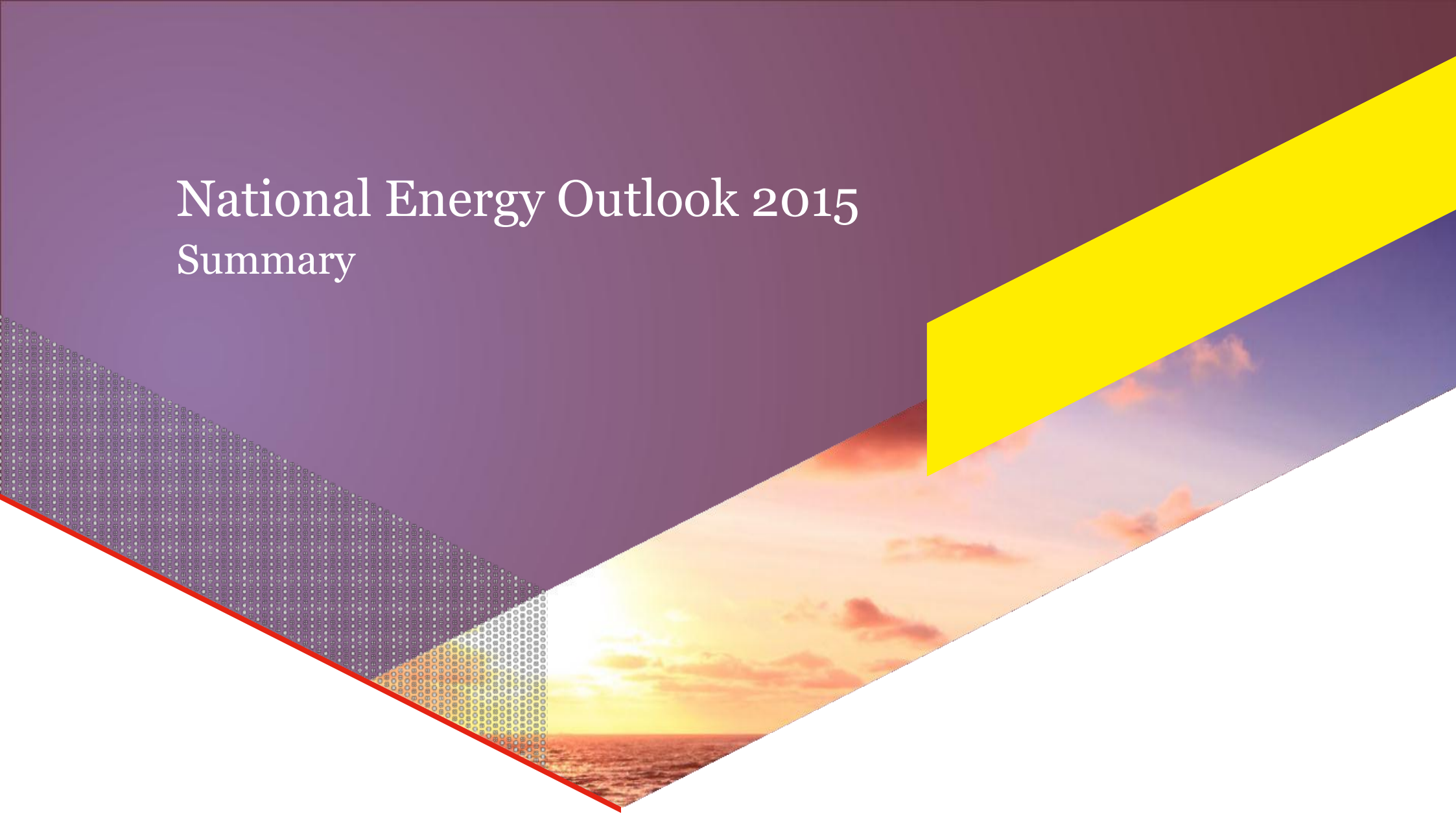
National Energy Outlook 2015

Summary



ECN

Planbureau voor de Leefomgeving

Centraal Bureau voor de Statistiek

Rijksdienst voor Ondernemend Nederland

National Energy Outlook 2015

Final responsibility

Energy research Centre of the Netherlands (ECN)

Project coordination

Koen Schoots (ECN) and Pieter Hammingh (PBL)

Contact and website

nev@ecn.nl, www.ecn.nl/energieverkenning

Authors, project team and other contributions:

ECN: Suzanne Brunsting, Bert Daniëls, Ton van Dril, Joost Gerdes, Michiel Hekkenberg, Marit van Hout, Bronia Jablonska, Jeroen de Joode, Paul Koutstaal, Carolien Kraan, Sander Lensink, Manuela Loos, Marijke Menkveld, Polleke Peeters, Arjan Plomp, Steven van Polen, Hilke Rosler, Koen Schoots, Koen Smekens, Joost van Stralen, Koen Straver, Kim Stutvoet-Mulder, Casper Tigchelaar, Omar Usmani, Matthijs Uyterlinde, Paul Vethman, Cees Volkers, Adriaan van der Welle;
PBL: Pieter Boot, Corjan Brink, Harm ten Broeke, Eric Drissen, Hans Elzenga, Gerben Geilenkirchen, Pieter Hammingh, Mathijs Harmsen, Mirjam Hartman, Anco Hoen, Peter Janssen, Robert Koelemeijer, Durk Nijdam, Jos Notenboom, Jos Olivier, Kees Peek (RIVM), Jeroen Peters, Jan Ros, Marian van Schijndel, Sietske van der Sluis, Winand Smeets, Bart Strengers, Michel Traa, Kees Vringer;
CBS: Sander Brummelkamp, Arthur Denneman, Gino Dingena, Rixt de Jong, Krista Keller, Sjoerd Schenau, Reinoud Segers, Ria Smit, Bart Staats, Otto Swertz, Ellen Timmer, Jurrien Vroom, Joram Vuik, Bart van Wezel;
RVO.nl: Various experts of RVO.nl.

