 and over M€ 53 in 2007.

Sub-sector	Policy instrument	Policy free	Fixed policy	Intended policy
	Subsidy Custom Energy Advice	n.a.	Flanking, advice costs up to maximally 200 euros per dwelling	Flanking
	More with Less incentivisation premium (20% saving or 1 label step premium of €350) 30% saving or 2 label steps premium €750 until the end of 2010)	n.a.	Flanking	Flanking
	Green Funds Scheme	Flanking	Flanking	Flanking
	National green loans for energy saving (Energiebesparingskrediet Rijk –EBK) offers loans for energy saving at a lower interest rate until the end of 2011	n.a.	Flanking	Flanking
	Sustainability loan to be obtained from municipalities: cheaper loans for energy saving	n.a.	Flanking	Flanking
	VAT lowered for insulation	n.a.	11% lower investment cost for wage cost insulation (excl. window insulation)	Same as under fixed policy.
	Subsidy Low-E glazing	n.a.	Lowering cost of Low-E glazing with 20% and creating benefit of maximally 1100 euros per dwelling, 50 mln budget for 2009-2011.	Same as under fixed policy.
	Subsidy Scheme for Renewable Heating	n.a.	66 mln for solar boilers, heat pumps and micro-chp in period 2008-2011	Same as under fixed policy.
Sub-sector	Policy instrument	Policy free	Fixed policy	Intended policy
Existing housing corporations	Covenant	n.a.	The corporations jointly realise 1.25 billion of the promised 2.5 billion of additional investments in energy saving measures.	Same as under fixed policy.

Sub-sector	Policy instrument	Policy free	Fixed policy	Intended policy
	VAT lowered for insulation	n.a.	11% lower investment cost for wage component insulation (excl. window insulation)	11% lower investment cost for insulation
	Subsidy Low-E glazing	n.a.	Lowering cost of Low-E glazing with 20% and creating benefit of maximally 1100 euros per dwelling, 50 mln budget for 2009-2011.	Same as under fixed policy.
	Subsidy scheme for renew-able heating	n.a.	66 mln for solar boilers, heat pumps and micro-chp in period 2008-2011	Same as under fixed policy.
	Adjusting the Property valua-tion system	n.a.	N.a. because not yet finalised	Proposal to link the height of the rent to the energy label by adjusting the property valuation system
	EIA	n.a.	The EIA is a fiscal measure, landlords get 11% of the investment amount back from the Tax au-thorities Per dwelling a maximum of €15,000 is eligible for EIA. Precondition is that the invest-ment involves measures from the Custom Energy Advice and that an improvement of at least two label steps is realised. These are investments made between 1 June 2009 and the end of 2020. A total of €277,50 million is available for this measure.	Same as under fixed policy.
Existing dwellings – private rental dwellings	More with Less covenant	n.a.	More with less is not yet developing initiatives for private rental. In private rental financial re-sults are more important than energy saving. In-vestments are minimalised. Once dwellings need to be renovated to make them rentable they will be sold.	Same as under fixed policy.

B.4 Policy for other greenhouse gases

Table B.4 *Policy for other greenhouse gases*

Measure C&E and corresponding instruments	Instrument description	Status
Agriculture		
The emission of other greenhouse gases from agriculture is mainly influenced by manure and ammonia policy. The Reference projection assumed the fixed manure and ammonia policy (e.g. Action Plan Nitrate guideline and the Ammonia Emissions Decree for Livestock Housing). It is assumed that milk quotes and the animal rights system in intensive animal husbandry will expire in 2015.		
Covenant Clean and Efficient Agriculture	Agreements on emissions reductions to be realised and generating biogas.	Fixed
SDE for co-digestion	Subsidy scheme for the production of biogas by co-firing manure	Fixed (current budget) Intended (extended budget)
Other sectors		
BEMS (decree on emission regulation mid-sized combustion plants)	Inclusion of standards for CH_4 emission from gas engines	Fixed
BEMS (decree on emission regulation mid-sized combustion plants)	Tightening the standards for CH_4 emissions from gas engines	Intended
EIA-VAMIL (Energy Investment Tax Deduction/voluntary depreciation on environmental investment	Deployment of EIA/VAMIL subsidy to incentivise the use of natural coolants.	Intended
Include N_2O emission Nitric Acid industry in ETS	Include N2O emission Nitric Acid industry in ETS	Fixed
SDE for green gas sewage water treatment plants	Subsidy scheme for incentivising green gas from landfill gas sewage water treatment plants	Intended

Appendix C Emissions of greenhouse gases and air-polluting substances

Table C.1 *Greenhouse gas emission per sector, including temperature correction, excluding land use, land use change and forestry (LULUCF) and international bunkers*

