Long abstract

National energy outlook of the Netherlands 2014 / M. Hekkenberg – Energy research centre of the Netherlands ECN[1]

1. Introduction:

The Netherlands is a highly industrialized country in western Europe with a population of roughly 17 million people. The exploitation of its large natural gas reserves since the 1960s has led to natural gas being the main energy carrier used for heating in buildings, agriculture, industry, as well as in the power sector. Its gas reserves have allowed the Netherlands to develop a relatively large energy intensive industry sector and to become a gas exporting country. Energy policy in the Netherlands focuses on the trias reliable, affordable and clean. As an EU-member state, the Netherlands has committed to energy and climate targets for the year 2020, that relate to its share of renewable energy (14% in 2020), greenhouse gas emissions (16% reduction in non-ETS sectors), and energy efficiency (1.5% improvement per year). A large set of policy instruments has been implemented over the course of years to guide the development of the Dutch energy system. In addition, in the summer of 2013, more than 40 industrial, governmental and societal organisations in the Netherlands signed the ´Energy Agreement for sustainable growth´, in which these parties commonly commit to a set of measures and goals that should speed up the development of a sustainable energy system and lead to additional employment. The transition towards a sustainable energy system touches upon many different stakes and leads to frequent debate in and outside the political arena. This debate is most meaningful when it is grounded in a commonly acknowledged factual base.

2. Goal:

The National Energy Outlook (NEO) aims to provide the factual base for political and societal debate. It outlines the current state of the Dutch energy system and describes the observed development from 2000 up to the present, as well as expected developments up to 2030. It covers physical indicators, such as energy supply, energy demand and the emission of greenhouse gases, and economic indicators, such as Economic Value Added and employment related to energy.

3. Methodology:

The NEO describes the expected development following two policy variants, which include government policy and measures and the activities of other societal actors. The 'with existing measures' variant' includes specific, officially published measures and activities that are binding for stakeholders as much as possible. The 'with additional measures' variant also includes published intentions for measures which, by early May 2014, were considered specific enough to process in the calculations. Many elements of the national Energy Agreement have been included in the 'with additional measures' policy variant. For maximum relevance, the selection of measures included in the policy variants is done in agreement with the relevant ministries and stakeholder representatives.

[1] This paper forms a long abstract of the National Energy Outlook of the Netherlands 2014 (Hekkenberg & Verdonk, 2014).

The NEO uses a wide set of sources. Historic statistics are composed from various registers and questionnaires, following the procedures common for the national bureau of statistics. Actual activities from industry and other societal stakeholders related to e.g. the deployment of renewable energy and energy efficiency measures is collected through the state agency for entrepreneurship that facilitates, monitors and reports on these activities.

To provide detailed, integrated and internally consistent projections for the future national and sectoral energy balance, ECN's National Energy Outlook Modelling System (NEOMS) is used (Volkers 2013). NEOMS consists of a set of of 12 sectoral and integrated energy and investment models, which communicate iteratively. It allows to calculate the energy use and the corresponding emissions for the Dutch energy system and for individual sectors. Detailed results include energy demand, supply, emissions, technology uptake, investments, costs, prices and policy impacts. The total system includes about 22 sub-sectors with all relevant technologies and fuels per sub-sector. Their CO2 emissions are also calculated. Table 1 below shows the sectors that NEOMS currently covers and their corresponding models:

Table 1 Overview of sectors and corresponding energy models in the National Energy Outlook Modelling System

Energy demand	Energy supply
• Industry and agriculture (SAVE-Production), • Service sector (SAVE-Services) • Households (SAWEC and EVA) • Transport (TEMPO and/or external inputs)	• Combined heat and power (SAVE-Production) • Electricity supply (Competes) • Refineries and oil supply (SERUM) • Renewables (RESolve-E) • Gas supply (Gas production)

The outputs of all the separate models are combined in a model of the total energy sector (SELPE) in which the validity and consistency of the energy system as a whole is verified. Ultimately, all the results feed into MONIT-Conversion, a tool which calculates the energy savings per sector and produces aggregated results for all kinds of analyses. Figure 1 provides a graphical representation of the interlinkages between the different NEOMS models.