Steering Group

Jaco Stremler (EZ), Timon Verheule (EZ), Birgitta Westgren (EZ), Heleen Haverkort (EZ), Diederik de Jong (I&M), Gerben Roest (BZK), Wijnand van Goudoever (FIN), Foppe de Haan (SER), Jamilja van der Meulen (ECN), Pieter Boot (PBL), Gerard Eding (CBS) en Bert Stuij (RVO.nl)

Design

Sixtyseven Communicatie BV

The report (in Dutch) is available at the above-mentioned website. Copying parts of this publication is allowed under the condition of referencing to: K. Schoots en P. Hammingh (2015), Nationale Energieverkenning 2015. ECN-O--15-033. Petten: Energy research Centre of the Netherlands.

The National Energy Outlook 2015 is produced by order of the Dutch Ministry of Economic Affairs, the Ministry of Infrastructure and Environment, The Ministry of the Interior and Kingdom Relations and the Standing Committee of the Energy Agreement and established with contributions by the Netherlands Environmental Assessment Agency (PBL), Statistics Netherlands (CBS) and the Netherlands Enterprise Agency (RVO.nl).

Summary

National Energy Outlook 2015

The National Energy Outlook (NEO) 2015 outlines the current state of the Dutch energy system in an international context

The Dutch energy system is not isolated from other countries' systems. In that context, the NEO describes the observed development from 2000 up to the present, as well as expected developments up to 2030. This relates to energy demand as well as to energy supply, emissions of greenhouse gases and air pollutants, and also economic factors relating to energy, such as contributions to the national product and employment. The NEO thus provides a factual basis for political decision-making and the societal debate about energy in the Netherlands. This is the second NEO to be published. The NEO 2015 includes the baseline forecast for air pollutants, which was not included in the previous NEO. The present NEO also provides greater statistical insight into innovation within the energy system, and describes in greater detail the progress made in the context of the Energy Agreement for Sustainable Growth (hereafter 'Energy Agreement').

The NEO gives the most plausible forecast for two policy variants

The future scenario in the NEO sets out the most plausible developments, based on information as at 1 May 2015 relating to prices, markets, technology and policy. The NEO provides forecasts for two different policy 'variants', which include government policy as well as measures and the activities of other actors in society. The 'existing policy' variant refers to specific, officially published measures and measures that are as binding as possible, such as the European Emissions Trading System (ETS) and subsidies for renewable energy. The 'intended policy' variant is based on existing policy plus published intended measures that, as at 1 May, were not yet officially implemented but were specific enough to incorporate in the calculations, for example the Real Driving Emissions (RDE) regulations for private cars and delivery vehicles, and a large number of measures from the Energy Agreement.

The future is uncertain

Global energy prices sometimes rise and fall faster than any projection can foresee. Actual economic growth, demographic development, technology costs and other developments within and outside the Netherlands are not always in line with the projections. In addition, the effects of policy measures are sometimes uncertain, for example because it is usually difficult to predict behaviour (including the behaviour of markets). Where relevant and possible, therefore, these uncertainties are translated into 'bandwidths' (ranges) for the projections relating to indicators such as primary and final energy consumption, energy savings, the proportion of renewables, and emissions of greenhouse gases and air pollutants.

General overview

The NEO 2015 makes four general observations.

Faster growth in renewable energy
As a result of the efforts by the public and private sectors and by citizens, combined in the Energy Agreement, the growth rate of renewable energy is increasing. Whereas an increase of around 3 percentage points was realised in 2000-2013, the forecast for the period 2013-2023 is 10 to 11 percentage points. Policy incentives will be necessary in order to realise further increases after 2023.

Fall in energy consumption and greenhouse gas emissions not yet a structural trend
Energy consumption and greenhouse emissions fell until 2013. This is not yet a structural trend, however. Energy consumption will remain stable or decrease slightly until 2030. Greenhouse gas emissions will fall only slightly after 2020. This relates partly to a presumed increase in electricity production in the Netherlands due to falling imports and rising exports. However, this increase is subject to the ETS emissions ceiling, which balances the local increase in the Netherlands with reductions elsewhere in Europe. Greenhouse gas emissions outside the ETS sector are no longer showing a rapid decrease. The stagnations described here are probably related to the lack of a specific climate and energy policy for the period after 2023.

A long-term perspective on climate and energy policy is necessary for setting priorities
The lack of a concrete long-term perspective in the Netherlands makes it difficult to make decisions and choices regarding the innovations that are needed. In many cases, it is not easy to achieve proper coherence between the various necessary steps in the innovation process. In neighbouring countries it is evident that a long-term perspective also helps in structuring energy-transition policy, setting priorities at the national level, and also in consulting and coordinating with neighbouring countries.

