International Energy Agency

Energy Policies of IEA Countries

The Netherlands

2014 Review

INTERNATIONAL ENERGY AGENCY

The International Energy Agency (IEA), an autonomous agency, was established in November 1974. Its primary mandate was – and is – two-fold: to promote energy security amongst its member countries through collective response to physical disruptions in oil supply, and provide authoritative research and analysis on ways to ensure reliable, affordable and clean energy for its 28 member countries and beyond. The IEA carries out a comprehensive programme of energy co-operation among its member countries, each of which is obliged to hold oil stocks equivalent to 90 days of its net imports. The Agency's aims include the following objectives:

- Secure member countries' access to reliable and ample supplies of all forms of energy; in particular, through maintaining effective emergency response capabilities in case of oil supply disruptions.
- Promote sustainable energy policies that spur economic growth and environmental protection in a global context – particularly in terms of reducing greenhouse-gas emissions that contribute to climate change.
- Improve transparency of international markets through collection and analysis of energy data.
- Support global collaboration on energy technology to secure future energy supplies and mitigate their environmental impact, including through improved energy efficiency and development and deployment of low-carbon technologies.
- Find solutions to global energy challenges through engagement and dialogue with non-member countries, industry, international organisations and other stakeholders.

IEA member countries:

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The European Commission also participates in the work of the IEA.

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TABLE OF CONTENTS

List of figures, tables and boxes

FIGURES

TABLES

BOXES

1. EXECUTIVE SUMMARY AND KEY RECOMMENDATIONS

EXECUTIVE SUMMARY

Since the last International Energy Agency (IEA) in-depth review published in 2008, the Netherlands has succeeded in consolidating its energy policy within the EU 2020 energy and climate targets. Amid challenges imposed by the global financial and economic crisis and changing energy markets, the Dutch energy policy emerges reinforced to leverage both economic growth and a sustainable energy economy.

The Netherlands has made further progress towards an open, liberalised and advanced market economy, and today it ranks among the leading IEA member countries in terms of market integration, ease of entrepreneurship, investment and innovation. The country made notable progress in decoupling greenhouse gas (GHG) emissions from economic growth and is on track to meet its targets under the Kyoto Protocol and the EU Burden Sharing Agreement, thanks to emissions reductions of non-CO_2 greenhouse gases. In 2012, its GHG emissions were 8.8% lower than in 1990, while gross domestic product (GDP) had increased by 50% in the same period.

The country leveraged investment in energy infrastructure facilities, including ports, modern power plants and efficient industrial processes. It is a major producer of natural gas and maintains competitive oil-refining and petrochemical industries. This integrated supply chain and open market approach resulted in innovative, energy-efficient industrial processes. Together with its geographic position, these features make the Netherlands one of Europe's largest hubs in energy trade and support energy security – an experience from which other countries can learn.

On the basis of the coalition agreement, *Building Bridges,* of 29 October 2012, the Netherlands reached a society-wide Energy Agreement for Sustainable Growth (the "Energy Agreement") in September 2013 laying out the actions needed for the 2020 horizon. Relying on the Dutch polder model, a consensus-driven and bottom-up decision-making process, the Agreement is ambitious and aims to align the interests of industry, civil society and government towards the key objectives of sustainable and secure energy supply, industrial competitiveness and affordability for the consumers.

The Agreement shows a strong consensus on the benefits from doubling planned energy efficiency savings to 1.5% or 100 petajoules (PJ) from the country's final energy consumption by 2020 and deploying more renewable energies (14% by 2020 and 16% by 2023). It promotes sustainable energy at local level, network investment and a strong EU Emissions Trading Scheme. It also supports the transition to clean coal and carbon capture and storage technologies, energy savings and emissions reductions in transport, and the commercialisation of clean technologies, while stimulating employment and training. Commendably, the government has committed resources from the public budget for the implementation of these priority actions.

The Netherlands remains strongly committed to EU and international climate action. On the basis of the Agreement and the *Climate Agenda* of October 2013, the country reaffirmed

its ambition to reduce CO_2 emissions in the transport sector by 17% by 2030 and by 60% by 2050. It also supports an EU-wide reduction in GHG emissions of at least 40% by 2030 and further reductions of between 80% and 95% by 2050, in line with international commitments. The government considers this 40% goal a minimum commitment.

Looking forward, the Netherlands should focus first and foremost on the implementation of the actions for 2020 under the Energy Agreement and lay the ground for a longer-term consistent energy policy framework for the time beyond, up to 2030. Considerable challenges remain to be addressed by 2020, if the government wants to succeed in the transition towards secure, sustainable, competitive and affordable energy.

First, the Netherlands lags behind its national target for renewable energy sources and earlier leadership in wind power, while neighbouring countries have been strongly promoting renewables, notably Denmark and Germany. Since 2005, the share of renewables in final energy consumption has increased from 2.3% to 4.5% in 2013, which is still far from the ambitious target of 14% by 2020. The regional renewable growth leads to substantial variable flows of electricity with impacts on electricity prices and cross-border trade.

Secondly, gas production from the large Groningen field is declining and the outlook for domestic unconventional gas remains uncertain. As a result, the Netherlands is expected to shift from a net exporter to a net importer of gas around 2025. This marks a significant transition as, today, almost all household heating, industries (21%) and power generation (35%) rely on natural gas. The transition will change the gas composition and require investment in conversion and new appliances by industry and households. The transition has implications on the whole energy system and its use of fuels and technologies. The Netherlands has been preparing for this transition by creating the gas hub, with large gas storages, networks and the Gas Access to Europe (GATE) liquefied natural gas (LNG) terminal. Also, the Netherlands is preparing industrial users and consumers for a change in gas composition. The pace of decline and impact on the flexibility of the gas system, however, could be faster than expected in case of further production reductions amid earthquakes in the Groningen area.

Thirdly, electricity market dynamics are changing with high volumes of low or zero short-run marginal cost, low carbon prices and the strong competitiveness of coal over gas in power generation in Europe. As an open economy, the Netherlands benefits from trade, but at the same time it is impacted by global energy market trends as well as by the energy policy choices of its neighbouring countries. There is a high risk of increased market distortion from nationally focussed subsidies of renewables and capacity mechanisms in neighbouring countries. Global price differences in gas, coal and raw materials between the Netherlands and its major trading partners are growing with an impact on the competitiveness of the Dutch industry.

Fourthly, the Dutch energy sector, accounting for 10.9% of GDP, strongly defines the national emission profile. Despite the significant progress in decoupling emissions from economic growth and industrial energy efficiency, the Netherlands remains one of the most fossil fuel- and CO_2-intensive economies among IEA member countries. The share of fossil fuels in the energy mix is above 90%, linked to its use in industry (petrochemical, iron and steel, horticulture and agriculture) and in transport. There is a trend in industry to use oil and oil products, thereby boosting CO_2 emissions. The Netherlands is on track to reach Kyoto targets; however, CO_2 and related emissions have been growing, with impacts on soil, water and air quality, making it more challenging to attain the 2020 targets for sectors outside the EU Emissions Trading Scheme (EU-ETS).

Three elements will shape the success of future Dutch energy and climate policies: *i)* the implementation of the 2020 actions and the development of a longer-term and cost-effective policy framework for the period beyond 2020*; ii)* the consolidation of energy security and resilience during the transition; and *iii)* the pursuit of a regional and international approach on energy markets and technology innovation, notably for the deployment of renewable and other clean energy technologies. These elements need to be approached within the context of the European policy after 2020.

SHAPING PROGRESS

STABILITY FOR 2020 AND BUILDING A FRAMEWORK FOR 2030

The Energy Agreement sets out the key actions for 2020. In order for the Netherlands to reach its 2020 objectives, notably in the area of renewable energies and energy efficiency, it is important to ensure the effective implementation of the Agreement. The government can maintain stability up to 2020 by ensuring a process for the progress review and for the co-ordination of the actions set out in the Agreement through a continuous dialogue with all stakeholders involved.

Stability and predictability for energy investment are fundamental to secure the investments needed in the coming decade. In the Energy Agreement, a 16% share of renewable energy is foreseen in 2023. For the years beyond 2023, the parties have agreed that the Netherlands will formulate a timely and coherent deployment strategy for the period 2024-30 to assure investment.

Many important choices will have to be made with regard to the optimal decarbonisation pathways for 2030-50, notably in the industry and transport sectors which remain CO_2-intensive. Focus on cost-effectiveness of the energy transition will help to control the cost and provide new opportunities for business. It is crucial to encourage technology innovation and the cost-efficient use of energy resources today.

In order to achieve the 14% renewables goal by 2020 and 16% by 2023, the Netherlands will need to adopt a comprehensive and longer-term policy for renewable energies. The parties to the Energy Agreement undertook a broad range of commitments for scaling up renewable energy generation, notably onshore and offshore wind capacities, through the planned integrated offshore electricity grid by TenneT, competitive tendering of offshore wind capacities, the participation of local residents in the planning and operation of wind farms and through tackling other non-financial barriers.

In order to achieve the new renewables targets in a cost-efficient manner with the reformed support scheme, the sliding market premium is a sound approach. The new Sustainable Energy Incentive Scheme (SDE+) can keep up with market prices and fosters cost efficiency and competition among technologies, while driving down deployment cost. Other countries can learn from this model. In addition, the IEA considers that the Netherlands can benefit from the current learning curves in other markets, in terms of both technology development and policy design. The renewables policy should also be integrated with the CO_2 price signals under the EU-ETS, and include actions to reduce non-economic barriers, notably for the deployment of onshore and offshore wind, while seizing opportunities from co-operation mechanisms with neighbouring countries. A comprehensive renewables policy needs to be adjusted over time, from the inception to the take-off and consolidation phase of renewable energy deployment.

Developing a roadmap for 2030-50 can help facilitate judgements about the nature and value of post-2020 targets, about the costs and benefits of different potential courses of action, and about what long-term innovation support would most likely deliver cost-effectiveness over time. Providing reliable energy supply at competitive prices and supporting economic growth, while paving the way towards the transition to a clean energy supply, will require a stable and consistent energy policy framework towards 2030. The consistency between policies for renewable energy, climate actions and energy efficiency needs to be ensured.

Within the EU discussion on the 2030 framework, the government has to define its own position and long-term framework, relying on a policy mix of effective carbon prices in a strengthened EU-ETS and support to technology innovation. The IEA believes that such a market-based long-term investment framework should be flexible so as to address future uncertainties, but open enough to glean economic benefits from the use of all the low-carbon energy supply options. Recognising the economic value of energy efficiency will foster innovation in clean energy technologies.

ENSURING ENERGY SECURITY DURING THE TRANSITION

The energy security situation is increasingly complex and requires a comprehensive assessment of all aspects, including security of gas supply, the interlinkages of electricity and gas systems, climate change impacts and the system integration challenges imposed by the future increase of variable renewable energies.

The Netherlands remains Europe's second-largest producer of natural gas after Norway. However, the country faces a fast decline of indigenous gas production of its Groningen field and uncertain prospects for unconventional gas. This means that the country will start to experience the transition from a net exporter to a net importer of gas around 2025. The Netherlands should reassess its security of supply and seize all economic opportunities in developing remaining gas reserves, including innovative uses of natural gas and infrastructure (including power-to-gas, gas in transportation). The IEA recommends that the government continue the security assessments and test the resilience of the energy systems while discussing the gas transition with the Groningen gas consumers at home and abroad and evaluating technology options and implications in this transition.

Commendably, the Netherlands is well on the way to the transition and has completed the critical investment in the Dutch gas hub, including new large gas storages and the GATE LNG terminal, to ensure flexibility and supply security of the Dutch gas market. It is remarkable that the Dutch Title Transfer Facility (TTF) has developed into one of Europe's most liquid gas hubs in recent years.

Since the last in-depth review, the Netherlands has significantly improved security of electricity supply for end-consumers and enjoys comfortable levels of power generation adequacy. It does not need to adopt a capacity mechanism at this point in time. The Netherlands boosted cross-border trade flows following the launch of the NorNed interconnection between the Netherlands and Norway (2008) and the BritNed interconnection between the United Kingdom and the Netherlands (2011). TenneT completed the Randstad380 South Ring, a crucial link for the integration of renewable energy and for lifting internal bottlenecks.

The government has successfully streamlined and speeded up permitting procedures. Other IEA member countries have now also adapted similar models, as the Dutch State Coordination Programme with the one-stop shop and the bundling of permit decisions.

Nonetheless, the Netherlands is a densely populated country, and it remains challenging to gain public acceptance for the development of new energy sources and infrastructure, despite the economic benefits. Supporting local initiatives on the development of energy infrastructures, citizen dialogue, public acceptance and local ownership of projects will be a crucial prerequisite for further developing renewable energies, including wind power.

The Netherlands has taken the lead in climate change adaptation, notably in flood prevention. With changing climate patterns and increasing industrialisation of some regions of the country (Rotterdam and the wider Randstad), there is a need to renew the national climate change adaptation strategy, taking into account the latest climate change projections from the Intergovernmental Panel on Climate Change and their anticipated impact on the resilience of the energy infrastructure.

TAKING AN INTERNATIONAL APPROACH

The Netherlands is strongly integrated into the European and global energy markets. Energy infrastructure and market integration have developed further since the last IEA in-depth review in 2008.

The government supports free trade and open energy markets, consistently looking beyond national solutions. With growing needs of imported energy, the Netherlands will be further exposed to global market trends. Import price differences compared to its global trade partners are likely to remain. The competitiveness of the Dutch industry will thus depend on the development of new export opportunities and access to affordable energy supplies. Ensuring the exploitation of indigenous resources and pursuing further energy efficiency in industry can build competitiveness over time.

Current power generation overcapacity in the Netherlands can serve as a flexible source to the North-West European power markets. Instead of pursuing a national approach, the Netherlands is right to promote cross-border electricity trade in the region, as it can benefit from cost and resource efficiency of the larger market. To this end, the Netherlands should further strengthen its electricity network within the country and across the borders to lift congestions, while at the same time supporting the integration of renewable energy policies into electricity markets, and integrating cross-border balancing, intra-day markets and system operation as well as reserve mechanisms.

Despite the constraints imposed by the global economic and financial crisis, the government succeeded in maintaining its energy RD&D support. The new Top Sector policy (see Chapter 10) makes energy one of the priority sectors. At the global level, the Dutch R&D sector stands out in terms of ease of entrepreneurship, innovation and energy research capacities. It is important to maintain support and a balance between the importance of fundamental research and commercialisation goals. To achieve its ambitions to be among the top ten in the global cleantech rankings by 2030, the Netherlands should consistently build on the results of the Top Sector approach and develop international technology partnerships in areas where it has a competitive edge, notably in natural gas, carbon capture and storage (CCS), biofuels and energy efficiency in industrial processes.

KEY RECOMMENDATIONS

The government of the Netherlands should:

- ☐ *Ensure timely implementation of the Energy Agreement for Sustainable Growth by establishing a process for regular progress review in co-ordination with all stakeholders involved.*
- ☐ *Within the EU discussion on the 2030 framework, develop a longer-term, consistent energy policy framework for 2030 which will act as a bridge to 2050, based on:*
  - *economic and social benefits from energy efficiency action across the energy system, by mobilising demand-side services, investment in energy-efficient buildings, and promoting energy efficiency in industry and the heat sector*
  - *a strong EU-ETS regime to provide cost-effective GHG abatement incentives, while securing the position of energy-intensive internationally competitive companies*
  - *complementary technology support to secure investment in all low-carbon technologies.*
- ☐ *Ensure security of supply and energy infrastructure resilience in the country during the transition to becoming a net importer by:*
  - *Developing the remaining natural gas production potential from small and/or unconventional gas fields and supporting innovative uses of natural gas and of the gas infrastructure.*
  - *Leading a dialogue with all stakeholders, including neighbouring countries, on this transition and its implications for the security of the energy system.*
  - *Taking into account the assessment of climate change impacts on the resilience of the energy sector, including the interrelations between gas and electricity sectors.*
- ☐ *Continue to actively engage with North-West European electricity and gas market jurisdictions, and more broadly across the European Union, on sustainable energy supply and competitive energy markets, recognising the extent to which the energy markets and systems of the Netherlands are interconnected with those of its neighbours, and the need for dialogue at EU and North-West European levels.*
- ☐ *Create opportunities for international technology and innovation partnerships for the development and demonstration of key emerging clean energy technologies, building on the Top Sector energy approach, notably for natural gas, CCS, and biofuels, in collaboration with business and other stakeholders.*

PART I
POLICY ANALYSIS

Figure 2.1 Map of the Netherlands

This map is without prejudice to the status of or sovereignty over any territory, to the delimitation of international frontiers and boundaries and to the name of any territory, city or area.

Source: IEA, 2013.

2. GENERAL ENERGY POLICY

Key data (2012)

TPES: 78.6 Mtoe (natural gas 41.7%, oil 39.4%, coal 10.4%, biofuels and waste 4.7%, nuclear 1.3%, wind 0.5%, solar 0.1%), +3.8% since 2002

TPES per capita: 4.7 toe (IEA average: 4.5 toe), no change since 2002

TPES per GDP: 0.13 toe/USD 1 000 GDP PPP (IEA average: 0.14 toe/USD 1 000 GDP PPP), -7.4% since 2002

Inland energy production: 64.7 Mtoe (natural gas 88.8%, biofuels and waste 6.1%, oil 2.8%, nuclear 1.6%, wind 0.7%, solar 0.1%), +6.7% since 2002

Electricity generation: 102.5 TWh (natural gas 54.4%, coal 26.6%, biofuels and waste 8.7%, wind 4.9%, nuclear 3.8%, oil 1.1%, solar 0.4, hydro 0.1%), +6.8% since 2002

Electricity consumption per capita: 8.3 MWh (IEA average in 2011: 10.1 MWh)

COUNTRY OVERVIEW

Located at the delta of the rivers Rhine, Ijssel and Meuse, the Netherlands is a densely populated country on low lands, with 16.8 million inhabitants living on a surface of 41 500 square kilometres, out of which 20% is located below and 50% less than one metre above sea level. While the north around Groningen is less populated, the overall population density is high (403.9 inhabitants per square kilometre), notably in the western parts of the country, around the Randstad area with the cities of The Hague, Rotterdam, Amsterdam and Utrecht. Despite the overall decrease in population growth (0.3% in 2012 versus 1.5% in 1990), the number of households and single-person homes is increasing, which results in higher infrastructure and housing needs.

The Netherlands shares borders with Belgium and Germany, and has maritime borders with the United Kingdom. The capital is Amsterdam, while the seat of government is located in The Hague. The Kingdom of the Netherlands is divided into 12 provinces in North-West Europe; three overseas special municipalities in the Caribbean (islands of Bonaire, Sint Eustatius and Saba, also known as the BES islands) and 408 municipalities. It is a parliamentary democracy organised as a unitary state.

The Dutch economy withstood the global financial and economic crisis. During a double recession in 2008-12, domestic demand slowed down and unemployment increased (5.3% in 2012).[1] In 2012, the total gross domestic product (GDP) amounted to EUR 599.34 billion in current market prices.[2] At times of low domestic demand and slow-down in world trade amid the global financial turmoil, an open economy, like the Netherlands, is impacted more than other countries. Thanks to a strong fiscal consolidation course and

1. Centraal Bureau voor de Statistiek (CBS), Statistics Netherlands.

2. *Ibid*.

high trade activities as well as Dutch foreign direct investment, economic recovery is slowly on its way, leading to a current account surplus of 10% of GDP in 2012.[3]

The Netherlands is a constitutional monarchy since 1815 and a parliamentary democracy since 1848. On 30 April 2013, King Willem-Alexander was confirmed as head of state. Following the 2012 general elections, Prime Minister Mark Rutte, head of government since October 2010 and leader of the liberal People's Party for Freedom and Democracy (VVD), was reconfirmed for a second term in a coalition government together with the Labour Party (PvdA) under the leadership of Lodewijk Asscher. In November 2012, the second Rutte Cabinet was formed.

The Netherlands has a tradition of coalition governments in a multi-party system; no single party has held a majority in Parliament since the 19th century. Policies on social and economic matters are made in close consultation with the trade unions and employers organisations, represented through the Social-Economic Council (SER).

The Netherlands has an advanced economy with a modern energy system and well-developed energy markets. The country's strategic location makes it an important transit and trade hub for natural gas, coal, oil and electricity. The Netherlands has significant natural gas production and a large oil-refining and chemical industry. The Dutch energy sector is strong, drives exports, innovation and economic growth. In 2010, the Dutch energy sector reached almost EUR 55 billion or 10.9% of Dutch GDP, generated around EUR 15 billion worth in exports and a net value-added of EUR 26.74 billion. There were around 1 270 firms and 47 000 people (full time equivalents) working in the energy industry.[4] Revenues from the gas sector accounted for EUR 13 billion and around 70 000 jobs.[5]

The country is both a major exporter and importer of energy, and so the competitiveness of Dutch industry also depends on affordable and secure energy supplies. The openness of the Dutch market place and the high share of trade have made the country resistant, but also exposed to the developments in global energy markets. While in 1989 the Netherlands was among the most competitive economies (next to Japan and Switzerland), in 2013 the country ranks 14th, indicating the acceleration of globalisation and increasing competitiveness pressure. In 2013, the most competitive nations in Europe included Switzerland (second), Sweden (fourth) and Germany (ninth). Their success relies upon export-oriented manufacturing, diversified economies, strong small and medium-sized enterprises (SMEs) and fiscal discipline.[6]

The energy policy of the Netherlands (a founding member state of the European Union), is also framed by EU requirements on issues such as the electricity and gas markets, energy efficiency, renewable energy, state aid, the environment and greenhouse gas (GHG) emissions. As the country is a major trade and transit hub for oil, gas, electricity and coal, close co-operation with its neighbouring countries (Benelux, the Pentalateral Energy Forum and North Sea Region) has been a priority and expanded from the electricity and gas markets to new energy policy challenges, including the transition to a low-carbon economy, the increase in the use of renewable energies, carbon capture and storage (CCS) in the North Sea, and to security of oil and gas supply.

3. *Economic Survey of the Netherlands*, OECD, Paris, 2014; and CBS, Statistics Netherlands.

4. *Monitor topsectoren: uitkomst eerste meting*, CBS, 2013, The Hague.

5. Ministry of Economic Affairs, 2012.

6. *World Competiveness Report*, IMD, 2013. See: www.imd.org/news/World-Competitiveness-2013.cfm.

SUPPLY AND DEMAND

SUPPLY

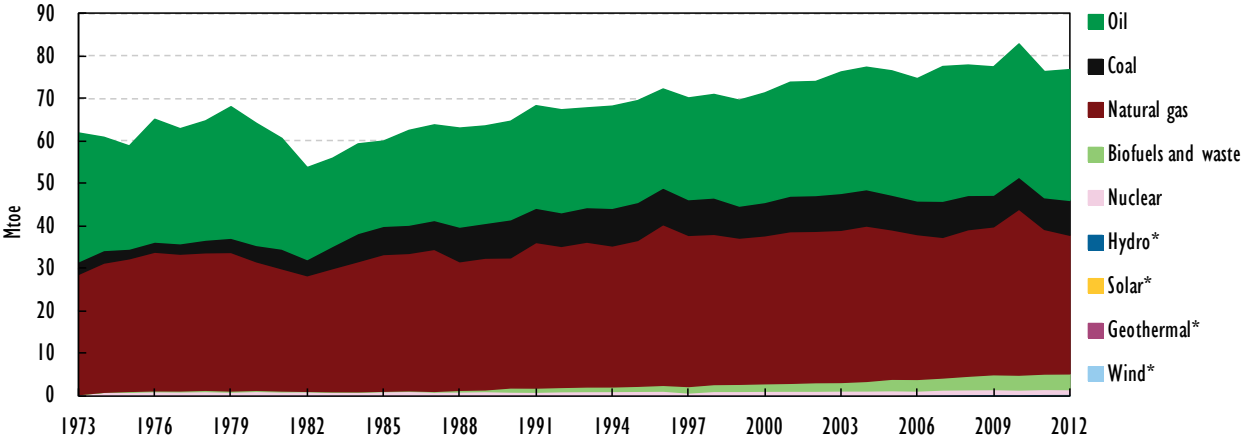
Total primary energy supply (TPES) in the Netherlands was 78.6 million tonnes of oil-equivalent (Mtoe) in 2012. The supply of energy peaked at 83.4 Mtoe in 2010 and has since declined for two consecutive years. Despite this contraction, TPES was higher in 2012 compared to ten years earlier, increasing by 3.8% since 2002.

The Netherland's energy mix is dominated by fossil fuels which represent more than 90% of TPES. Natural gas supplied 41.7% of energy in 2012, followed by oil at 39.4% and coal at 10.4%. With less than 6% of total supply, renewable energy is made up of biofuels and waste (4.7% of TPES), wind (0.5%) and solar (0.1%). Nuclear accounts for 1.3% of TPES, and the use of geothermal is still at the development stage. The importance of hydropower is marginal and provides a mere 0.01% of total energy.

Over the past decade, there has been a slight shift in the energy mix towards more use of renewables. Thus, the penetration of fossil fuels has fallen from 94% of TPES in 2002 to 91.5% in 2012. Total supply from natural gas has contracted the most, by 8.5% since 2002, while the use of coal saw a decline of 3%. Conversely, oil supply has increased by 13.6%, growing at a faster rate than overall TPES.

The strongest developments have been in wind power and biofuels and waste, with energy from these sources increasing by 427.2% and 85.6%, respectively. The use of solar energy has also risen by 60%. Despite these enormous increases, however, renewable energies remain at a very low base. There have been no significant changes in the supply of energy from nuclear or hydro.

Figure 2.2 TPES, 1973-2012



* Negligible.

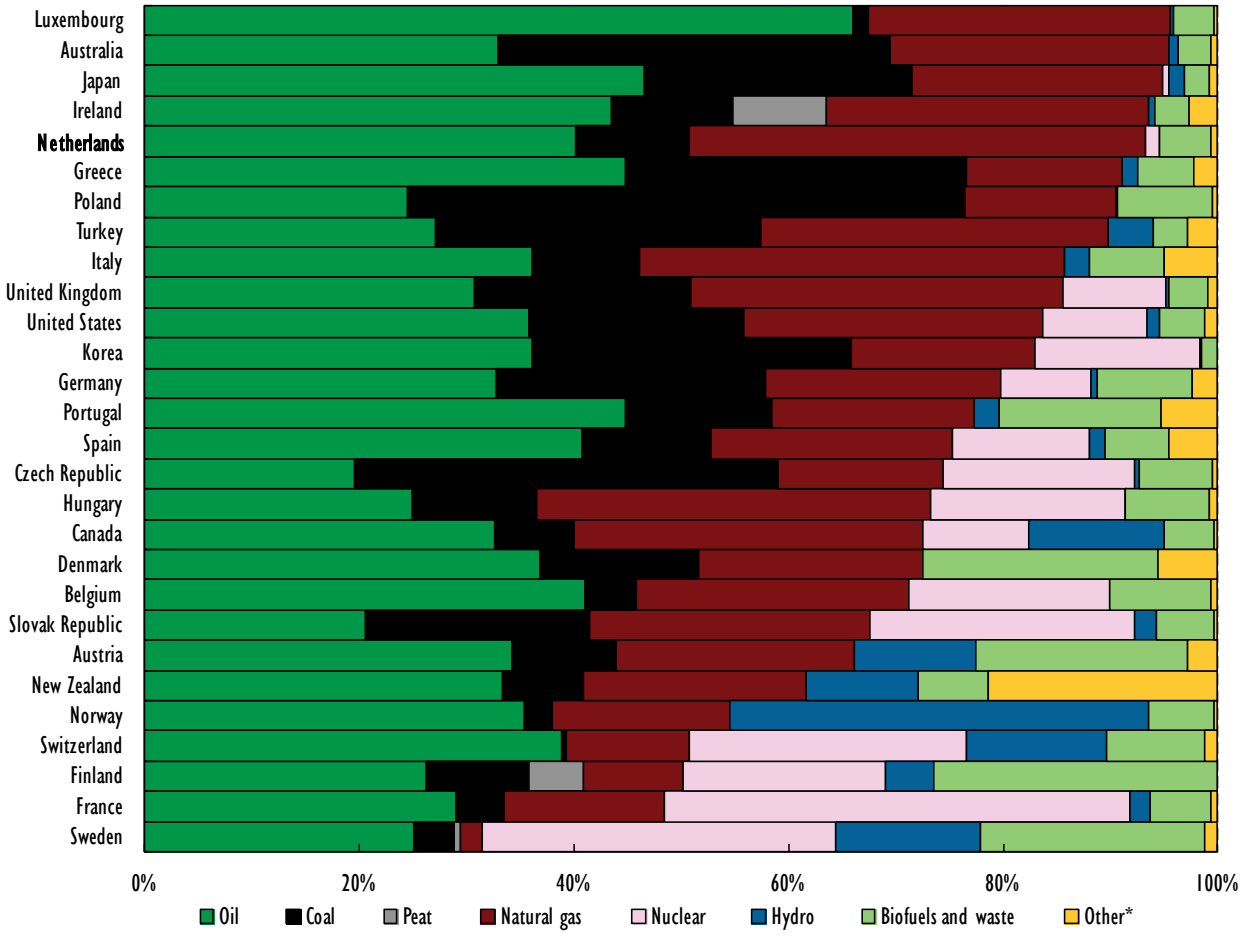
Sources: *Energy Balances of OECD Countries*, OECD/IEA, Paris, 2013; country submission.

The Netherlands has one of the largest shares of fossil fuels in its energy mix among IEA member countries, ranking fifth-highest behind Luxembourg, Australia, Japan and Ireland. It is also the tenth-lowest with regard to the share of biofuels and waste in TPES.

More than 80% of energy supplied in the Netherlands is produced locally, with total energy production reaching 64.7 Mtoe in 2012. Natural gas accounts for 88.8% of energy produced, biofuels and waste for 6.1% and oil for 2.8%. Nuclear, wind, solar and geothermal energies together account for just over 2%.

The country has significant natural gas production, twice as much as the Netherlands consumes, and trades large quantities of gas. Oil is also traded through these main European ports as refined oil products. The country also imports large quantities of oil for domestic consumption as it has no significant indigenous oil production.

Figure 2.3 Breakdown of TPES in IEA member countries, 2012



Note: data for the Netherlands and Austria are actual and estimated for other countries.