Mton CO_2 eq	1990	2000	2008	RR2010-0[*] 2010	2015	2020	RR2010-V 2010	2015	2020	RR2010-VV 2010	2015	2020
Carbon dioxide (CO_2)	162.7	171.8	175.6	173.6	203.6	205.1	173.9	192.3	191.5	173.6	183.5	166.4
Industry and energy sector:	92.8	97.1	98.9	100.8	130.6	131.3	100.9	121.8	122.6	100.7	115.1	103.4
Of which industry and construction	39.4	33.2	32.8	33.1	38.2	40.1	33.1	38.0	39.2	33.1	38.8	40.8
Of which energy sector	42.3	51.8	54.3	54.4	78.4	75.1	54.5	70.9	69.3	54.4	63.2	48.8
Of which refineries	11.0	12.1	11.8	13.3	14.0	16.1	13.3	12.8	14.1	13.3	13.0	13.9
Agriculture	8.1	7.9	7.8	8.9	8.9	9.7	8.7	8.2	8.4	8.6	7.7	7.1
Traffic	30.5	36.8	39.7	37.7	38.9	40.1	38.3	37.6	36.9	38.2	36.5	33.3
Built environment	31.3	30.1	29.2	26.2	25.1	24.0	26.2	24.7	23.5	26.1	24.2	22.5
Of which consumers	21.4	20.5	18.1	17.0	16.4	15.7	17.0	16.0	15.0	17.0	15.9	14.5
Of which TSG	9.9	9.5	11.2	9.2	8.7	8.3	9.1	8.7	8.6	9.0	8.3	7.9
Other greenhouse gases	52.7	44.8	31.2	34.8	**33.7**	32.4	30.2	28.9	27.3	30.2	28.7	26.7
Of which agriculture	22.5	20.4	18.5	18.6	18.4	17.5	18.6	18.1	17.5	18.6	18.0	17.2
Of which other sectors	30.2	24.5	12.7	16.2	15.6	14.9	11.6	10.8	9.8	11.6	10.7	9.5
Total	215.4	216.7	206.8	208.5	**237.3**	237.5	204.2	221.3	218.8	203.9	212.2	193.0

* RR2010-0 = without Clean and Efficient policy; RR2010-V = with fixed Clean and Efficient policy; RR2010-VV = with intended and fixed Clean and Efficient policy.

Table C.2 *Other greenhouse gases per substance*

[Mton CO_2-eq]				RR2010-0*			RR2010-V			RR2010-VV		
	1990	2000	2008	2010	2015	2020	2010	2015	2020	2010	2015	2020
Methane (CH_4)	25.5	19.8	17.1	15.8	14.8	13.7	15.8	14.7	13.5	15.8	14.6	13.0
Of which agriculture:	10.6	9.5	10.1	9.3	9.2	8.9	9.3	9.2	8.9	9.3	9.1	8,4
Of which waste removal	12.0	8.2	5.0	4.0	2.8	2.0	4.0	2.8	2.0	4.0	2.8	2.0
Of which energy sector	1.7	0.9	0.9	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0,5
Nitrous oxide (N2O)	20.2	19.3	11.8	16.2	16.0	15.9	11.6	11.2	11.0	11.6	11.2	11.2
Of which agriculture:	11.9	11.1	9.4	9.3	8.9	8.6	9.3	8.9	8.6	9.3	8.9	8.8
Of which industry:	7.1	6.8	1.0	5.6	5.8	6.0	1.0	1.0	1.1	1.0	1.0	1.1
HFCs	4.4	3.8	1.9	2.2	2.4	2.2	2.2	2.4	2.2	2.2	2.2	1.9
PFCs	2.3	1.6	0.3	0.3	0.3	0.4	0.3	0.3	0.4	0.3	0.3	0.4
SF6	0.2	0.3	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Total other greenhouse gases	52.7	44.8	31.2	34.8	33.7	32.4	30.2	28.9	27.3	30.2	28.7	26.7

* RR2010-0 = without Clean and Efficient policy; RR2010-V = with fixed Clean and Efficient policy; RR2010-VV = with intended and fixed Clean and Efficient policy.