Air quality also benefits from a well-designed climate and energy policy
In recent decades, a great deal has been achieved with regard to air quality, but progress is stagnating. Apart from nitrogen oxides, which are still decreasing sharply as a result of policy relating to road traffic and non-road traffic, air-pollutant emissions are no longer showing substantial decreases. A well-designed climate and energy policy can also have a positive long-term effect on air quality, in addition to policy relating specifically to air. For example, greater energy savings and the use of wind and solar power have a favourable effect, but replacing natural gas with biomass in smaller combustion plants can have the opposite effect and lead to more air pollution.

Tipping point
These four observations support the conclusion that energy supply in the Netherlands is at a tipping point. On the one hand there are signs that the transition to a sustainable energy system is being effected: energy efficiency is increasing, energy consumption and the related air pollution have fallen, and the

share of renewable energy will increase in the years to come. On the other hand, the signs are not very robust: although non-CO_2 greenhouse gases have shown a downward trend since 1990, CO_2 emissions have been constant for many years, the contours of a sustainable energy system are still vague, and a specific long-term term perspective for this is lacking. Lack of clarity with regard to the position of natural gas is contributing to the uncertainty.

Developments since the NEO 2014

Since the NEO 2014 was compiled, a great deal has happened within and outside the Netherlands that has influenced the development of the energy system. A great deal has been done to bring the targets of the Energy Agreement within reach and to further specify agreements made. In addition, oil prices have fallen sharply and it has been decided to reduce gas extraction in Groningen in 2015. Information about future electricity demand and supply outside the Netherlands, and economic growth forecasts, have also been updated. The effects of these changes are shown in this NEO.

Where relevant, we will describe and explain insights that have changed since the previous NEO was published. In the past year, for example, energy statistics were revised, which means that not all the current statistics can be compared directly to those in the NEO 2014. One result of the revision of the statistics is that the proportion of renewable energy for 2013 is 0.3 percentage points higher than in the previous NEO. The revised energy statistics were also used in the projections in this NEO. Another change in relation to the previous NEO relates to the method for determining greenhouse gas emissions. The present NEO uses the most recent IPCC guidelines (2006), whereas the NEO 2014 was still based on older IPCC guidelines (1996). As a result of this and of changes to the method for determining methane levels in agriculture (expressed as CO_2 equivalents), emissions have been adjusted upwards across the board (1990-2013). For 2012, for example, the changes to the method resulted in an increase of approx. 5 megatons of CO_2 equivalents compared to the 'old' figure for 2012. The changes are also having an upward effect on estimates for the period after 2013.

The table below shows the key figures from the NEO 2015. The core table shows a number of important input variables for the NEO, such as global energy prices and CO_2 prices. The table also contains key outcomes of the projections, such as gross final energy consumption, the proportion of renewables as calculated with the method from the EU directive on renewable energy and calculated according to expected actual production, emissions of greenhouse gases and air pollutants, energy savings in the context of the Energy Agreement, and (net) employment.

Core table for the National Energy Outlook 2015

Key indicator	2000	2010	2013	2020[1]		2030[1]	
				EP[2]	IP[2]	EP[2]	IP[2]
GDP (index)	100	114	114	128		152	
Oil price[3] (US$/barrel)	39	87	114	89		140	
Gas price[3] (eurocents/m^3)	16	20	26	28		33	
Coal price[3] (euros/ton)	52	89	80	81		88	
CO_2 price [3,4](euros/ton)	-	16	4	8	11	15	20
Renewable energy (petajoules)	35	92	105	230 (2023: 310)	250 (2023: 320)	400	380
Gross final energy consumption[5] (petajoules)	2,222	2,214	2,104	2,090	2,070	2,070	2,030
Percentage of renewable energy in accordance with EU Directive (NEO 2015 calculation method)	1.6	4.0	4.8	11.1 (2023: 15.1)	11.9 (2023: 15.7)	19	19
Percentage of renewable energy according to actual production (NEO 2014 calculation method)					12.4 (2023: 16.1)		
Energy-savings rate (in percent per year in a previous period)[6]		1.1[7]		1.3[8]	1.5[8]	0.9[9]	1.0[9]

1 The figures shown have considerable uncertainty bandwidths. These are discussed in the relevant chapters of the NEO 2015.

2 EP = existing policy, IP = intended policy.

3 Constant prices 2014.

4 European policy is also incorporated in existing as well as intended policy. The proposals to raise (from 1.74% to 2.2%) the reduction factor by which permitted emission volumes are reduced each year, and to introduce market stability reserve with effect from 2019 are incorporated in intended policy.