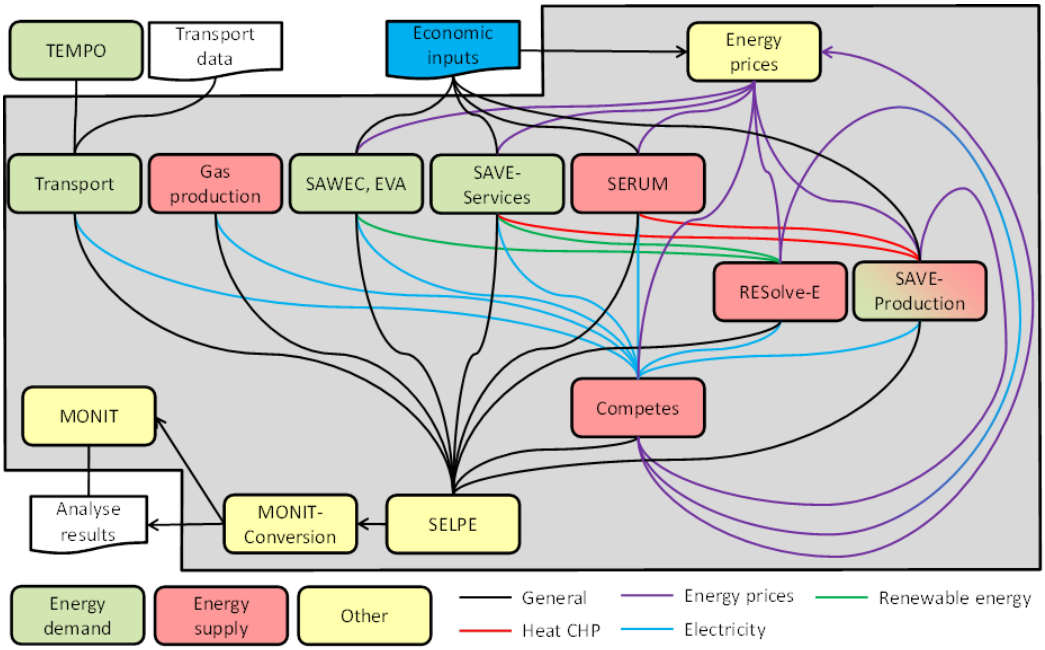

Figure 1 Interlinkages between models in NEOMS

To complement the national greenhouse gas inventory, projections for non-CO2 greenhouse gases are additionally modeled using consistent input data.

The projections in the NEO aim to reflect the most plausible developments according to the selected policy variant, by using insights on prices, markets and the state of technology as of May 2014. However, as the future is inherently uncertain, interpreting projections is not possible without accounting for these uncertainties. A variety of factors such as prices, economic growth, sector-specific developments, or developments abroad can evolve differently than assumed in the projections. Based on additional model calculations and expert judgements, the sensitivity of the results and 5-95% confidence intervals have been assessed for the most important uncertain factors. Using Monte Carlo analysis, the cumulative ranges for the most important result indicators have been calculated. Where relevant and available, these ranges are shown in brackets [] and should be interpreted as uncertainty ranges for projected future values.

4. Results:

Energy consumption

Since 2004, the total energy use of final consumers in the Netherlands has followed a slightly decreasing trend. Corrected for temperature influences, the total gross energy use of final consumers in the Netherlands in the year 2013 was almost 3 per cent lower than in the year 2000, and over 5 per cent lower than in the year 2004 (Figure 2).

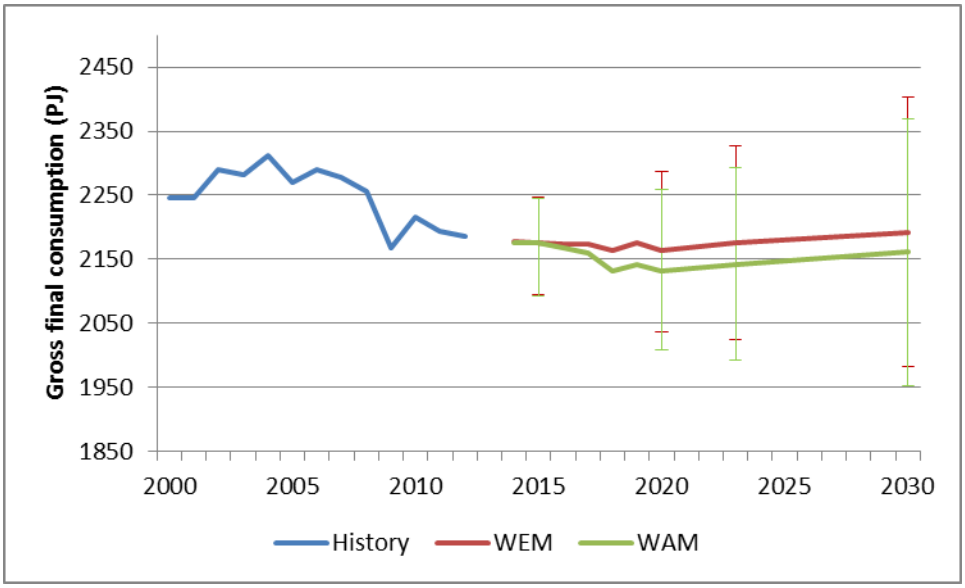

Figure 2 Gross final energy consumption in the Netherlands. 2000-2012 historic realization, 2014-2030 projections with existion measures (WEM) and with additional measures (WAM)

With existing policies a slight decrease in energy consumption is projected for the period 2013 - 2020, amounting to approximately 1 per cent [-6 to +4 per cent]. Especially in the built environment and the transport sector, the historic trend of increasing energy consumption is expected to reverse, resulting in decreasing consumption over the coming decade. This change is attributed to a combination of factors including slower economic growth, slower population increase, technological progress and increased attention to energy efficiency. Energy consumption in industry is expected to grow, which offsets most of the projected reductions in the other sectors.

With additional measures energy consumption is expected to decrease by approximately 2.5 per cent between 2013 and 2020 [-8,5 to +3 per cent]. In this policy variant, energy consumption is lower because of the implementation of additional energy efficiency measures. After 2020 energy consumption may increase again slightly, due to an increase in industrial production, among other reasons.