Table C.3 *Air-polluting emission per sector*

[kton]				RR2010-V		
NO_x	1990	2000	2008	2010	2015	2020
Industry, Energy and Refineries	188.6	103.2	72.7	67.2	70.9	71.3
Traffic	328.2	239.9	187.4	165.6	135.0	98.9
Consumers	20.3	18.4	13.5	9.9	7.1	5.8
TSG and construction	14.1	14.2	11.0	8.9	7.3	5.5
Agriculture	8.7	13.0	11.6	12.1	9.9	3.9
Total	559.9	388.6	296.1	263.8	230.1	185.3

`

				RR2010-V		
SO_2	1990	2000	2008	2010	2015	2020
Industry. Energy and Refineries	168.3	61.8	46.9	38.9	43.8	45.2
Traffic	18.6	9.0	3.4	2.6	0.3	0.3
Consumers	1,1	0.5	0.5	0.3	0.3	0.3
TSG and construction	2,7	1.3	0.2	0.3	0.3	0.3
Agriculture	1,0	0.1	0.1	0.0	0.0	0.0
Total	191.7	72.8	51.0	42.0	44.6	46.1

				RR2010-V		
NMVOC	1990	2000	2008	2010	2015	2020
Industry, Energy and Refineries	168.1	84.7	54.7	49.0	49.9	50.9
Traffic	181.0	79.1	48.4	34.0	28.5	25.3
Consumers	37.4	33.6	32.2	32.7	36.6	40.4
TSG and construction	73.4	31.4	28.4	27.2	29.0	31.1
Agriculture	1.8	1.8	1.8	1.6	1.6	1.6
Total	461.7	230.7	165.4	144.5	145.6	149.3

				RR2010-V		
NH_3	1990	2000	2008	2010	2015	2020
Industry, Energy and Refineries	4.6	3.0	2.4	2.1	2.3	2.5

[kton]				RR2010-V		
NO_x	1990	2000	2008	2010	2015	2020
Traffic	0.9	2.5	2.5	2.4	2.5	2.5
Consumers	6.5	6.9	8.2	8.5	8.8	9.0
TSG and construction	2.8	2.7	2.5	2.6	2.7	2.8
Agriculture	237.8	140.3	114.1	115.8	105.9	101.6
Total	252.5	155.4	129.6	131.5	122.1	118.4
				RR2010-V		
PM_{10}	1990	2000	2008	2010	2015	2020
Industry, Energy and Refineries	37.7	13.3	9.9	9.2	9.9	10.3
Traffic	20.6	14.3	10.7	8.8	6.8	5.8
Consumers	4.4	3.8	3.4	3.4	3.5	3.6
TSG and construction	2.8	2.5	2.4	2.2	2.4	2.6
Agriculture	5.9	6.1	6.8	6.6	7.1	6.7
Total	71.3	40.0	33.1	30.1	29.6	28.9
				RR2010-V		
PM2.5	1990	2000	2008	2010	2015	2020
Industry, Energy and Refineries	20.4	7.0	4.7	4.1	4.6	4.7
Traffic	18.6	12.2	8.4	6.5	4.4	3.3
Consumers	4.1	3.6	3.2	3.2	3.3	3.4
TSG and construction	0.9	0.8	0.6	0.6	0.6	0.6
Agriculture	0.8	0.7	0.7	0.6	0.7	0.7
Total	44.8	24.2	17.5	15.0	13.6	12.7

RR2010-V = including fixed policy

Appendix D Differences energy and greenhouse gases compared to previous projection

This appendix addresses the main differences compared to previous projections. The comparison is limited to the update of the Reference projection of 2009 (Update Reference Projection Global Economy) with a high price variant (UR-GE(h). The table shows a number of indicators for CO_2 emission, energy use and renewable energy in 2020.

	Unit	UR-GE	UR-GE(h)	RR2010-0	RR2010-V	RR2010-VV
CO_2 emission total	[Mton CO_2 eq]	225	223	205	191	166
OGHG total	[Mton CO_2 eq]	29	29	32	27	27
Total GHG	[Mton CO_2 eq]	254	252	237	219	193
Total energy use	[PJ]	3942	3913	3526	3394	3283
Total fossil use	[PJ]	3729	3712	3355	3172	2813
Total energy use for feedstocks	[PJ]	656	651	561	552	553
Share of renewables	[%]	4.9	5.3	2.6	6.3	15.5
Renewables (avoided primary)	[PJ]	193	208	90	214	508
Electricity production (excl. wind, water and solar)	[TWh]	164	168	145	133	111
Renewable electricity production	[TWh]	19	21	4	18	50
Renewable heat production	[PJ]	28	28	20	29	42

The main differences in starting points are:

- Recession. The current projection takes into account the economic downturn of 2009 and 2010.
- Economic growth 2010-2020. UR-GE assumed the growth of the Global Economy scenario, i.e. 2.7% annually; the current projection assumes moderate growth, i.e. 1.7% annually.
- CO_2 prices UR-GE assumed 35€/tonne CO_2 as the price of the European emission trading system, the current projection assumed 20€/tonne.
- Energy prices UR-GE(h) assumed the much higher energy prices of the WEO2008. The difference between UR-GE and the current projection is not large.
- Policy The current projection distinguishes three policy variants. UR-GE assumed only fixed policy. The policy intensity of UR-GE lies somewhere between RR2010-0 and RR2010V.