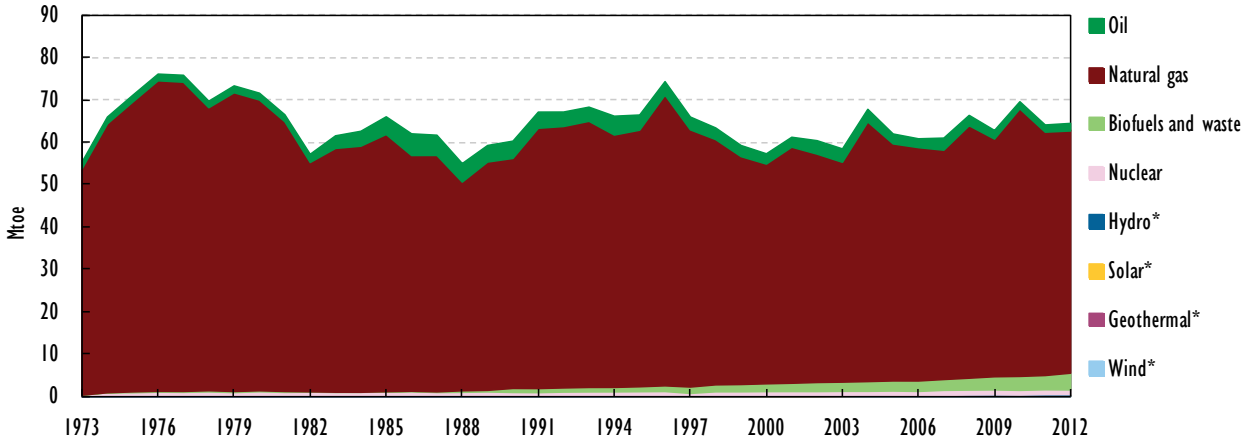
* *Other* includes geothermal, solar, wind, and ambient heat production.

Sources: *Energy Balances of OECD Countries*, OECD/IEA, Paris, 2013; country submissions.

DEMAND

The industry sector is the largest consumer of energy in the Netherlands, with a consumption of 27.2 Mtoe in 2012. This represents 44.6% of total final consumption (TFC) of energy. Industry has increased its consumption by 13.1% since 2002, whereas TFC grew by 6.4% in total. The Netherlands ranked fourth among IEA member countries in 2011 with regard to the share of industry in TFC, behind Korea, Finland and Belgium. The commercial and services sector accounted for 12.2 Mtoe in 2012 or 19.9% of TFC, while energy use in transport amounted to 11.4 Mtoe or 18.6% of TFC. While energy demand in the commercial sector has increased by 3.3% in total since 2002, demand in transport grew at a slower rate of 0.7% in total. Energy consumption in the residential sector has also experienced slower growth, up by 0.3% compared to 2002, reaching 10.3 Mtoe in 2012, or 16.9% of TFC.

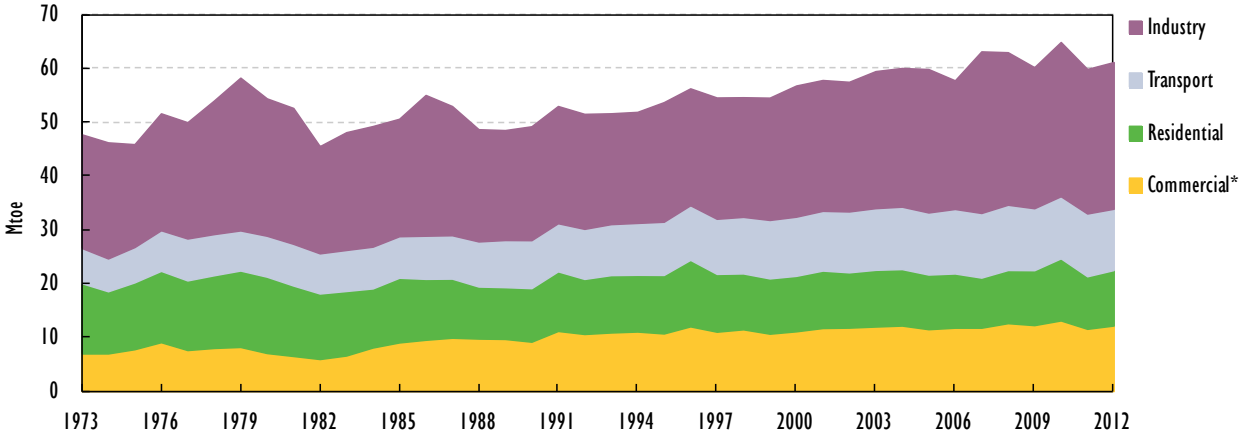
Figure 2.4 Energy production by source, 1973-2012



* Negligible.

Sources: *Energy Balances of OECD Countries*, OECD/IEA, Paris, 2013; country submission.

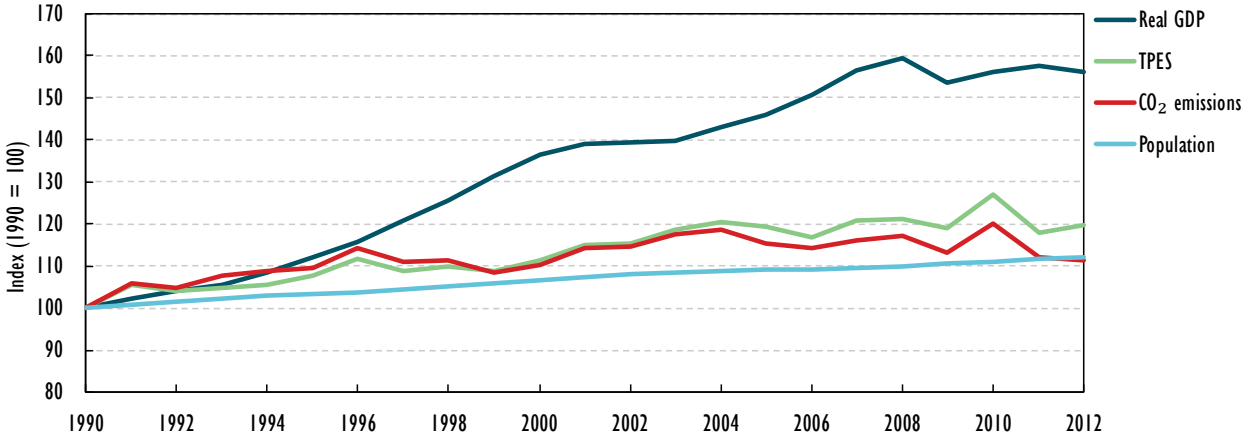
Figure 2.5 TFC by sector, 1973-2012



* *Commercial* includes commercial and other services, agriculture/forestry and fishing.

Sources: *Energy Balances of OECD Countries*, OECD/IEA, Paris, 2013; country submission.

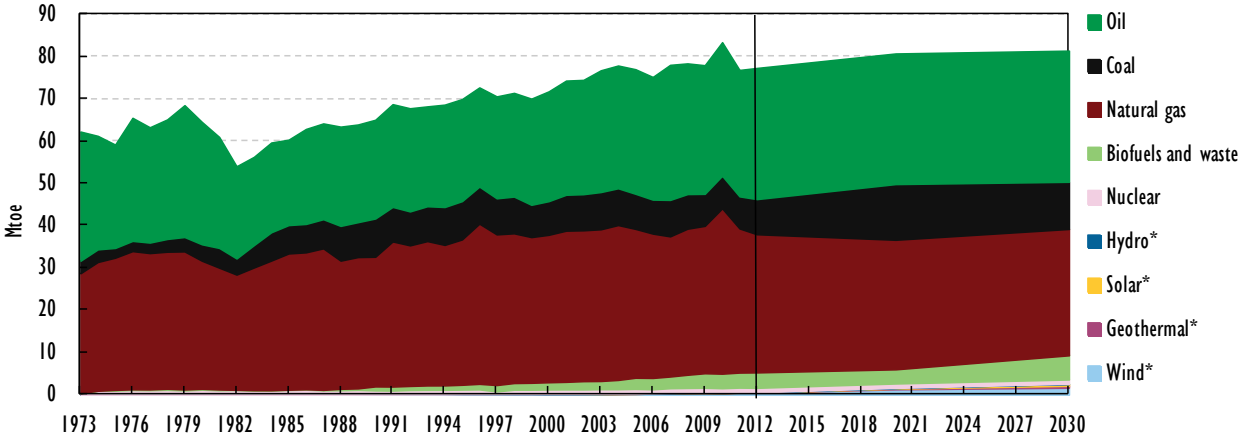
Figure 2.6 CO_2 emissions and main drivers, 1990-2012



Sources: *Energy Balances of OECD Countries*, OECD/IEA, Paris, 2013; country submission.

While GDP grew by around 50%, GHG emissions declined by 8% in the period 1990-2011 (see chapter on Climate Change and Figure 2.6). The Netherlands has partly decoupled emissions from economic and population growth, also as a result of a reduction in domestic demand and subsequent emissions reductions following the financial and economic crisis in 2008-09.[7] In line with the latest long-term projections of the Dutch Environmental Assessment Agency (PBL), Dutch final consumption is expected to grow on a constant path towards 2020, with increases from oil and coal, but then to largely remain flat towards 2030, thanks to energy efficiency improvements.

Figure 2.7 TPES with projections, 1973-2030



* Negligible.

Sources: *Energy Balances of OECD Countries*, OECD/IEA, Paris, 2013; country submission.

INSTITUTIONS

The **Ministry of Economic Affairs** *(Ministerie van Economische Zaken)* has the overall responsibility for the Dutch energy policy, including polices for renewable energy, energy transition and bio-based economy, and research, development and demonstration (RD&D). The Ministry is also the lead authority for the State Co-ordination Programme for the planning of large-scale energy infrastructure projects.

The **Ministry of Infrastructure and Environment** (*Ministerie van Infrastructuur en Milieu)* is responsible for policies on climate, environment, transport, water and public works. It supervises the administrative procedures under the Dutch Environmental Management Act. Together with the Ministry of Economic Affairs it co-ordinates the environmental impact assessments and permits for spatial planning, including maritime waters. The regional governments are responsible for granting environmental licences and permits.

Responsibility for energy efficiency is shared among several ministries and implementing agencies. The **Ministry of Economic Affairs** is in charge of overall energy policy, including energy efficiency, and measures in agriculture and other sectors. The **Ministry of Infrastructure and Environment** is responsible for energy efficiency in transport policy, whereas the **Ministry of the Interior and Kingdom Relations** is responsible for energy efficiency in buildings.

The Ministry of Education and Science is responsible for fundamental science and research (through publicly funded universities and research institutes).

7. United Nations Framework Convention on Climate Change (UNFCCC), Sixth Netherlands National Communication, 2014.

The **Netherlands Authority for Consumers and Markets (ACM)**, established in April 2013, is the new authority under the Ministry of Economic Affairs with regulatory powers to supervise electricity and natural gas markets as well as district heating markets. ACM is the result of the consolidation of the Netherlands Consumer Authority (CA), the Netherlands Competition Authority (NMa) and its energy branch, the Dutch Office of Energy Regulation (*Energiekamer)*, and the Netherlands Independent Post and Telecommunication Authority (OPTA).

In 2014, the Dutch government created a single nuclear safety authority, the **Authority for Nuclear Safety and Radiation Protection** *(Autoriteit Nucleaire Veiligheid en Stralingsbescherming,* **ANVS)**, as an independent administrative authority under the responsibility of the Minister of Infrastructure and Environment, but independent from the licensee.

The Dutch Statistical Office, the **CBS Statistics Netherlands**, is an autonomous agency since 2004, responsible for collecting and processing data in order to publish national statistics and European Community statistics.

The **Energy Research Centre of the Netherlands (ECN)** is the largest national research centre in the field of energy, carrying out dedicated research programmes. ECN partners with academic and research institutes in the Netherlands and abroad.

The **Environmental Assessment Agency (PBL)** has a key role in implementing environmental policy. In co-operation with the ECN, the PBL is monitoring the implementation of national energy and climate objectives and develops long-term scenarios.

As an authority under the Ministry of Economic Affairs, the **Netherlands Enterprise Agency** (*Rijksdienst voor Ondernemend Nederland*, **RVO**),[8] implements R&D policy and funding programmes with a focus on sustainability, innovation and international co-operation. RVO facilitates market parties and other organisations to set up training and certification facilities for renewable energies and supports innovation contracts between private companies, universities, R&D institutes.

There are several implementing bodies and intermediary organisations supporting RD&D funding under the energy research programmes, including **the National Organisation for Scientific Research** (*Nederlandse Organisatie voor Wetenschappelijk Onderzoek*, **NWO**) and the **Technology Foundation** (*Stichting Technische Wetenschappen,* **STW**).

KEY POLICIES

Since 2008, the Netherlands has relied upon the Clean & Efficient Programme and the Energy Transition Framework.

The country's energy policy is based on the EU framework, notably the EU 20-20-20 targets, which call for the reduction of 20% in GHG emissions, a 20% increase in energy efficiency and a total share of 20% of renewable energy in 2020.

Those objectives were translated into national targets as follows: the country has a national target of 14% of renewable energy in TFC under the EU Renewable Energy Directive 2009/28/EC and is committed under the EU Effort Sharing Decision to a binding reduction of GHG emissions by 16% in 2020 (for the non-ETS sector), below 2005 levels.

8. The creation of RVO is the result of a merger between the former NL Agency and the Dienst Regelingen as of 1 January 2014. It also includes some activities of the Commodities Boards.

In 2011, the government presented the *Energy Report 2011*, which is prepared every four years to set the energy and climate policies. The 2011 version outlined the ambition of the Netherlands to become more sustainable in energy terms and less dependent on fossil fuels in the transition to a low-carbon economy by 2050. The report presented the pillars of the Dutch energy strategy: ensuring reliable energy supply at competitive prices and green growth as primary economic objectives, while maintaining an international approach in the long-term transition to a sustainable energy supply. The Netherlands adopts the following approach and key policy objectives:

- A modern industrial policy to strengthen the competitiveness of the Dutch energy sector through public support to businesses and knowledge institutes to work together in the development of energy technologies (for both green and grey energy) in which the Netherlands excels on the international market. This should make renewable energy cost-effective and bring benefits to the Dutch economy.
- Expanding the share of renewable energy to reach European targets by stimulating the production of the most efficient renewable energy options through the Sustainable Energy Incentive Scheme (SDE+), efforts to promote offshore wind and the co-firing of biomass in coal-fired power plants within the sustainability criteria.
- Encouraging energy conservation and decentralised sustainable energy generation by promoting a Green Deal for energy with the society.
- Providing scope for all energy options for a reliable energy supply to ensure a balanced mix of green and conventional energy, including nuclear energy.
- Investing in a sound European energy market with a good infrastructure by ensuring careful spatial planning, including the connection of future offshore wind, and cross-border co-operation of transmission system operators (TSOs).

THE NATIONAL ENERGY AGREEMENT FOR SUSTAINABLE GROWTH

Sustainable growth is a key priority of the Rutte-Asscher coalition government with a view to achieve a sustainable energy supply system within the international context of the Dutch economy.[9]

Observers had seen that the Dutch energy transition policy, which was largely an industrial policy, had reached a point of stagnation and suffered from short-term priorities of changing government coalitions. The Dutch Parliament therefore called for a longer-term vision and more consistency in policy making with regard to energy in its motion of April 2011 concerning a "National Energy Transition Agreement".

The coalition agreement *Building Bridges* of 29 October 2012 sets out an agenda for economic recovery from the financial and economic crisis. The coalition agreement raised the ambition for the share of renewable energy to reach 16% by 2020 and made energy efficiency a key priority. On the basis of the coalition agreement and the Dutch Parliament's motion of 26 April 2011, a new Energy Agreement for Sustainable Growth (hereinafter the Energy Agreement) was adopted in September 2013.[10] Focussed on driving investment

9. *Green Growth: for a strong, sustainable economy*, letter submitted to Parliament by the Dutch government in March 2013.

10. *Energy Agreement for Sustainable Growth* (Energieakkoord voor duurzame groei), The Social and Economic Council of the Netherlands (SER), 6 September 2013. See the full Dutch version: www.ser.nl/~/media/files/internet/publicaties/overige/2010_2019/2013/energieakkoord-duurzame-groei/energieakkoord-duurzame-groei.ashx; and the summary in English at: www.ser.nl/en/publications/publications/2013/energy-agreement-sustainable-growth.aspx.

at time of the economic recession, the Energy Agreement is expected to deliver around EUR 13 to 18 billion of extra investments and approximately 15 000 extra jobs between 2016 and 2020.

The Netherlands has a strong tradition in taking a consensus-driven approach for the setting of the energy policy actions, the so-called *polder model*. The Energy Agreement was prepared by the Social and Economic Council (SER) throughout an eight-month negotiation process between employers' federations, trade unions, government representatives and environmental non-governmental organisations (NGOs). The SER acted as a platform to facilitate the process.

The Energy Agreement presents a ten-point action plan for 2020, as set out in Box 2.1. The aims are to ensure a balance between sustainability and competitiveness, enhancing energy efficiency and stimulating new investment in the sector, while reducing the financial burden for citizens and companies.

Next to quantified targets up to 2020, the Energy Agreement includes commitments to longer-term actions, notably regarding CCS, the development of a bio-based economy, emissions reductions in the transport/mobility sectors, all of which were subsequently included in the new Climate Agenda of the government, as published at the end of 2013.

Other areas, notably the development of shale gas or the future role of nuclear or co-generation were not covered by the Energy Agreement. In general, it remains at the level of commitments by the parties and many detailed arrangements are to be elaborated in the coming months.

Under the Energy Agreement, the Netherlands is committed to achieve the following objectives:

- energy efficiency savings of 1.5% or 100 PJ by 2020 (at least 35% by end-2016 and at least 65% by end-2018), by reinforcing energy efficiency in buildings, industry and agriculture, commercial and transport/mobility sectors
- a share of 14% renewable energy in TFC by 2020 and 16% by 2023 through the reformed SDE+ and R&D support with a focus on offshore wind and decentralised energy at local and regional levels
- 60% CO_2 reductions by 2050 and 17% reductions by 2030, compared to 1990 levels, in the transport and mobility sectors.

Box 2.1 The ten pillars of the Energy Agreement for Sustainable Growth of September 2013

1. Energy savings and energy efficiency in the buildings, industry, commercial, transport and agriculture sectors of around 100 PJ by 2020. The package of measures builds on existing long-term energy saving covenants, complemented by company-specific agreements, and includes the enforcement of the energy-saving obligations under the Environmental Management Act; strengthening of energy labelling in buildings and the review of energy efficiency measures, notably in buildings and non-ETS industries (energy performance assessment pilots). Next to the creation of a revolving national energy-saving fund of EUR 600 million in the buildings sector, public grants are made available to the rental housing sector. An action plan on industrial waste and a CO_2-saving system in the greenhouse horticulture sector are announced.

Box 2.1 The ten pillars of the Energy Agreement for Sustainable Growth of September 2013 (continued)

2. Scaling-up of renewable energy generation, notably on- and offshore wind capacities through the creation of an integrated offshore electricity grid by TenneT, competitive tendering of offshore wind capacities and the participation of local residents to the planning and operation of wind farms. The use of biomass will be supported up to a sustainable level of 25 PJ for 2020. Specific SDE+ funds are to be dedicated to RD&D support for renewable energy demonstration and deployment, which should drive down technology cost and reduce the future SDE+ support.

3. Encouraging local sustainable energy through the introduction of tax breaks (EUR 0.075 per kWh as of 1 January 2014) for locally generated renewable energy by a co-operative or by an association of owners located in the same neighbourhood (with the same four-digit postcode plus adjoining postcode areas), and using the production for self-consumption.

4. Completing the energy transmission network (smart grids, innovative use of energy infrastructure, including storage and demand-side participation). The investments are to be supported by adequate conditions for infrastructure financing and a strong regional and EU-wide co-operation on the integration of energy networks.

5. A properly functioning EU-ETS to secure effective volumes of emissions reductions and an link-up to the global level, while ensuring the competitiveness of energy-intensive companies that operate internationally, on the basis of the criteria for best-performing companies in the sector worldwide.

6. Coal-fired power stations and CCS to support the sustainable use of fossil fuels. With a view to ensure the phase-out of the least efficient coal-fired power plants, the three oldest plants are to be closed in the coming years, subject to review by ACM. A commitment to the longer-term importance of CCS is part of the Agreement.

7. Mobility and transport to contribute to energy savings (15 PJ to 20 PJ of the overall 100 PJ savings by 2020) with a view to reduce the emissions in the sector by 17% by 2030 and by 60% by 2050 (below 1990 levels). Twelve priority measures include traffic management, the roll-out of the charging infrastructure for electric vehicles and other elements.

8. Employment and training in the installation and construction sectors and, in the longer term, in the renewable energy sector (approximately 15 000 extra jobs from 2017 onwards.) A cross-sector training pilot is to be set up in collaboration with educational institutions, sector-specific training centres, business and regional employers' associations and trade unions to provide training ("green skills") for professionals and job-seekers.

9. Encouragement of commercialisation of new technologies for growth and export to join the global top ten cleantech rankings by 2030. Measures are to be developed to boost financing of demonstration and innovation, and the necessary legislative framework, to foster the domestic and international market development, building on the Top Sector policy, the SME sector and investment in human capital.

10. Leveraging financing of investments in sustainable energy, notably for renewable energy and energy-saving projects, by increasing the contribution from the capital markets. New financing models are to be developed in co-operation with the financial parties and various umbrella organisations (the Dutch Banking Association/NVB, the Dutch Association of Insurers and the Federation of the Dutch Pension Funds).

It is expected that the measures in the Energy Agreement will deliver energy savings between 22 PJ and 60 PJ, depending on the actual implementation of the different savings objectives, and surplus potential, ensure the feasibility of the Dutch renewable targets for 2020-23, reduce CO_2 emissions by 16 Mt to 17 Mt, and create health benefits of EUR 70 million to 2020 from reduced particulates, and stimulate a total of EUR 13 billion to EUR 18 billion in investment.

The Energy Agreement relies on the responsibility of the parties to implement their commitments, and creates a shared responsibility and shared ownership. As a follow-up measure, the parties agreed to set up a committee at the SER to regularly monitor progress and amend measures, as needed. A major evaluation of the Energy Agreement is scheduled for 2016 in order to track progress towards achieving the agreed targets for 2020 and 2030, and the need for supplementary measures.

CLIMATE AGENDA

The Dutch government is committed to an international climate policy and has prepared the ground for a longer-term vision for 2030 and the transition towards a sustainable energy supply by 2050.

In the Climate Letter 2050 (*Klimaatbrief 2050)* of 18 November 2011, the Rutte-I government set out the four core elements to achieve a climate-neutral economy by 2050: CO_2-free electricity supply, sustainable use of biomass, energy savings and CCS.

In October 2013, the *Climate Agenda*[11] reaffirmed the Dutch commitment to achieve a CO_2 reduction of 80% to 95% in 2050 compared to 1990 and the need to reinforce action on climate mitigation and adaptation. Importantly, the Climate Agenda outlines the support to a European GHG emissions reduction objective for 2030 of at least 40% emissions reduction below 1990 levels and the EU-ETS reform to match the pathway of the EU low-carbon roadmap to 2050.

ENERGY TAXATION

The Netherlands uses an effective system of environmental taxation to encourage sustainable use of resources. After Denmark, the Netherlands raised the second-highest environmental tax revenues among OECD countries, amounting to EUR 21 billion or 9.2% of total government tax revenues, including social contributions and almost 4% of GDP (half of it as energy tax alone) in 2012.[12]

Introduced in 1996, the Netherlands has been applying an energy tax on mineral oils (other than motor fuel), electricity and natural gas, a tax which has increased over time.

Energy products and fuels used to generate electricity are exempted from the energy tax (except coal). Fossil fuels are subsidised indirectly in the form of an exemption from the energy tax for energy-intensive industries equal to EUR 2 billion per year. Natural gas use in efficient combined heat and power (CHP) generation and in the horticultural sector (greenhouses) is exempted. Unlike other countries, the Netherlands has no tax exemptions or reductions for the use of natural gas in mineralogical processes and dual use. In the transport sector, the tax breaks from the road tax aim to promote the purchase of clean and efficient motor cars.

11. *Climate Agenda for 2030*, the Ministry of Infrastructure and Environment, The Hague, 2013. See: www.government.nl/news/2013/10/04/climate-agenda-mitigation-adaptation-and-business-sense.html.

12. *Green growth in the Netherlands 2012*, CBS Statistics Netherlands, November 2013.

The share of revenues from environmental taxes in total tax revenues decreased in recent years. The industry sector, including manufacturing and utilities, pays on average 12% of energy taxes; more than half is paid by households. Energy taxes for the stimulation of renewable energy were abolished in 2003. As of 2013, the subsidy on renewable energy (SDE+) is financed by households as a surcharge on the energy tax.

ASSESSMENT

The Netherlands is an advanced economy with well-developed markets and robust energy infrastructure. It plays an important role in the European and global energy trade. The country is a major producer and consumer of natural gas and maintains a competitive oil-refining and petrochemical industry. The Netherlands has liberalised natural gas and electricity supply markets; the transmission grids are owned and operated by independent state-owned companies. These features of the Dutch energy system, together with its geographic position and excellent ports, notably Europe's largest coal port (EMO), have enabled it to become an important hub for energy trade and reinforced its comfortable energy security position.

While the Netherlands is largely on track to reach its emissions reduction targets for 2020, increasing the share of renewables in energy supply from around 4.5% in 2013 to 14% by 2020 and 16% by 2023 and increasing energy efficiency remain challenging.

Commendably, the Energy Agreement has set out a concrete action plan for meeting the 2020 targets, together with a process for monitoring and implementation. On the basis of the coalition agreement, *Building Bridges,* of 29 October 2012 and supported by the Social and Economic Council (SER), the Netherlands concluded an Energy Agreement for Sustainable Growth in September 2013. The Agreement focusses on ten pillars which prioritise energy efficiency and renewable energies, support network investment, effective carbon markets, clean coal technologies and CCS, ambitions in the transport and mobility area and for the commercialisation of clean energy technologies. The IEA applauds the strong engagement of stakeholders and the ambitions of the Agreement. It is challenging, however, to ensure the actual delivery of the many actions and commitments. In particular, if one party steps out, it might delay or even risk the implementation of other actions. The monitoring of progress and the continuous dialogue with all stakeholders involved is therefore a crucial for the future success.

Maintaining policy stability is a key priority in the Netherlands over the time-span of changing government coalitions. The broader the support base and understanding of the policy approaches to be adopted, the greater are the chances of developing a shared vision. The unique Dutch *polder model* and the SER's process to come to a National Energy Agreement for Sustainable Growth help in achieving this shared vision. The success of the Netherlands to meet its objectives will now depend on safeguarding the agreements made, monitoring and following up on the key actions set out in the Energy Agreement.

Between now and 2030, many important choices will have to be made. Assessing what decarbonisation options for 2050 are optimal and cost-effective, and at what stage in the energy transition, will help control the cost and provide new opportunities for business. For example, the future transition of gas with low calorific value (L-gas) to gas with high calorific value (H-gas) will result in gas quality changes and therefore in a technology switch in the residential and industry sectors around 2020. It will be crucial to assess and decide on the most appropriate technology combination, including nuclear or coal, renewables, and

where the different energy sources can be used most effectively. This will be necessary to avoid using high-quality energy sources for low value-added activities such as heat services or agriculture and horticulture exports.

Equally, the potential contribution from nuclear energy can be evaluated, if the Netherlands wishes to continue to use nuclear energy after the end of lifetime of the Borssele nuclear power plant. Today, nuclear energy provides around 4% of the electricity in the Netherlands. The only existing nuclear power plant, at Borssele, is expected to supply electricity until around 2033. It is noteworthy that the government's key strategies adopted since 2011 (Energy Agreement, Climate Letter 2050 and Climate Agenda) do not provide for any explicit role for nuclear energy for the time after 2033, despite the focus on low-carbon electricity supply.

The key strategies of the government for 2050, including the Climate Letter 2050, the Climate Agenda and the future Energy Agreement, do not consider different cost-effective pathways to reach the longer-term goals. Developing a GHG emission roadmap towards 2050, including analysis of the regional impacts, could help facilitate judgements about the nature and value of post-2020 targets, about the costs and benefits of different potential courses of action and about what long-term support to innovation would be most likely to deliver cost-effectiveness over time.

The Energy Agreement focusses mainly on achieving the objectives for 2020. In the medium to longer term, the government will need to set a consistent long-term policy framework up to 2030 that encourages investment in new low-carbon technologies, energy efficiency and demand-side responses. Policy needs to better integrate renewable, climate and energy efficiency objectives and to provide greater stability and predictability for energy investment than has been the case in the past. Maintaining a market-based approach which recognises future uncertainties and the need for flexibility will also be required. The discussions on the EU-wide framework for 2030 will provide a good platform for the Dutch government to advance these priorities.

The efforts of the Dutch government to implement the EU internal energy market legislation and to lead regional co-operation are commendable, as are its efforts to maintain a strong market-based and technology-neutral approach to supply. Given strong integration of the Dutch energy system within the EU internal energy market, some of the concerns the country faces are best tackled on a European stage, or, failing that, at a North-Western regional level: these include establishing a price for CO_2 through the EU-ETS reform and the development of the EU renewable energy, gas and electricity markets. The government is right to seek political alignment of energy policies within the Pentalateral Forum and other forums.

The government supports the so-called Green Deals to encourage private-public partnerships and to reduce non-economic barriers in the energy sector. The streamlining of permit granting procedures will facilitate the investment in a strong electricity grid. As the country is a densely populated, it is sometimes difficult to gain public acceptance for major new energy infrastructure. Through the Energy Agreement, the government can ensure broad support from citizens and consumers for the energy and climate objectives of the country. In addition, local initiatives and local ownership of energy infrastructure projects may support the acceptance and gain social and economic consensus by industry and citizens on the benefits and cost of energy infrastructure needs.