5 Adjusted for changes in temperature which, for example, influence the heating of homes and cooling in offices.

6 Energy-savings rate according to the Protocol for Monitoring Energy Savings, in primary terms.

Core table for the National Energy Outlook 2015

Key indicator	2000	2010	2013	2020[1]		2030[1]	
				EP[2]	IP[2]	EP[2]	IP[2]
Energy savings in accordance with EU energy-efficiency directive (petajoules, cumulative, 2014-2020)				470	540		
Energy savings resulting from measures in the Energy Agreement (petajoules)				36 (2016: 7)	55 (2016: 10)		
Total greenhouse gas emissions (megatons of CO_2 equivalents)[10]	219 (1990: 219)	214	196	181	178	175	173
Reduction in total greenhouse gas emissions in relation to 1990 (%)				18	19	21	21
Greenhouse gas emissions by non-ETS sectors (megatons of CO_2 equivalents)		129	109	100	100	93	92
Sulphur dioxide (kilotons)	73	34	30	30	30	31	30
Nitrogen oxides (kilotons)	395	274	240	175	172	148	125
Ammonia (kilotons)	182	144	134	127	127	120	118
Non-methane volatile organic substances (kilotons)	239	158	150	147	146	150	149
Particulate matter – $PM_{2.5}$ (kilotons)	25.5	15.2	12.8	10.6	10.4	10.2	9.6
Energy related employment (x1,000 full-time equivalents)		127	153	169	170		
Net additional employment resulting from the Energy Agreement, cumulative, 2014-2020 (x1,000 work years)					80		

7 Average for the period 2000-2010.

8 Average for the period 2013-2020

9 Average for the period 2021-2030

10 According to 2006 IPCC guidelines; 2000-2013 not yet adjusted for the revised energy balance and – unlike energy consumption figures in that period – in compliance with emission registration, not adjusted for temperature influences.

Energy consumption

Total gross energy consumption in the Netherlands has shown a downward trend since 2004

The decrease in gross energy consumption (adjusted for temperature influences) in the period 2000-2013 was almost 120 petajoules. The reductions were realised mainly in industry and agriculture. The reduction in the built environment was relatively limited, and consumption by traffic and transport was more or less the same as in 2000. According to the initial figures for 2014, total gross energy consumption is approximately 45 petajoules lower than in 2013. Due to the fact that the statistics are not yet complete, it is not possible to pinpoint the exact causes of this notably sharp increase that occurred in a single year. There is a notable reduction (27 petajoules) in energy consumption by road traffic. Some 20 petajoules of this are due to lower diesel consumption.

Total gross energy consumption may continue to fall slightly

After implementation of the adopted policy, gross final consumption between 2013 and 2020 may fall very slightly, but the decrease will not be significant [-3 percent to +3 percent]. We will see a fall in heat consumption in the built environment as a result of increasingly energy-efficient construction, while industrial heat consumption will increase. Total gross electricity consumption will remain generally constant until 2020. Energy consumption in the traffic and transport sector will stabilise until 2020. If intended policy is also implemented, a decrease is expected of roughly 1 percent [-3 percent to +3 percent] in the years to 2020. This further reduction will be mainly due to intended policy in the built environment, but energy consumption will also show a slightly larger reduction in industry, transport and agriculture. Between 2020 and 2030, gross final consumption will decrease further, mainly as a result of falling heat consumption in the built environment and, to a lesser extent, falling energy demand by traffic. On the basis of forecast growth, energy consumption by industry will show an upward trend after 2020.

Energy savings

The average energy-savings rate in the Netherlands will increase in the coming years

In the period 2000-2010, the average energy-savings rate in accordance with the Protocol for Monitoring Energy Savings was 1.1 percent per year. Under existing policy, this rate will increase in the period 2013-2020 to approximately 1.3 [1.2-1.5] percent per year. Taking intended policy into account, the rate in that period is expected to be 1.5 [1.4 –1.6] percent per year. The increase in the energy-savings rate in relation to the period 2000-2010 is largely attributable to the provisions of the Energy Agreement. The savings referred to here relate to primary energy and are not the same as the 1.5% energy-savings target in the Energy Agreement, which relates to final energy consumption. In the built environment in particular, an increase in the energy-savings rate is expected. In the longer term (2020-2030), an average annual savings rate of 0.9 percent is projected. Despite the fact that certain policy measures will continue to have an

effect in this period, this rate is lower because the remaining potential of current energy-saving measures will decrease over time. The energy-saving effect cannot be directly compared to a reduction in final energy consumption. This is because energy saving is defined as the difference between actual energy consumption and reconstructed reference energy consumption, which indicates what consumption would have been without energy-saving measures. The reference consumption is determined by all manner of developments that have nothing to do with saving energy but do affect final energy consumption, such as economic growth, and growth distribution between sectors.

The Netherlands is expected to easily achieve the energy-savings target set in the EU Energy Efficiency Directive

There is a relatively high level of uncertainty with regard to the Netherlands achieving the target in the directive. Under existing policy, the Netherlands will almost attain its target of 482 petajoules in energy savings by 2020. If intended policy is also taken into account, it is expected that the target will be achieved by a wide margin. This also fulfils the expectation in the Energy Agreement, namely that the Netherlands will comply with the EU Directive. In this context it is important to note that discussions are still ongoing in Europe as to which savings the Member States are allowed to count.

The effects of the measures in the Energy Agreement will become clearer, but the energy-savings target of 100 petajoules will remain out of reach

The further specification of energy-saving measures by the signatories to the Energy Agreement makes it easier to estimate their impact in this NEO. This year, the estimate also includes the savings as a result of European vehicle standards. The estimated effect of all measures that count towards the Energy Agreement target is 10 petajoules [5-13 petajoules] of savings in 2016 and 55 petajoules [33-76 petajoules] in 2020. This means that both the interim target of 35 petajoules of energy savings in 2016 and the final target of 100 petajoules in savings in 2020 are out of reach. The revision of values from the NEO 2014 is mainly due to the fact that this year's figures include savings realised in the transport sector.