Appendix E Targets, tasks and realisations

	Target/Task	Realisation			Policy deficit		
		RR2010-0	RR2010-V	RR2010-VV	RR2010-0	RR2010-V	RR2010-VV
GHG emissions (Mton CO_2 eq)							
Total	150	183 (175 - 191)	177 (169 - 185)	171 (162 - 179)	33 (25 - 41)	27 (19 - 35)	21 (12 - 29)
Non ETS	87	108 (100 - 116)	102 (94 - 110)	96 (87 - 104)	21 (13 - 29)	15 (7 - 23)	8 (0 - 17)
ETS realisation	63	75	75	75	12	12	12
ETS physical		*130 (113 - 137)*	*116 (99 - 124)*	*97 (82 - 108)*			
Non ETS (Mton CO_2 eq)							
Built environment	17.3	23.7 (22.4 - 25.0)	23.2 (21.4 - 24.2)	22.2 (20.5 - 23.4)	6.4 (5.1 - 7.7)	6.0 (4.1 - 6.9)	4.9 (3.3 - 6.2)
Industry/energy	5.3	9.3 (8.7 - 9.7)	9.0 (8.3 - 9.4)	8.4 (7.8 - 8.8)	4.0 (3.4 - 4.4)	3.6 (3.0 - 4.0)	3.1 (2.5 - 3.5)
Traffic and transport	32.0	40.1 (38.3 - 43.4)	36.9 (34.5 - 40.3)	33.3 (30.6 - 37.1)	8.1 (6.3 - 11.4)	4.9 (2.5 - 8.3)	1.3 (-1.4 - 5.1)
Agriculture	4.3[53]	7.8 (6.5 - 8.7)	6.8 (5.4 - 7.6)	5.6 (4.4 - 6.6)	3.5 (2.2 - 4.4)	2.5 (1.1 - 3.3)	1.4 (0.1 - 2.3)
OGHG agriculture:	16.6	17.5 (10.6 - 24.2)	17.5 (10.6 - 24.2)	17.2 (10.4 - 24.0)	0.9 (-6.0 - 7.6)	0.9 (-6.0 - 7.6)	0.6 (-6.2 - 7.4)
OGHG other	8.4	9.3 (8.1 - 10.6)	9.2 (7.9 - 10.4)	8.8 (7.6 - 10.1)	0.9 (-0.3 - 2.2)	0.8 (-0.4 - 2.0)	0.4 (-0.8 - 1.7)
20% renewable energy (PJ primary)							
Renewables total	653	90 (73 - 107)	214 (186 - 241)	508 (428 - 511)	563 (546 - 580)	439 (412 - 467)	145 (143 - 226)
2% energy saving 2011-2020 (PJ)							
Savings total	578	284 (195 - 350)	376 (290 - 458)	389 (305 - 477)	294 (228 - 383)	202 (120 - 288)	189 (101 - 273)

[53] On the occasion of presenting the Clean and Efficient Outlook to the Dutch Lower Chamber in April 2009, the ministry of the environment announced a change in the target of agriculture. This is due to the fact that the target of 4.3 Mton pays insufficient attention to the efforts of the sector with regard to CHP. This change has meanwhile taken place. The target has been adjusted to 6.8 Mton for the entire sector, including the ETS share. Without the ETS share, the target for agriculture amounts to 5.6 Mton. This figure does not take into account an opt-out of small CHP installations from the ETS. In case of an opt out, the non ETS target becomes higher than 5.6 Mton because CO_2 is transferred from the ETS space to the non ETS space. It is likely that in case of an opt out 0.8 Mton will be transferred from ETS to non ETS, setting the target at 6.4 Mton.

Appendix F Oil extraction

TNO has provided a prognosis for natural gas extraction (TNO, 2009). This section will mainly address the energy content of the much smaller oil extraction. This is also related to the gas production, because during the extraction of natural gas a low percentage of oil is often released. To determine the volume of this natural gas condensate the prognosis of TNO has been adopted for natural gas extraction. The volume of natural gas condensate was also collected from previous publications. Afterwards a comparison was made of the extracted volume of natural gas and the production of natural gas condensate. Per cubic metre of natural gas, the condensate production of offshore is a factor 4 higher than onshore. Moreover, a decreasing trend can be noticed. In the last four years the average condensate production amounted to 7.5 m^3/mln m^3 natural gas onshore and 28 m^3/mln m^3 natural gas offshore. A comparison with the energy statistics shows that on average the condensate is heavier than indicated by the international indicators of the IPPC (Vreuls, 2006). The combustion value per m^3 is therefore also higher. The variation is wide, however. By linking the volume of natural gas condensate to the expected volume of natural gas, a scenario can be made for the production of natural gas condensate.