RECOMMENDATIONS

The government of the Netherlands should:

- *Continue to ensure communication and collaboration with relevant stakeholders and the public, promoting transparency, dialogue and evidence-based policy making, with the aim of increasing engagement and gaining social consensus, if the effective implementation of the Energy Agreement for Sustainable Growth is to succeed.*
- *Develop a 2050 GHG emission roadmap, so as to facilitate the discovery of cost-effective options for achieving the energy policy goals and long-term objectives, while allowing for sufficient flexibility for GHG abatement across sectors and a corresponding evolution of the Dutch energy mix, taking full account of the energy efficiency potential and all fuel options, in line with and in support of the Netherlands' EU and international commitments.*
- *Continue to facilitate public acceptance through local engagement and innovation, including through Green Deals, and support for local supply and consumption of renewable energy.*

3. CLIMATE CHANGE

Key data (2012)

Total GHG emissions excluding LULUCF (2011):* 194.4 Mt of CO_2-eq, -8.8% since 1990

Total GHG emissions including LULUCF (2011):* 197.7 Mt CO_2-eq, -8% since 1990

2008-12 target: -6% from 213 Mt CO_2-eq in the base year

CO_2 emissions from fuel combustion: 173.8 Mt CO_2-eq, +11.5% since 1990

CO_2 emissions by fuel: natural gas 43.5%, oil 37.1%, coal 17.5%, other 2%

CO_2 emissions by sector: power generation 30.8%, manufacturing and construction 23.3%, transport 18.7%, commercial and other services 10.5%, residential 10.2%, other energy industries 6.6%

* Source: UNFCCC.

OVERVIEW

As major trading hub, the Netherlands plays a significant role in the international commodity trade from and to Europe, as it hosts Europe's largest port in Rotterdam. The Netherlands is the largest importer and exporter of oil and oil products in the world and a leading exporter of agricultural products (cattle, crop and greenhouse horticulture). The country has invested in infrastructure, including road, rail, aviation and maritime transportation, connecting the Netherlands to its European neighbours, and global trade.

The Netherlands decoupled economic growth from domestic greenhouse gas emissions (GHG). In 2012, these were 8.8% lower than in 1990, while gross domestic product (GDP) had increased by 50% in the same period. GHG emissions from industrial processes, such as oil/gas extraction, machinery, iron and steel, paper and pulp decreased.

The energy sector strongly defines the Dutch emission profile and makes the Dutch economy CO_2-intensive. Accounting for 10.9% of the Dutch GDP, the sector makes up almost all GHG emissions.[1] With industry and power generation sectors using natural gas, oil and coal as feedstock, the country maintains a fossil fuel-intensive economy. The share of the energy sector in total GHG was around 72% in 1990; in 2011 it reached 85%, and stems from heat and power generation, the petrochemical, transport, construction and the horticulture and agriculture sectors. Over the 1990-2011 period, CO_2 emissions from fuel combustion have grown (11.5%), while emissions of non-CO_2 greenhouse gases, such as methane (CH_4), nitrous oxide (N_2O) and fluorinated gases (F-gases), decreased by 50% versus base year emissions.[2]

1. National Institute for Public Health and the Environment, Ministry of Health, Welfare and Sport, Greenhouse Gas Emissions in the Netherlands 1990-2010, National Inventory Report 2012.

2. United Nations Framework Convention on Climate Change (UNFCCC), Sixth Netherlands National Communication, 2014.

GHG EMISSIONS, TARGETS AND PROJECTIONS

The Netherlands ratified the Kyoto Protocol in May 2003 and has a commitment to reduce GHG emissions on average by 6% within the 2008-12 period compared to 213 Mt CO_2-eq in the base year.[3] The Netherlands thus shares the burden of the collective EU-15 target which aims to reduce GHG emissions by 8% below 1990 levels during 2008-12.

By 2012, the Netherlands emitted 194.4 Mt CO_2-eq[4] or around 8.8% less than in the 1990 base year, reaching its Kyoto target and the lowest level of GHG emissions since then. This is partly thanks to domestic emissions reductions (in ETS sectors), partly thanks to the purchase of international emission allowances (to cover higher emissions in non-ETS sectors).

Under European Commission Decision 2010/778/EU, the Dutch national Kyoto target for 2008-12 was translated into an emissions level 1 001 Mt CO_2-eq, which was then split between the EU-ETS sector (437 Mt CO_2-eq) and the non-ETS sectors (564 Mt CO_2-eq), which includes agriculture, services, consumers, buildings and waste. Here, the Netherlands is committed under the EU Effort Sharing Decision to a binding reduction target of 16% in 2020 below 2005 levels, which corresponds to 105 Mt CO_2-eq.

During 2008-12, ETS emission allowances allocated were 421 million, but emissions were lower with 406 Mt CO_2-eq, leading to a surplus of 15 million allowances. In the non-ETS sectors, emissions were 594 Mt CO_2-eq, thus slightly higher than the allowed budget (564 Mt CO_2-eq), requiring the use of so-called flexible mechanisms under the Kyoto Protocol (see below international measures). The Netherlands estimates it can use 30 Mt CO_2-eq from already purchased clean development mechanisms (CDM) and joint implementation (JI) credits which are worth 48 Mt CO_2-eq.

The country is also on track to achieve its 2020 target with planned and additional measures for ETS and non-ETS sectors.[5] Emissions in 2020 are projected to be in the range of 93 to 108 Mt CO_2-eq, on track for the target of 105 Mt CO_2-eq. It is expected that, non-ETS emissions in the Netherlands are to fall by 2030, as increased energy efficiency and CO_2 reductions in transport should deliver in the coming years.

Table 3.1 Overview of total expected GHG emissions by gases in 2010, 2020 and 2030 (Mt CO_2-eq)

	2010	2020 (framework policies adopted)	2020 (framework policies adopted and implemented)	2030 (outlook policies adopted)	2030 (outlook policies adopted and implemented)
ETS	85	112	103	103	95
Non-ETS	125	100	99	95	89
Total	**210**	**212**	**202**	**198**	**184**

Source: PBL and ECN, 2012.

3. The base year is 1990 for CO_2, methane (CH_4) and nitrous oxide (N_2O) and 1995 for F-gases, namely hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulphur hexafluoride (SF_6).

4. European Environment Agency, 2013: GHG viewer: www.eea.europa.eu/data-and-maps/data/data-viewers/greenhouse-gases-viewer.

5. *Trends and projections in Europe 2013 – Tracking progress towards Europe's climate and energy targets until 2020*, European Environment Agency, October 2013.

CO_2 EMISSIONS FROM FUEL COMBUSTION

CO_2 EMISSIONS BY SOURCE AND SECTOR

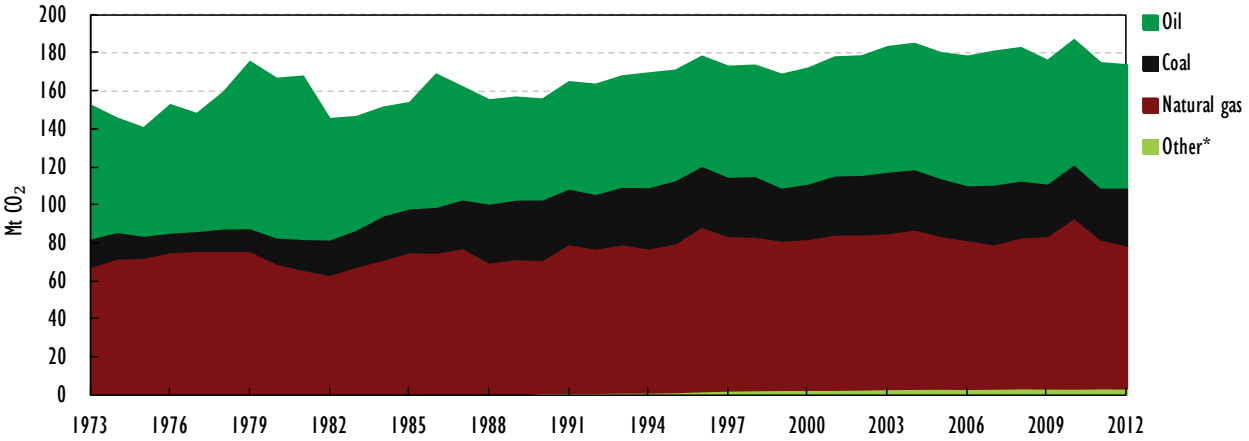
In 2011, CO_2 accounted for 86.2% of GHG emissions in the Netherlands, increasing from 75.2% in 1990. The majority share of CO_2 emissions is from the energy sector (96%).[6] Emissions from CO_2 have increased, while emissions from other gases have fallen, notably emissions from methane (CH_4) and nitrous oxide (N_20).

CO_2 emissions from fuel combustion amounted to 173.8 Mt in 2012, according to IEA data. These emissions have increased by 11.5% compared to 1990, despite an overall fall in GHG emissions over the same period because of strong additions from petrochemical industry and agriculture (see below).

Natural gas is the largest source of CO_2 emissions in the Netherlands, accounting for 43.5% of CO_2 emissions from fuel combustion in 2012, mainly thanks to its wide use as heating and power generation fuel.

Emissions from the use of oil represented 37.1% of the total, while coal usage accounted for 17.5%. Over the decade since 2002, there has been a slight shift in the emissions from coal and natural gas to oil, mainly because of increased oil and oil product use in industry, while emissions from natural gas have remained at around 45%.

Figure 3.1 CO_2 emissions by fuel, 1973-2012



* *Other* includes industrial waste and non-renewable municipal waste.

Sources: *CO_2 Emissions from Fuel Combustion*, OECD/IEA, Paris, 2013; country submission.

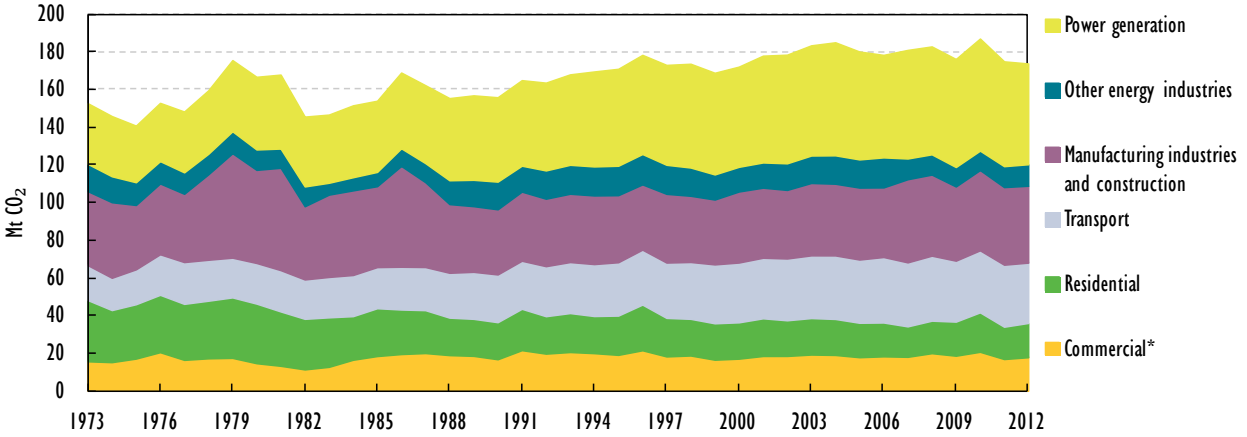
Electricity and heat generation is the largest CO_2-emitting sector in the Netherlands, with 53.5 Mt CO_2 (30.8% of the total) in 2012. This share has fallen slightly from 32.8% over the ten years since 2002. Manufacturing industry and construction accounted for 23.3% of CO_2 emissions from fuel combustion in 2012, while transport represented 18.7% of the total. Since 2002, emissions increased by 12.2%, while emissions in transport have declined by 2.3%. Within manufacturing, chemical and petrochemical industry and wood and wood products saw substantial increases in their CO_2 emissions since 2002.

6. United Nations Framework Convention on Climate Change (UNFCCC), Sixth Netherlands National Communication, 2014.

Commercial services and the residential sector accounted for 10.5% and 10.2% of total CO_2 emissions in 2012, respectively, while other energy industries accounted for 6.6%. Emissions in these sectors have fallen since 2002, with emissions in other energy industries (including oil and gas extraction) declining by 19.2%, residential by 4.1% and commercial services by 3.5%.

In addition to increasing CO_2 emissions, air pollution and other GHGs are on the rise, in particular from livestock and horticultural production (nitrates, phosphates), which negatively affect the Dutch water, soil and air quality in recent years. Under the OECD Better Life Index, which includes an assessment of the environment performance, the Netherlands ranks rather low, owing to air pollution in urban areas, mainly from particulates (PM_{10}).[7]

Figure 3.2 CO_2 emissions by sector, 1973-2012



* *Commercial* includes commercial and public services, agriculture/forestry and fishing.

Sources: *CO_2 Emissions from Fuel Combustion*, OECD/IEA, Paris, 2013; country submission.

CARBON INTENSITY

CO_2 intensity is measured as kilograms of CO_2 emissions per unit of gross domestic product at purchasing power parity using 2005 USD prices (kg CO_2/USD GDP PPP). In 2012, carbon intensity in the Netherlands was 0.28 kg CO_2/USD GDP PPP, which is lower than the IEA average of 0.33 kg CO_2/USD GDP PPP in 2011. Since 2002, carbon intensity in the Netherlands has decreased by 13.1% while the IEA average has fallen at a faster rate by 18% (from 2001 to 2011). The Netherlands ranked fourteenth-most carbon-intensive economy among IEA member countries in 2011, which is a median level.

With regard to the carbon intensity of energy supply, measured as CO_2 emissions per total primary energy supply (TPES), the Netherlands ranked fourteenth among IEA member countries in 2011 with 2.3 tonnes of CO_2 emissions per tonne of oil-equivalent (t CO_2/toe) in 2011. This ratio decreased by 4.2% from 2001 to 2011, falling at a faster rate than the IEA average decline of 3.1% over the same period.

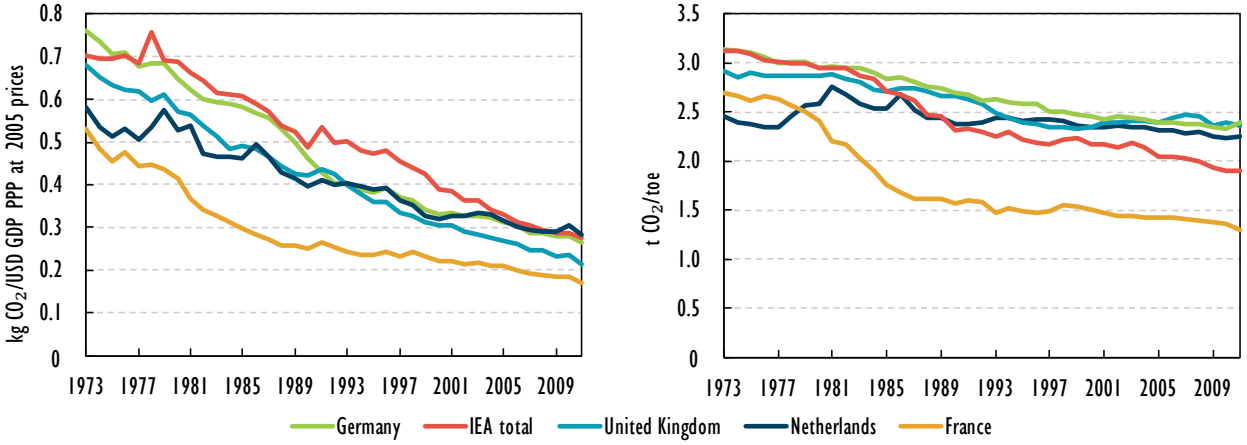
The ratio of CO_2 emissions per capita in the Netherlands was 10.4 t CO_2 per capita in 2012, declining by 6.1% since 2002. The Netherlands had the seventh-largest emissions

7. OECD Better Life Index 2013: www.oecdbetterlifeindex.org/topics/environment/. "PM10 levels are 29.6 micrograms per cubic metre, much higher than the OECD average of 20.9 micrograms per cubic metre and the annual guideline limit of 20 micrograms per cubic metre set by the World Health Organization."

per capita among IEA member countries in 2011. The IEA average is at a similar level, namely 10.6 t CO_2 per capita in 2011 and it decreased by 9.6% from 2001 to 2011.

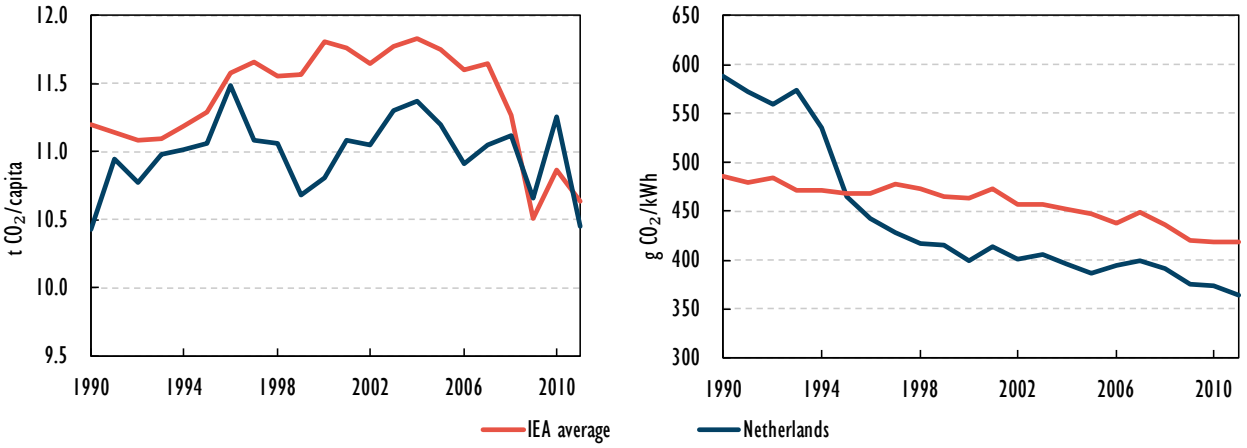
Carbon intensity in electricity generation is measured as grammes of electricity- and heat-related CO_2 emissions per kilowatt hour of electricity and heat generation (g CO_2/kWh). The Netherlands recorded 384 g CO_2/kWh in 2012, which is a decrease of 4.5% from 40.2.2 g CO_2/kWh in 2002. The country had a median level of carbon intensity from electricity generation among IEA member countries in 2011; the IEA average was 418.9 g CO_2 per kWh in 2011, also decreasing by 12% since 2001.

Figure 3.3 Energy-related CO_2 emissions per real GDP and TPES in the Netherlands and in other selected IEA member countries, 1973-2011



Sources: *Energy Balances of OECD Countries*, OECD/IEA, Paris, 2013; *National Accounts of OECD Countries*, OECD, Paris, 2013; country submissions.

Figure 3.4 Energy-related CO_2 emissions per capita and per electricity and heat generation in the Netherlands and IEA average, 1990-2011



Sources: *Energy Balances of OECD Countries*, OECD/IEA, Paris, 2013; *National Accounts of OECD Countries*, OECD, Paris, 2013.

INSTITUTIONS

Overall responsibility for climate policies lies with the **Ministry of Infrastructure and Environment**, which has the lead on environmental policies (air, water and soil quality, environmental impacts, climate change and adaptation), environmental and spatial planning

as well as transport and mobility. The Ministry is also responsible for contracting projects under the Kyoto clean development mechanism (CDM). The **Dutch Emission Authority (NEa)** issues CO_2 and NO_x emission rights and ensures the functioning of the market for trading emission rights.

Other ministries have responsibility for related tasks: the **Ministry of Finance** is in charge of energy taxation and the **Ministry of Health, Welfare and Sport (VWS)** oversees the national GHG emission inventory.

The **Ministry of the Interior and Kingdom Relations** is responsible for energy efficiency in housing.

The **Ministry of Economic Affairs** conducts energy policy in general and the energy sector. The latter is also responsible for the purchase of emission credits under JI projects, the Green Investment Scheme (GIS) and the World Bank's Prototype Carbon Fund (PCF).

In addition, the **Energy Research Centre of the Netherlands (ECN)** and the **Environmental Assessment Agency (PBL)** provide the government with forecasts of the developments in GHG emissions.

POLICIES AND MEASURES

Since 2008, the Netherlands has been continuing to implement climate policies through a broad range of measures under the Clean & Efficient Programme (CEP, *Schoon en Zuinig Program*) which remain largely in place still today (see Table 3.3). National energy and climate targets and the support scheme for renewable energies, however, changed considerably over time.

The Environmental Management Act (*Wet milieubeheer*) and the National Climate Policy Implementation Plan form the legal framework for Dutch climate and energy efficiency policies, in line with the Kyoto target and the objectives of the European Union Emissions Trading Scheme (EU-ETS) under the EU energy and climate package for 2020.

The Netherlands contributes to the efforts of the European Union to reduce the GHG emissions by 20% by 2020. At EU level, this overall effort is divided between a 21 % reduction target compared to 2005 for the emissions covered by the EU-ETS and a 10% reduction target compared to 2005 for the remaining non-ETS emissions. The 21% target is largely implemented at EU level through the emission trading scheme, while the 10% reduction target is split into national sub-targets for the non-ETS sectors.

The government relies on the following instruments among others:

- European Union ETS
- energy taxation and green tax incentives such as energy investment allowances
- subsidy on renewable energy (SDE+) as surcharge on the consumers' energy bill to achieve a share of 14% of renewable in 2020
- broad range of energy efficiency measures, including voluntary agreements with industry (for the ETS sector and the non-ETS sectors).

An overview of the policy measures to reduce GHG emissions is provided in Table 3.3.

There is a long tradition in the Netherlands to support policies for the transition towards a fully sustainable energy supply by 2050. The Dutch energy transition policy framework is a continuous feature of the national energy and climate policies.

In the Climate Letter 2050 (*Klimaatbrief 2050)* of 18 November 2011, the Rutte-I government reaffirmed this commitment and set out the four core elements to achieve a climate-neutral economy by 2050: *i)* CO_2-free electricity supply*, ii)* sustainable use of biomass, *iii)* energy savings and *iv)* carbon capture and storage (CCS).

The Dutch Parliament in its motion of 26 April 2011 called upon the government to develop a national energy transition accord. In September 2013, the National Energy Agreement for Sustainable Growth (*Energieakkoord voor duurzame groei,* hereinafter: the Energy Agreement) was adopted through the Social and Economic Council (SER) and sets out the main actions needed to meet the energy and climate targets for the horizon 2020. In particular, the Energy Agreement envisages an overall energy-saving target of 100 petajoules (PJ) by 2020 and the ambition to reduce the final energy consumption by 1.5% per year and to increase the share of renewables to 16% by 2023.

On the basis of the Climate Letter 2050 and the Energy Agreement*,* the government presented in October 2013 the *Climate Agenda*[8] which takes a longer-term view with measures on how to achieve a CO_2 reduction of 80% to 95% in 2050 below 1990 levels. The Netherlands supports a European GHG emissions reduction objective for 2030 of at least 40% below 1990 levels, supports innovation in low-carbon technologies and the EU-ETS reform to match the pathway of the EU low-carbon roadmap.

The Netherlands has thus already prepared its position in relation to the ambitions of the EU-wide 2030 framework. On 22 January 2014, the European Commission proposed a domestic GHG reduction target of 40% from 1990 to 2030 and an EU-wide target of at least 27% of renewables by 2030 as the pillars of the 2030 Energy and Climate Framework (hereinafter the "2030 Package"), together with a proposal for the reform of the ETS post-2020 and a stability reserve. The sectors covered by the ETS are to cut emissions by 43% in 2030 (versus 2005). The emissions reductions in the non-ETS sectors are set at -30% in 2030 (versus 2005). The agreement on these EU-wide targets and their burden sharing by the member states is expected to be discussed in 2014/15.

The Dutch government uses initiatives for public-private partnership to reduce non-economic barriers, through Green Deals and Local Climate Policy Initiatives. Under the Local Climate Agenda 2011-2014, the central government has taken the commendable step of actively engaging local authorities on climate and sustainability.

Over 135 local and regional governments have signed up to the agenda and set their own climate and CO_2 reduction targets and elected local climate ambassadors, representing the municipal, provincial and water authorities (see Box 3.1).

EU EMISSIONS TRADING SCHEME (EU-ETS)

A large part (currently 45%)[9] of the emissions the Netherlands is covered under the EU-ETS cap-and-trade system which was set up in 2003 for the implementation of the Kyoto Protocol by the Directive 2003/87/EC and started in 2005.

Each EU member state set out the total quantity of CO_2 emission allowances and the quantity allocated for each installation covered by the EU-ETS in the first (2005-07) and the second (2008-12) trading periods in a national allocation plan (NAP). For the third

8. *Climate Agenda for 2030*, the Ministry of Infrastructure and Environment, the Hague 2013, at: www.government.nl/news/2013/10/04/climate-agenda-mitigation-adaptation-and-business-sense.html.

9. National Emission Inventory. See at: www.emissieregistratie.nl/erpubliek/erpub/ets.aspx.

trading period 2013-20, the NAPs are being progressively replaced with harmonised allocation rules across the European Union, with auctioning as the main allocation principle. On 5 September 2013, the European Commission adopted a decision on the national implementation measures for 2013-20.

ETS sectors include power stations and other combustion plants, oil refineries, coke ovens, iron and steel plants, and factories making cement, glass, lime, bricks, ceramics, pulp, paper and board.[10] As of 1 January 2012, ETS extends to aviation, including all airlines operating on EU territory whether European or not.[11] Since 2013, the production of petrochemicals, aluminium and ammonia, and capture, transport and geological storage of all GHG emissions and emissions of nitrous oxide in certain industries are also included in the ETS.

Process industries may receive part, or, if subject to carbon leakage, all of their allowances for free at the level of harmonised industry best practice benchmarks. These benchmarks and the allocation rules were adopted by the European Commission for the whole third trading period. The so-called "carbon leakage list" was adopted for five years. The existing list was adopted in 2009. A new list is currently being prepared for the period 2015-19. EU member states can compensate companies under national state aid schemes faced with significant risk of carbon leakage for up to 85% of the cost increase of electricity resulting from the ETS borne by the most efficient installations in 2013-15, falling gradually to 75% by 2019-20.

Under the scheme, in return for energy efficiency commitments, the Dutch government plans to compensate industries at risk of carbon leakage for the cost incurred for emissions reduction during the past year by maximum EUR 78 million annually (the government assumes a carbon price of around EUR 8 per tonne CO_2-eq).

During the first trading period, 2005-07, the Netherlands was granted an exemption for 53, plus 93 installations from the ETS. With a view to achieve emissions reductions in those installations, several long-term agreements on energy efficiency and benchmarking covenants (see Table 3.3. and Chapter 4 on Energy Efficiency) were put in place in addition to the obligations from the Netherlands' Environmental Management Act. In October 2009, a long-term agreement on increasing energy efficiency in ETS installations was concluded; it requires the industries (breweries, chemical, glass, metal, paper and pulp, refineries and others)[12] to draw up and implement a 2020 Energy Efficiency Action Plan.

In the second trading period, a relatively low ETS cap in comparison with 2005 ETS levels, increased the necessary emissions reductions in non-ETS sectors. A total of 349 installations was covered under the EU-ETS, which is almost 90% of the CO_2 emissions from industry and energy sectors. In the second NAP for the period 2008-12 the Netherlands allocated 77.2 Mt CO_2-eq of free allowances to ETS installations. The free allocation to electricity

10. While in general ETS only covers CO_2 emissions, in the case of the Netherlands, emissions of nitrous oxide (NO_x) are also included.

11. The European Court of Justice (ECJ) confirmed the application of the EU-ETS Directive to third countries with respect to international law in Case C-366/10. In April 2013, the European Union decided to defer application of the scheme to flights operated to and from countries outside the ETS so as to allow more time for a global agreement addressing aviation emissions to be reached. In October 2013, a first agreement with the International Civil Aviation Organisation (ICAO) was reached which allows the application of the EU-ETS to non-EU air transport above EU territory with a view to develop by 2016 a global market-based mechanism (MBM) addressing international aviation emissions and apply it by 2020. In the meantime, bilateral agreements can be done. In 2014, changes to the ETS are being discussed at EU level to ensure a solution during the interim period 2013-16 and re-adjust the ETS scope after 2017.

12. Others include cement, mineral wool, starch sugar, beverage and textile industries.

producers was reduced by 15% and participation of industry increased. In the second period (in 2010), the country started the auctioning of emission allowances with a total of 16 million emission unit allowances (EUAs) or 4%. The proceeds are used to compensate high electricity prices at retail level. A reserve for new entrants is held for the amount of 5.9 Mt CO_2-eq. The use of JI/CDM is limited to 10% per year per facility.

In the third trading period 2013-20, the Netherlands allocated on average 46 million allowances per year.

The Netherlands supports the strengthening of the EU-ETS for the period post-2020 by tightening the ETS cap, by promoting cost-efficient CO_2 reductions, by improving prospects for expanding the ETS internationally, while securing the position of internationally competitive companies and allowing for compensation of indirect electricity cost. The carbon price should be a driver for low-carbon power generation and clean energy technologies in the coming years.

Box 3.1 Reforming the European Union Emissions Trading Scheme (EU-ETS)

As a short-term measure, the European Union will postpone the auctioning of 900 million allowances from the years 2013-15 to 2019-20, following an amendment to the EU-ETS Auctioning Regulation. Back-loading does not reduce the overall number of allowances to be auctioned during phase three, but only the distribution of auctions over the period. It is expected that this "back-loading" can adjust the CO_2 price, rebalance supply and demand in the transition to phase three of EU-ETS, reduce price volatility without any significant impacts on competitiveness, and strengthen government revenues in phase three. In early 2014, the back-loading proposal was adopted by Parliament and Council. In 2014, about 400 million quota will be withdrawn from the system.

As a longer-term measure to strengthen the EU-ETS in the period after 2020, the European Commission proposed on 22 January 2014 to establish a market stability reserve at the beginning of the next ETS trading period in 2021. The reserve should both address the surplus of emission allowances that has built up and improve the system's resilience to major shocks by automatically adjusting the supply of allowances to be auctioned. The ETS cap, determined by a linear annual reduction factor, is to be increased to 2.2% per year from 2021 (compared with 1.74% currently), an increase needed to achieve the target of a 40% reduction in EU GHG emissions by 2030 below 1990 levels.

DOMESTIC MEASURES OUTSIDE THE EU-ETS

Under the EU Effort Sharing Decision (406/2009/EC), the Netherlands has a binding national target of 16% emissions reduction from 2005 levels in 2020 for those sectors not in the ETS, which corresponds to 105 Mt CO_2-eq. With this target, the country contributes to the overall EU objective to share the efforts to reduce GHG emissions in the non-ETS sectors by 10% compared to 2005 levels. The non-ETS sectors in the Netherlands represented 55% of GHG emissions in 2011.[13] This included transport, housing, waste disposal, agriculture and forestry, aquaculture and some areas of industry.

13. www.emissieregistratie.nl/erpubliek/erpub/ets.aspx.