With regard to these figures it should be noted that, as at 1 May, measures in five domains of the Energy Agreement were yet not specific enough for use in calculations. The domains are: heating, transport, other renewables, energy savings in the built environment and energy savings in industry. On 1 May 2015, the Standing Committee for the Energy Committee agreed that if possible additional indicative calculations will be made this autumn. These will be included in the Energy Agreement progress report, which will be published in November 2015.

Primary energy supply and energy mix

Primary energy consumption will decrease slightly until 2030

The primary energy supply initially increased between 2000 and 2013, then decreased again to the 2000 level (approx. 3,200 petajoules). In that period there was little change in the composition of the supply; the energy mix remained more or less the same. The expectation is that, under existing as well as intended policy, primary energy consumption in the period 2013-2030 will show a slight

decrease of 100 petajoules. The small decrease in final consumption will be offset by electricity exports. The energy mix is changing, however: the proportion of gas in the energy supply is decreasing and the proportion of renewables in increasing.

The proportion of renewables in the energy mix is increasing, the target of 14 percent renewable energy by 2020 is not yet within reach

The proportion of renewable energy in gross energy consumption increased gradually to 4.8 percent in the period to 2013. In 2014 this increased further to 5.6 percent. The difference between 2014 and 2013 is mainly explained by the lower gross final consumption in 2014, and to a limited extent by an increase in the production of renewable energy. In addition to the reasons already mentioned, the lower final consumption in 2014 was also due to a mild winter. Under adopted policy, the proportion is expected to increase further to 11.1 percent [10 to 12 percent] by 2020. Under intended policy, the proportion will increase to 11.9 percent [11 to 13 percent]. The target of 14 percent renewable energy by 2020 is therefore not yet within reach. There are various reasons why this target is not expected to be met; it is not possible to pinpoint one specific cause. In 2023, the proportion of renewables will be 15.1 percent [14 to 16 percent] under existing policy and 15.7 percent [14 to 16 percent] under intended policy. The uncertainty bandwidth for 2020 is smaller than in the NEO 2014, and the proportion forecast for 2023 is higher as result of measures implemented under the Energy Agreement.

New calculation method will result in slight decrease in proportion of renewables in projections

A method change in this NEO 2015 results in a slightly lower proportion of renewables in the projections in comparison to the method used in the NEO 2014. In the present NEO, renewable energy production was calculated using specific calculation rules set out in the EU Renewable Energy Directive. The normalisation rules are designed to smooth out annual climatic variations, but have the side-effect that innovations such as wind turbines with more operating hours do not count immediately. This EU calculation method was not used in the NEO 2014. Instead, expected actual production of renewable energy was calculated. In order to clarify the effects of the different calculation methods, the core table shows the proportion of renewables for both methods, for 2020 and 2023 for the policy variant with existing and intended policy.

Attaining the goal of 16 percent renewable energy in 2023 is possible

The measures in the Energy Agreement will result in faster growth in renewable energy after 2017. The rate of growth in onshore wind power is sufficient to realise 6,000 megawatts in 2020 but, due to slowing growth from 2018 onwards, installed capacity will be 5,100 megawatts in 2020. This is because, in particular, the projects in the north of the Netherlands are subject to significant project risks, partly due to resistance among the general public and the effects of this on local government departments and the required throughput time for realising the projects. The adopted SDE+ budget is not a constraining factor in terms of achieving the targets for 2020 and 2023, provided the budget is made available timely for new initiatives. The growth to 6,000 megawatts is not considered

impossible, and is within the bandwidth of the forecast for 2020. The Energy Agreement target of 16 percent by 2023 is within reach under existing policy.

Uncertainty after 2023

Policy on renewable energy for the period after 2023 has not yet been formulated in detail. Consequently, there is a large degree of policy uncertainty with regard to the development of the proportion of renewable energy, which in turn means that forecasts are inherently low. Both existing and intended policy are based on the assumption that the use of biofuels in transport will remain stable after 2020 and that the SDE+ budget will be continued in the years towards 2030. In that case, the proportion of renewables will continue to increase after 2023, reaching around 19% in 2030. In 2030, the proportion of renewables will be slightly lower under intended policy than under existing policy. In accordance with the Energy Agreement, we have only taken account of tender calls for the period up to 2023. There are no tenders announces after 2023. This means that the rollout of offshore wind power will be limited to 4,350 megawatts. Existing policy is based on the standard SDE+ scheme that does not have this upper limit, which means that more offshore wind power can also be generated after 2023.

Consumption of oil products and coal in the Netherlands will remain constant

As in the NEO 2014, the expectation is that the growing consumption of oil products for non-energy purposes in the chemical industry will offset the fall in consumption in the traffic sector. Because natural gas consumption will fall in the coming years, oil will be the main fuel used in industry and the energy sector. The commissioning of three coal-fired power stations in 2014 resulted in a rise in coal consumption in 2014 and 2015. Following the closure of five old coal-fired power stations from 2016 onwards, and due to increasing co-firing with biomass, coal consumption will fall until 2020. Coal consumption is then expected to remain at the same level until 2030.