A second source of oil extraction are the existing fields, both onshore and offshore. Onshore has been decreasing for quite some time already and the offshore stock is also decreasing rapidly. The reopening of the Schoonebeek field, which is currently being prepared, will lead to a slight increase in onshore oil production. Large-scale production is not expected to take place here before 2011[54]. The prognosis is that in twenty years about 100 million barrels of oil can be extracted annually (Dagblad van het Noorden, 2004). As the oil extraction will be done by means of steam injection, the oil extraction process will require much more energy than usual in the Netherlands.

The resulting development can be seen in Table F.1 and Figure F.2. The various policy variants have not been differentiated here.

Table F.1 *Oil extraction in the Netherlands, historical and forecast*

[PJ]	Onshore extraction	Offshore extraction	Reopening of Schoonebeek	Natural gas condensate	Total
1970	81	0		0	81
1975	60	0		7	67
1980	54	0		13	67
1985	52	100		15	166
1990	48	97		19	164
1995	39	78		33	150
2000	27	32		40	99
2005	14	49		34	98
2010	5	26		38	70
2015	2	14	31	29	76
2020	1	7	31	22	62
2025	0	4	31	12	47
2030	0	5	31	8	43
2035	0	0	0	5	5
2040	0	0	0	4	4

[54] News messages about Schoonebeek at the internet site of NAM http://www.nam.nl/.

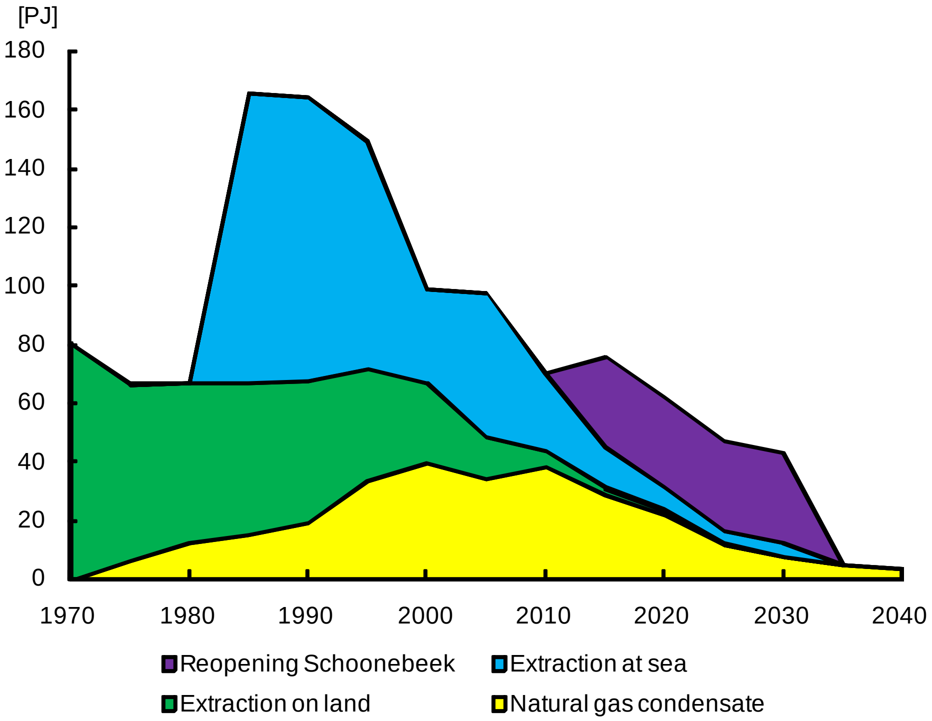

Figure F.1 *Development of the oil extraction in the Netherlands [PJ]*

Appendix G List of abbreviations and glossary

G.1 List of used abbreviations

ACCM	Section 3.3
AVI	Waste incineration plant
BAT	Best Available Technique
BEMS	Decree on emission regulation mid-sized combustion plants
BPM	Tax on passenger cars and motor vehicles
CBS	Statistics Netherlands
CCGT	Combined Cycle Steam and Gas Turbine
CCS	Carbon capture and storage
CDM	Clean Development Mechanism
CHP	Combined Heat and Power
CPB	Netherlands Bureau for Economic Policy Analysis
CV	Central heating system
EC	European Commission
ECN	Energy research Centre of the Netherlands
EIA	Energy Investment Tax Deduction
EIB	Economic Institute for the Building Industry
EPA	Energy Performance Advice
EPBD	Energy Performance of Buildings Directive
EPC	Energy Performance Coefficient
ETS	Emission Trade System
EU	European Union
FTE	Fulltime Equivalent (full working week)
GDP	Gross Domestic Product
GE	The WLO scenario Global Economy
GEHP	The WLO scenario Global Economy with higher oil price
GHG	Greenhouse gases
GJ	Gigajoule
GW	Gigawatt
HCFC	Hydrochlorofluorocarbon
HFC	Hydrofluorcarbons
HR-	High efficiency
HR++	Low-E glazing (Current standard for glazing)
ICT	Information and Communication technology