The Netherlands has a policy package in place for each of the non-ETS sectors with the aim of reaching Kyoto and EU CO_2 targets. On the basis of an analysis of cost-effectiveness and potentials, in 2011 the Netherlands put in place sectoral CO_2 emission ceilings for 2020 in the following non-ETS sectors:

- industry (mainly construction industry and waste disposal) and energy (mainly extraction): 10.7 Mt CO_2-eq
- transport: 35.5 Mt CO_2-eq
- buildings: 22.5 Mt CO_2-eq
- agriculture and horticulture: 5.75 Mt CO_2-eq
- non-CO_2 emission ceilings for GHG from agriculture: 16 Mt CO_2-eq
- non-CO_2 emission ceilings for GHG from other sectors: 8.8 Mt CO_2-eq.

ENERGY TAXATION

The Netherlands raised the second-highest environmental tax revenues among OECD countries after Denmark, amounting to 4% of GDP (2% P for the energy tax alone) in 2012.

Since 1996, the Netherlands has been applying an energy tax on mineral oils (other than motor fuel), electricity and natural gas. The tax has increased over the years. Energy products and power used to generate electricity are exempted from the energy tax. Fossil fuels are subsidised indirectly in the form of an exemption from the energy tax for energy-intensive industries equivalent to EUR 2 billion per year (see compensation under EU-ETS). Natural gas use in efficient CHP generation and in the horticultural sector (greenhouses) is exempted. The tax on coal use in power generation is set to deliver high carbon emissions reductions, in addition to the EU-ETS. Unlike other countries, the Netherlands has no tax exemptions or reductions for the use of natural gas in mineralogical processes and dual use. In the transport sector, the reduction on the road tax aims to promote the purchase of clean and efficient motor cars.

FOCUS ON THE TRANSPORT SECTOR

Transport accounted for 18.7% of total energy-related CO_2 emissions in 2012. The Netherlands aims to reach a national target for the transport sector (35.5 Mt CO_2 in 2020), thanks to fiscal measures and initiatives encouraging biofuels blending and sustainable mobility. Importantly, for the medium- to longer-term horizon, the Energy Agreement sets out the ambition to generate energy savings of around 15 PJ to 20 PJ by 2020 and to cap CO_2 emissions at 25 Mt or achieve a total CO_2 emission reduction of 17% by 2030 and by 60% in 2050 compared to 1990.

With average CO_2 emissions of the new car fleet decreasing to 126 g CO_2 per km in 2011, the Netherlands recorded the largest annual relative CO_2 emissions reductions in newly registered cars in 2012, next to Greece. With regard to average CO_2 emissions from new cars, the country ranks fourth among EU member states.[14] This is largely the result of new EU regulations, tax incentives for the purchase of low-emission and more efficient cars and the highest petrol taxes in the European Union (see Chapter 8).

14. *Monitoring CO_2 emissions from new passenger cars in the EU: summary of data for 2011*, European Environment Agency (EEA) 2012, available at: www.eea.europa.eu/publications/monitoring-co2-emissions-from-new/at_download/file.

The share of renewables in transport increased over the past years thanks to the implementation of the biofuels blending obligation, mainly with biodiesel and bioethanol. The country is not far from reaching its target for the share of renewables in transport (in 2011, the share was 4.6% versus the indicative 5.1% target).

The Netherlands has seen an increase in the amount of refuelling and recharging points for alternative fuels: 88 natural gas stations, 32 stations offer bioethanol, almost 4 000 electric charging locations (that is almost twice as much as in 2011). The port of Rotterdam has been expanding its biofuel import capacities. Thanks to a subsidy programme of EUR 2.5 million, about 200 biogas-driven vehicles are on the roads in the Netherlands.

The government initiated an Action Plan in 2009 to stimulate electrification in the transport sector (with the goal of one million electric cars by 2020). In 2013, the country has over 70 000 electric vehicles, leading European efforts, but still clearly staying behind its ambitions and potential. Green Deals are agreed upon between companies and several government bodies focussing on stimulating cycling and zero-emission buses. In 2013, 75% of the bus fleet in the Netherlands was environment-friendly with natural gas and hybrid buses.

All new passenger cars in the Netherlands must have an energy label stating its fuel consumption, level of CO_2 emissions and efficiency category. These efficiency ratings are used in schemes providing favourable tax treatment for buyers of more efficient vehicles. The private motor vehicle and motorcycle tax (BPM) is a tax levied on the purchase of new cars. The motor vehicle tax (MRB) is differentiated by the weight of the car. Exemption is provided until 2014 for vehicles with an emission factor below 110 grammes of CO_2 per km using petrol and 95 grammes CO_2 per km using diesel. As of 2015, only vehicles with an emission below 50 grammes of CO_2 per km are exempted from the tax.

The Ministry of Infrastructure and Environment has carried out an extensive analysis and concludes that the use of light-heavy duty vehicles (LHVs) is helping to reduce both emissions and costs for society. As of January 2013, LHVs are regulated under an exemption regulation, without restrictions on the number of vehicles but with requirements as to the driver certificate and to the use of the specific road network for LHVs.

Despite its ambitions in reducing emissions in the transport sector, the central government increased the speed limit on some highways from 120 km per hour (km/h) to 130 km/h. In this case, an increase of CO_2 emissions of 0.35 Mt is expected.

The share of freight in the Dutch transport sector has remained constant since 1990.[15] While the government is decided not to introduce road pricing, it could be worthwhile considering the introduction of road pricing for freight, as done in neighbouring countries (Germany) or a modal shift to rail. Amsterdam is among the most congested cities in Europe, next to London, Brussels and Cologne, and requires additional action beyond an increase in road capacity. The urban growth in the Randstad area requires a stronger focus on public transport, congestion charges and traffic management than in the past. The Dutch passion for cycling was a success story on which can be build for the development of modern city mobility.

Beyond 2020, the Energy Agreement also includes a ceiling for keeping the CO_2 emissions at 25 Mt in the transport sector by 2030, which translates into emissions reductions equivalent to the removal of some 3 million traditional motor cars from the road and a reduction of 6 Mt more than with current policies.

15. *A closer look at urban transport TERM 2013: transport indicators tracking progress towards environmental targets in Europe*, European Environment Agency (EEA), No 11/2013.

CARBON CAPTURE AND STORAGE

The Netherlands supports the use of CCS as an essential pillar of the transition towards a low-carbon economy by 2050. The government's stated intention is to promote and accelerate CCS, among other things via large-scale demonstration projects. The government currently promotes the development of CCS in order to ensure that it can be deployed on a wide scale by the energy production and industrial sectors, those that emit large quantities of CO_2. The Netherlands is one of a relatively small number of European countries that have developed substantial competences in CCS and the Dutch government is keen to maintain a leading position globally.

Box 3.2 Rotterdam as Europe's CO_2 hub and the ROAD CCS Project

The Rotterdam Capture and Storage Demonstration Project (ROAD) is a project of E.ON Benelux and GDF Suez Energie Nederland to capture 1.1 million tonnes of CO_2 per year from a new coal-fired power plant at Maasvlakte. If the companies are able to secure financing, storage of the captured CO_2 in a depleted gas reservoir under the North Sea could begin in the next few years.

The project plans to capture CO_2 from a flue gas stream arising from approximately one-quarter of the total capacity of a 1 070 MW coal power plant. Thus, the project is equivalent to CO_2 capture from a 250 MW plant. The captured CO_2 will be transported through a 26 km pipeline to the P-18-A Platform of TAQA in the North Sea and injected into depleted gas reservoirs at a depth of 3 500 metres under the seabed.

It would be one of the first projects worldwide to realise an integrated chain of CO_2 capture, transport and storage from power generation on a large scale. ROAD would provide valuable information on the technical and economic feasibility of CCS. Learning about CO_2 transport and storage would also provide highly valuable information about offshore storage and knowledge for other sectors that would require CCS in the future. Within the context of climate policy, CCS will have to make an important contribution to the reduction of CO_2 emissions and ROAD projects to help it to achieve its potential in the Netherlands and the European Union.

In 2009, ROAD was awarded co-financing from the European Commission of up to EUR 180 million from the European Energy Programme for Recovery. The government of the Netherlands has pledged a sum of additional support if financing can be found to cover the remaining financial gap. The Global CCS Institute has funded a number of projects to publish the findings of the project so far.

In terms of advancing towards final investment decision (FID), issues concerning permits, regulatory uncertainties and negotiations with the envisaged storage provider have all been resolved. The FID planned for 2011 has, however, been rescheduled a number of times owing to continuing political and economic uncertainty with the low carbon price under the ETS and an ambiguous outlook for CCS. E.ON and GDF Suez continue to review their positioning in close co-ordination with key stakeholders and are keen to succeed with the project. The Netherlands' depleted offshore gas fields offer a unique CO_2 storage potential in the North Sea offshore. Rotterdam has the ambition to become Europe's CO_2 storage hub. The vision involves a regional offshore storage of CO_2, connected by a CO_2 pipeline system, and comprehensive carbon capture storage and utilisation, making full use of CO_2 in other industry sectors, including green houses and chemical industry.

The Netherlands started working on small-scale CCS pilot projects before 2008 and accommodated CCS in the Dutch Mining Law. In 2011, it transposed the EU CCS Directive 2009/31/EC by amending the Dutch Mining Law and issued the European Union's first draft CO_2 storage permit for the Rotterdam Capture and Storage Demonstration Project (ROAD) (see Box 3.2), which was accepted as satisfactory by the European Commission in 2012. For the period 2015-20, a large-scale demonstration is envisaged.

The Netherlands has decided in favour of offshore storage, after onshore storage met with strong public opposition. The government will grant permission only for demonstration projects involving undersea storage. Present estimates suggest that this will be sufficient, at least for the medium term. Safety is the prime consideration. The government will make no planning reservation for a CCS demonstration project on land. Most large-scale onshore demonstration projects have stopped. These included the Shell Pernis refinery near Barendrecht and a power station in north Netherlands.

The Netherlands has a specific research and development programme for CCS, CATO-2, which runs until 2014, with 50% public co-financing totalling EUR 60 million for the period 2010-14. With a view to proceed with the programme in a CATO-3 phase, the Dutch government made CCS part of the Topsectoren Energie approach under the Top Consortia for Knowledge and Innovation (TKI) Gas pillar (however no public funding has been allocated to the project so far). The central is also set to produce a long-term strategy regarding the role of carbon capture, utilisation and storage in the transition to a sustainable energy system by mid- or end-2014.

The Netherlands hosts a high number of active small-scale pilots, including the CATO-2 catcher E.ON, Maasvlakte, the post-combustion Electrabel, Nijmegen, the pre-combustion Nuon, Buggenum, an offshore storage GDF Suez, North Sea, the OCAP and horticulture, Rotterdam. The next stage of development, demonstration projects, is the important pre-commercial stage on which most global attention is focussed. The Netherlands has an advanced project at the planning stage – the ROAD Project (see Box 3.2). Another planned demonstration project, at a new hydrogen plant and called Green Hydrogen, is no longer being developed after the application to the European Commission for funding under the NER 300 funding programme did not meet the necessary criteria despite having the financial backing of the government.

Dutch research institutes and companies have been involved in preparing or carrying out large-scale CCS projects around the world. Wide deployment of CCS in the Netherlands or overseas could therefore benefit the Dutch economy as well as the climate if Dutch companies are successful in competing to engage in commercial projects.

INTERNATIONAL MEASURES

The Netherlands uses flexible Kyoto mechanisms: the CDM, JI projects and emissions trading for its 2008-12 target. Ultimately, domestic emissions over 2008-12 were about 30 Mt CO_2-eq above the Kyoto target.[16] Around 48 million emission credits has been purchased.[17] As set out in Table 3.2, the government initially contracted a total volume of 66.4 million credits, out of which 32 million rights have already been delivered by July 2012 with another 13 to 19 million credits to be added in 2014-15.

16. www.pbl.nl/publicaties/nederland-voldoet-aan-de-kyoto-verplichting-uitstoot-broeikasgassen.

17. *Ibid*.

Next to Austria, the Netherlands leads EU financial allocations to Kyoto mechanisms (EUR 500 million). The Dutch portfolio consists of 99 projects in 32 countries, including Latin America, Africa and Asia, managed through the World Bank, the Latin American Development Bank and Rabobank. The Ministry of Economic Affairs oversees 25 JI projects, which are administered by the Netherlands Enterprise Agency (*Rijksdienst voor Ondernemend Nederland, RVO*) (ERUPT programme), the World Bank and also the European Bank for Reconstruction and Development (EBRD). In addition, the Ministry purchased credits under the GIS and the World Bank's PCF.

The Netherlands does not plan to rely on international flexibility mechanisms for the post-Kyoto period, if it can meet its goals by domestic emissions reductions under present policies. The government is in favour of setting more ambitious international climate goals for 2020, 2030, as set out in the 2012 coalition agreement.

Table 3.2 International GHG emission credits (in million rights)

Portfolio	Contracted	Delivered
Clean development mechanism	43.4	19.8
Joint implementation – RVO	12.7	5.6
Joint implementation – banks	5.1	3.1
Green Investment Scheme	3.0	3.0
Prototype Carbon Fund	2.2	0.6
Total	**66.4**	**32**

Sources: NL Agency (2012); Ministry of Economic Affairs (2012); Ministry of Infrastructure (2012); NEa (2012).

CLIMATE CHANGE ADAPTATION

Climate change considerations have been at the forefront of the water safety and spatial planning and are reflected in the excellent Dutch track record in flood protection, notably the DELTA Act and DELTA Programme, both of which focus on land use and spatial planning to mitigate rising sea levels, floods and growing salinisation of arable land.

As a signatory to the United Nations Framework Convention on Climate Change (UNFCCC), the Netherlands also supports the Green Climate Fund and climate adaptation actions in developing countries, for instance under the Global Environmental Facility (GEF) Least Developed Countries Fund with support to water and coastal zone management in Africa and Asia. Over the period 2010-12, the Netherlands provided EUR 300 million funding to actions under Fast Start Finance.

With 24% of its surface located under the sea level, around 60% of the surface of the Netherlands is vulnerable to flooding from the sea and the three large rivers Rhine, Ijssel and Meuse. Next to floods, water scarcity and droughts have been identified as potential risks in some parts of the country as a result of climate change, in particular rising temperature fluctuations and reduced precipitation.

On the basis of an impact assessment by the Royal Netherlands Meteorological Institute (KNMI) in 2006, the government prepared a first national adaptation strategy "Make Space for Climate" (*Ruimte en Klimaat)*. The Strategy focussed on impacts on water safety, nature, agriculture, recreation, urban environment and industry. The first national adaptation action programme was rolled out to increase flood protection and climate proofing of spatial planning.

Adaptation issues are considered under the spatial planning which integrates economic, environmental and climate impacts. The Netherlands is a world leader in adapting spatial planning to flood protection, e.g. under the Room for River programme of 2007, the installation of climate buffers (water storages),[18] the DELTA programme of 2011 and DELTA Act of 2012. The country has the highest flood safety levels in the world (with a one in 10 000 year risk). In 2011, the Netherlands Environmental Assessment Agency (PBL) assessed climate adaptation needs in the Dutch Delta and proposed strategic options for a climate-proof development of the country. The study analysed how the Netherlands could adapt to expected changes in climate in four areas: water issues (including flood protection and freshwater supplies); rural areas, ecosystems and biodiversity; and urban areas.[19] Energy has not been treated specifically, but water availability and flooding have important implications for the energy infrastructure and the sector.

The first national adaptation strategy and the related programmes have not been followed up by a new strategy. The release of new climate projections from the Intergovernmental Panel on Climate Change (IPCC) suggests that a revised plan, taking into account global climate projections and extrapolating regional impacts for the Netherlands, would be timely. Despite frequent risk assessments, the government has yet to examine the impacts of climate change on the energy sector. This is also the conclusion of the report by the Court of Auditors (*Algemene Rekenkamer*) on the implementation of the 2007 strategy. It outlines that the Netherlands lacks a coherent policy framework, and that the country is lagging behind other EU member states and is thus not prepared to address all climate change impacts in a timely and adequate manner.[20] The report concludes that the policy framework lacks clearly allocated responsibilities, co-ordination and timeline for actions.

The government is currently reviewing its safety standards and water governance (see OECD 2013 for the results of the water governance review). The European Commission presented in April 2013 the EU Climate Adaptation Strategy,[21] which encourages all EU member states to adopt national adaptation strategies. Commendably, in October 2013, the government launched a Climate Agenda, including the plan to develop a new national adaptation strategy by 2016 to manage the risks to health, transport and food production and to better equip the country to deal with the effects of climate change. The strategy is to include measures, such as flood prevention, increasing green space in cities to improve heat resistance, and anticipating new diseases. Impacts of the energy sector (on the supply and the demand sides) are important elements which are to be integrated into this process. The new adaptation strategy is timely, as urban development and climate impacts have been changing in the past decade.

Amsterdam and Rotterdam areas are among the top 20 cities in the world that are most exposed to climate change, in particular coastal flooding, ranking 14 and 15 in the global index, with assets worth USD 128 billion and USD 115 billion currently exposed.[22] In addition, industrial activity is increasingly concentrated in vulnerable areas around the

18. The Netherlands introduced water storage and developed an active use of water for recharge, reuse and retention to support the so-called climate buffers, which are to keep the CO_2 cycle in balance.

19. OECD (2013), *Studies on Water and Climate Change Adaptation, Policies to Navigate Unchartered Waters*.

20. *Aanpassing aan klimaatverandering: strategie en beleid*, Algemene Rekenkamer (2012). Tweede Kamer, vergaderjaar 2012-2013, 33 470, nr. 2. ISBN 9789012576277. Den Haag: Sdu. Available online at: www.rekenkamer.nl/dsresource?objectid=96605&type=org.

21. COM/2013/0216 final: Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions: *An EU Strategy on adaptation to climate change*.

22. OECD, "Ranking of the World's Cities Most Exposed to Coastal Flooding Today and in the Future", OECD Environment Working Paper No. 1 (ENV/WKP(2007)1) OECD 2007.

Randstad region where the power and agriculture sectors have expanded in recent years. This is likely to impact vulnerability and exposure of the country to water scarcity and flood risks and it may be useful to consider siting plans in light of the latest projections on local climate impacts. The Rotterdam Climate Initiative (see Box 3.3) has set encouraging standards which could prove useful for other cities in the Netherlands.

Box 3.3 The Rotterdam Climate Initiative (RCI)

Europe's largest international port, Rotterdam, has set out ambitions to become the world's most sustainable port city. Initiated by the port of Rotterdam, the City of Rotterdam co-operates with employers' organisation Deltalinqs, and DCMR (Environmental Protection Agency Rijnmond) under the Rotterdam Climate Initiative to implement a Programme on Sustainability and Climate Change. The actions under the programme are intended to achieve a 50% reduction of CO_2 emissions by 2014, full adaptation to climate change, air quality improvements and noise pollution reduction as well as the promotion of the economy in the Rotterdam region. To that end, the Rotterdam Municipal Executive will invest EUR 31 million.

With rapid industrial growth, the city and port of Rotterdam is becoming a centre for CO_2 processing. In this context, the ambition is to develop a large-scale CCS hub, starting with a demonstration project and scaling up to CO_2 emissions reductions of 7.6 Mt CO_2 by 2025. RCI is a good example of an advanced concept for the stepwise integration of CCS into various industrial processes, from power generation to refining and bioethanol production, in a co-ordinated manner. Industrial CCS clusters have excellent potential to minimise costs and use local advantages, such as nearby North Sea CO_2 storage and shared utilities, to become centres for low-carbon production. In addition to CCS, the City of Rotterdam set up the Rotterdam Climate Proof programme at the end of 2008. Rotterdam Climate Proof is to make Rotterdam resilient to climate change by 2025. In addition to CO_2 processing, water knowledge is an integral part of Rotterdam's expertise on climate change adaptation.

Table 3.3 Overview of main measures to reduce GHG emissions, 2005-20

Sector	Measure	Objective/activity	Estimate of average annual mitigation impact per year (Mt CO_2-eq)	
			2005-15	2005-20
Energy	CO_2 Emissions Trading Scheme (ETS)	Cost optimisation of CO_2 reduction efforts	0.8*	0.6
	SDE+ and other financial incentives of renewables (Green investment, EIA/VAMIL, MEP, Coal covenant, BLOW covenant, energy tax)	Stimulate the production of energy with renewable energy sources by subsidising the as-yet unprofitable components of application	3	4.3
Industry	CO_2 Emissions Trading Scheme and Long-term Agreement on Energy Efficiency for ETS enterprises (MEE)	Cost optimisation of CO_2 reduction efforts	1.4*	0.5
	Long-term Agreement on Energy Efficiency for non-ETS enterprises (MJA) and fiscal measures for energy and other green investments (EIA, MIA, VAMIL)	Improving energy efficiency and reduce CO_2 emissions	0.3	0.4
	N_2O nitric acid production	Reduction Programme Non-CO_2 Gases	0.6	0.4

Transport	Decision on biofuels as renewable energy for transport	To curb the CO_2 emissions from transport by setting obligation for a mandatory share of biofuels that needs to be blended with fossil sources of transport fuels	0.1	0.2
	Efficient Driving Campaign and Trucks for the Future	Increase the energy efficiency of driving by training and awareness	0.1	0
	EU CO_2 emission standards for cars and fiscal policy on car efficiency	To curb the CO_2 emissions of transport by setting CO_2 standards for cars within the European Union and stimulating the purchase of passenger cars with low CO_2 emissions through fiscal incentives	0	0.1
Agriculture	Covenant Clean and Efficient Agriculture sectors	Reduce GHG emissions up to 10.5 Mt by 2020 compared to 1990; increase energy efficiency of 2% per year in the period 2011-20; approximately 150 PJ of sustainable energy in 2020	0.1	0.2
	EU-ETS and sectoral emissions trading system horticulture	ETS and a national sectoral trading system	0.1	0.1
	Emission regulation on CH_4 emissions from gas engines (Besluit Emissie-eisen Stookinstallaties [BEMS])	A regulation to curb the emissions of CH_4 from gas engines	0	0.1
	Size of cattle stock and manure management	Milk quota, livestock reduction; ended in 2015	0	0
	Ammonia and manure policy	Reduce emissions through manure and ammonia management	0.1	0.1
Waste	Landfill policy	Reduction in amount of landfilled waste, reduction of CH_4 emissions from landfill sites	0.2	0.2
Built environment	Energy performance standards (EPN) (new buildings) and Ecodesign Directive	To stimulate energy savings in new buildings by setting minimum energy performance standards. To limit the environmental impact of energy-using and energy-related products by setting standards for the design of products	0	0
	Covenant energy efficiency in the built environment (More with Less; Koepel convenant)	To stimulate energy savings in existing residential buildings through a package of instruments	0.3	0.4
	"Block-by-block incentive scheme" [*Blok-voor-blok programma*] and Innovation programme on built environment	Facilitating investments in the improvement of the energy quality of homes and to speed up application of renewable energy concepts in built environment through innovation	0	0

* 2008-12.

Source: Ministry of Infrastructure and Environment, 6th National Communication to the UNFCCC, 2014.

ASSESSMENT

A signatory of the Kyoto Protocol, the Netherlands is committed to reduce GHG emissions by 6% below 1990 levels during the period 2008 to 2012. For the sectors outside the EU-ETS (55% of the total energy-related CO_2 emissions), the government agreed to a GHG emissions reduction target of 16% between 2005 and 2020 under the EU Effort Sharing Decision. During 2008-12, ETS emissions were lower than expected but non-ETS emissions were above the allowed emission budgets. The Netherlands is on track to reach the Kyoto goals, partly thanks to the emissions reduction brought about by the economic crisis, energy efficiency improvements and the use of the Kyoto flexibility mechanisms (to cover non-ETS emission increases) and is thus on track with regard to the 2020 target. Among EU member states, the Netherlands had the second-highest volume of CDMs/JIs between 2008 and 2011. According to projections, the Netherlands will not need any credits in order to reach its 2013-20 burden sharing goal.

45% of the Dutch energy-related CO_2 emissions are under the EU-ETS while 55% are not covered by the scheme. Energy-related CO_2 emissions per unit of GDP in the Netherlands are in the range of the IEA average, thanks to the wide-spread use of natural gas in the heating sector. Overall GHG emissions decreased since 2008, as a result of lower energy demand and the implementation of a number of sectoral measures. However, since 1990, CO_2 emissions from fuel combustion increased by 11.5%, as the Netherlands maintains a fossil fuel- and carbon-intensive power generation sector, with growing emissions from petrochemical (12.2% since 2002) and agriculture activities (livestock, greenhouse horticulture crops) and related emissions (nitrates, phosphates), which also impact air, water and soil quality. That means that the country will need to further increase its efforts with a view to achieving a more sustainable energy economy.

The Netherlands has a fossil fuel-intensive economy, these fuels represent 92% of total energy supply and 82% of electricity generation. Electricity generation, covered under the EU-ETS, and industry drive CO_2 emissions in the Netherlands with a rising share of oil supply to industry and transport and coal supply to power generation underpinned by continuous use of natural gas in the residential sector, in power generation and in industry. This reinforces the importance of CCS in the power sector and in emission-intensive sectors such as refining, chemicals and steel production.

Since the last in-depth review in 2008, the policy and investment framework for renewable energy and energy efficiency, both of which are of central relevance for the attainment of GHG emission targets, has continued to be characterised by relative instability. In light of the 2009 financial and economic crisis, the driver of climate change policies has become green growth. The government remains committed to the international goal of achieving a sustainable energy supply by 2050 through CO_2-neutral electricity supply, sustainable biomass production, energy savings and CCS.

Commendably, the Energy Agreement sets out a comprehensive set of ten main measures to boost the achievement of the 2020 objectives. The Energy Agreement includes a target of 1.5% energy saving per year or 100 PJ by 2020 and the ambition to reach 14% renewable energy in 2020 and 16% in 2023. Next to the implementation of the measures, the Social and Economic Council's process for regularly reviewing the impact of those measures to help reach the ambitious 2050 targets is commendable.

However, the Energy Agreement does not provide for new concrete actions towards 2030 to implement the current 2050 vision, including technology innovation and demonstration,

to achieve the CO_2 neutrality of power generation, to support CCS and sustainable biomass production. Pending the EU-wide agreement on the energy and climate framework for 2030, no emissions reduction targets are set beyond 2020 at national level. The government has announced its support towards an EU-wide CO_2 reduction target of at least 40% below 1990 levels by 2030. A new EU burden sharing with national targets is to be elaborated by 2014-15.

A comprehensive new 2030 energy framework, building on a vision for 2050 and the Climate Agenda, could be helpful for several reasons. First, present projections show that emissions in the non-ETS sectors in the Netherlands under currently proposed policies will not meet the 2030 GHG emission targets set out in the EU Roadmap. These emissions reductions can only be met if substantial new measures are formulated and implemented. Secondly, in October 2013 the government presented a new *Climate Agenda,* building on the actions set out in the Energy Agreement, with a view to keep within reach the international CO_2 emissions reduction targets of 80% to 95% in 2050 below 1990 levels.

In this respect, the new renewables target needs to be embedded into a stable long-term framework that establishes a clear relationship with GHG emissions and energy efficiency targets. A new strategy would provide an opportunity to combine high ambitions with a framework that allows for flexibility, and further development of the sectoral policy mix – including cross-border GHG abatement support. It should also provide a clear perspective for long-run technological development, in particular CCS which is likely to miss its 2015 policy objectives and for which stated government commitment has not yet translated into operational projects or deployment policies.

There appears to be consensus in the Netherlands that effective GHG abatement policies are best formulated at EU level, notably with respect to adaptation and reform of the ETS system to create adequate incentives for emissions reduction. While the Netherlands supports a stronger EU-ETS post-2020, it should also engage on a regional basis with a view to develop a common approach among its most important trading partners in the Union. In this context, the effects of differing regimes for energy and CO_2 taxation should be taken into account. Depending on the 2030 framework, competitiveness concerns relating to trade-exposed, energy-intensive industry are likely to remain. Possible counteracting measures should focus on reinforced support for energy efficiency improvement as far as possible and avoid undermining related targets.

Among the non-ETS sectors, the transport sector maintains high GHG emissions – they increased from 26.5 to 35 Mt CO_2-eq between 1990 and 2010 or 2.5% since 2001. While the government has launched new initiatives in addition to the implementation of EU legislation, including the promotion of electric mobility and alternative fuels, there remains scope for further action, for example with energy efficiency and modal shifts in international freight. Commendably, the Energy Agreement has now set out an ambitious goal of achieving energy savings of 15 to 20 PJ by 2020 in the transport and mobility sector, with a view to reach a 60% CO_2 reduction by 2050 below 1990 levels and a 17% or 25 Mt CO_2 emissions reduction by 2030. The GHG abatement potentials of different measures should be fully assessed, exploited and integrated into a 2050 technology roadmap for the transport sector.

The Netherlands has taken the lead in climate change adaptation, in particular in flood prevention. With changing climate patterns and increasing industrialisation of some regions of the country (Rotterdam and the wider Randstad), there is a need to renew the national climate change adaptation strategy, taking into account latest climate change

projections from the IPCC and their implications at the regional level. The forthcoming strategy should include an assessment of the exposure of the energy sector to climate change risks as well as the impact that climate change could have on demand. This should be accompanied by measures supporting both the deployment of resilient energy infrastructure and technologies, and encouraging investment by industry in resilience-building action, through either fiscal or regulatory measures, in order to further enhance the Netherlands' resilience against climate change impacts for the coming decades.