Gas extraction

As a result of the Gas Extraction Decree relating to the Groningen field, Dutch natural gas production will fall in the coming decade

In the past decade, natural gas production in the Netherlands has been around 75 billion cubic metres per year. Future production is uncertain, because earthquake problems mean that policy decisions have to be made. As a result of the 2015 Gas Decree and the downward trend in production from small fields, production is expected to be 25% lower in the coming decade, at approximately 55 billion cubic metres per year. Given current prospects, production will show a slight downward trend between 2015 and 2025, and a sharp decrease after 2025 when the Groningen field will no longer be productive.

The Netherlands will become a net gas importer later than was originally foreseen, due to the fall in production as of 2015

Given present prospects, the Netherlands will become a net importer of gas in around 2030, several years later than predicted in the NEO 2014. This is because gas that is not extracted in the short term remains in reserve for use in the longer term.

Electricity

Fossil fuels play a predominant role in electricity generation
In the period 2000 to 2010, most electricity was gas-generated. In recent years, and in particular in 2014, the proportion of gas used to generate electricity fell substantially, and the proportion of coal increased. In the period to 2030, coal will be predominant in central electricity generation. However, the share of gas in total electricity production will remain larger than that of coal, as a result of decentralised electricity production by gas-fired cogeneration plants.

In the long term, the proportion of coal and gas used to provide electricity will fall, and that of renewables will rise
Despite all the fluctuations in the proportions of the various types of fuel used in electricity generation in the Netherlands, the long-term trend is clear: the proportion of conventionally generated electricity will decrease and that of renewably generated electricity will increase. In 2013, approximately 82 percent of electricity was conventionally generated. This figure is expected to fall to approximately 60 percent in 2020, and to fall further to around 50 percent in 2030. In 2030, some 50% of all electricity will be generated from renewable sources, against approximately 10 percent in 2013. The remainder of the electricity supply in 2030 will be generated from nuclear power and other sources such as waste incineration.

The electricity market will be increasingly influenced by developments outside the Netherlands
Due to the combination of low coal prices (in relation to natural gas), the low price of CO_2 emission rights, over-capacity and low wholesale electricity prices in Germany, the position of natural gas in electricity production has declined in recent years. In the years to come, this will be reinforced by the increase in network connections with Germany. This will exert further downward pressure on electricity prices. This situation will change in the longer term, however. Compared to the NEO 2014, this NEO assumes a stronger upward trend in foreign electricity demand and a less strong upward trend in production capacity abroad. As a result, the situation for Dutch electricity production from natural gas will become somewhat more favourable again in the long term. In combination with the expected increase in fuel prices, this will lead to a rise in wholesale electricity prices. As result of these developments, in the years around 2022 the Netherlands will switch from becoming a net importer of electricity to a net exporter. This could mean that, despite the increasing proportion of renewable electricity, gas-fired power stations that have been mothballed are re-opened in the decade to come. Developments in the Netherlands depend to a large extent on developments in demand and supply in other countries in northwest Europe.

Heat

Gas will gradually become less important in heat generation

Approximately 55 percent of final consumption as an energy carrier is accounted for by the heating demand in the end-user sectors. This percentage will also remain constant in the future. Combustion of natural gas meets approximately 80 percent of heat demand through gas boilers or cogeneration plants. Under existing policy, this percentage will fall to 77 percent in 2020 and 71 percent in 2030. The increase in the proportion of renewable energy in heat generation is the main cause of this: the proportion will increase to 4% in 2013, to 6% in 2020 and to 10% in 2030. Under existing policy, the proportion of home heating produced by collective systems (heat networks) will increase to 4.5 percent in 2013 to more than 6 percent in 2030.

Energy bill

The expected increase in energy prices will lead to higher energy bills for households

Due to increases in gas prices and taxes, the average household energy bill has increased considerably in the past decade. In 2000, the average bill was 1,460 euros, and in 2010 it had risen to 1,780 euros[11]. In 2014, gas and electricity prices fell sharply. As a result, the average bill is expected to fall to approximately 1,640 euros in 2015. Energy prices are expected to increase again in the coming years, partly due to rising gas and electricity prices and an increase in the surcharge for sustainable energy. As a result of increasing energy savings and private generation of solar power, the average supply of gas and electricity to households will decrease in the period to 2020. The cost incurred by individual households for this investment, and the subsequent avoided costs per year, are determined to a large extent by the specific circumstances. Investments in energy-saving measures result in cost savings from reduced use of mains power. The expectation is that between 2015-2020, on average, the cost reduction due to energy savings will be smaller than the cost increase due to rising prices. This effect will be less marked for households that invest more than the average amount in energy-saving measures and renewables, or realise above-average energy savings. As a result, the average energy bill is expected to increase by 150 euros to approximately 1,800 euros between 2015 and 2020. It should be noted that this projection is subject to a higher-than-average degree of uncertainty.

The NEO 2014 assumed a decrease of 46 euros between 2014 and 2020. The difference is due to the changed base year and to a number of other - sometimes conflicting - changes. Although energy prices will not rise as fast as was expected in the NEO 2014, this will be offset by an increase in fixed costs. In addition, the surcharge for sustainable energy will be higher, because the calculation is based on covering SDE+ expenditure that is in line with achieving a target of 14% renewable energy in 2020.