IGCC	Combined Steam and Gas turbine
IMO	International Maritime Organization
IPPC	Integrated Pollution Prevention and Control
LEI	Agricultural Economics Research Institute
LMS	National Model System
LTA	Long Term Agreement
LTA2	Long-term agreement Energy Efficiency 2001-2012
LTA3	Long-term agreement Energy Efficiency 2001-2020
MB	Environmental Balance
MEE	Long-term Agreement Energy Efficiency ETS enterprises
MEI	Market introduction of energy innovations
MEP	Environmental Quality of Electricity production
MmM	The energy saving covenant ‘More with Less’ (MmM= Meer met Minder)
MRB	Road Tax
Mton	Megatonne
MW	Megawatt
MW_e	Megawatt Electric capacity
MWh	Megawatt hour
MW_{th}	Megawatt thermal capacity
NEA	Dutch Emissions Authority
NEC	National Emission Ceiling
NMVOC	Non methane volatile organic compounds (NMVOC)
NSL	National Collaboration Programme Air Quality
OCAP	Organic Carbon dioxide for Assimilation of Plants
OGHG	Other greenhouse gases
PBL	Netherlands Environmental Assessment Agency
PFC	Perfluorhydrocarbons
PJ	Petajoule
PJ_e	PJ electricity
PJp	PJ primary
PJprimary	PJ primary energy (including the energy losses of conversion and transport)
PJ_{th}	PJ thermal
PM_{10}	Particulate Matter up to 10 microns
$PM_{2.5}$	Particulate Matter up to 2.5 microns
PME	Protocol Monitoring Energy Saving
PMth	See Section 6.1
ppm	parts per million

PRIMES	See Chapter 4
Primos	See Section 3.4
PSR	Performance Standard Rate
PV	Photovoltaic
RAP	CH4
RC	The WLO scenario Regional Communities
RIVM	National Institute for Health and the Environment
RR2010-0	Policy variant without Clean and Efficient Policy
RR2010-V	Policy variant with fixed Clean and Efficient Policy
RR2010-VV	Policy variant with fixed and intended Clean and Efficient Policy
SDE	Subsidy scheme for incentivising renewable energy
SE	The WLO scenario Strong Europe
SECA	SO_x Emission Control Area (Baltic, North Sea, The Channel)
SEO	SEO Economic Research
TM	The WLO scenario Transatlantic Market
TNO	Dutch Organisation for Applied Scientific Research
TSG	Trade, Services and Government
TWh	Terrawatt hour
UR-GE	Update Reference projection Global Economy
UR-GE(h)	Update Reference projection Global Economy high energy price variant
VAT	Value added tax
VFG	Vegetable, fruit and garden waste
VOC	Volatile organic compounds (including methane)
WEO	World Energy Outlook
WLO	Welfare, Prosperity and Quality of the Living Environment, long-term outlook
WWTP	Waste water treatment plant

G.2 Glossary

The glossary explains a number of terms used in this report. The explanation primarily aims at elucidating the specific meaning of a term within the context of the Reference projection.

Table G.2 *Glossary*

90% Reliability interval	The projected bandwidth in emission, in which the emission or the share of renewable energy in 2020 will most probably (with 90% certainty) end up.
Additional Policy agreement	The additional policy agreement of 'Work together, live together' (Working on the future) of the Balkenende IV Cabinet. It includes measures of the Cabinet that were taken as a result of the economic crisis.
Application standard	Standard for the use of fertilisers in agriculture. The new Fertilizer Act distinguishes three types of application standards: An application standard for phosphate, an application standard for nitrogen and an application standard for nitrogen from animal manure.
Avoided primary energy	The energy that need not be used, for example as a result of the production of renewable energy.
Bio-energy	Energy generated from biomass.
Biofuels	Liquid biofuels obtained from biomass.
Boiler efficiency	Efficiency with which the boiler converts fuel into heat.
Boundary value	Standard that has a result obligation for compliance.
Bunkers/bunkering	Excise free fuels used by inland shipping, sea shipping and aviation.
Business-as-usual	Continuance of current trends
Caprolactam	A colourless solid substance prepared from derivatives of cyclohexane and used as raw material for nylon.
CCGT plant	Electricity plant based on the use of a steam and gas turbine
Chain efficiency	(Energy) efficiency in the entire product chain Involves more than just the energy use in the production stage.
Chimney emissions	Used in this report to distinguish physical emissions from the manner in which emissions count in realising the target.
CO_2 equivalents	The weighed sum of various greenhouse gases in equivalents of CO_2.
Coal gasification	Technology in which coal is converted into gas. The gas that arises can subsequently be burned in a gas turbine or CCGT.
Co-digestion	Process in which methane bacteria produce biogas (a mixture of methane and carbon dioxide) by means of anaerobic (non oxygenated) degradation of organic compounds in manure and other biomass (co-substrate).