RECOMMENDATIONS

The government of the Netherlands should:

- ☐ *Develop a long-term policy framework for 2030 which will act as a bridge to 2050 in line with both EU and neighbouring countries' commitments. To this end:*
  - *Continue to support the implementation of a sound EU-ETS regime to provide adequate GHG abatement incentives; while considering stronger market integration and taking into account differing energy and CO_2 tax regimes in neighbouring countries.*
  - *Create an incentive mechanism within this long-term policy framework that will secure investment in low-carbon technologies, in particular CCS, that are identified as necessary. A clear vision for CCS, communicated by policy makers to the public and supported by all CO_2-intensive industries, has an important role to play.*
- ☐ *Explore the potential of strengthened energy efficiency improvements on the basis of an evaluation of existing measures, when monitoring and assessing the implications of ambitious GHG targets for the competitiveness of Dutch industry.*
- ☐ *Further strengthen the contribution of the transport sector to GHG abatement goals by developing a technology roadmap for the sector to achieve the 2030 ambitions and continue efforts for the promotion of electric mobility, public transport and alternative fuels in transport, including natural gas and biofuels.*
- ☐ *Integrate the assessment of climate change impacts on the energy sector into the forthcoming national adaptation strategy, providing for resilience-building measures and a framework which can facilitate a coherent approach to adaptation and mitigation issues.*

4. ENERGY EFFICIENCY

Key data (2012)

Energy supply per capita: 4.7 toe (IEA average: 4.5 toe), no change since 2002

Energy intensity: 0.13 toe/USD 1 000 GDP PPP (IEA average: 0.14 toe/USD 1 000 GDP PPP), -7.4% since 2002

TFC: 61 Mtoe (oil 44.1%, natural gas 34.9%, electricity 15%, heat 3.1%, coal 1.4%, biofuels and waste 1.4%), +6.4% since 2002

TFC by sector: industry 44.6%, commercial and services 19.9%, transport 18.6%, residential 16.9%

OVERVIEW

TOTAL FINAL CONSUMPTION

Similar to other IEA member countries, the Dutch economy exhibits relatively high energy intensity with industry (including petrochemical, chemical and pharmaceutical industry, iron and steel, horticulture and agriculture) and transport accounting for around 63% of total final consumption (TFC) of energy which stood at 61 million tonnes of oil-equivalent (Mtoe) in 2012. Since 2002, total final energy consumption has increased gradually by 6.4%, following an upward trend since the early 1990s.

Energy supply per square kilometre is one of the highest in the world. In relation to its area, the Netherlands has a large chemical and transformation industry, consuming increasing amounts of oil and natural gas as feedstock.

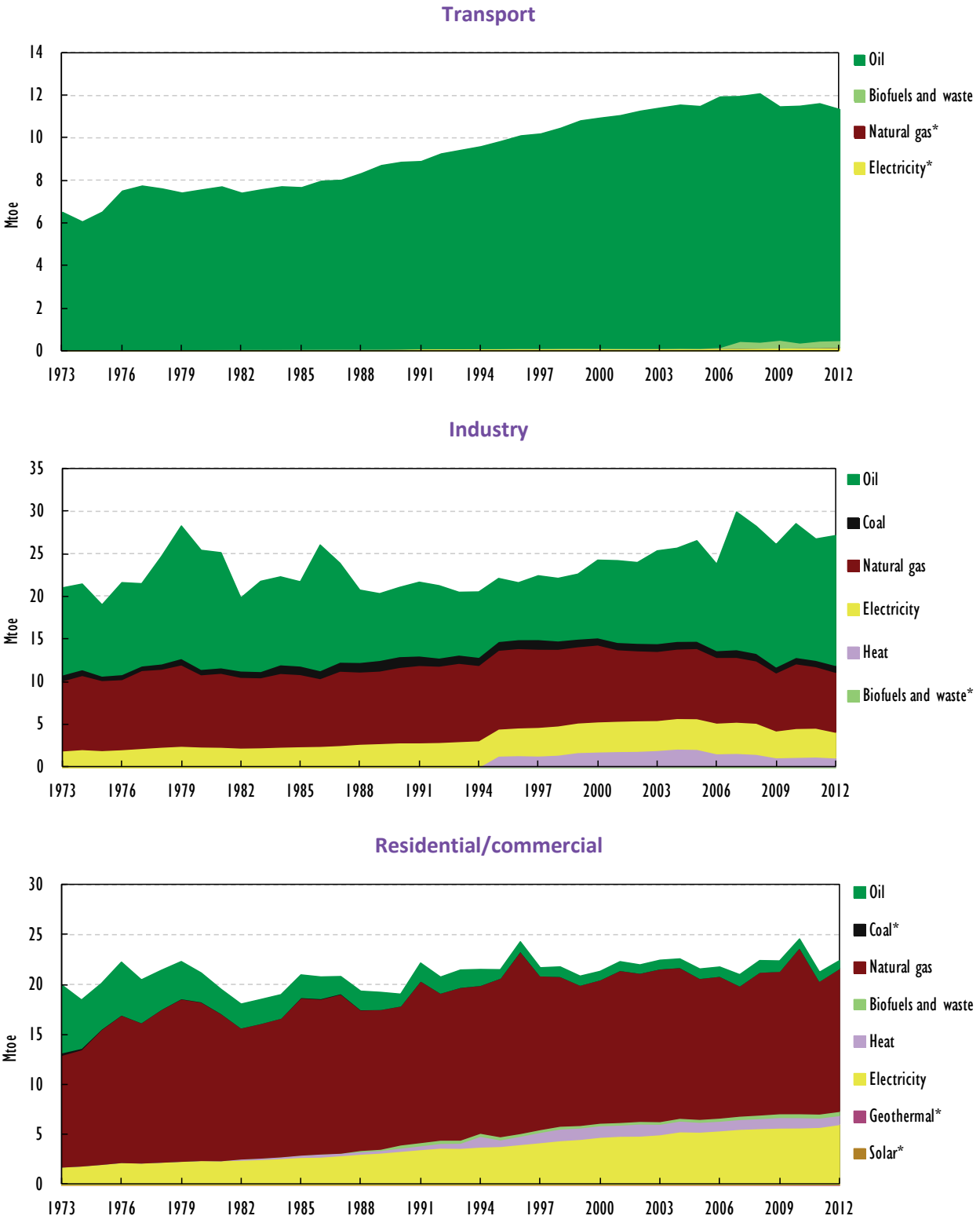
It is noteworthy that Dutch GDP increased more than total primary energy supply (TPES) which led to a decrease of the energy intensity by 7.4% since 2002. This is however only half of the decrease achieved in other IEA member countries on the average. Energy supply per capita remained unchanged compared to 2002.

Industry is the largest consumer of energy, representing 44.6% of TFC in 2012. Energy consumption in industry has increased at an average rate of 1.2% per year since 2002, expanding its share in TFC from 42%. Oil products are the largest source of fuel for the industry sector (56%), followed by natural gas (25.6%), electricity (11%) and heat (3.9%).

In 2012, commercial and residential sectors represented 19.9% and 16.9% of TFC, respectively. Natural gas is the main source of energy in both sectors combined (63.7%), as almost all households and commercial buildings use gas for heating, followed by electricity (26.8%) and heat (4.8%). Consumption has increased marginally since 2002.

The transport sector accounted for 18.6% of TFC in 2012, mainly fuelled by oil products (95.6%) and to a smaller extent by biofuels and waste (2.9%), electricity (1.4%) and natural gas (0.1%). Energy consumption in transport has increased at 0.1% per year since 2002. TFC by transport saw a growing use of electricity and biofuels and waste since 2006, while the use of oil products in transport has declined at 0.3% per annum.

Figure 4.1 TFC by sector and by source, 1973-2012



* Negligible.

Sources: *Energy Balances of OECD Countries*, OECD/IEA, Paris, 2013; country submission.

ENERGY INTENSITY

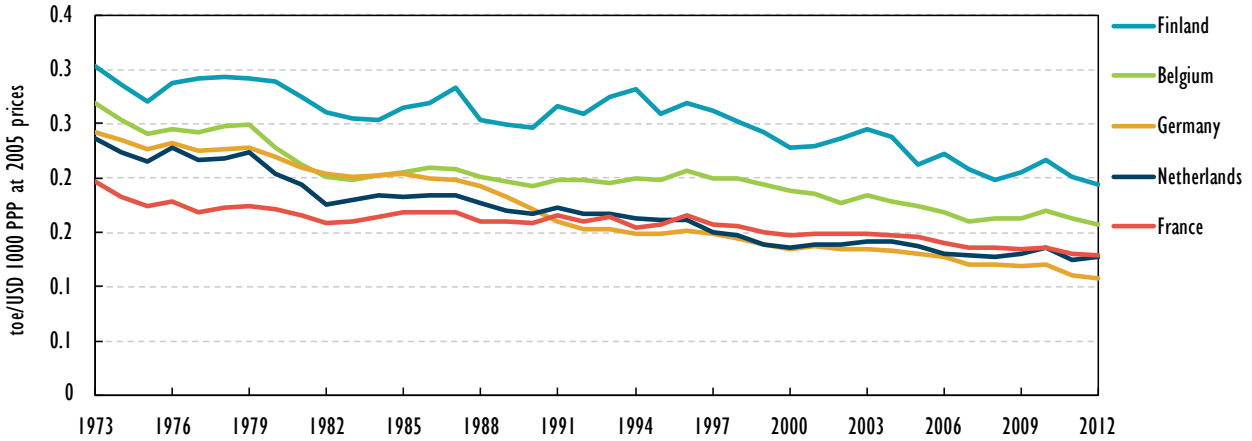
Energy intensity, measured as the ratio of TPES by GDP, was 0.13 tonnes of oil-equivalent per USD 1 000 GDP PPP (toe/USD 1 000 GDP PPP) in the Netherlands in 2012. This level of energy intensity is similar to the IEA average of 0.14 toe/USD 1 000 GDP PPP; the country is the twelfth-least energy-intensive country among IEA member countries. Compared to its neighbours, the Netherlands has a higher level of energy intensity than Germany (0.11 toe/USD 1 000 GDP PPP), yet lower than Belgium (0.16 toe/USD 1 000 GDP PPP).

Over the ten years to 2012, the ratio of energy supply to GDP in the Netherlands has decreased by 7.4%, as TPES was growing at a slower rate than GDP. However, the average IEA energy intensity declined by a faster 16.6% over the same period.

Energy supply per capita, measured as TPES per population, was 4.7 toe in 2012, a level which is unchanged compared to 2002. This indicates that TPES has increased at similar rate to population over the same period. Electricity per capita has decreased from 8.9 kilowatt hours (kWh) per person in 2002 to 8.3 kWh in 2012.

For the average IEA member country, energy supply per capita has fallen from 4.9 toe in 2002 to 4.5 toe in 2012, while electricity usage per person has increased from 9.8 kWh in 2002 to 10.1 kWh in 2011.

Figure 4.2 Energy intensity in the Netherlands and in other selected IEA member countries, 1973-2012



Note: actual data for the Netherlands and estimated for 2012 for other countries.

Sources: *CO_2 Emissions from Fuel Combustion,* OECD/IEA, Paris, 2013; country submission.

INSTITUTIONS

Responsibility for energy efficiency is shared among several ministries and implementing agencies. The **Ministry of Economic Affairs** is in charge of overall energy policy, including energy efficiency and related measures in agriculture and other sectors. The **Ministry of Infrastructure and Environment** conducts the overall climate policy, including energy efficiency in transport policy. The **Ministry of the Interior and Kingdom Relations** is responsible for energy efficiency in buildings.

As authority under the Ministry of Economic Affairs, the **Netherlands Enterprise Agency** (*Rijksdienst voor Ondernemend Nederland,* **RVO**) leads on implementing energy efficiency programmes. The Agency acts as an intermediary between energy users and the government to stimulate sustainable development in the field of energy and environment. It advises

on energy efficiency solutions which can improve the environmental and economic performance of businesses and consumers. The government also supports energy users with guidance and advice in the **Environment Centre** (Milieucentraal).

In addition, the **Energy Research Centre of the Netherlands (ECN**) and the **Environmental Assessment Agency (PBL)** provide the government with forecasts of the developments in CO_2 emissions and energy efficiency.

POLICIES AND MEASURES

EUROPEAN UNION POLICIES

As an EU member state, the energy efficiency policies are determined by several EU regulations and directives in the area of energy efficiency.

The European Union has a primary energy reduction target of 20% below the 2007 projected energy demand target of 2020. Several European Union directives relating to energy efficiency guide the policy of the Netherlands.

The Directive on Energy Efficiency (2012/27/EU), repealing Directives 2006/32/EC and 2004/8/EC, establishes a common framework of measures for the promotion of energy efficiency within the Union in order to ensure the achievement of the Union's 2020 headline target of 20% on energy efficiency and to pave the way for further energy efficiency improvements beyond that date. The legal definition and quantification of the EU 2020 energy efficiency target has been revised after the accession of Croatia to 1 483 Mtoe primary energy or no more than 1 086 Mtoe of final energy. The directive lays down rules designed to remove barriers in the energy market and overcome market failures that impede efficiency in the supply and use of energy, and provides for the establishment of indicative national energy efficiency targets for 2020 (see Box 4.1).

Up to 2012, the framework was based on the Directive on Energy End-Use Efficiency and Energy Services (2006/32/EC) which required member states to develop national energy efficiency action plans and to meet an indicative target to reduce final energy use in the sectors not covered by the European Union Emissions Trading Scheme (EU-ETS) by 9% by 2016. The directive obliged member states to establish national energy efficiency action plans (NEEAP) in 2007, in 2011 and in 2014 about the implementation of the directive.

The Directive on the Energy Performance of Buildings (EPBD, 2002/91/EC) and its 2010 successor (EPBD, 2010/31/EU) established requirements for building codes. These codes include minimum energy performance requirements (MEPs) and energy certificates. The 2010 recast requires new buildings to be at "nearly zero-energy" performance by the end of 2020.

The Ecodesign Directive (2009/125/EC) sets minimum energy performance standards (MEPS) for energy-related products with the objective to reduce the environmental impact, including the energy consumption, throughout the entire life cycle. It includes EU-wide rules for improving the environmental performance of energy-related products (ERPs). There is no mandatory requirement but energy-related products are chosen by implementing measures and voluntary agreements. Fifteen product groups have been regulated so far by product-specific implementing regulations. Energy labelling of energy-related products incentivises consumers to choose and industry to develop energy-efficient products. EU-wide requirements are set under the Energy Labelling Directive (2010/30/EU); product-specific labelling standards are set up in delegated acts under this directive.

Since May 2009, new passenger cars manufactured in the European Union fall under the CO_2 emissions regulation (Regulation 443/2009), which effectively limits the fuel efficiency of vehicles. By 2015, CO_2 emissions of new passenger cars must be at, or below, 130 grammes CO_2 per kilometre (g CO_2/km). Complementary measures are being introduced to reduce the CO_2 emissions of other than engines components by a further 10 g CO_2/km through efficiency improvements in those components, such as tyres and transmission technology. The CO_2 emission limit is expected to be reduced to 95 g CO_2/km by 2020. A similar regulation for new vans was introduced (Regulation 253/2014) with limits of 175 g CO_2/km by 2017 and 147g by 2020. The CO_2 emissions of heavy-duty vehicles are not regulated at present; however, the future introduction of regulations is planned.

Box 4.1 EU energy efficiency regulations

On 25 October 2012, the European Union adopted the Directive 2012/27/EU on Energy Efficiency (EU EED), which establishes a common framework of measures for the promotion of energy efficiency within the European Union in order to achieve the Union's 20% target on energy efficiency by 2020 and to pave the way for further energy efficiency improvements beyond that date. It lays down rules designed to remove barriers in the energy market and overcome market failures that impede efficiency in the supply and use of energy, and provides for the establishment of indicative national energy efficiency targets for 2020.

Overall, the directive is considered an important milestone for EU-wide co-operation on energy efficiency. It calls for binding measures rather than binding targets. Each member state should set its own target and present a national energy efficiency action plan every three years, beginning in 2014. The new directive requires each member state to:

- Set an indicative national energy savings target for the period 1 January 2014 to 31 December 2020 in line with the EU-wide 20-20-20 target.
- Establish a long-term strategy for renovating the building stock, including a renovation rate of 3% for buildings occupied and used by central government.
- Develop public procurement rules ensuring that central governments purchase only high-efficiency products.
- Oblige energy providers to achieve cumulative end-use energy savings by 2020 equivalent to 1.5% of annual energy sales over the period 2014-20. Member states can pursue alternative ways to achieve equivalent energy savings.
- Require all large enterprises to undergo quadrennial energy audits.
- Facilitate the development of national financing facilities for energy efficiency measures.
- Ensure that individual meters of energy consumption are installed at the end-user's premises, if technically possible and economically feasible.

The directive may fall short (by 3% to 5%) of the 2020 target. It requires a review in mid-2014; a shortfall in energy savings may result in a shift from binding measures to binding targets.

DOMESTIC STRATEGIES AND PLANS

The Rutte-Asscher coalition government makes energy efficiency a key priority, as it is considered a driver for the competitiveness of the Dutch economy and economic benefits for business and citizens.

The Dutch energy efficiency policies are set out in the Environmental Management Act (*Wet milieubeheer*) and the Second National Energy Efficiency Action Plan (NEEAP2) of June 2011.

The European Environment Agency (EEA) acknowledges progress made by the Netherlands in reducing energy consumption, but calls for better implementation of the existing policies and further initiatives.[1] The European Commission evaluated the Dutch NEEAP2 in 2013 and concluded that the Netherlands can achieve its 2016 savings target, required under the Directive on Energy End-Use Efficiency and Energy Services, if it implements all measures set out in the NEEAP2.[2]

The Netherlands has a long tradition of voluntary agreements, so-called multi-annual covenants or meerjarenafspraak (MJA). The latest MJA consists of the "MJA3" for non-ETS and "*meerjarenafspraken energie-efficiëntie* (MEE)" for ETS sectors. Companies commit themselves to energy efficiency actions in return for tax incentives or compensation under the EU-ETS. The covenants are explained below for each sector.

In addition, all sectors can benefit from tax incentives for the use of energy-efficient equipment, under the energy investment allowance (EIA).

Implemented jointly by the Netherlands Enterprise Agency (*Rijksdienst voor Ondernemend Nederland,* RVO) and the tax authorities, the EIA offers Dutch companies a tax deduction for investments in energy-saving equipment and the generation of renewable energy. A company can deduct up to 44% of such investments from their taxable profit. The programme has a maximum annual budget ceiling of EUR 160 million.

The Dutch government also supports green investment and finance through the Green Funds Scheme and the Green Projects Scheme (VAMIL and MIA).

Under the Green Funds Scheme the government offers a tax advantage to "green" saving and investment projects, allowing banks to offer loans at lower interest rates. Examples of projects that would qualify are sustainably built houses, wind farms and organic agricultural businesses. The scheme is run collectively by the Ministry of Infrastructure and Environment, the Ministry of Finance and the Ministry of Economic Affairs. The Netherlands Enterprise Agency and the Ministry of Economic Affairs are responsible for evaluating the projects. If a project is approved, these organisations also issue green certificates on behalf of the minister. The Green Project Scheme MIA (Environmental Investment Deduction, *Milieu Investerings Aftrek*) offers businesses which invest in environment-friendly equipment the opportunity to deduct up to 36% of the investment cost from their taxable profits. The VAMIL (Arbitrary Depreciation of Environmental Investments; *Vrije Afschrijving Milieu Investeringen*) provides for voluntary depreciation on environmental investment.

1. *Trends and projections in Europe 2013 – Tracking progress towards Europe's climate and energy targets until 2020*, European Environment Agency, October 2013.

2. European Commission COM(2013)938 final, Report from the Commission to the European Parliament and the Council, Progress report on the application of Directive2006/32/EC on energy end-use efficiency and energy services, and on the application of Directive 2004/8/EC on the promotion of co-generation based on a useful heat demand in the internal energy market. Staff Working Report SWP (2013) 541 final, Progress Report on energy efficiency in the European Union, 8 January 2014.

The Dutch Energy Agreement for Sustainable Growth (hereinafter the Energy Agreement) of September 2013 reflects this reinforced commitment to energy efficiency action as a societal consensus. The Energy Agreement sets out ten pillars for boosting the Dutch green growth and includes these headline targets:

- reduction of the total final energy consumption by 100 petajoules (PJ) in 2020 and saving of 1.5% per year in final energy consumption
- increase in the proportion of energy generated from renewable sources from 4.5% currently to 14% in 2020, in line with EU commitments and a further increase to 16% in 2023.

The reduction of total final energy consumption by 100 PJ in 2020 should enable the Netherlands to contribute to the EU-wide goal of saving energy consumption by 20% up to 2020 and the target of 1.5% savings per year at end-user level, as required under the EU Energy Efficiency Directive (EED, 2012/27/EU). As interim goals, the Netherlands aims to reach 35% of this reduction (100 PJ) by the end of 2016 and at least 65% by the end of 2018.[3] PBL and ECN evaluated the impact of the newly agreed measures towards the reduction objectives (see Table 4.1) and finds that agreed specified actions can deliver between 22 and 60 PJ savings, and together with possible additional measures a total 50 and 107 PJ, all depending on the actual contributions from energy-intensive sectors, such as transport, horticulture, industry (ETS) and private housing. For instance, the envisaged saving target for the transport and mobility sector has yet to be worked out in a separate strategy; possible additional measures are foreseen but were not quantified yet.

Table 4.1 Estimated energy savings from the measures under the Energy Agreement

Sectors of the economy	Total energy savings (final PJ) in 2020 compared to 2013	Savings per sector (PJ)
Total agreed specific measures	22-60	50% of the Energy Efficiency Directive goals
Buildings	13-43	Private property housing: 3 Rental housing: 7-12 Service sector: 3-28
Industry, agriculture	9-17	Industry in ETS: 0.5 Industry in non-ETS: 0.3 Other industry: 1-8 Energy investment allowances: 5 Indoor horticulture: 3

Source: PBL/ECN, Marc Londo (ECN), Koen Schoots (ECN), Pieter Boot (PBL), the Dutch National Energy Agreement, Presentation prepared for the IEA, October 2013.

The main focus of the Energy Agreement is the implementation and enforcement of the Environmental Management Act and the Environmental Management of Non-Residential Buildings Act. The Act sets out an obligation to implement energy-saving measures with a payback period of five years or less. A pilot Energy Performance Assessment (EPA) will evaluate the implementation of energy efficiency measures with a checkpoint in 2015. Such an evaluation is welcome, as the Netherlands has yet to fully evaluate the energy savings made in the past period and the expected savings for the future.

3. The Netherlands aims to reduce primary energy consumption or gross inland consumption, excluding non-energy uses. The objective is to achieve a primary energy consumption of 2 541 PJ in 2020 with proposed and adopted policies.

Commendably, the Energy Agreement foresees additional funding:

- revolving fund for energy efficiency in buildings, with EUR 600 million in total (EUR 150 million will be covered by the government and the remainder is to be supplied by the private sector)
- EUR 400 million in grants for owners of social housing buildings
- central government funding to regional and local governments to support the implementation of energy efficiency policies and measures.

Table 4.2 Overview of funding of energy efficiency measures

Programme	Funding (EUR million)
Top Sector energy programme	23.8
Energy innovation programmes	31.7
Green Deal projects	25
Energy investment allowance	151
Market introduction of energy innovations	13.7
Investment scheme for energy efficiency	2.3

Source: country submission.

BUILDINGS INCLUDING APPLIANCES, LIGHTING AND EQUIPMENT

With regard to energy efficiency in buildings, the Netherlands has strong building codes, effective compliance systems and is committed to foster the implementation of energy performance certificates (EPC).[4]

The Netherlands continues to transpose the EPBD Directive into domestic law. Energy labels for buildings are mandatory, but implementation has been slow. The Energy Agreement fosters the acceleration of the energy labelling of buildings. Houses with EPCs can have access to favourable funding for renovation. At the same time, all home-owners without a label will be assigned a label in 2015, according to a uniform method for the country.

A number of voluntary agreements, so-called covenants, stimulate large-scale investments in energy efficiency in existing buildings, including the "More with Less Covenant" (*Meer met Minder*) and the agreement on energy efficiency in the rental sector. Under the new Voluntary Energy Saving Agreement for the Rental Sector (*Covenant Energiebesparing Huursector*) the parties are committed to apply an energy label B for residential buildings owned by corporations and a minimum label C for residential buildings owned by private landlords by 2020. To support this, the central government will provide EUR 400 million between 2014 and 2017 in public grants to support investments in energy-saving measures in the rental housing sector.

There are strong building codes for new buildings in place and sanctions for non-compliance are being strengthened. Building codes for newly built houses are strengthened

4. In 2013, the European Commission opened an infringement procedure and requested the Netherlands to transpose all legal provisions of the EU Energy Efficiency in Buildings Directive (2010/31/EU) and comply with requirements under the directive with regard to the availability of energy performance certificates (when buildings are sold or rented).

by 25% in 2011 and 50% in 2015 compared to 2007. For new buildings, the energy performance coefficient is being tightened considerably from 0.8 to 0.6 in 2011 and to 0.4 in 2015, with the aim of reducing energy use by 50% (compared to 2007) in new buildings. The Dutch National Plan for nearly zero-energy buildings defines zero-energy and sets targets in line with the EPBD. By 2020, the aim is that all new buildings will be energy-neutral. All public government buildings with a surface above 500 m^2 will receive an energy label from 2013 onwards. This will apply to all buildings beyond 250 m^2 from 2015 onwards.

A promising approach to foster energy efficiency of existing buildings is the "block-by-block" renovation initiative. The government is committed to several Green Deals to remove non-economic barriers. The "Smart Community" deal aims to encourage home-owners and tenants to save energy.

Historically, public research and development (R&D) support for energy efficiency innovation in the building sector has been rather low. Recently, the Netherlands has launched and updated a number of initiatives aimed to stimulate energy efficiency investments in existing and new buildings and to upgrade the energy efficiency of the rental stock.

In terms of R&D and innovation, the buildings sector is included in the Energy Leap Programme (*Energiesprong*) and the Dutch government also has an innovation agenda for Energy Neutral Areas (*Gebieden Energie Neutraal*). Within the framework of the Energy Transition Platform for the building sector, the Dutch government launched a large range of demonstration projects aiming for 5 000 highly energy-efficient buildings by 2012 and to develop energy-neutral buildings by 2020. The Energy Agreement foresees the creation of a revolving fund for energy efficiency of EUR 600 million to promote energy conservation in the residential housing sector, both private homeowners and rental sectors, stimulate the market for energy efficiency and create employment in the construction sector.

Public subsidies for renovation are available through the Green Fund Scheme (preferential loans to a maximum of EUR 100 000), the EIAs (for energy efficiency investments by business), the Energy Savings Credit Guarantee, the Green Projects Scheme or the National Mortgage Guarantee.

Regarding appliances, lighting and equipment, the Netherlands transposed the Ecodesign Directive and its October 2009 recast which aim to improve energy efficiency throughout a product's life cycle. In this context, the government implemented mandatory energy performance requirements for appliances.

INDUSTRY AND SERVICES

The EU EED requires mandatory audits for large enterprises and supports audits for small and medium-sized enterprises.

The Netherlands has long-standing experience with voluntary long-term agreements to stimulate energy efficiency in industry, covering both medium-sized companies and large energy-intensive industry, in non-ETS (MJA3) and ETS sectors (MEE). As part of the Long-term Voluntary Agreements on Energy Efficiency in the non-ETS sector, industry has agreed to improve energy efficiency by 2% per year.

However, the voluntary agreements lack mechanisms for enforcement and do not provide for penalties for non-compliance. Expectations that the EU-ETS would deliver considerable energy savings have not been achieved owing to the low CO_2 price.

The Energy Agreement calls for the implementation and enforcement of the Environmental Management Act in the industrial, agricultural and commercial sectors. Opportunities for large energy-intensive industries (covered by the ETS) to enter into company-specific energy efficiency agreements with the central government will be explored as a supplement to the Long-term Voluntary Agreements on Energy Efficiency.

Like in the buildings sector, an EPA pilot for the non-ETS sector is envisaged. Under the Energy Agreement, the greenhouse horticulture sector agreed to save 11 PJ by 2020. Some programmes targeting energy efficiency and CO_2 reductions in greenhouses are under way and additional action is announced as follow-up to the Energy Agreement with an improved CO_2 system. The long-term agreement has been replaced by a CO_2 equalisation measure which imposes a cap on the emissions and a market price for CO_2 based on the ETS price.

In addition, the two tax incentive programmes, MIA and VAMIL, continue to stimulate the use of environment-friendly equipment by businesses, as outlined above.

The recently developed industrial roadmaps are a promising approach to facilitate energy efficiency in industry; however, it remains unclear how these will be implemented.

The Green Deals have become a central part of the industrial energy efficiency policy; the results will become available only during 2014. Initiated in 2009, the Green Deals involve businesses, provinces, municipalities and non-governmental organisations. Green Deals do not provide for financial support, but the government helps to lift administrative barriers with projects in five areas: material and product chains, water and land use, food, mobility, climate and energy. In October 2011, a first round of projects was completed with 59 Green Deals in climate and energy. In 2012, 75 new deals were signed in the second round, involving projects in the use of renewable energy, bioplastic production, mobility and water.

Combined heat and power (CHP) and district heating

CHP and district heating have made a significant contribution to energy efficiency in the Netherlands, in particular in industrial processes, such as the paper, chemical and horticultural (agricultural) sectors. Around 50% of the Dutch power supply is generated by CHP (4 500 plants), which are up to 90% fired by natural gas. Current market conditions have led to significant overcapacity. Old CHP capacities are expected to disappear towards 2020, as more renewable energies will become available and new, highly efficient power generation will replace inefficient CHP capacities.

CHP in the Netherlands is covered under the EU-ETS and supported by an exemption from the energy tax.[5] Since 2011, there are no more subsidies for CHP within the standard energy investment allowance (EIA) or renewables support schemes under the Sustainable Energy Incentive Scheme (SDE+). Up to 2009, a feed-in tariff for existing and new CHP was in place. From 2009 to early 2010 the SDE+ supported new industrial steam and gas turbines (with zero tariff, but coverage for setbacks), although there were no applications. The EIA applies to all investments in energy efficiency with limited market penetration. As CHP reached broad market penetration, standard EIA for CHP has been phased out in 2011. Only CHP configurations with above-average efficiency factors may receive EIA support.

5. Heat production is not subject to the energy tax, while gas and electricity production other than for own use is taxed. Heat production is thus profitable also as retail heat prices are gas price indexed.

The share of district heating in the heating market is only 4%, as gas distribution networks cover most of the country and gas accounts for 35% of final residential energy consumption. District heating is supplied almost entirely by natural gas; other fuels, including waste or renewable energy, play a negligible role. There is a potential for an increased share of renewable (biomass) or waste co-generation.

The future for new district heating infrastructure remains uncertain. After a long legislative adoption process (eight years), on 1 January 2014, a new regulatory framework under the new Heat Law entered into force. It remains to be seen how the new framework can promote efficient CHP/district heating.

There are no particular incentives for CHP, but the Energy Agreement foresees the adoption of a plan for the use of industrial residual heat, as required under the EU Energy Efficiency Directive (EED).

Energy service providers

The Netherlands has yet to develop markets for energy service providers. In 2013, smart meters are still in the testing and development phase and the full (80%) roll-out is yet to be implemented (see Chapter 5 on Electricity).

The EU EED 2012/27/EU requires the implementation of a 1.5% annual energy-saving obligation on energy providers or alternative policies with an equivalent impact. While energy providers are well placed to create services enabling attractive energy-saving opportunities for customers, international experience shows that energy efficiency obligations can be a foundation for new business opportunities for providers. Energy providers in the Netherlands are currently engaged in end-use efficiency to a very limited extent.