Energy efficiency

The average rate of annual energy efficiency improvement in the Netherlands was approximately 1.1 per cent in the period 2000 - 2010. For the period 2010 up to 2020, the implementation of existing measures is expected to lead to an annual efficiency improvement rate of 1.0 per cent [0.7 to 1.2 per cent]. The efficiency improvement is mainly explained by the use of increasingly efficient appliances and vehicles, and improved insulation of buildings.

With both existing and additional measures, a higher energy efficiency improvement rate of on average 1.2 per cent [1.0 to 1.4 per cent] per year is expected. The additional efficiency improvement is mainly explained by the implementation of measures from the Dutch Energy Agreement. The efficiency improvement rate is expected to decrease after 2020, because most prevailing measures will have reached a high penetration rate and will have less incremental impact.

Not all energy efficiency targets are within reach. The Dutch objective of the European Energy Efficiency Directive will most likely not be reached with existing measures. Including additional measures, the target is expected to be within reach. The objective of the national Energy Agreement of additional energy efficiency improvement of 100 petajoules in 2020 will not be achieved with the currently known measures in either policy variant; combined, the measures in the Energy Agreement are projected to cumulate to 19-61 Petajoule.

Primary energy fuel mix

Natural gas loses its position as number one energy carrier in the Netherlands. For several years, the use of natural gas in the Netherlands has shown a decreasing trend. A further decrease in the gas demand of final consumers, combined with a reduction in gas use in gas-fired power plants and CHP plants, leads to a continued declining trend up to 2030 (Figure 3). The use of coal increases strongly in the short term, and is then expected to decline again towards 2030. The use of energy from renewable sources increases strongly. Because the use of oil as a raw material in the industry will increase in the coming years, the total oil demand remains relatively constant despite the decreasing demand for oil products in the transport sector. From 2015, oil will take over the position of mostly used energy carrier in the energy system from natural gas.

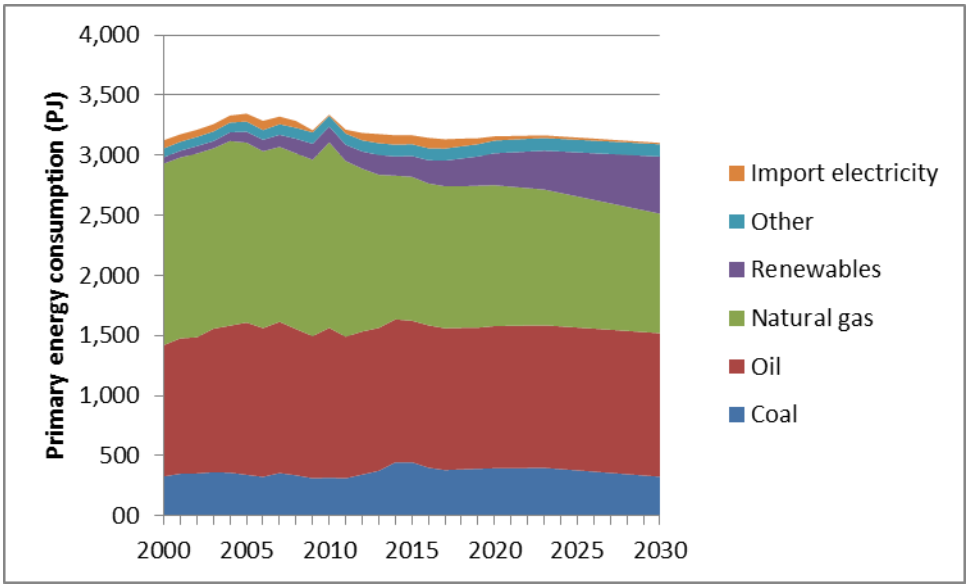

Figure 3 Primary energy consumption in the Netherlands. 2000-2013 historic realization, 2014-2030 projection with existing measures.

Between 2025 and 2030 the Netherlands will switch from being a net exporter to becoming a net importer of natural gas. The Dutch gas production will decrease only slightly in the coming 10 years, but afterwards it will decrease more rapidly due to exhaustion of the large Groningen field. As a result, despite the expected fall in gas demand, the Netherlands will become a net importer of natural gas at the end of the next decade.

Electricity supply and electricity market

Fossil fuels play a dominant role in electricity generation. In the period 2000 up to 2010 the largest share of electricity was produced from natural gas. However, in the past years, and particularly in 2014, the production of electricity from natural gas has decreased strongly while the production from coal has increased. This is caused by an unfavourable market situation for natural gas fired power plants and CHP plants. Several factors play a role: a relatively low price for coal compared to natural gas, the low price of CO2 emission allowances, the high production capacity in the Netherlands and low electricity prices in Germany. The expected closure of five old coal fired power plants in 2016-2017 will bring no substantial change to the market situation, because new coal fired plants will become operational and the capacity of electricity connections with neighbouring countries will be expanded. The continuing increase of renewable electricity generation in the Netherlands towards 2030 will also lead to a more unfavourable market situation for electricity generation from coal-fired plants (Figure 4).