Co-firing biomass	Combustion of biomass in (coal-fired) plants; biomass is used the same was as coal (i.e. no additional conversion step).
Combined Heat and Power (CHP)	Combined generation of heat and electricity.
Combustion value	The amount of heat released in the combustion of an energy carrier.
Commercial services	Services with a profit motive.
Conversion efficiency	The efficiency of turning one energy carrier into another.
Cooling degree days	A cooling degree day is a calculation unit to include the (varying) temperature in a simple manner in calculations, particularly in calculations of energy use. A cooling degree day is relative compared to the reference temperature, usually those that do not require cooling.
Co-substrate	Biomass that is added to wet biomass (e.g. manure) to produce biogas; the added biomass can be a vegetable agricultural product (crops or crop residues) or a by-product from the food industry.
Covenant	Non legal agreement
Decentralised CHP	CHP that is (partially) owned by the end use sector.
Degree days	A degree day is a calculation unit to include the (varying) temperature in a simple manner in calculations, particularly in calculations of energy use. A degree day is relative compared to a reference temperature, usually the one that does not require heating (in the Reference projection an average daily temperature of 18 degrees Celsius has been used).
Derogation	To temporarily suspend a legal obligation under certain conditions.
Digestate	The wet end product that remains after digestion of wet biomass such as manure (excl. or incl. co-substrate), which can be used as fertilizer.
Dispensable income	The gross income minus the current transfers, taxes on income and capital/property and premiums for healthcare and income insurances.
Ecodesign guideline	Guideline that subjects appliances to requirements with regard to energy use
Efficiency	Policy is efficient if the intended policy objectives are realised at the lowest possible cost.
Emission ceiling	The maximum amount of a substance, expressed in kilo tonnes, which a Member State is allowed to emit in a calendar year.
Emission space	Space for emissions that is limited by the emission ceiling and the emission allowances possessed.
Emission Trade System; ETS	System in which emission ceilings for example for CO_2 are established and in which emission allowances can be traded among participating parties.
Energy efficiency	Energy use per unit of product or service

Energy Performance Coefficient	A measure that indicates how energy efficient a building is, assuming standardised residential behaviour. The lower the EPC, the more energy efficient the building
Energy saving pace	Change in the average energy saving in a certain year compared to a certain reference year
EPC standard	The minimum EPC value that a building must meet.
ETS sectors/businesses	Sectors/businesses that are covered by the European CO_2 emission trade system.
Euro standardisation (EURO 0-6 and 0 – VI)	European emission requirements for road traffic. Standards for freight traffic are indicated in Roman numerals; passenger traffic and light delivery vans are described with Arabic numerals.
Feedstocks	Energy carriers that are used for non energetic products
F-gases	HFCs, PFCs and SF_6
Final energy use	End use of energy (for example electricity and gas) by consuming sectors.
First and second generation biofuels	Biofuels of the *first generation* are based on sugars, amylum, vegetable oil or animal fats that are converted into fuels by means of conventional chemical processes or digestion. Usually food crops are used as fuel. Biofuels that are not related to food are usually called *second generation*. These are produced from especially cultivated plants (energy crops) or inedible parts of food crops.
Fixed policy	Policy for which the instruments, finance and authorisations are available and for which decision-making has been finalised.
Flaring	Burning superfluous fuels. Takes place for example in case of malfunctions in the installation that normally uses energy by-products of other processes.
Fossil fuels	All energy carriers that have a fossil origin (coal, oil, natural gas)
Green gas	Gas of biogenic origin (e.g. digestion processes) that is fed in the natural gas grid.
Gross Domestic Product (GDP)	The value of the income generated within the Netherlands. The change in terms of percentage in the GDP equals the economic growth.
Heat buffer	Buffer for storing heat in greenhouses. Balances the lack of synchronicity of electricity production and heat demand
Heat pump	A heat pump is a device that moves heat (e.g. ambient heat) by means of labour. It can be used both for heating and for cooling.
Heat-cold storage	Storage of season-dependent heat or cold surplus in underground aquifers.
House valuation system	System in which the maximum height of the rent is determined by the characteristics of the dwelling.
Household size	Number of persons that are part of a private household
Indicative target	Standard that encompasses a commitment towards realisation