The Energy Agreement calls for stronger engagement of energy providers in the delivery of end-use energy efficiency. Proposed measures include energy conservation measures to be financed through the energy bill. This would allow end-users to avoid the need to find funding to cover up-front costs but instead they would pay investment costs in instalments. The investment cost would thus be mitigated by monetary savings resulting from the implemented energy efficiency measures. A consultation process is ongoing between the Ministry of Finance and relevant stakeholders to develop a proposal for how such a scheme can be designed and administrated.

TRANSPORT

Over the past few years, the transport sector in the Netherlands followed EU regulations which foster energy efficiency in public and private transport, such as labelling of tyres, the setting of emission standards for new passenger cars, vans and light-duty vehicles and others. As outlined in Chapter 3 on Climate Change policies, the Netherlands has been successful in promoting more efficient cars with lower CO_2 emissions. Thanks to fiscal incentives for the purchase of efficient and low-emission cars and with the highest petrol taxation in the EU, there has been an increase in the share of fuel-efficient cars in recent years.[6]

All new passenger cars in the Netherlands must have an energy label stating its fuel consumption, level of CO_2 emissions and efficiency category. These ratings are used in schemes providing favourable tax treatment for buyers of more efficient vehicles. The

6. *A closer look at urban transport – TERM 2013: transport indicators tracking progress towards environmental targets in Europe*, European Environment Agency (EEA), 2013.

private motor vehicle (MRB) and motorcycle tax (BPM) are levied on the purchase of new cars. MRB is differentiated by the weight of the vehicle. The Netherlands is also implementing eco-driving programmes. The Institute for Sustainable Mobility (IVDM) runs a government co-financed campaign to promote eco-driving for professional drivers. Another campaign advertises the importance of tyre pressure. IVDM has set a target to achieve 1 Mt of CO_2 savings by end-2014.

Recently, programmes to stimulate the deployment of electric vehicles have been initiated under Green Deals and at local and city level, as described in Chapter 3. Success can be seen in the public transport with the Better Utilisation (*Beter Benutten*) programme for which a total of EUR 794 million was allocated for the period 2011-14. The programme aims to render public transport more sustainable by reducing congestion by approximately 20% on special lanes in the most congested areas.

Table 4.3 Modal split of passenger transport on land, 2011

Type of transport	Share
Car	82.7%
Bus	7%
Train	9.3%
Tram and metro	0.9%

Source: *EU Transport in Figures – Statistical Pocketbook 2013.*

Despite existing measures, energy efficiency of the Dutch transport sector is lower than the EU average and urban areas (Rotterdam, Randstad) remain highly congested. Freight transport still takes place on the road and the number of new cars sold per year increased further.[7] Modal shift and transport management, linking up maritime, fluvial and road, rail and air transport could be attractive for the Netherlands, if it aims to achieve its energy savings ambitions of 15 to 20 PJ by 2020 under the Energy Agreement and cut CO_2 emissions by 17% by 2030 and by 60% by 2050 from 1990.

ASSESSMENT

Energy consumption has increased by 6.4% over the decade to 2012, a moderate increase of 0.6% per annum, partly owing to the economic crisis in 2009 and partly thanks to the implementation of a wide range of innovative energy efficiency policies.

Commendably, the Rutte-Asscher government makes energy efficiency a priority, as reflected in the Energy Agreement. Energy savings translate into reduced reliance on energy imports and a lower financial burden for businesses and consumers as well as improved competitiveness.

Energy efficiency is a shared responsibility of various ministries, municipalities, the public and private sectors and supported by local initiatives. Effective co-ordination and co-operation are key to implement the policies and to fully leverage the economic benefits of energy efficiency for the whole Dutch economy.

7. PBL, CBS and Wageningen UR (2012), Compendium of the Human Environment (Compendium voor de Leefomgeving). www.compendiumvoordeleefomgeving.nl, The Hague/Wageningen.

Considering the carbon and energy intensity of the Dutch electricity generation and industry as well as the slow renewable energy development, strong efforts on energy efficiency are a no-regret policy and the starting point for long-term sustainability in line with the EU-wide goal of reducing GHG emissions by 80% to 95% by 2050, compared to 1990 levels.

To foster the contribution of energy efficiency to economic growth opportunities, an evaluation of the cost-effectiveness of the different energy efficiency policies, and of the potential contributions from different industries and their impacts (including non-energy benefits) would be timely. This will allow the government to evaluate the effectiveness of the legal framework and all existing and new voluntary agreements to signal cost saving potentials and prioritise actions with regard to RD&D and innovation policy design.

The strong focus of the Dutch energy efficiency policy on voluntary agreements with industry and public-private co-operation at local level has to be commended. Two key success factors in terms of industrial energy efficiency policy in the Netherlands are that the programmes have been long-term and updated at regular intervals. However, insufficient compliance with surveillance and enforcement mechanisms, as well as unified saving targets for diverse industries may have contributed to reducing the energy savings that could have been achieved. Several of the measures proposed in the Energy Agreement, including the energy performance assessments, will rectify this. However, further efforts should be made in exploring the possibility for realistic and differentiated mandatory energy savings targets. Concrete actions have yet to be agreed with energy-intensive industries, transport and mobility, and greenhouse horticulture.

Commendably, the government has put forward a range of energy efficiency policies in the buildings sector. Innovative actions were implemented to lower financial barriers to renovation, like the linking of EPCs to the rent setting, reduced interest rates for energy-saving investments and support for renewable energy investments at home. The proposed actions in the Energy Agreement will contribute to strengthening the energy efficiency policy for buildings, in particular with regard to the effective use of certificates and energy labelling. Additional measures could be explored, for instance tax incentives, easier access to finance or the review of rental price-setting systems so as to create stronger incentives for landlords to invest in energy efficiency.

The focus on the fast implementation of measures with short payback periods may lead to less than optimal outcomes from an energy efficiency perspective. The challenge of renovating the Dutch building stock requires financial instruments, which are based on the rewards from long-term savings of future energy consumption. The government should improve access to finance with private contributions from the large Dutch banking sector, pension funds and insurance organisations.

Commendably, the Netherlands has achieved significant progress in CHP, notably in the horticulture sector where the country exhibits best practices, an experience from which other IEA member countries can benefit. Space and water heating remains the largest end-use with 81% of final residential energy consumption. Next to increasing the use of renewables in this area, there is a large potential to increase the role of CHP in the industrial sector and the use of industrial heat. The Energy Agreement, however, does not include new measures for efficient CHP/DH, but proposes the adoption of a plan for the use of industrial residual heat.

Energy efficiency in the Dutch transport sector is improving, but progress is difficult to achieve, as in many other IEA member countries. Radical behavioural changes in mobility

and transport can bring significant emission and financial savings but require integrated urban planning and consistent modal shifts, including congestion charges or road pricing for freight, support of public transport and others.

There has been limited focus on the role that energy efficiency can play on the energy demand side. The contribution from the roll-out of smart metering after 2014 and the development of energy service providers should be strengthened. Effective retail markets will be able to translate energy prices into energy savings. Energy service providers can facilitate such energy savings for final users, but the market is still at its early stages.

Municipalities and the public sector play an important role in promoting and implementing energy efficiency and in ensuring compliance with regulations. Further capacity building and resourcing is needed to enable these entities to effectively play this role. Commendably, the Energy Agreement, despite the context of economic recession, foresees additional funding for municipalities. Further steps should be taken to ensure that municipalities and the public sector have sustained capacity and resources to support energy efficiency action at local level. Also, further efforts should be made in promoting energy efficiency in small and medium-sized enterprises.

Box 4.2 IEA 25 energy efficiency recommendations

In 2011, in order to reflect emerging priorities, the IEA, in consultation with international experts and member countries, streamlined and updated the 25 recommendations. The updated 25 recommendations cover a robust portfolio of policies that member and non-member countries should consider in the context of their energy economies.

This portfolio of recommendations includes policies to cost-effectively increase energy efficiency by establishing market signals to motivate effective action, accelerate the introduction of new technologies, and strengthen and enforce MEPS for appliances, lighting, equipment and building energy codes.

1. To improve *energy efficiency* across all sectors, the IEA recommends action in the following areas:

- energy efficiency data collection and indicators
- strategies and action plans
- competitive energy markets, with appropriate regulation
- private investment in energy efficiency
- monitoring, enforcement and evaluation of policies and measures.

2. To achieve savings in the *buildings sector*, the IEA recommends:

- mandatory building energy codes and minimum energy performance requirements
- aiming for net zero-energy consumption in new buildings
- improving energy efficiency of existing buildings
- buildings energy labels and certificates
- energy performance of building components and systems.

Box 4.2 IEA 25 energy efficiency recommendations (continued)

3. To achieve significant energy savings in the *appliances and equipment sector*, the IEA recommends:

- mandatory energy performance standards and labels for appliances and equipment
- test standards and measurement protocols for appliances and equipment.

4. To achieve significant energy savings in the *lighting sector*, the IEA recommends:

- phase-out of inefficient lighting products and systems
- energy-efficient lighting systems.

5. To achieve significant energy savings in the *transport sector*, the IEA recommends:

- mandatory vehicle fuel efficiency standards
- measures to improve vehicle fuel efficiency
- fuel-efficient non-engine components
- improving operational efficiency through eco-driving and other measures
- improve transport system efficiency.

6. To achieve significant energy savings in the *industrial sector*, the IEA recommends:

- energy management in industry
- high-efficiency industrial equipment and systems
- energy efficiency services for SMEs
- complementary policies to support industrial energy efficiency.

7. To achieve significant *energy savings* in energy utilities and end-use efficiency, the IEA recommends:

- governments should establish regulatory and other policies to ensure that energy utilities support cost-effective, verifiable end-use energy efficiency improvements.

RECOMMENDATIONS

The government of the Netherlands should:

- ☐ *Continue to strengthen the co-operation and co-ordination on energy efficiency policies at government and regional levels.*
- ☐ *Ensure that implementation of energy efficiency is supported by a stable policy framework that provides market actors with sufficient confidence to invest in energy efficiency and in the development of energy efficiency services and technologies.*
- ☐ *Continue and scale up measures aimed at improving the energy efficiency of existing buildings with particular emphasis on setting ambitious timelines and mandatory energy efficiency renovation rates for all types of buildings. Explore new mechanisms to attract long-term finance, such as pension fund investments.*

- *Develop mechanisms to implement the industrial roadmaps and ensure sufficient support to stimulate R&D and innovation. Consider mandatory approaches to stimulate the uptake of energy management and energy efficiency implementation in industry, and in this context, explore opportunities for differentiated industrial energy efficiency target-setting on the basis of assessed sector-specific potentials.*
- *Promote transport system efficiency at national, regional and local levels and shifts of passengers and freight to more efficient modes. Support the development of the infrastructure needed for the most energy-efficient, economically efficient and environmentally benign modes. Particular emphasis should be placed on ensuring integrated urban and commercial planning so as to take into account the transport and energy demand as well as behavioural impacts.*

  Facilitate opportunities for energy providers to foster cost-effective, verifiable end-use energy efficiency improvements.

PART II
SECTOR ANALYSIS

5. ELECTRICITY

Key data (2012)

Electricity generation: 102.5 TWh, +6.8% since 2002

Electricity generation mix: natural gas 54.4%, coal 26.6%, biofuels and waste 8.7%, wind 4.9%, nuclear 3.8%, oil 1.1%, solar 0.3%, hydro 0.1%

Installed capacity: 29.9 GW

Peak demand: 16.8 GW

Inland consumption: 111.3 TWh (commercial and other services 40.4%, industry 35.5%, residential 22.5%, transport 1.6%)

SUPPLY AND DEMAND

ELECTRICITY GENERATION

Electricity generation in the Netherlands was 102.5 terawatt hours (TWh) in 2012. This represents a decline of 9.3% compared to 2011, the largest annual contraction over the past three decades. Nevertheless, since 2002 electricity generation has increased by 6.8%, with significant growth in the years between 2006 and 2010.

The electricity mix is dominated by fossil fuels, namely natural gas and coal. Natural gas accounted for 54.4% of electricity generation in 2012 while coal amounted to 26.6%. Oil had a small share of 1.1%. Over the past decade there has been a shift towards more renewables, with the total share of fossil fuels in electricity generation falling from 90.3% in 2002 to 82.1% in 2012. Electricity generated from natural gas has experienced only a marginal growth of 0.5% since 2002, while electricity from coal and oil has declined by 5.9% and 51.5%, respectively. Nuclear energy accounted for 3.8% of electricity generation in 2012, a share which has reduced slightly from 4.1% in 2002.

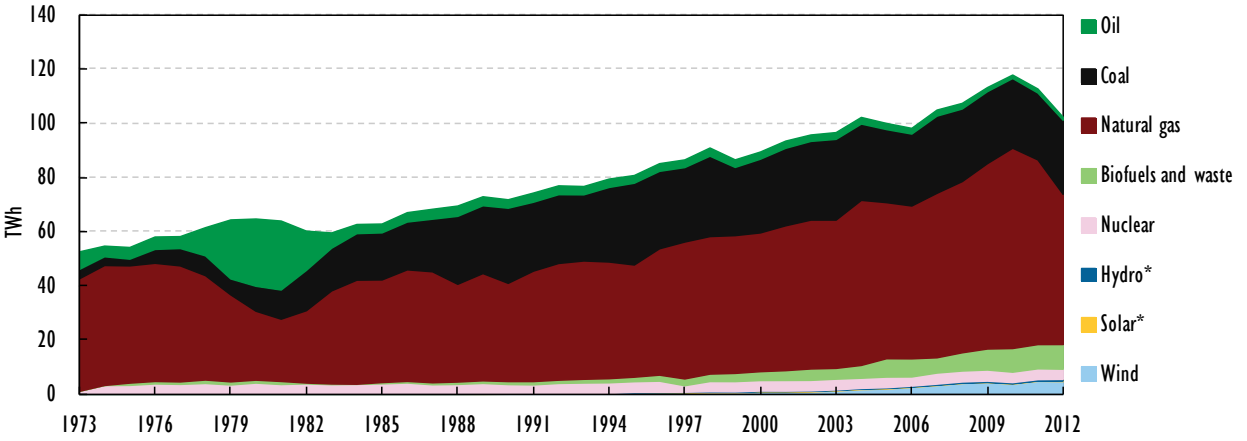
Renewable energy sources in the electricity mix in the Netherlands are principally from biofuels and waste, and wind. Biofuels and waste accounted for 8.7% of generation in 2012 while wind represented a further 4.9%. Solar energy and hydro also play a role, albeit to a small extent, contributing 0.3% and 0.1% of the total, respectively. Wind power has experienced the fastest growth over the decade to 2012, growing fivefold, from 1 TWh in 2002 to 5 TWh in 2012. Electricity from biofuels and waste has more than doubled over the same period, from 4.1 TWh in 2002 to 8.9 TWh in 2012. As a share of electricity generation, renewable energy sources have increased from 5.7% in 2002 to 14% in 2012.

Netherlands ranks sixth-highest among IEA member countries with regard to the share of fossil fuels in its energy mix, behind Australia, Poland, Luxembourg, Japan and Greece.

In the outlook to 2030, government projections indicate that the relative share of fossil fuels is to continuously decline in the electricity mix over the next two decades to 71.5% by 2030. This is supported by the share of wind and solar energy in electricity generation which

is expected to grow to 13.6% and 3.5%, respectively. The contribution from solid biofuels, however, is expected to contract to 8.2%, as will the share of nuclear energy, to 3.1%.

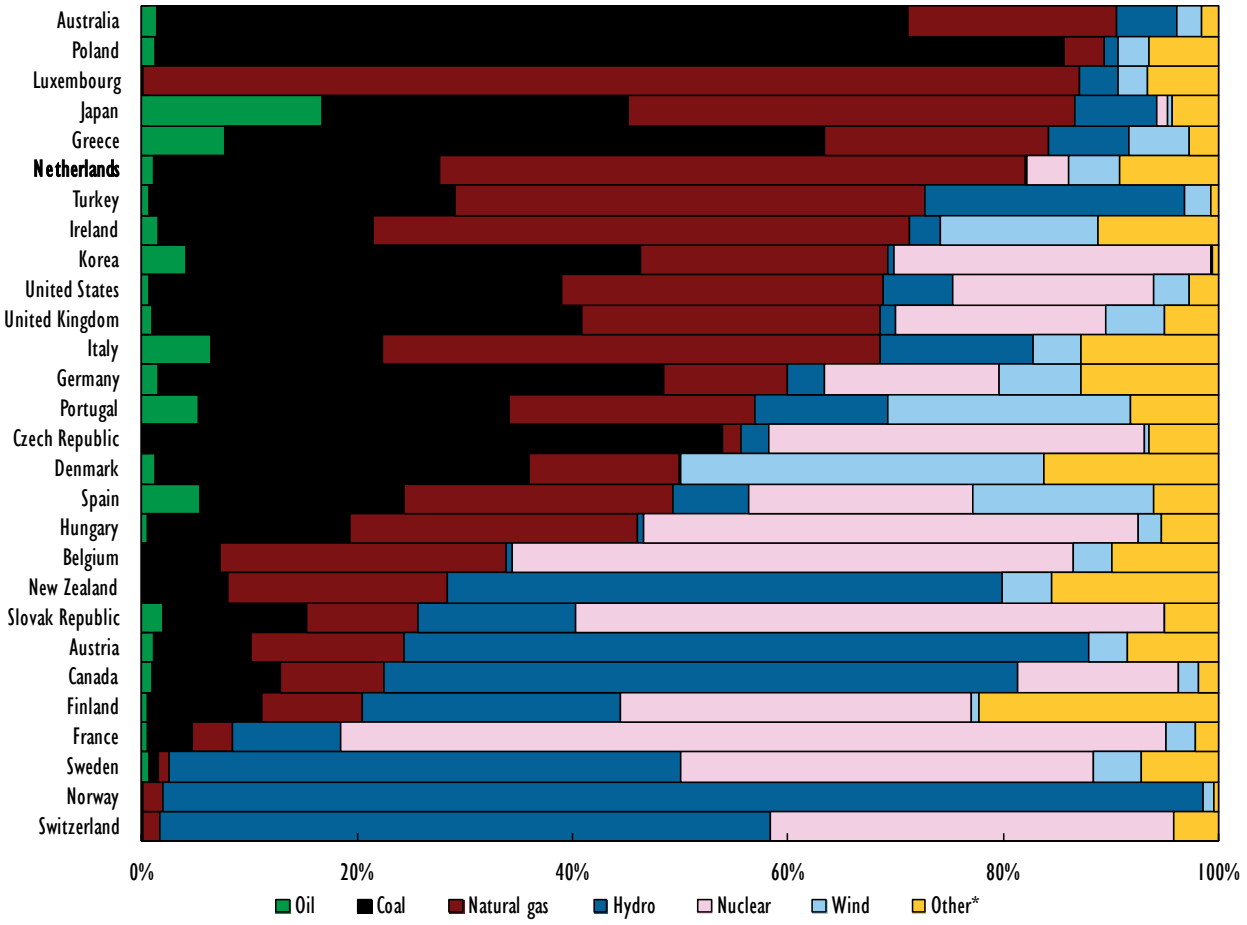
Figure 5.1 Electricity generation by source, 1973-2012



* Negligible.

Sources: *Energy Balances of OECD Countries*, OECD/IEA, Paris, 2013; country submission.

Figure 5.2 Breakdown of electricity generation by source in IEA member countries, 2012



Note: data for the Netherlands and Austria are actual and estimated for other countries.

* *Other* includes solar, biofuels and waste, and geothermal.

Sources: *Energy Balances of OECD Countries*, OECD/IEA, Paris, 2013; country submissions.

GENERATING CAPACITY

The Dutch electricity system is dominated by fossil fuel capacity. In 2012, total installed generating capacity in the Netherlands was around 29 GW (see Table 5.1). Thermal power generating capacity amounted to 24.3 GW or 87% of total capacity and out of total thermal power 18.6 GW or 77% was natural gas-fired plant. Renewable generation represented only 2.8 GW or 0.099% of total generating capacity. Coal capacity runs at baseload with a capacity factor of 76%, which is the result also of the current overcapacity in the Dutch power system, growing imports and the age of current baseload coal-fired power plants. Natural gas capacity has a capacity factor of 45%, reflecting its role as a shoulder and peak service provider.

Table 5.1 Installed generating capacity and production, 2012

Fuel type	Capacity (MW)	Electricity production (GWh)	Capacity factor (%)
Renewables	**2 777**	**12 298**	**38**
Hydro	38	56.9	17
Solar	88	100.3	13
Other renewables	325	7 040	59
Wind, *of which:*	2 326	5 100.7	26
Onshore	2 098		
Offshore	228		
Other non-renewables	**620**	**3 311.7**	**68**
Nuclear	**485**	**4 140.8**	**97**
Thermal	**24 265**	**93 215.5**	**48**
Natural gas	18 637	67 946.1	45
Coal	4 157	20 766.7	76
Oil	260	15.4	1
Industrial gas	1 211	4 487.3	42
Total	**28 147**	**112 966**	**48**

Sources: TenneT; CBS; country submission.

Over the past ten years, the Netherlands saw strong growth in generating capacity, notably from coal- and natural gas-fired power plants, leading to a significant surplus capacity. The majority of capacities planned in 2007-09 came online in 2012 and 2013.

ELECTRICITY CONSUMPTION

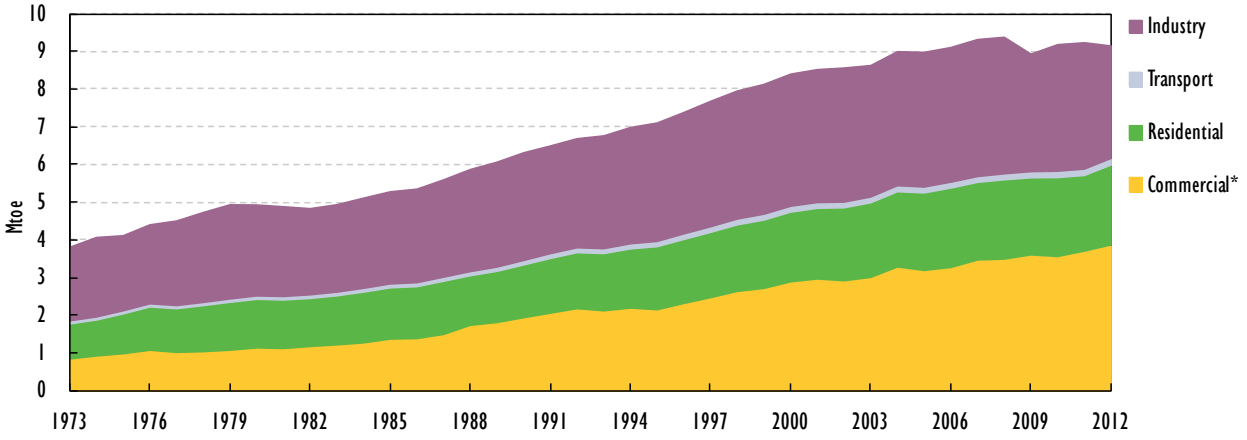
Domestic electricity consumption was 111.3 TWh in 2012 or 9.2 million tonnes of oil-equivalent (Mtoe), increasing by 6.8% compared to 2002. Electricity consumption is dominated by the commercial and public services sector, including agriculture and forestry. In 2012, 40.4% of electricity was consumed by this sector (33.7% by commercial and public services and 6.7% by agriculture and forestry), up from 34% in 2002. Demand

from this sector grew by 32.6% from 2002 to 2012, increasing at a faster rate than any other sector, as the Dutch economy strongly developed in this area during the decade.

Industry is also a significant consumer of electricity, with a share of 35.5% of total demand in 2012. Electricity usage by this sector has declined by 14% since 2002, falling by 14% in 2009 alone, during the economic recession. As a result, the overall share of demand has fallen from 41.5% in 2002 when the industry sector was the main consumer of electricity.

The residential sector represents 22.5% of electricity demand and the remaining 1.6% is consumed by the transport sector. Electricity consumption in transport has increased by 15.4% since 2002 while the residential sector experienced a slower growth of 9.7% over this period.

Figure 5.3 Electricity consumption by sector, 1973-2012



* *Commercial* includes commercial and other services, agriculture/forestry and fishing.

Sources: *Energy Balances of OECD Countries*, OECD/IEA, Paris, 2013; country submission.

IMPORTS AND EXPORTS

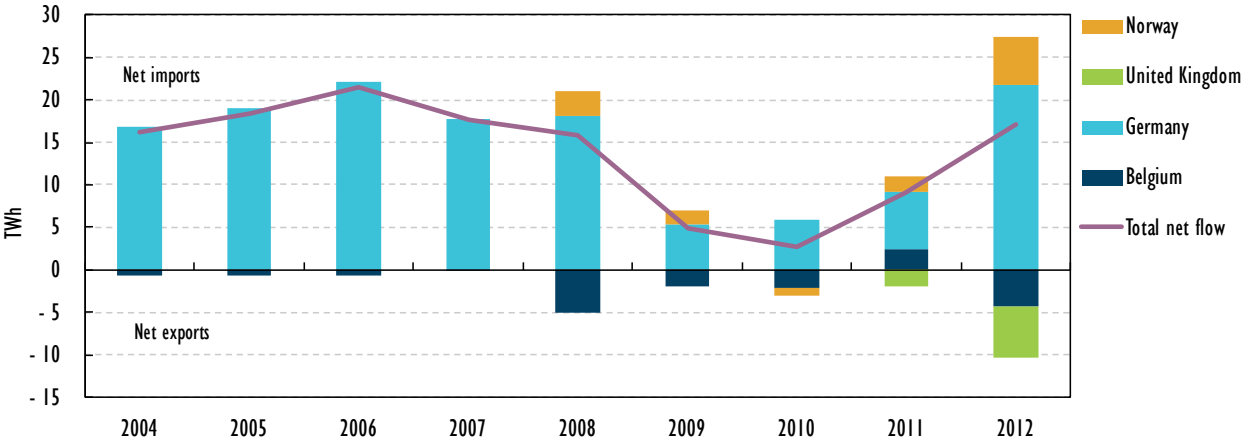
The Netherlands is located at the centre of the North-Western European electricity market with interconnections to Belgium, Germany, Norway and the United Kingdom and is rapidly emerging as a key transit country within this market. The Netherlands has been a net importer of electricity since 1982.

The interconnectivity of the Netherlands has grown rapidly thanks to market coupling with neighbouring markets and new physical connections to Norway and the United Kingdom. Import/export flows reflect the impact of more effective market integration and growing regional trade, and congestion reflecting network reliability and security requirements. Since 2002, imports have grown by 206.3%, while exports have increased by 149.8%. The main boost in electricity trade came in particular with the development of two new interconnectors: the NorNed interconnection between the Netherlands and Norway became operational in 2008 and the BritNed interconnection between the United Kingdom and the Netherlands became operational in 2011. Before 2008, the bulk of imports came from Germany, in line with price differentials between Germany and the Netherlands. The introduction of new interconnectors has particularly aided Dutch exports which have tripled since 2008.

Imports saw a decline between 2006 and 2010, but in 2012, net imports jumped to 17.1 TWh (an 88% increase in comparison to 2011), reaching again mid-2000 levels,

owing to higher German production of solar and wind energy. Compared to 2011, imports from Germany more than doubled and exports to both Belgium and the United Kingdom grew. In 2012, 70.1% of imports were from Germany, 17.6% from Norway, 11.5% from Belgium, and the remainder from the United Kingdom. Exports were destined for Belgium (53.3%), the United Kingdom (41.1%), Germany (4.9%) and Norway (0.6%).

Figure 5.4 Net electricity imports to and exports from the Netherlands by country, 2004-12



Sources: *Electricity Information*, OECD/IEA, Paris, 2013; country submission.

REGIONAL FLOWS AND CONGESTION MANAGEMENT

In 2013, net transfer capacity is 3 900 megawatts (MW) on the borders with Belgium and Germany, 700 MW with Norway and 1000 MW with the United Kingdom.[1] In the second quarter of 2013, the Dutch market was the only market in the Central-West European (CWE) region to maintain a wholesale price premium, driven by the gas-to-coal price spreads in the Netherlands and increasing power exports to the United Kingdom.[2] Market dispatched gas-fired power plants can currently not compete with electricity production from coal, solar, wind and hydro in other markets.

The transmission system operator (TSO) TenneT outlines that the nature of 2012 import flows differs from the mid-2000 levels. In the mid-2000s, imports were used to cover increasing Dutch demand. Today, domestic demand is lower and import flows are mostly unscheduled flows from renewable sources in meshed grids. During periods of decreased supply of renewable energy from Germany, the interconnectors are used to export large amounts of electricity generated in the Netherlands, for instance during times of net demand peaks in Germany. CORESO, the regional security co-operation body for the transmission system, also confirms the growing power flows between Germany and the Netherlands, driven by higher solar and wind production in Germany which results in growing day-ahead power system "stress levels" for the North-West Europe (NWE) and Central-West Europe (CWE) regions.[3]

With rising unscheduled regional power flows (loop flows or transit flows) to the Netherlands and changing power generation patterns in neighbouring Belgium and Germany, increasing

1. *Rapport Monitoring Leveringszekerheid 2012-2028*, TenneT, June 2013. Available transfer capacity can differ and go 2 300 MW with Belgium and 1 900 with Germany (North and South zones).

2. *EU Quarterly Electricity Markets*, Market Observatory for Energy DG, Energy Volume 6, Issue 2, second quarter 2013.

3. CORESO, Operational Review 2013.

congestion on the interconnection between Germany and the Netherlands and between Belgium and the Netherlands has begun to affect system security in the Netherlands and the wider NWE and CWE region.[4]

On the cross-border interconnection Germany-Netherlands, all flows are in import mode to the Netherlands (same direction), but there are substantial deviations between commercial and physical flows. In addition, there are transit flows in CWE, involving Germany, the Netherlands, Belgium and France.

TenneT indicates that reduction of the available transfer capacity (ATC) can occur owing to unscheduled parallel flows across the Dutch grid, which are caused by unforeseen unavailability of cross-border interconnectors, a significant increase of wind and solar power fed into the high-voltage grid in Germany, significant fluctuations in the direct current (DC) flows between France and the United Kingdom which impact the flows between France and Belgium and subsequently in the Netherlands. (The net transfer capacity (NTC) values on DC lines, NorNed or BritNed, are not impacted by the flow situations on the Belgian or German borders.)