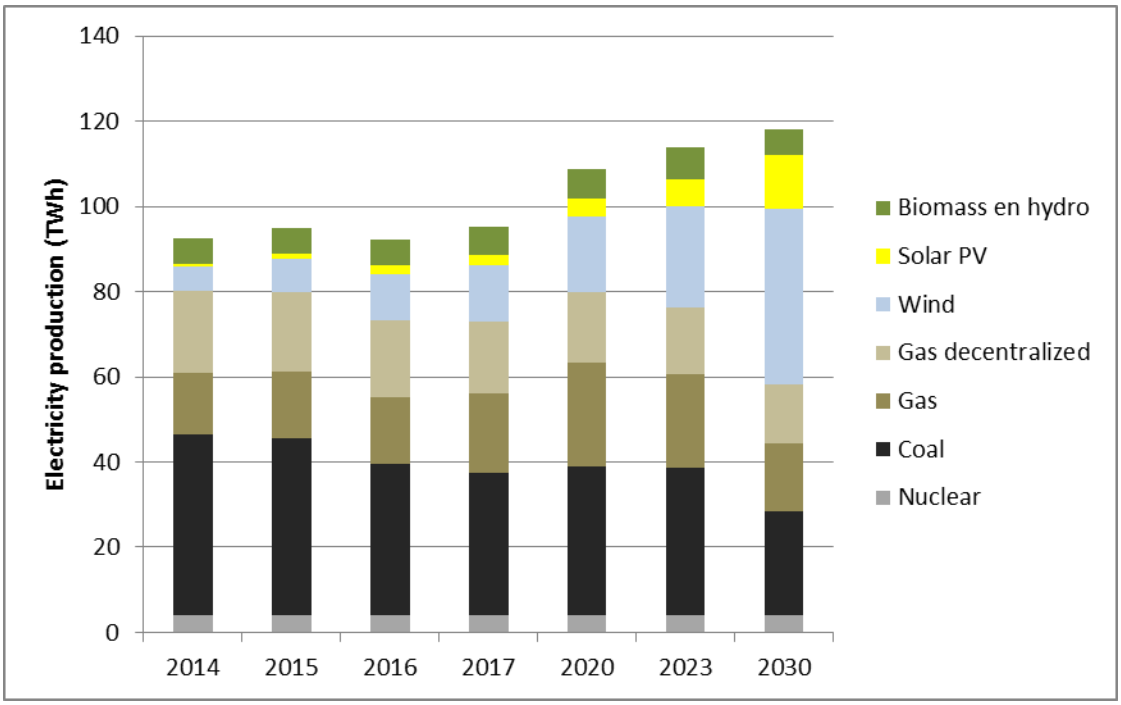

Figure 4 Projected electricity production in the Netherlands, with existing policy

The low wholesale trade prices of electricity in the Netherlands will be maintained in the next years. The market situation for electricity generation has recently led to a decrease in wholesale trade prices. In the longer term, the prices of gas and coal are expected to increase. Combined with a decrease in overcapacity, this is expected to lead to an increase of the wholesale electricity price towards 2020.

The increase of renewable electricity production, particularly after 2020, has a mitigating impact on the wholesale prices. Over time, wind and solar power will increasingly replace gas and coal fired plants that have higher marginal production costs. This is expected to lead to a relatively constant average wholesale price after 2020, despite rising coal, gas and CO_2 prices.

Renewable energy

The share of renewable energy will grow strongly in the coming decade. In the previous decade the share of renewable energy in final energy consumption has increased from 1.4 per cent in the year 2000 up to 4.5 per cent in 2013. Based on bottom-up information on project activities and subsidy applications, moderate growth is expected in the next few years, but the share will grow significantly from 2017 onwards under the influence of renewable energy feed-in premiums, regulation of renewable energy in transport, energy performance standards for buildings, and tax measures. The expected acceleration in growth is partly explained by the fact that some large projects that were delayed are expected to become operational by 2017.

Strong uncertainties surround the expected increase of renewable energy. Uncertainties exist in, amongst other things, the development of the willingness to invest, costs, societal support**,** and availability of capital. Moreover there are some technology-specific uncertainties. For example, policy design to stimulate offshore wind is still in full swing and may change expected outcomes. As shown in Figure 5, a share of 10.6 per cent is expected for 2020 with existing measures [9.1 to 11.1 per cent]. Including additional measures, the share in 2020 is expected to be 12.4 per cent [10.5 to 13.0 per cent]. The Dutch target for renewable energy that has been agreed in the European context (14 per cent in 2020), is therefore not met in either policy variant. Increase is expected for nearly all technologies, but the most important contributions are expected to come from wind energy, solar power and various biomass applications. The additional growth in case of additional measures originates from co-firing of biomass in coal fired plants and from an accelerated growth of offshore wind power.