Intended policy	Policy announced to the Lower Chamber by the Cabinet, which (still) lacks instruments, finance or authorisations and for which the decision-making process has not been finalised.
Labour productivity	The gross added value in base prices per unit of labour volume
Large-scale electricity generation	All electricity generation that is not generated in (partial) property of the end use sectors.
Manure disposal	Distribution of manure (prior to or after processing) for manuring the soil. In agriculture, the manure can be disposed of within one's own business or at another business (inland or abroad) Another option is to dispose of the manure outside agriculture (e.g. private persons or in natural areas).
Methane slip	Emission of uncombusted methane from natural gas by gas engines
Mobile equipment	Tractors, fork-lift trucks, cranes, etcetera in industry, agriculture, construction and services sectors
Monitoring uncertainty	Uncertainty in perception, particularly important in relation to many NEC substances and other greenhouse gases.
Must-run CHP	The CHP which, for technical or other reasons, cannot be/are not deployed in a flexible manner
Natural gas condensate	Natural gas condensate consists of a mixture of substances, mainly hydrocarbons, that condensate during the extraction of natural gas as a result of the lowering of temperature and pressure occurring during gas treatment. The condensate is collected and removed to an oil refinery for refining.
Non methane volatile organic compounds (NMVOC)	All organic substances of anthropogenic nature, except for methane, which can produce ozone through a reaction with nitrogen and sunlight.
Non-ETS sectors	Sectors that do not participate in the European Emission Trade system (ETS).
Non-residential buildings	Buildings of the sector Trade, services and government (such as hospitals, schools, offices).
Offshore and onshore	Wind turbines: Wind energy offshore and onshore
Open ending arrangement	Supporting arrangement without budget ceiling.
Post insulation	Insulating existing buildings that lack insulation.
Potential working population	The share of the population which, in view of their age, are eligible for participating in the labour process. In the Netherlands this means all persons aged 15 to 65.
Primary energy	The energy for which conversion losses of the energy companies are distributed equally among the end user sectors.
Process emissions	Emissions from (industrial) processes as opposed to combustion emissions
Quaternary services	Non profit services.
Red diesel	Diesel not charged with excise, intended for mobile equipment.
Renewable electricity	Electricity generated from renewable sources such as wind, solar and biomass.

Renewable energy	Energy generated from renewable sources such as wind, solar and biomass.
Rumen fermentation	The rumen is the first stomach of ruminants such as dairy cows. In this stomach the food will be subjected to pre-digestion by micro-organisms that live in the rumen. In this process the food is fermented, i.e. digested; in an anaerobic (oxygen free) environment food is broken down into substances that the ruminants can subsequently digest themselves.
Sector system	System in which a sector is given an emission ceiling. Exceedings of the ceiling must be compensated by purchasing JI/CDM credits. In the projection this applies to greenhouse horticulture, but the ceiling has not been specified.
Spring Agreement	The Spring Agreement is an initiative of Aedes, Bouwend Nederland, NEPROM, NVB, the ministry of the environment, the Minister of Housing, Communities and Integration, aimed at energy saving in the built environment.
Surface water	Inland waterways (except for groundwater), transitional waters, coastal waters and with regard to the chemical state also territorial waters.
Sustainable heat	Heat that is produced from renewable energy or by using waste heat.
Temperature correction	Adjusting energy use by means of degree days in such a way that the energy use results in a normal temperature year.
Tertiary services	See Commercial services
Thermal use	Useful demand for heat. All energy use for heating is calculated into produced heat.
Throughput	The volume of crude oil that is converted into oil products.
Tonne kilometre	A uniform unit of measuring for the transport performance and equals the movement of one tonne of freight across a distance of one kilometre.
Trailing shoe manure spreader	Equipment to spread animal manure on grassland in a low emission manner. In this process the manure is superficially deposited in strips between the grass after having opened up the grass or pushed the grass aside.
VFG digestion	Process in which methane bacteria produce biogas (a mixture of methane and carbon dioxide) by means of anaerobic (non oxygenated) degradation of organic compounds in manure and other biomass (co-substrate).
Working population	All persons working at least 12 hours per week, persons that have accepted a job of at least 12 hours or persons who have declared to be willing to work at least 12 hours per week, are available and are actively looking for a job.