Today, interconnection capacity is determined in consultation with the other TSOs, operating within the integrated regional power system, and offered firm to the day-ahead market on the basis of international norms for network security.

Any reduction of ATC at the Dutch-German border (a remedy which would reduce both commercial and physical flows) however results in a significant price increase in the Netherlands and wholesale market distortion with loop flows elsewhere. The low price convergence between the CWE markets illustrates the persistence of physical congestion between the grids. In fact, interconnection capacity in the CWE grid has not increased since 2008 (the planned Dutch-German cable has been delayed), but capacity was even reduced in the past years. Pending major grid investment into North-South interconnections both in Germany and in the Netherlands, the decision was taken to improve congestion management and install phase-shifters as temporary solutions at the Dutch-German border and the Dutch-Belgian border. An alternative can be the split of the CWE market area into internal price zones to show internal bottlenecks and thus provide investment signals (congestion rents) for lifting those limitations between the countries and within their territory.

TenneT operates both the Northern German and the Dutch grids and is well placed to integrate the markets. Increasing wind power flows from existing German wind parks and planned offshore facilities are likely to increase the stress on the system. These circumstances need to be addressed at a regional level with a view to ensure security of supply and efficient market functioning in the CWE region (see below under “Electricity security”). Enhanced data transparency, information exchange and co-ordination at a system operational level between the adjacent TSOs in the Pentalateral region, through regional bodies such as CORESO, SSC (TenneT/Amprion) and/or TSC, are crucial in this context.

INSTITUTIONS

The **Ministry of Economic Affairs** has the lead responsibility for the formulation and implementation of the energy policy, while environmental, climate change and transport

4. THEMA Report, Loop Flows – Final Advice, prepared for the European Commission, October 2013. The report outlines correlation between the measured unscheduled flows between Germany and the Netherlands vs. German wind production and internal flow, plotted for the two-year period 2011-12. However, for transit flows the report cannot provide causality analysis.

policies are within the remit of the **Ministry of Infrastructure and Environment**. The **Ministry of Finance** is on behalf of the Dutch state 100% shareholder in Gasunie and TenneT. Provinces and municipalities are the shareholders of the several gas and electricity distribution system operators (DSOs).

The Netherlands **Authority for Consumers and Markets** (**ACM)**, established in April 2013, is the new authority under the Ministry of Economic Affairs with regulatory powers to supervise electricity and natural gas as well as district heating markets. ACM is the result of the consolidation of the Netherlands Consumer Authority (CA), the Netherlands Competition Authority (NMa) and its energy branch, the Dutch Office of Energy Regulation, *Energiekamer*, and the Netherlands Independent Post and Telecommunication Authority (OPTA). The Energy Regulation Unit within ACM deals with competition, market transparency and regulation of the wholesale and retail electricity and gas markets. ACM supports consumers through its dedicated consumer information desk *Consumwijzer.* It co-operates with other regulators in NWE/CWE and at EU level through the Agency for the Co-operation of Energy Regulators and the Council of European Energy Regulators (CEER), on the development of Framework Guidelines and Network Codes and the implementation of the internal electricity market, consistent with the requirements of the Third Internal Energy Market Package.

The transmission network company **TenneT** owns, operates and develops the Dutch high-voltage network as TSO and is responsible for maintaining the power balance and operational security of the electricity system, on the basis of consumption and generation forecasts which are submitted by market actors to the TSO.

MARKET DESIGN AND REGULATION

REFORM AND REGULATION

The liberalisation of the Dutch electricity market started in the 1990s in the framework of the EU energy market liberalisation and followed an energy-only market model. The Electricity Law of 1998 anticipated the principles which were later enshrined in the 2003 Second EU Electricity Directive, including the creation of a national regulatory authority for energy (NRA), the Dutch Office for Energy Regulation (*Energiekamer)* as a chamber of NMa, the legal unbundling of networks from competitive generation and supply activities, third-party access to the networks and the gradual liberalisation of the retail market.

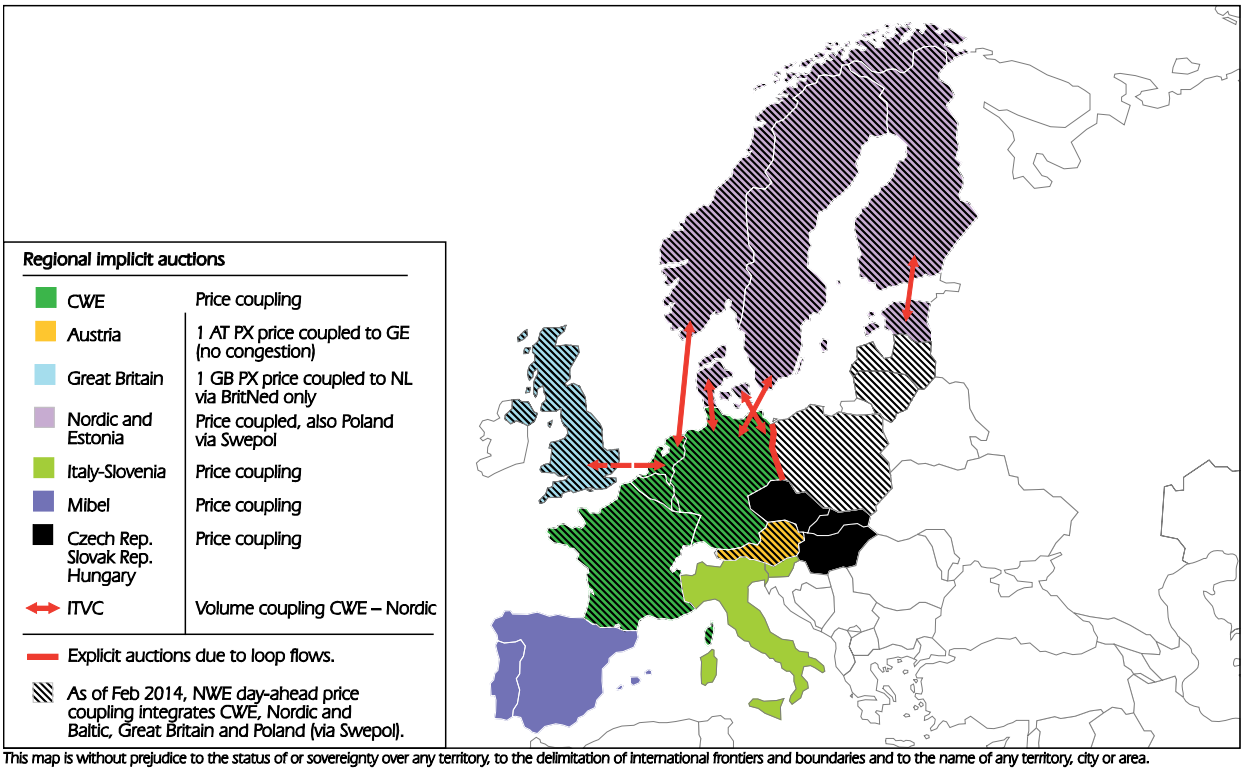
The retail market was opened in 2002 for industry and in 2004 for households. In 2007, full ownership unbundling of the electricity transmission and distribution networks was introduced. The Dutch choice was to privatise generation but to maintain regulated networks under public ownership (the Ministry of Finance is 100% shareholder of the Dutch transmission network). It is not allowed for network operators to be part of a group engaged in supply, production or trading of gas and electricity (so-called group prohibition), or privatised or engaged in other activities. At international level, only New Zealand prohibits distribution companies from retailing.

On the one hand, market opening at wholesale and retail market levels with ownership unbundling led to considerable investment by large EU utilities; on the other hand, it fostered consolidation on the generation side. Ownership unbundling is to some extent limited, taking into account the substantial shareholdings by the Dutch state in electricity transmission and in the supply of gas through TenneT, *Energie Beheer Nederland* (EBN) and GasTerra.

In the light of the Dutch market structure, the regulatory authority in the Netherlands has to have strong competences on competition, ensure objective decision making, and effective independence from the government. Such independence is an essential prerequisite to ensure that investment decisions in natural monopolies are considered objective by the consumers and market participants.

The energy regulator is established as an independent authority under the Ministry of Economic Affairs, with its own budget. However, under the Framework Law on Independent Policy Authorities (*Kaderwet Zelfstandige Bestuursorganen*), the minister determines the responsibilities of the independent policy authorities, approves their governance, their budget, gives directions or can annul their decisions. The Law on the ACM (*Instellingswet ACM*) enables the minister to annul decisions by the energy regulator (Article 10). ACM does not have the final say in approving final investments, access conditions, tariff structures or the granting of licences for new generation facilities, which remain a competence of the Ministry. There are limits to the minister's ability to give instructions on individual cases (Art. 9), mirrored in the 1998 Electricity Act (*Elektriciteitswet 1998*) and the Gas Act (*Gaswet*). While the institutional structure is not ensuring independence, in legal practice the regulator confirms its independent decision making, notably on competition issues. In the past, the regulator refused the creation of a national power generation champion during liberalisation and recently ACM opposed the closure of coal-fired power plants as foreseen in the agreement of the Social and Economic Council (SER).

Figure 5.5 Overview of market coupling in the European internal electricity market



This map is without prejudice to the status of or sovereignty over any territory, to the delimitation of international frontiers and boundaries and to the name of any territory, city or area.

Source: European Commission and ACER, 2013.

Another pillar of the Dutch electricity market regulation is the strong integration within the North-West region and the EU internal electricity market. The so-called market coupling (see

Figure 5.5 and Box 5.1) has been progressing over time and determines the market realities on the Dutch wholesale market and the use of interconnection capacities. In 2014, market coupling reached an even greater scope with the link-up of the Netherlands to the Nordic market area. The government has consistently supported the full integration of the Netherlands into the wider regional and EU internal energy market. This also has contributed to an inflow of new investment on the wholesale generation side. Retail markets remain however national in scope with distribution networks in public ownership without supply or retail activities.

Box 5.1 Market coupling in Western Europe

The Netherlands has been a strong advocate of market integration in the CWE regions, since the start of the Trilateral Market Coupling between the Netherlands, Belgium and France in 2007, and the extension to Luxembourg, Germany/Austria (market splitting) in 2010 and to Norway and the United Kingdom. The primary aim of the mechanism is to improve market liquidity and, consequently, to induce lower and more stable electricity prices by integrating a number of energy markets into one single area for energy exchanges.

This overall integration process was supported at political level by the Pentalateral Energy Forum, together with Austria, Belgium, France, Germany, Luxembourg, the Netherlands and Switzerland (observer since 2011). Further liquidity and depth was added to the CWE market by so-called interim tight volume market coupling (ITVC) with the Nordic region via four DC cables, including NorNed, and the day-ahead coupling with the British market via the BritNed cable.

The day-ahead market coupling applied in CWE allows hourly transactions between buyers and sellers on the exchanges, independent of their physical location. Cross-border capacity is used to eliminate price spreads between the markets, as long as capacity remains available. The cross-border capacity allocation is carried out together with the financial energy settlement in one single operation, which renders prior reservation of cross-border capacity unnecessary.

In cases of sufficient cross-border capacity, this so-called implicit auctioning process delivers one single market price across borders. In cases of cross-border capacity constraints, optimal trades become restricted and lead to price spreads.

Next to market coupling, there has been a trend to merge national power exchanges across several price zones in the CWE region.

Market coupling has also led to a more efficient use of cross-border interconnector capacity, as transmission capacity use supported the most beneficial financial arrangements in a flexible manner. However, it fails to reflect the cost of transmission network use (*e.g*. losses) which would encourage even more cost-efficient trades across regions.

Intra-day capacity auctions as well as long-term (month or year ahead) auctions remain covered under the so-called explicit capacity allocation methodology. Explicit auctioning requires *ex ante* reservation of cross-border capacities to cover single financial transactions between supply and demand.

In 2009, auction rules for the CWE region were harmonised. Since then, the explicit allocation of cross-border capacity is carried out by one single auction operator (CASC.EU), based upon a harmonised set of auction rules across several regions, CWE, Central South and Scandinavia.

Box 5.1 Market coupling in Western Europe (continued)

Explicit auctioning tends to maintain inefficient utilisation of interconnectors and creates opportunities for incumbents to distort the market by withholding network capacity. The introduction of a functioning and liquid secondary market for trading of obtained physical cross-border capacity rights can provide with greater transparency for the value of these rights. Such capacity trades, comparable to the concept of financial transmission rights, can also encourage the respective capacity holders to make capacity available to the market, as economically rational.

Market coupling was first operational in the day-ahead market of the CWE regions and has been rolled out across the European Union through the price coupling of North-West Europe (Central-West Europe, Nordic, Baltic, Great Britain and Poland) as of 4 February 2014. This so-called NWE day-ahead market coupling now links Nordpool (including the Baltic states, Poland and Sweden), Great Britain and CWE. After that, in autumn 2014, the introduction of flow-based market coupling (for implicit auctions) is foreseen to add greater accuracy to the market coupling method. This accuracy comes from a more detailed description and modelling of the underlying physical network and thus allows for a more precise evaluation of feasible financial trading contracts. Flow-based market coupling is meant to further enhance network integrity and price convergence. It is planned to be introduced across the EU internal energy market, and will include Central Eastern and Southern regions in the medium term to cope with growing loop flows.

The flow-based allocation is expected to deliver welfare benefits from increased price convergence (58% to 90%), trade and reliability in the range of EUR 136 000 per day across all regions, with clear benefits for the Netherlands.* However, to ensure efficient grid integration of renewable energies, the flow-based algorithm is only one element; it will also require renewable sources to be fully integrated in the wholesale markets and merit order dispatch in the region.

The introduction of smaller price zones across the EU, which would be defined by congestion and not by national borders, is under consideration to better deal with congestion in the networks, both at national and cross-border levels.

Market coupling and flow-based market coupling are largely focussed on the day-ahead markets, while intra-day and balancing markets largely remain national or bilateral, as organised by TSOs. Up to now, the Dutch intra-day market remains small in scope and liquidity, as intra-day trading across the Nordic and CWE markets is still low and has been implemented at a bilateral/regional level, as follows:

- Dutch-German border (December 2008) – first-come-first served
- Dutch-Belgian border (May 2009) – implicit auctions
- Nordpool Elbas platform (February 2011) – continuous trading
- Dutch-Norwegian NorNed interconnector (March 2012) – continuous trading
- Great Britain on BritNed (May 2012) – explicit auctions.

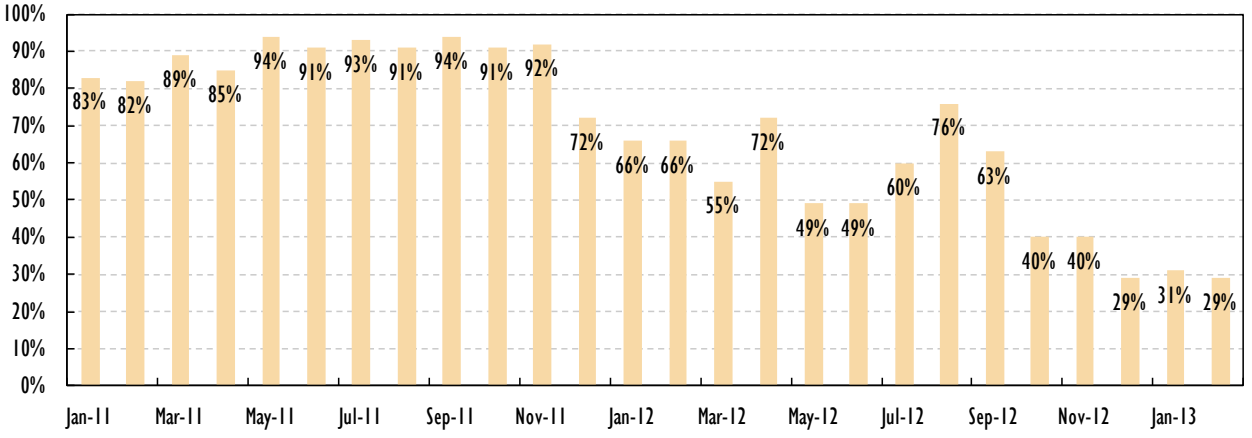
With the rising shares of variable renewables and more dynamic power flows in the NWE market, integrated intra-day markets will play a strong role in providing flexibility and strengthening cross-border trade. The creation of a harmonised platform for continuous implicit cross-border intra-day trading in CWE region is currently under development.

* CWE Enhanced Flow-Based MC feasibility report, Version 2.0, APX, 2011: www.apxgroup.com/wp-content/uploads/CWE_FB-MC_feasibility_report_2_October_2011.pdf.

Data from the Amsterdam Power Exchange (APX) illustrate that throughout 2010 and 2011, electricity prices on the Dutch market were identical to those on the German market for more than 90% of the time.

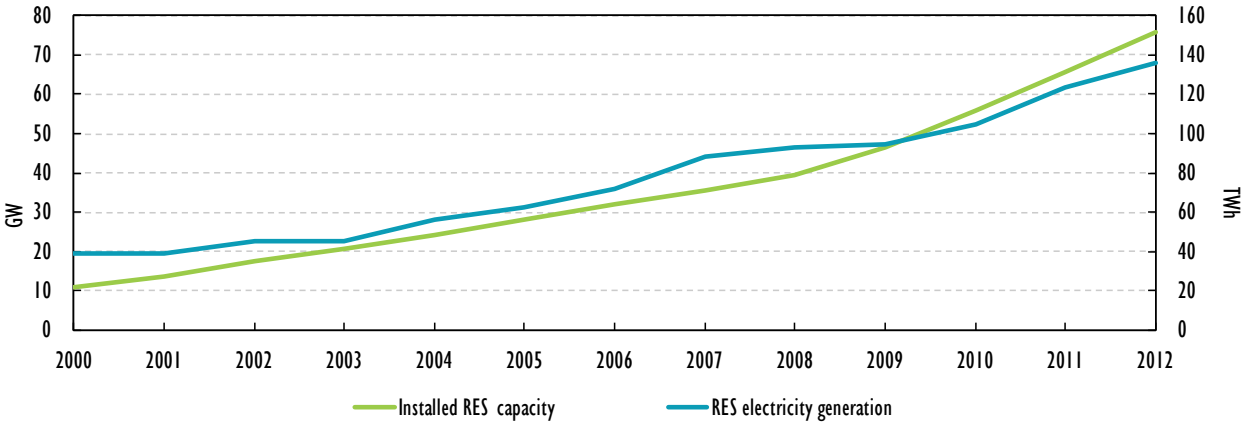
Since 2012/13 convergence in the CWE has dropped considerably (see Figure 5.6). Data by the Netherlands Competition Authority (NMa) and APX[5] show price convergence after market coupling (in 2011) occurred 70% of the time between the Netherlands and Belgium, almost 90% of the time with Germany, and about 7% with Norway.[6] These low convergence rates to Nordpool are linked to substantial congestion on the interconnectors.

Figure 5.6 Price convergence at the Dutch-German border, January 2011 to February 2013



Source: TenneT, 2013.

Figure 5.7 Installed capacity and electricity generation in Germany, 2000-12 (capacity in gigawatts and generation in terawatt hours)



Source: *Naturschutz und Reaktorsicherheit*, Bundesministerium für Umwelt (BMU) Germany, 2013.

In 2013, electricity prices on the Dutch market were identical to those on the German market for only 30% of the time.[7] During 2011, price convergence in the CWE region had

5. 2012 Liquidity Report Wholesale Markets for Natural Gas and Electricity, NMa, The Hague, July 2012.

6. National Report on Energy Regulation in 2012, Authority for Consumers and Markets (ACM), September 2013.

7. Bert Den Ouden, APX Presentation, IEA in-depth review visit, The Hague, 10 April 2013.

occurred 66% of the time.[8] The price differentials between wholesale exchanges in the CWE region started diverging again when power flows are predominantly directed to the Netherlands and increasing renewable production in Germany (see Figures 5.6 and 5.7).

MARKET STRUCTURE

WHOLESALE LEVEL

With liberalisation and market integration, the Dutch market saw the entry of foreign vertically integrated players from neighbouring markets (RWE, Vattenfall, E.ON, Electrabel/GDF Suez) which acquired the assets of the Dutch generation and distribution companies Nuon, Essent, Eneco and Delta. Three large utilities Nuon (Vattenfall), Essent (RWE) and E.ON together held 59% of power generating capacity in 2009, leading to an HHI Index of 1 881.[9] Generation and supply/retail of gas and electricity remain vertically integrated. The Dutch energy regulator and competition authority concludes that the Dutch wholesale market has become more concentrated in terms of production capacity, but less concentrated in terms of actual production. The C3 ratio of installed capacity[10] equalled 65% and the C5 ratio 87% for 2011. In terms of production, the C3 ratio amounted to 54% and the C5 ratio to 83% in 2011.

The Dutch wholesale market has several sub-markets: *i)* the commodity market for the trade in bilateral contracts (which makes around 20% of the total trade) and over-the-counter trade (OTC) which accounts for 60%; *ii)* the day-ahead physical and financial trading on the APX and ICE ENDEX power exchanges (formerly APX-ENDEX)[11] representing 20% of all trade and *iii)* the balancing market for control and reserve power which is operated by TenneT.

In 2012 trade volumes at the APX day-ahead in the Netherlands increased to 50.1 TWh for spot market and 34.2 TWh in futures. (In comparison, German-French EEX power exchange had trade volumes of 339 TWh in 2012.) At the APX spot, there were 54 traders active in 2012. Market liquidity, measured as the ratio of the annual traded volume of day-ahead power to gross inland electricity consumption in the Netherlands, was 33.1% in 2011.

Market coupling has boosted liquidity of the Dutch market. The wholesale electricity spot price for baseload capacity in APX Netherlands fluctuated around EUR 50 per MWh during 2012-13. Most transactions on the APX are short-term day-ahead and within-day trades for which volumes have increased substantially. Annual contracts make up to 60% of the Dutch wholesale market, but their volume has been falling during 2008-11. In 2012, the volumes picked up again to 2009 levels. With imports to the Netherlands being at their maximum limit, there is a preference by market players to hedge their position with forward contracts on the German rather than Dutch wholesale market.

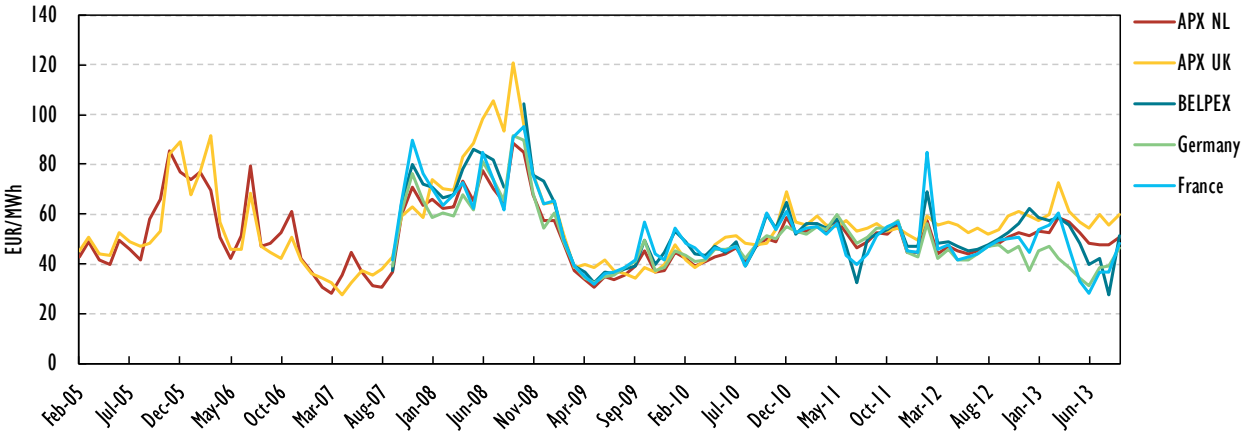
8. *National Monitoring Report 2012*, NMa, the Hague, 2012.

9. *Energy Markets in the European Union in 2011, 2012, Country fiche Netherlands*, the European Commission. The Herfindahl-Hirschman Index or HHI) is a measure for competition taking into account the size of firms in relation to the industry.

10. The Three-Firm Concentration Ratio (C3) measures the total market share of the three largest firms in an industry. The Five-Firm Concentration Ratio (C5) analyses the same for the five largest firms. This assessment is not done at a regional level of the coupled electricity markets in CWE.

11. On 1 March 2013, APX-ENDEX was split into two companies: the power spot exchange APX and the gas spot, gas derivatives and power derivatives exchange ENDEX. As of 27 March, Intercontinental Exchange (ICE) is the majority shareholder of ENDEX. The name of the new company is ICE Endex. APX operates three power spot markets in the Netherlands, the United Kingdom and Belgium with a total volume of 86 TWh traded and cleared in 2012.

Figure 5.8 Central-West European spot power prices for baseload capacity



Source: Bloomberg, 2013.

The balancing market

The balancing mechanism in the Netherlands is market-based and operated by the Dutch TSO TenneT. It obliges all consumers, including renewable installations, to balance their net trade position and offer surplus capacity of above 60 MW to the balancing market. Demand-side providers and non-contracted balancing responsible parties can also participate. Permanent reserve capacity is procured through tenders; additional reserve capacity can be offered on a non-permanent basis. The market is settled on the basis of the system marginal price set by the most expensive bid dispatched to clear the balancing market.

A comparison of APX spot prices and TenneT imbalance prices shows that price differences between the intra-day market and the imbalance market are larger than those between the day-ahead market and the imbalance market. This seems to be linked to limited trading on the APX intra-day market. The liquidity of the Dutch intra-day markets would need to be raised considerably, if it were to provide flexibility to other market areas in the region and to integrate renewable energy sources in the wholesale electricity market.

APX intra-day markets therefore offer only a limited view on provision of flexibility. The TSO enables all balancing responsible parties to support system balance through self-dispatch by, first, an incentive compatible imbalance pricing system, and by, secondly, publishing near real-time information on system balance and on actual marginal prices. The TSO facilitates bilateral intra-day trading on the hub by allowing *ex post* notification of internal trade positions.

NETWORKS

TRANSMISSION NETWORKS

The Dutch high-voltage transmission network (110 kV, 150 kV, 220 kV and 380 kV) is operated by TSO TenneT B.V., following the transfer of management of the Dutch 150 kV and 110 kV grids to TenneT in 2008. In 2013, the transmission network had a total length of around 20 000 circuit km and consisted of 443 substations connecting 36 million end-users and 67 GW of installed capacity. In 2013, there was a total cross-border import capacity of 5 277 MW and export capacity of 5 095 MW.

DISTRIBUTION NETWORKS

The Dutch distribution system is operated by eight distribution system operators (DSOs), mostly owned by the Dutch municipalities and provinces. All but one also operate gas distribution systems.[12] The 2006 Network Unbundling Act (*Wet onafhankelijk netbeheer*) required full ownership unbundling of electricity and gas distribution networks from supply activities by 1 January 2011. It also prohibited network companies from being part of a vertically integrated group, from engaging in other commercial activities and from being privatised.

Six operators have been fully ownership-unbundled since 2010, while two DSOs still form part of a vertically integrated company. The requirement for distribution unbundling has been challenged by Eneco, Essent and Delta and annulled by the Dutch Court of Appeal in 2009. The Ministry of Economic Affairs challenged the decision at the Supreme Court of the Netherlands which requested a preliminary ruling from the European Court of Justice (ECJ) in 2012. In April 2013, the attorney-general's opinion found the Dutch law in line with EU law. On 22 October 2013, the European Court of Justice (ECJ) confirmed the current Dutch arrangements, taking into account the opinion by the attorney-general. It is now up to the Dutch Supreme Court to follow up on the ECJ judgement and implement it in the Dutch framework.[13]

TRANSMISSION REGULATION

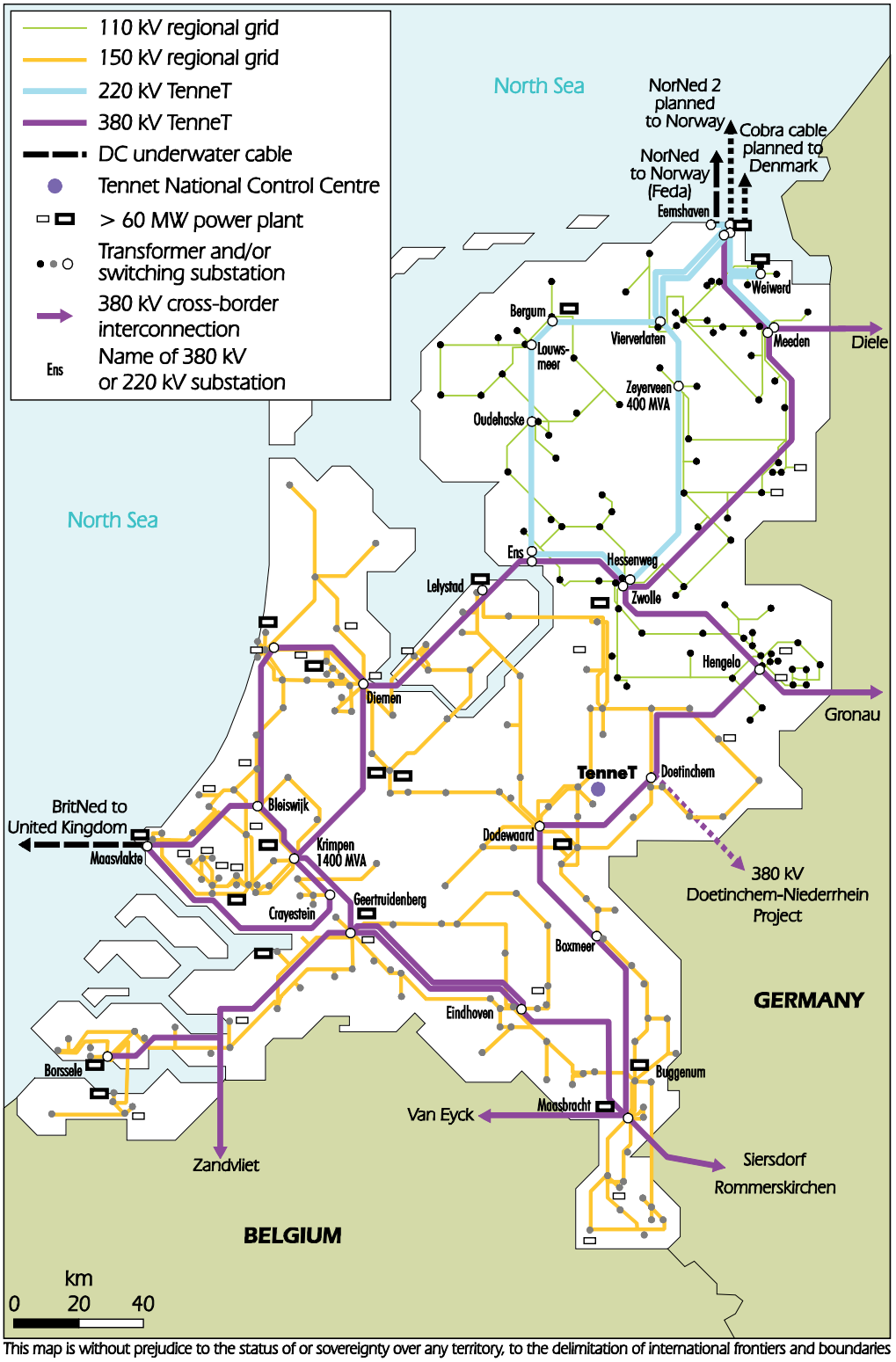
In 2013, TenneT B.V. was 100% owned by the Dutch state (Ministry of Finance) under the TenneT Holding structure, which also owns TenneT Germany, a TSO in Germany, TenneT Offshore GmbH and holds shares in a number of energy exchanges in NWE, including APX-ENDEX. TenneT also operates the balancing market for regulating power. The NorNed interconnector is co-owned and co-operated by TenneT together with Norwegian TSO Statnett. The BritNed interconnector is jointly owned by TenneT B.V. and National Grid, but operated independently in Great Britain and the Netherlands.