11 Prices adjusted for inflation, in euros of 2014.

Greenhouse gases and air pollutants

Emissions of greenhouse gases in the Netherlands are showing a downward trend

Total emissions of greenhouse gases in the Netherlands fell by 11 percent between 1990 and 2013, from 219 to 196 megatons of CO_2 equivalents. This reduction is due to the fact that emissions of non-CO_2 greenhouse gases fell sharply after 1995 as a result of reduction measures; at 166 megatons, CO_2 emissions were around 3 percent higher in 2013 than in 1990. Under existing policy, total emissions of greenhouse gases will decrease further to 181 [177-185] megatons of CO_2 equivalents in 2020, and under intended policy to 178 [175-182] megatons of CO_2 equivalents. Compared to 1990, this corresponds to a reduction of around 18 percent under existing policy, and 19 percent under intended policy. After 2020, emissions under existing policy will decrease further to 175 [168-186] megatons of CO_2 equivalents in 2030, and under intended policy to 173 [164-181] megatons of CO_2 equivalents. Emissions will decrease from the 1990 level to almost 21 percent in 2030 under existing policy and more than 21 percent under intended policy.

Estimates of greenhouse gas emissions in 2030 higher than in NEO 2014

In this NEO 2015, emissions of greenhouse gases in 2030 are approximately 14 to 15 megatons of CO_2 equivalents higher than in the NEO 2014. Roughly half of this figure is explained by changes in the future scenario for energy production, whereby the Netherlands will start to export electricity generated from fossil fuels. One-quarter of the figure is explained by a slight reduction in renewable energy production in 2030, and the remaining one-quarter is due to the aforementioned change in the method for calculating greenhouse gas emissions.

The Netherlands is expected to meet its European target for greenhouse gas reductions in 2020 by a comfortable margin

In the European context, the Netherlands only has a national emissions target for the emission of greenhouse gases that are not regulated by the European Emissions Trading Scheme (ETS). This target relates to cumulative (non-ETS) emissions in the period 2013-2020 and is set at 920 megatons of CO_2 equivalents. Annual non-ETS emissions will decrease under existing as well as intended policy from 109 megatons of CO_2 equivalents in 2013 to 100 [97-102] megatons in 2020. Cumulative emissions amount to approximately 820 megatons of CO_2 equivalents. The Netherlands will thus meet the target by a comfortable margin. In June this year, the government announced that any surpluses will be cancelled and therefore will not be carried over to the period after 2020.

It is very likely that the Netherlands will achieve the emission targets for air pollutants; the targets proposed for a number of substances for 2030 go beyond current estimates

Under existing policy, it is very likely that the Netherlands will be able to meet the emission-reduction requirements for the period 2005 to 2020 that are specified in the revised Gothenburg protocol. In December 2013, the European Commission proposed national targets for emission reductions for 2030. These targets were recalculated in January 2015 because many EU countries wanted their most recent emission information to be taken into account. For two of the

five substances, the revised reduction targets for the Netherlands go beyond the national estimates in existing policy. Estimated emissions of non-methane volatile organic substances in the Netherlands in 2030 are still approximately 11 [2-18] kilotons above the revised target. Estimated sulphur dioxide emissions in 2030 are still 3 [1-6] kilotons above the target. The revised targets for nitrogen oxides, ammonia and particulate matter are within reach under current existing and intended policy. However, if a number of uncertain factors develop unfavourably, the estimate for nitrogen oxides may also be approximately 9 kilotons above the target. Because the European Parliament and European Council are still engaged in the decision-making process relating to the goals for 2030, and the process will be concluded at the earliest in 2016, it is not yet clear what the final targets will be. We cannot therefore say precisely which substances will be subject to stricter requirements for the Netherlands, and to what extent.

Local developments

The number of energy cooperations has risen rapidly in recent years, but the contribution to renewable energy supply is still small

Most energy cooperations begin with service provision, but an increasing number are also involved in realising large-scale solar and wind projects. In the case of solar power plants, it is not easy to realise a sufficiently profitable business solution. In its present form, the lower tariff for local sustainable energy is not yet effective. In 2014, many cooperations opted for the SDE+ scheme, and the available budget is substantially oversubscribed. In the case of wind power, the challenge is to establish a local support base. Despite these problems, it seems possible for energy cooperations to make a greater contribution to the generation of renewable energy in the future.

European developments

Policy in the Netherlands is less geared to the long term than that of other countries

Dutch energy policy currently focuses on implementing the Energy Agreement and meeting the related targets in 2020 and 2023. For 2030 there exists a Dutch greenhouse gas target for the transport sector of 25 megatons of CO_2 equivalents. Besides these targets, there is a lack of specific energy and climate targets for the long term in the Netherlands. In neighbouring countries, such long-term targets help in the structuring of national policy for the energy transition, and in setting priorities. Germany has long-term targets not only for greenhouse gases, but also for renewable electricity (55-60 percent in 2030 and 80 percent in 2050). The target for growth in renewable electricity means that Germany has to give timely thought to structuring the electricity market in order to increase flexibility and ensure security of supply. A clear long-term policy framework also helps countries to formulate an agenda for cooperation. France and Germany are cooperating more closely in the development of renewable energy, and Germany is focusing efforts on making agreements with neighbouring countries regarding market organisation for the electricity sector.