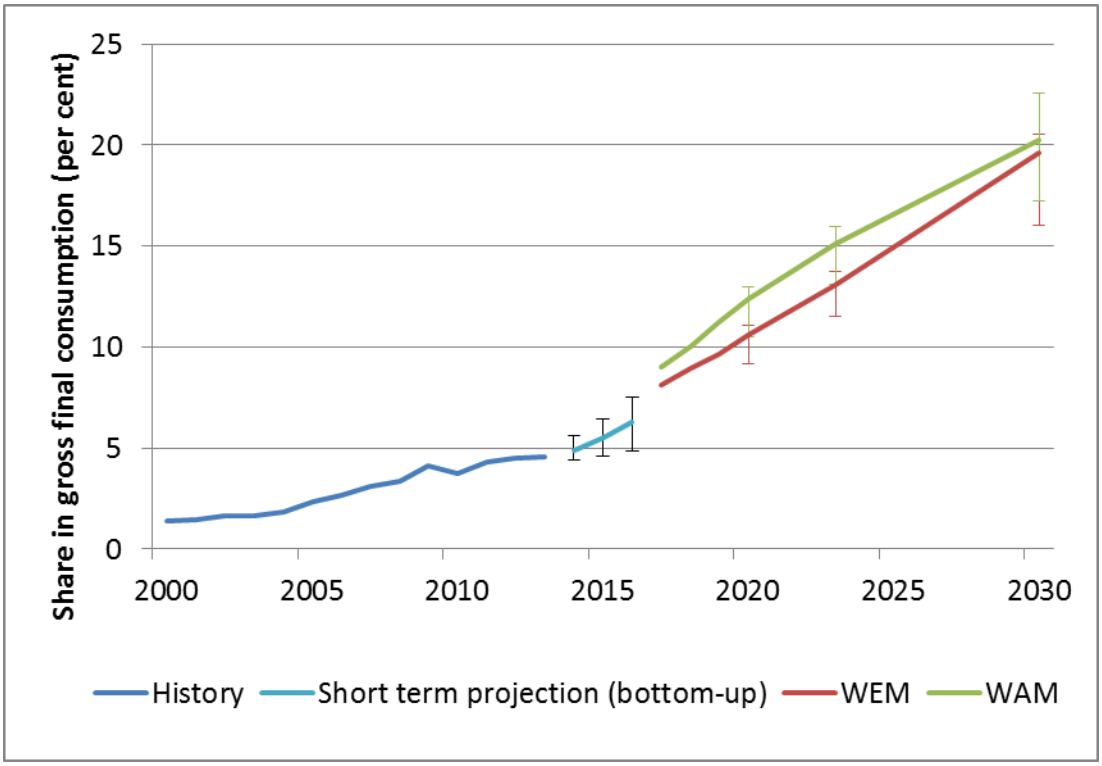

Figure 5 Renewable energy consumptions as share of gross final consumption. WEM = with existing measures, WAM = with additional measures

After 2020 the share of renewable energy will grow further. With existing measures a share of 13.1 per cent in 2023 is expected [11.5 to 13.7 per cent]. Including additional measures, the expected share in 2023 is 15.1 per cent [13.1 to 15.9 per cent]. The objective from the Energy Agreement (16 per cent in 2023) can only be achieved if all uncertainties develop favourably. In 2030, assuming continued incentivisation of renewable energy by means of the aforementioned regulations, about 20 per cent of the final energy consumption will originate from renewable sources. Almost 50 per cent of domestic electricity generation would be renewable.

Greenhouse gas emissions

The emissions of greenhouse gases in the Netherlands show a decreasing trend (Figure 6). The total emissions of greenhouse gases in the Netherlands have decreased by 9 per cent to 192 megatons of CO_2 equivalents between 2000 and 2013. A large part of this reduction is caused by a reduction of non- CO_2 greenhouse gas emissions, which are not energy related. With existing measures, the total emissions will continue to decrease significantly, to 161 megatons in 2030 [147 to 175 megatons]. With additional measures, emissions are further reduced, to 158 megatons [147 to 170 megatons]. The expected emissions reduction originates mainly from decreasing CO_2 emissions and relates strongly to the increasing share of renewable energy.

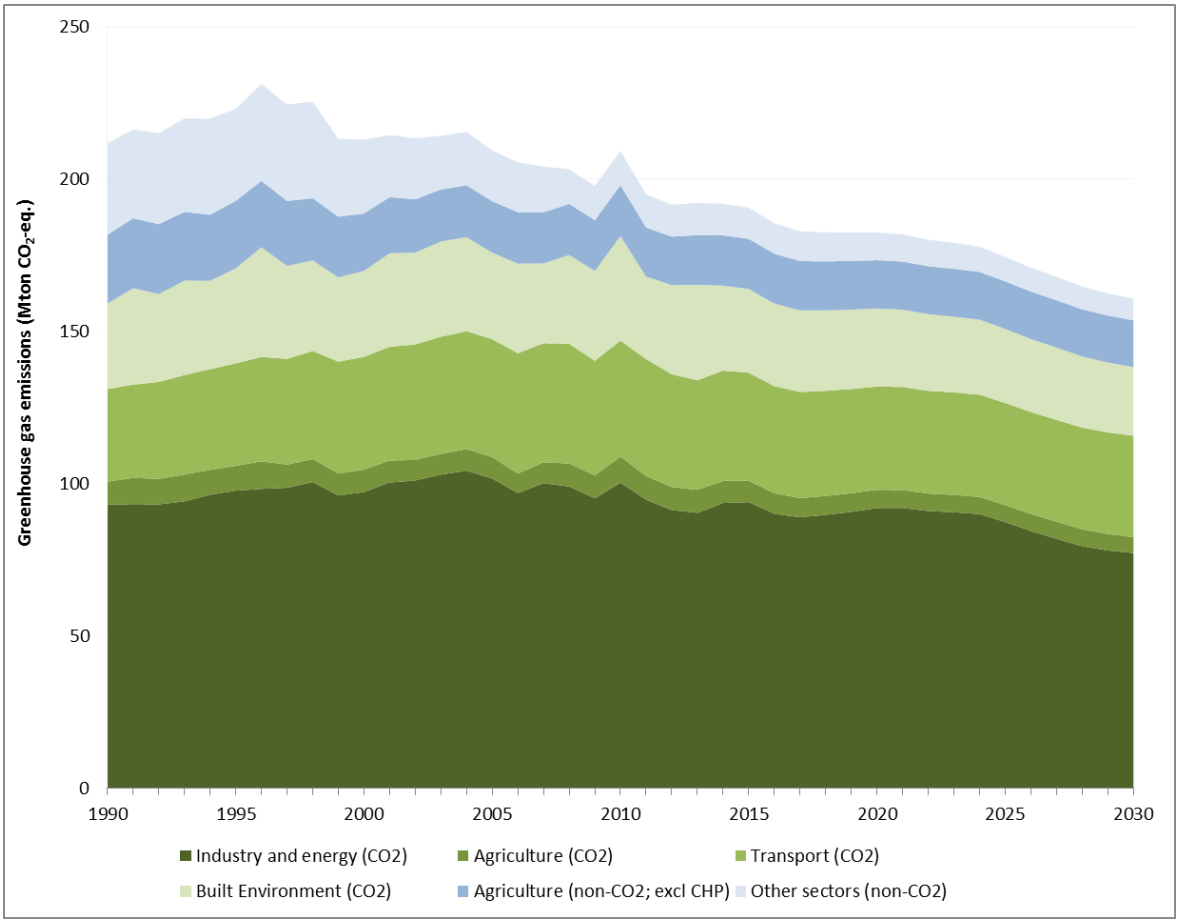

Figure 6 Greenhouse gas emisisons in the Netherlands, projection with existing measures

The Netherlands will achieve its European greenhouse gas emissions target in 2020. In the European context, the Netherlands only has a national emission target for the emission of greenhouse gases that are not regulated by the European Emissions Trading Scheme (EU ETS). This target relates to the cumulative (non-ETS) emissions in the period 2013-2020 and is set at 897 megatons of CO2 equivalents. With existing policy, the annual emissions of sources not covered by the ETS decrease from 105 to 97 [88-106] megatons of CO_2-eq in the period 2013-2020. Including additional measures, the emissions reduction is slightly larger, i.e. to 96 [87-105] megatons in 2020. The cumulative emissions with existing measures amounts to about 811 megatons. Including additional measures, the cumulative emissions in this period amounts to 808 megatons. Hence, the Netherlands will amply meet its emission target (Figure 7).