Long-term policy also helps countries to take a proactive stance in the discussion surrounding the shaping of European energy policy. In Europe, a balance has to be found between what needs to be organised at EU level in order to facilitate the Member States in their energy transition, national choices regarding the energy mix and ensuring security of supply, and which activities in these areas are to be carried out by the Member States themselves. This is a complicated undertaking because the countries of northwest Europe make very different choices with regard to the composition of their energy mix. This is most evident in the position on nuclear power. Germany, and to a lesser extent France, provide for a decrease in the proportion of nuclear power, whereas the United Kingdom wishes to increase this proportion.

Innovation

Policy ambitions for the long term require innovations in all the main clean technologies

As part of energy policy for the long term, it is important to spread innovation efforts over all development phases, including the initial application phase. Efforts are beginning to be spread more effectively in the Netherlands, but this is not yet the case for all potentially important options. Successful market development for innovations requires co-investment by all the societal parties involved. Private investment is lagging behind, not only in the Netherlands but also in the rest of Europe. In the short term, the main aim of innovation efforts is to substantially reduce the cost of clean technologies so that they can compete more effectively with conventional technologies. To this end, support in the initial implementation phase is particularly important. Solar PV and electric vehicles are examples in which substantial investment has been made. In both cases, substantial cost reductions have been realised. Although this is mainly the result of international developments, advances in the Netherlands have also made a valuable contribution. Other options that are equally important in terms of achieving the climate targets for 2050 (e.g. carbon capture and storage - CCS - and large-scale biomass gasification) are not receiving the same amount of attention. Innovative developments geared to large-scale, sustainable bio-energy are at risk of stagnating, just at a stage when important steps towards demonstration and initial application are due to be taken. Innovation efforts for the long term are important not only for achieving ambitions relating to the energy system and CO_2 emissions, but also for ambitions in other sectors and in relation to non-CO_2 greenhouse gases.

The Netherlands invests a relatively high proportion of public research funding for energy in renewable energy and energy-saving measures

RD&D expenditure[12] on energy conservation and renewable energy as a proportion of total public RD&D spending on energy in the Netherlands was around 70 percent in the period 2008-2013. As in other countries in the West, the proportion of RD&D investment in fossil energy was relatively low. In a number of countries, however, the proportion of RD&D expenditure on nuclear power was relatively high. On a general level, the proportion of public

12 Research, Development and Demonstration

expenditure allocated to demonstration projects in the Netherlands has fallen in recent years.

A relatively high number of companies in the field of sustainable energy are applying for patents, and the number of Dutch patents in clean energy technologies is increasing

Some 15 percent of companies that are active in the field of renewable energy and energy conservation applied for a patent in the period 2006-2011. This is high in comparison to the average for all Dutch companies, which was approximately 1 percent in the first decade of this century. The number of Dutch patents in clean energy technology increased sharply in the period mentioned. The majority of patents were for solar PV and for the combination of biomass and waste processing.

Economic growth and employment

Energy is important to the Dutch economy

Energy-related activities contributed 6 percent to the gross domestic product (GDP) of the Netherlands in 2013. The Netherlands is an important trading country for energy carriers. Imports and exports of energy carriers are more than three times higher than total national consumption. Energy accounts for 16 percent of total exports and 19 percent of total imports. Energy-related investment accounts for 10 percent of total national investment (with a fairly even distribution between sustainable energy, conventional energy and grid companies). Because energy exploitation and generation are relatively capital-intensive, their share in employment (2 percent) is much smaller.

The contribution of conventional energy exploitation to Dutch GDP will decrease

As a result of the decreasing importance of Dutch gas extraction in particular, the contribution of energy exploitation to GDP will fall in the coming years, but will recover slightly at the end of the decade. Due to the growth in sustainable activities, the contribution of the entire energy sector to the economy in 2020 will return to the 2013 level.

Energy is important for government finances

Energy-related government revenues (particularly natural gas revenues, energy tax and duties) are a multiple of government expenditure on energy. This is a normal situation. The government budget separates revenue and expenditure. Despite falling gas revenues and increasing funding for renewable energy, government revenues in 2020 may amount to ten times the level of public spending on energy.

Gross energy-related employment is increasing

Gross energy-related employment has increased considerably since 2005, and the upward trend is continuing. It is expected to rise to 170,000 full-time jobs in 2020 (30,000 more than in 2014). Employment in sustainable activities will therefore be higher than employment in conventional activities. The increase in employment is the direct result of increased investment. In 2020, employment created through investment will account for almost three-quarters of total

energy-related employment. Most of the jobs will be created in the construction and installation sector.

Energy Agreement ambition regarding net employment will come within reach
Net employment in the period 2014-2020 will increase by approximately 80,000 work years as a result of the Energy Agreement, while the target is 90,000 work years. In the period up to 2017, the sector will benefit from the creation of at least 15,000 additional full-time jobs per year (net), after 2017 the effects of the Energy Agreement will decrease.

ECN
P.O. Box 1,
1755 ZG Petten

Contact:
+31(0) 88 515 4949
nev@ecn.nl

ecn.nl
pbl.nl
cbs.nl
rvo.nl