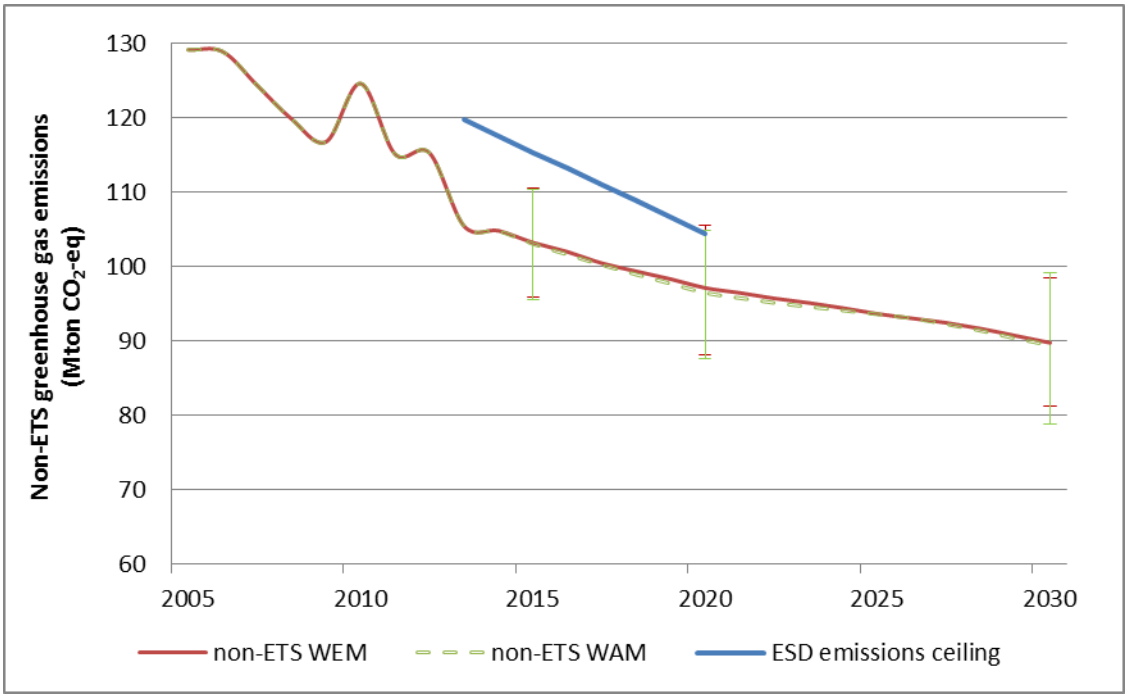

Figure 7 Non-ETS greenhouse gas emissions and the Dutch ESD emissions ceiling. WEM = with existing measures, WAM = with additional measures

Decoupling of economic growth, energy consumption and greenhouse gas emissions.

Structural changes in society, application of increasingly energy efficient technologies and other energy efficiency measures and the increasing use of renewable energy have resulted in a decoupling of economic growth, energy use and the emission of greenhouse gases in the Netherlands in the last decade. The projections show that this decoupling is expected to continue in the period up to 2030, in the both the policy variant with existing as well as that with additional measures. Despite the projected 30 per cent growth in the economy between 2013 and 2030, total energy consumption in the Netherlands is projected to remain nearly constant in this period, and the emission of greenhouse gases in this period will decrease with 17 [8-23] per cent.

Growth and employment

Energy-related activities deliver an important contribution to the Dutch economy. Both the exploitation of energy, and resulting investments create Economic Value Added and employment. The share of the observed activities in the Gross Domestic Product amounted to 5.4 per cent in 2012. The share of these observed activities in employment in 2013 is much lower at 1.3 per cent. Extraction companies in particular have a relatively high Economic Value Added per employee. The economic significance of the conventional energy sectors in the Netherlands is very high because of this. These sectors are facing a difficult market situation however. The oil and gas sectors are facing stagnation or downsizing. The electricity producers are dealing with losses on gas-fired power plants and CHP. An important part of the

activities is not directly monitored for economic statistics at this moment. A model approach shows that the total energy-related employment is more than twice as high as the direct monitored employment (200,000 jobs in 2013). Approximately half of these jobs are related to 'sustainable energy activities' (renewable energy and energy efficiency). The expectation is that sustainable energy activities in particular will grow in volume, as a result of which the total number of jobs in 2020 will be around 230,000 with existing measures and around 250,000 with additional measures (Figure 8). The growth mainly takes place in the construction sector. These figures do not take into account replacement of jobs in other activities.

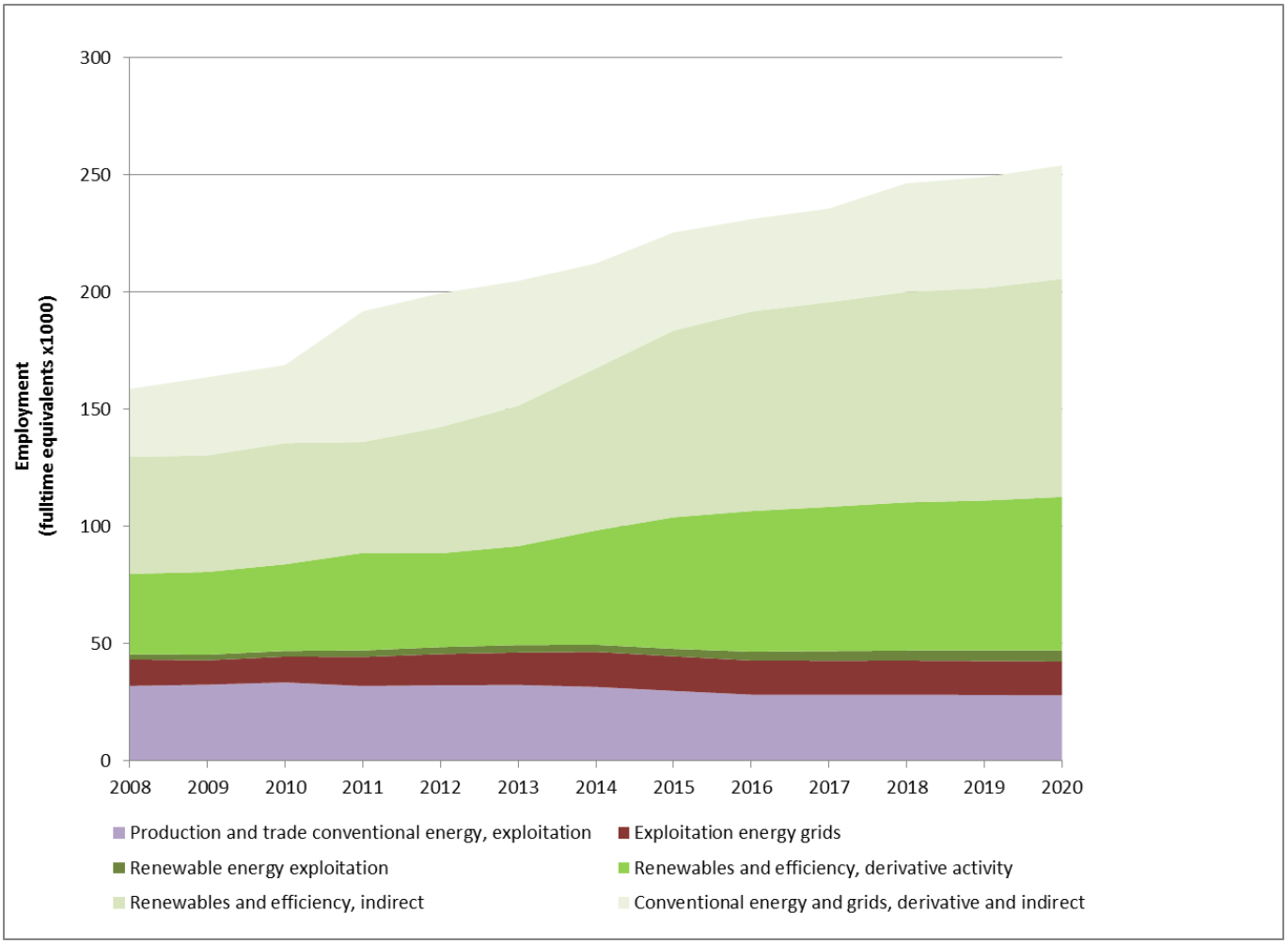

Figure 8 Employment in energy related activities, projection with additional measures

The employment in energy exploitation activities has increased by 14 per cent between 2005 and 2013. Especially the exploitation of natural gas and electricity grids and the production of renewable energy made an important contribution to this growth. The employment from energy exploitation is expected to remain approximately stable up to 2020. There is a slight shift from conventional to renewable energy. After 2020 the increase in renewable energy production continues, but this cannot entirely compensate for the loss in employment caused by declining natural gas extraction and other types of

exploitation of fossil energy. As a result, the employment in exploitation activities decreases in the long run.

The monitored activities that result from investments in the field of renewable energy and energy efficiency increased significantly in the period 2005-2013, by almost 60 per cent. Particularly activities related to solar energy (e.g. installation of solar panels) and wind energy (both offshore and onshore activities) have grown in the previous years. The employment related to electric transport is still limited but has increased considerably in the past four years. Investments in conventional energy activities, such as the construction of new coal-fired plants, have yielded additional employment in the past years. In the coming years this will slightly decrease due to a declining investment level. The investments in energy efficiency in the built environment and renewable energy generation will lead to further growth of gross employment up to 2020.

5. Overall conclusions

The National energy outlook shows an image of the Dutch energy economy that can be interpreted in multiple ways. Some policy goals seem to be within reach with existing or with additional measures, such as the Dutch target for non-ETS greenhouse gases under the European Effort Sharing Decision and the Dutch energy efficiency target under the EU Energy Efficiency Directive. Other targets, most notably the EU Renewable energy target and various national targets for renewable energy and energy efficiency still seem to be out of reach in either policy variant. Overall and across the board however, the projections show clear signs of the transition towards a more sustainable energy system in a broad range of sectors: energy consumption is decreasing in the built environment and transport, renewable energy is on the rise, greenhouse gases are being reduced and more people are being employed in energy related activities. Table 2 shows the key input and result parameters of the National Energy Outlook.

Table 2 Core table National Energy Outlook

	2000	2010	2012	2020[2)]		2030[2)]	
				WEM[3]	WAM[3]	WEM[3]	WAM[3]
GDP (index)	100[*]	113	113	124		147	
Oil price[1] (US dollar per barrel)	**37**	**86**	**113**	**127**		**143**	
Gas price[1] (eurocent per m3)	15	18	23	30		32	
Coal price[1] (euro per tonne)	**50**	**88**	**96**	**89**		**94**	
CO_2 price[1] (euro per tonne)	-	16	7	9	12	15	21
Final energy use[6] (Petajoule)	**2245**	**2215**	**2185**	**2163**	**2132**	**2193**	**2161**
Annual rate of energy efficiency improvement[4] (per cent per year in previous decade)	n.a.	1.1		1.0	1.2	0.7	0.7
Share of renewable energy in end use (per cent)	**1.4**	**3.7**	**4.5**	**10.6 (2023: 13.1)**	**12,4 (2023: 15.1)**	**20**	**20**
Greenhouse gas emissions (megatons of CO_2-eq)	213	209	192	183	176	161	158

of which non-ETS	-	125	115	97	96	90	89
Energy-related employment[5] (x1000 full-time equivalents)	81*	84	89	106			
Economic Value Added value as a share of GDP[5] (per cent)	**4,1***	**4.7**	**5.3**	**5.2**			

1) Constant prices 2013. 2) All shown values have significant uncertainty ranges that are not shown here. 3) WEM = with existing measures; WAM = with existing and additional measures. 4) Energy efficiency improvement rate according to the Protocol Monitoring Energy Saving, in primary terms. 5) Monitored activities, excluding activities from investments for conventional energy generation. 6) Temperature corrected. * 2001 instead of 2000

References:

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