In December 2013, TenneT has been certified compliant with the TSO ownership unbundling requirements set in the EU Third Electricity Package. This certification was a prerequisite for receiving a licence to operate as a TSO by the Dutch Ministry of Economic Affairs. In May 2013, ACM took the preliminary decision to certify TenneT as ownership-unbundled TSO in the Netherlands pursuant to Art. 3(1) of Regulation No 714/2009 and Article 10(6) of Directive 2009/72/EC and notified its decision to the European Commission in May 2013. BritNed was certified by the United Kingdom's national regulator Ofgem in June 2013. BritNed also requested certification in the Netherlands in September 2012; a decision by ACM is pending.

12. The eight DSOs are: Liander N.V., Enexis B.V., Stedin B.V., Delta Netwerkbedrijf B.V., Endinet B.V., Westland Infra Netbeheer B.V., Cogas infra en Beheer B.V., RENDO Netbeheer B.V.

13. Joined cases C-105/12, C-106/12, C-107/12, Staat der Nederlanden v Essent and others [16 April 2013], Opinion of AG Jääskinen, see: http://curia.europa.eu/juris/document/document.jsf?text&docid=143343&pageIndex=0&doclang=EN&mode=lst&dir&occ=first&part=1&cid=252828. The ECJ considers the ban of privatisation of gas and electricity distribution networks compatible with both Article 345 TFEU and Article 63 TFEU on free movement of capital. The Attorney General argued that the EU Treaties (Art. 345 TFEU) shall in no way prejudice the member states' rules governing property ownership. While group prohibition and side activities prohibition restrict the freedom of capital, such unbundling requirements can be justified under the economic objectives of the EU Treaties to achieve the goals of energy market transparency and to prevent distortions of competition. However, member states have to act in a proportional manner, when putting forward public interest objectives.

Figure 5.9 The Dutch electricity transmission grid, 2013



This map is without prejudice to the status of or sovereignty over any territory, to the delimitation of international frontiers and boundaries and to the name of any territory, city or area.

Sources: IEA, 2013.

In its opinion on the TenneT certification, the European Commission examined the level of state ownership and concluded that the structural separation of competences between ministries could be considered as a sufficient degree of separation. TenneT shareholdings are administered by the Dutch Minister of Finance, while the Minister of Economic Affairs manages the state's shareholdings in the production and supply of gas – EBN and GasTerra. However, the Commission raised concerns about provisions in the Electricity Act giving the Ministry of Economic Affairs the power to approve the appointment of members on TenneT's supervisory body, to determine bylaws governing TenneT's operations and powers to direct investment, all factors which could result in a potential conflict of interest between decisions in favour/against investment in gas production/supply and electricity transmission. ACM has addressed these concerns in its final certification decision.

The Dutch regulation of transmission networks strongly focusses on cost reduction and efficiency of the TSO, while providing comparatively low levels of return on investment.[14, 15] The main objective is to minimise costs to final consumers. The Netherlands applies a revenue-cap (CPI-X) regulation across total operational and capital expenditure (TOTEX) for a period of three years (2014-16). Efficiency factors are determined by benchmarking productivity growth against a basket of foreign TSOs. The benchmark is a total cost benchmark, which implies that all costs (including sunk CAPEX) are benchmarked. An incentive system, the so-called bonus-malus system, is applied to costs of energy and power, which allows network entities to retain any efficiency gains during the regulatory period; in the subsequent regulatory period efficiency gains are re-distributed to consumers. Quality is regulated through quality of supply standards and not through financial incentives under the revenue-cap regulation. For 2014-16, tariffs of regional network operators will decrease, on average, by 8% annually, and those of transmission operator TenneT by 7%, leading to consumer and business savings of EUR 2.1 billion.

The Dutch revenue and investment regulation has to strike a balance between minimising costs to consumers and ensuring sufficient return to support efficiently timed and sized investment. Commendably, the Netherlands has introduced a more *ex ante* focussed approach for large-scale infrastructure projects in order to reduce some of the risks, notably those linked to delays in planning and approval procedures. However, the regulatory regime maintains a strong efficiency-driven *ex post* approach and standardised quality regulation, which has the potential to emphasise cost reduction at the expense of efficient, timely investment.

The regulatory framework includes three different options for transmission investment approval:

- Ordinary investment (planned extensions and replacements) → *ex post* validation by the regulator.
- Extraordinary investment → the Minister of Economic Affairs validates the investment if it is necessary in terms of security of supply (*ex ante*). Once the new infrastructure is online, the efficient cost will be part of the regulated asset base (*ex post*).
- Investments that are covered by the national co-ordination procedure → see process about the extraordinary investment procedure.

14. *Incentives for investments: Comparing EU electricity TSO regulatory regimes*, Jean-Michel Glachant, Marcelo Saguan, Vincent Rious and Sébastien Douguet: EUI/FSR/Microeconomics, 11 June 2013.

15. *Ibid*. Allowed cost of capital in the Netherlands (nominal post-tax values): Return on Equity = 5.6% – with a notional gearing decided at 50%, meaning that the RoE with a hypothetical 60% gearing is up to 6.2% – and "vanilla" weighted average cost of capital = 4.7%.

In accordance with the Electricity Act and the State Coordination Programme for Infrastructure Projects (*Rijkscoördinatieregeling, RCR*), the minister has to establish the *ex ante* necessity of grid investment before projects can be deemed to be of national importance. For all transmission investment, the minister has the right to decide on the allowed investment, credit requirements and cost recovery (e.g. cost of capital) in practice ACM includes those investments into the benchmarking of TenneT. The minister also approves network access arrangements, in particular exemptions which may apply to interconnectors under the Electricity Act (Art. 86c Regulation Art. 17).

The extraordinary investment procedure uses a more *ex ante* focussed approach to identify projects that are needed for the network reliability, security, renewables and market integration. Despite this *ex ante* establishment of the necessity of the project, regulated returns on investment are determined *ex post* (as part of ACM's decision making on benchmarking). Investment in network expansion is included into the regulated asset base in an *ex post* manner, after an assessment of its efficiency, usefulness and necessity. This *ex post* approach aims to safeguard consumers' interests so that they pay only for efficient infrastructure investments. At the same time, the government (as the only shareholder) is responsible for delivering the necessary equity for the investment.

This pragmatic approach poses problems in the context of the growing investment requirements of a regional TSO. The approach tends to load risk on investors and has been identified as a factor leading to investment delays in other IEA jurisdictions. It may also struggle to provide the certainty required to facilitate efficiently timed and sized network investments needed to integrate renewable energies and facilitate efficient regional interconnection.

As a European TSO, TenneT pursues a co-ordinated regional grid investment programme, however, TenneT's German operations are subject to an *ex ante* regulatory framework which provides greater certainty for investors by ensuring that approved investments are immediately included in the regulated asset base and by allowing investors to begin recovering costs from the outset of the project rather than waiting until the project is commissioned. However, it is also true that TenneT investment in Germany benefit German consumers, despite the fact that the grids are well interconnected and that the sharing of overall welfare cost and benefits is not always fully acknowledged in nationally focussed regulatory frameworks.

TenneT noted during consultations that the current regulation in the Netherlands does not facilitate investments, because of low capital remuneration, unpredictable and strong efficiency incentives and not taking financeability issues into account. TenneT indicated that other European countries, for instance Germany, have taken steps to encourage and enable investments, for instance by recovering finance costs during construction. Other IEA jurisdictions have sought to address these concerns by adopting hybrid approaches where approved new investments are added to the regulated asset basis on an *ex ante* basis with related costs recovered once the assets are constructed. Policy makers are encouraged to review the current approach, with a view to improving certainty for investors while ensuring that consumers are not exposed to undue costs.

In 2012, congestion revenues on alternating current (AC) interconnections and NorNed amounted to EUR 102.5 million. This income from cross-border infrastructure is allocated to a separate account of TenneT and, subject to ACM approval, can be used for network investment. It has been used in the past for upgrading interconnections to Germany and also to help fund the initial project cost of the COBRAcable.

Concluding on the above, the public ownership, new offshore activities and regional operation scope of TenneT lead to several challenges in terms of investment approval, regulation and possible shareholdings by international financial investors, which are seen as important factors to ensure the delivery of an ambitious investment programme with RD&D intensive network expansions and cable solutions, as described in the next section on network planning and expansion needs. With longer development, start-up planning and construction phases, TSOs will require a more ex ante financing approach.

NETWORK EXPANSION AND INVESTMENT

TRANSMISSION NETWORK DEVELOPMENT

Over the past decade, the Netherlands has significantly increased interconnection capacity with neighbouring countries thanks to the two new interconnectors to the United Kingdom (BritNed) and Norway (NorNed) and the reinforcement of the internal transmission grid, with the successful completion of the Randstad 380 kV South Ring in September 2013.

The Dutch electricity network will need to evolve with the increasing cross-border trade flows, notably from renewable energies, across the European markets. In comparison to the Dutch gas grid, the electricity network is relatively small in size and a new interconnection to the United Kingdom could prove important during the transition period when the country's conventional electricity fleet will be retired.

Every two years, TenneT prepares a **Quality and Capacity Plan**, the most recent being for 2013-23.[16] TenneT aims to develop the Netherlands into a "power hub" of North-West Europe.

TenneT has also published a long-term grid development perspective titled a "**Vision for 2030**". This document suggests that the Dutch electricity grid will have a key role to play in integrating the European power system, especially in relation to connecting renewable energies from future North Sea wind farms to the South and across the European market. It suggests that ensuring cross-border (export) capacity and adequate expansion of the Dutch electricity grid to accommodate new conventional and renewable generation ought to be a key priority, to help minimise the cost of redispatch and congestion management in the Netherlands resulting from changing regional power flows. New investment in the intra-regional network interconnection capacity to Germany, Denmark and Norway will be required to realise this vision.

TenneT co-operates within the European Network of Transmission System Operators for Electricity (ENTSO-E) on the development and implementation of the EU-wide Ten-Year Network Development Plan (TYNDP). Together with the TSOs of the ENTSO-E Regional Group North Sea, including Belgium, Denmark, France, Germany, Ireland, Luxembourg, Netherlands, Norway and the United Kingdom, a **Regional Investment Plan for the North Sea Region 2012-2022** was prepared in July 2012. For the period 2013-23, TenneT B.V. plans to invest around EUR 5 billion in the Dutch high-voltage transmission network, notably in three large-scale projects: the Randstad 380 kV North Ring augmentation; the Noordwest 380 kV augmentation; and the Zuidwest 380 kV augmentation. In addition, investment is planned to increase the capacity of the interconnector with Doetinchem-Wesel in Germany; 300 small-scale projects are also planned.

16. TenneT, Voor de Zekerheid, Kwaliteits- en Capaciteitsdocument, 2013.

Beyond the Netherlands, TenneT plans substantial network investment in Germany including EUR 3.5 billion in its onshore transmission network and around EUR 4.5 billion to develop its offshore transmission network. Overall, TenneT (in the Netherlands and Germany) envisages investing around EUR 13 billion over the next decade.

Box 5.2 Major planned interconnections until 2025

TenneT plans a capacity upgrade of the existing interconnector between Meeden (Netherlands) and Diele (Germany) in the next three to five years. By 2016, a new 400 kV **Dutch-German interconnection line** (between Niederrhein/Wesel in Germany and Doetinchem in the Netherlands) should come into operation. The new interconnector is in the permitting phase and will add 1.5 GW of transmission capacity to reduce overloads from North-South power flows between the Netherlands and Germany in peak hours of wind in-feed. There is no new interconnection planned with Great Britain.

TenneT and Danish Energinet.dk plan an undersea high-voltage direct current (HVDC) interconnector (600 MW to 700 MW, 320 kV), the **COBRA Cable**, to directly connect the Dutch and Danish grids between Eemshaven (the Netherlands) and Endrup (Denmark) with the aim to ensure the integration of renewable energy, notably from offshore wind farms, in both Denmark and the Netherlands. An investment decision is expected in 2014 and design and permitting for 2017-18. The project cost of EUR 449 million is supported by the EU Energy Recovery Programme (EEPR) with EUR 86.5 million.

In Germany, TenneT develops the **NordLink interconnector** together with Norwegian TSO Statnett and Germany's KfW IPEX-Bank, as a subsea cable of 1 400 MW connecting Tonstad in Norway and Wilster in Germany. The final investment decision is expected for mid-2014 and operation by the end of 2018.

A second HVDC interconnector between Norway and the Netherlands, **NorNed 2**, is being considered with a view to link flexible Nordic hydropower and Dutch thermal capacities. According to TYNDP 2012, NorNed 2 is not likely to be realised in the next decade.

PERMITTING PROCEDURES AND CO-ORDINATION

The Ministry of Economic Affairs is responsible for the overall permitting procedure of high-voltage lines above 220 kV and cross-border interconnections (for both gas and electricity, and gas pipelines above 48 inches).

Large infrastructure projects require a high number of permits, including environmental impact assessments and the involvement of different government authorities and the public at national, regional and local levels. As in many European countries, the construction of energy infrastructure is challenged by these barriers as well by range of local factors, including the low-lying nature of land below sea levels, the high population density and vast natural protection zones.

In 2009, the Netherlands overhauled and streamlined its permitting procedures in order to address these barriers to investment (see Box 5.3). The main changes include: the introduction of target durations for the overall process and its stages and the creation of overall national co-ordination of the permitting process by local and regional governments through the Ministry of Economic Affairs for all projects of national importance. Co-ordination includes the environmental impact assessments, strategic impact assessment (zoning plan), decisions and permits that are necessary for the project to be realised. The environmental impact assessment and permits are bundled, published for consultation

(one during the environmental impact assessment and one during the national zoning scheme and permits) and granted at the same time. If challenged in Court, a decision on all permits and national zoning plan will be taken within six months. These elements limit the number of public inquiries and appeals.

Pending a first evaluation, results of the State Co-ordination Programme to date appear positive with approval times halved and proponents generally satisfied. These best practice elements of the Dutch programme have become part of the guidelines for trans-European energy infrastructure regulation (EU) 347/2013 and other countries use the Dutch model.

TenneT also uses underground cabling on several recent projects, e.g. in the Randstad 380 South Ring project, to help make projects more acceptable to local communities in densely populated areas.

The streamlining of procedures, however, should be accompanied by an active engagement at the local level and complemented by initiatives to secure local ownership on energy infrastructure projects, such as new wind farms or CHP plants, to respond to public opposition and ensure legitimate concerns of the citizens are taken on board.

Box 5.3 The State Co-ordination Programme for Energy Infrastructure Projects

In 2009, the Dutch government introduced the "State Co-ordination Programme for Energy Infrastructure Projects" with a view to improve the quality and timing of major energy infrastructure projects, including electricity infrastructure.

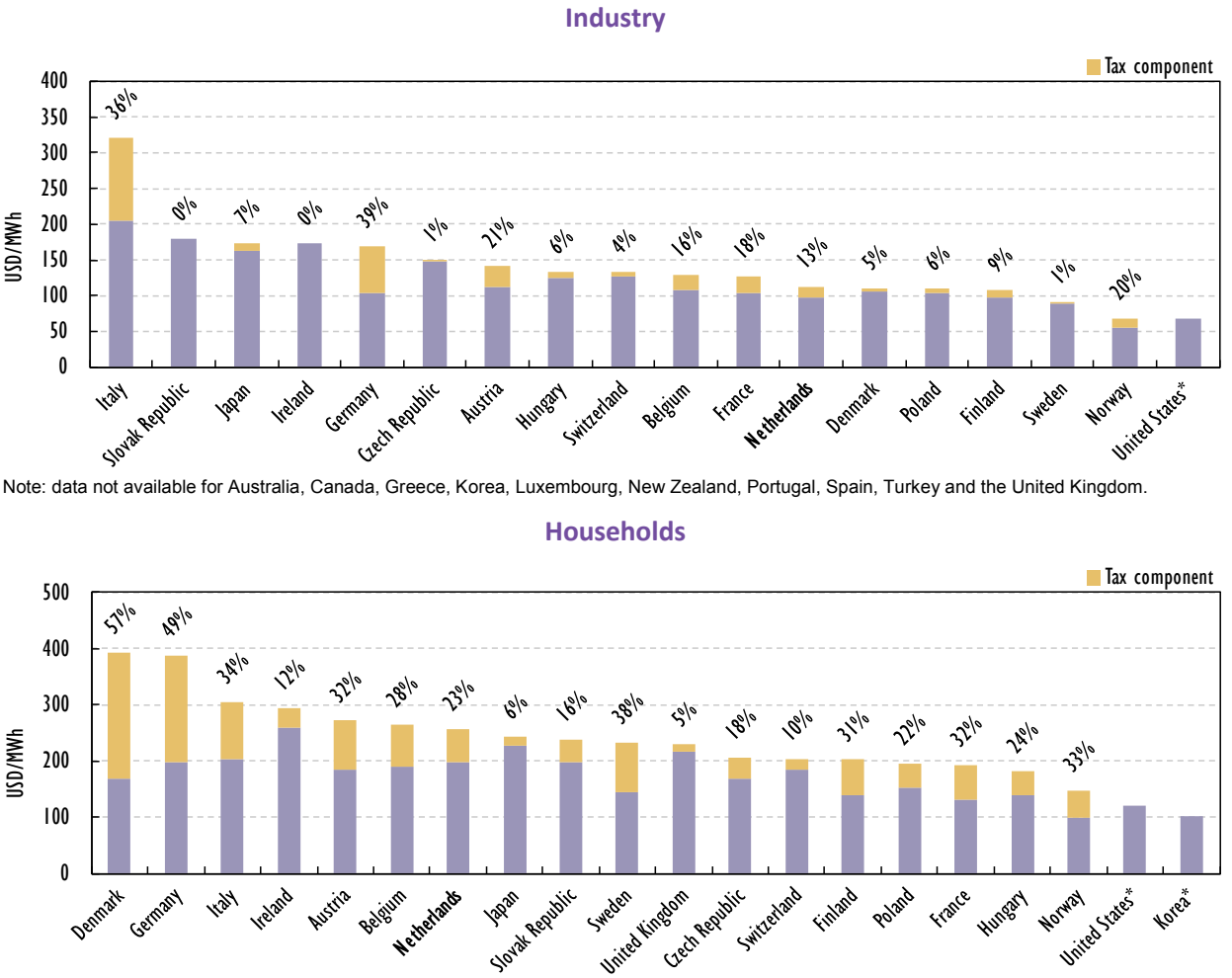
The programme streamlines procedures for major energy infrastructure projects deemed to be of national interest. It sets out legally binding criteria to designate energy infrastructure projects as projects of national interest (in the Electricity Act 1998), includes an automatic application of established rules in the national Environmental Planning Act to accelerate procedures, and provides direction by the central government (e.g. the Minister of Economic Affairs for electricity). Major elements of the State Co-ordination Programme are:

- Spatial reservation for the construction of energy infrastructure of national interest.
- Joint decision making by the Minister of Economic Affairs and the Minister of Infrastructure and Environment on a national zoning plan regarding projects of national interest. This national plan replaces (automatically) the zoning plan of a local authority.
- National co-ordination by minister(s) of the national zoning plan and linked permitting procedures, including permits granted by regional and local governments.
- Target duration for the overall process and the process stages: fast-track decisions on all permits and on the national zoning plan within six months and three months for regional and local input.
- Last-resort decision by the national ministers to overrule/decide on a regional or local government's permitting decision.
- Bundling of all permits which are to be granted and joint publication.
- Early public participation and consultation.
- Limit of one appeal per project.

RETAIL MARKET AND PRICES

The Dutch retail market is highly concentrated, but some competition is coming in with new retailers entering the market.[17] Three large supply companies hold 83% (HHI Index of 2 338) of a market of around 8.1 million energy customers, among them 7.4 million household clients. In total, there were 35 retailers active in the Dutch electricity market in 2012.[18]

Figure 5.10 Electricity prices and taxes, 2013



Note: data not available for Australia, Canada, Greece, Korea, Luxembourg, New Zealand, Portugal, Spain, Turkey and the United Kingdom.

Note: data not available for Australia, Canada, Greece, Luxembourg, New Zealand, Portugal, Spain and Turkey.

* Tax information not available.

Sources: *Energy Prices and Taxes*, OECD/IEA, Paris, 2013; country submission.

Retail prices are not regulated. Suppliers are obliged, however, to submit all prices to the regulator for review. ACM has the power to oblige suppliers to lower them. ACM has not set any price maximum, but requires every year several suppliers to give an explanation about the level of their prices, and to adjust them where necessary. While such regulatory powers may be justified from a consumer protection perspective, as retail competition is

17. *National Report on Energy Regulation in 2012*, ACM, The Hague, 2013.

18. ECN, Toegevoegde waarde van de elektriciteitssector voor de Nederlandse economie, October 2013.

developing, they have the potential to weaken incentives for efficient and timely investment and innovation in new products and services by suppliers and service providers, such as dynamic prices, in particular in a more mature and competitive market. Transparency and consumer protection can be ensured by other means, for instance by expanding the comparability between suppliers and by improving the understanding of energy bills. The government is encouraged to review these powers, with a view to removing them as competition has become effective.

In 2012, the Dutch household electricity bill reflected the split between the energy tax (36%), value-added tax (16%), the cost of the supply (28%), meter rental (3%) and network charges (17%).[19] On 1 December 2012, households paid on average EUR 1 835 per year for electricity and natural gas, 34% of which are supply costs, 23% network costs and meter rent, and 43% energy and value-added taxes.

Since market opening in July 2004, 65% of consumers have either switched suppliers or the contracts with their supplier. In the past years, the number of customers who switched supplier fluctuated around 10% and reached a record high of 12.6% in 2012. The propensity to switch is high with around 26%. The Netherlands is among the countries with the highest switching rates in Europe (which has switching rates of 6% to 8% on average). This success can be attributed to the companies' innovative offers, consumers' engagement to seek price savings and better services, and to past initiatives, such as collective switching and joint energy purchases.

Within an international comparison, the Dutch electricity prices for industry are below the IEA average but the household consumer bill is slightly above the IEA average. In a regional comparison, Dutch electricity prices for both households and industry are lower than in Germany and the United Kingdom, which may reflect lower wholesale prices in the region, resulting from efficient regional trade, effective market integration and higher shares of renewable energies.

SMART METERS, GRIDS AND MARKETS

Under the EU third internal market rules, every member state has to set out a timetable for the introduction of smart meters. After a positive cost-benefit analysis, at least 80% of consumers shall be equipped with such meters by 2020. The Energy Performance of Buildings Directive (EBPD) also requires national action plans to install smart meters.

The Dutch government adopted a vision and action plan for developing and deploying smart meters (for gas and electricity) in 2009. The revised Dutch Electricity Act and the Gas Act, which entered into force in 2012, oblige network operators (as owners of the smart meters) to offer all households and small businesses a smart meter. The law requires energy suppliers to provide bimonthly cost statements to those customers.[20] Customers are not obliged to accept the smart meter when offered, but can choose one with standard readings, or with detailed readings (real-time data beyond the minimum regulated level), no readings at all or to refuse the smart meter. The roll-out of smart meters in the Netherlands started in 2012 in a two-stage approach. Phase 1 (from 2012 to 2014) is an initial small-scale roll-out, covering regular meter replacements, new meters to be placed in newly built or renovated houses, and new meters on request by customers. During this phase, technical and economic matters, the level of energy savings and smart

19. *Energy and the Economy*, Ministry of Economic Affairs, 2012. See: www.government.nl/issues/energy/energy-and-the-economy.

20. *Smart Regions, European Smart Metering Landscape Report 2012*, Vienna.

metering services market development will be monitored. During the small-scale roll-out, approximately 500 000 smart meters were installed. In phase 2 (starting from 2015), a large-scale roll-out is planned to offer a smart meter to all households and small businesses in 2020.[21] The government and Parliament are to decide on this phase in the first half of 2014. If approved, the roll-out to all households in the Netherlands is to commence in January 2015.

Next to this, the smart city concept has been implemented in the city of Amsterdam and is being extended to all major Dutch cities. The Amsterdam Smart City Programme has been a driver for the development of smart and integrated projects for urban development. The PowerMatching City, involving a living lab of 25 households, has been the first "real" Smart Grid pilot project in Europe and became an international best practice case. All households are equipped with a mix of decentralised energy resources (wind, solar PV, micro-CHPs and hybrid heat pumps), energy buffering, smart appliances, smart meters and electric vehicles. The network use is optimised by trading the energy on a local market by real-time price signals using the PowerMatcher.

Box 5.4 Empowering consumer choice in electricity markets

International experience suggests that the key elements of an effective and integrated approach would include:

- increasing customer exposure to real-time pricing, with protection of vulnerable consumers addressed through targeted transfers that do not unduly distort efficient price formation
- a competitive, dynamic retail market to encourage the development of innovative products and services that can harness demand response effectively and at least cost
- ready access to detailed, real-time customer information, while ensuring privacy, to help stimulate competition, facilitate competitive entry, support the emergence of innovative business responses, and improve the quality of customer choice
- a knowledgeable and well-informed customer base that has the capability and opportunity to take full advantage of available choices
- market processes for contracting, switching and billing that are as simple and seamless as possible to keep transaction costs to a minimum
- legal and regulatory governance frameworks that reduce uncertainty, establish clearly specified rights, responsibilities and obligations on contracting parties, promote greater harmonisation of standards and functionality specifications, and maximise scope for participation among potential service providers and customers
- enabling technologies that provide cost-effective, real-time metering information, verification and control capability to support the introduction of real-time pricing, the development of a wider range of innovative demand response products, and more effective customer choice.

Source: IEA, Empowering Customer Choice in Electricity Markets, 2011, www.iea.org/publications/freepublications/publication/Empower.pdf.

21. *Ibid*.

The development of smart markets and energy-saving services will require regulatory and technology innovation. Providing business with a framework for innovative products, while securing consumers' privacy and security, will be a key task for policy makers in the coming years (See Box 5.4).

Experience in New Zealand and European markets, notably Ireland, shows that the deployment of smart meters can be facilitated by establishing an independent data management system, effective switching procedures, strong regulatory oversight and more dynamic pricing for innovative retail product development. The Dutch distribution unbundling and supplier switching experience can serve as an effective basis to develop a well-functioning Dutch retail market.

ELECTRICITY SECURITY

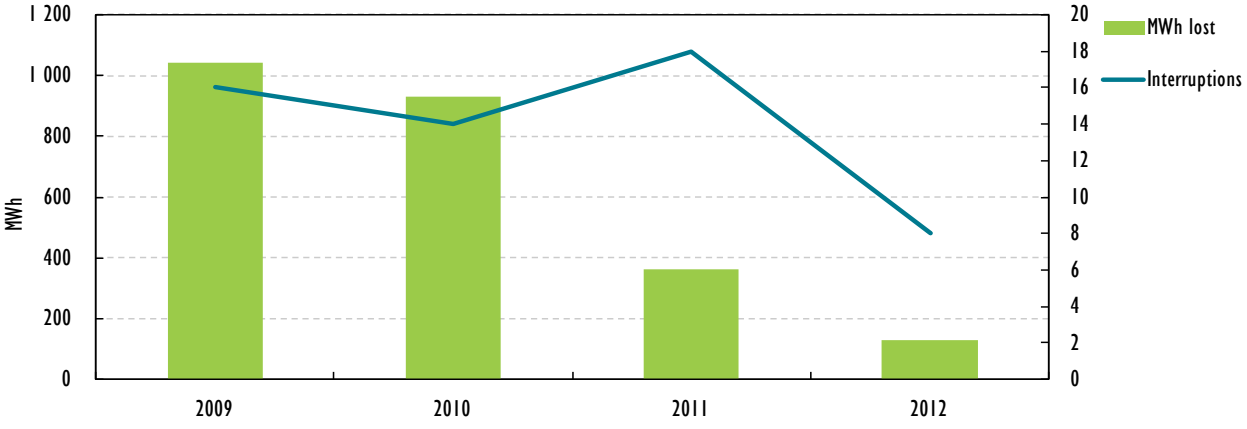
In-depth country reviews focus on the adequacy dimension of electricity security. Adequacy in this context refers to a power system's capability to meet changes in aggregate power requirements in the present and over time, through timely and flexible investment, operational and end-use responses.

POWER SYSTEM ADEQUACY

Overall power system adequacy appears to be rapidly improving in the Netherlands, as reported by TenneT[22] on recent trends in continuity of supply. Figure 5.12 shows data on the number of interruptions and the resulting power not supplied between 2009 and 2012.

The volume of electricity not supplied, which is a common measure of continuity of supply, has fallen dramatically from 1 043 MWh lost in 2009 to 127 MWh lost in 2012, representing a reduction of nearly 90%. It is an important success for the Netherlands to secure the reliability of the supplies of electricity.

Figure 5.12 Continuity of supply indicators for the Netherlands, 2009-12



Source: IEA, 2013.

At the same time, the number of interruptions has also fallen significantly from between 14 to 18 in 2009 to 2011 down to 8 in 2012. The average number of megawatt hours lost

22. The data set for the assessment of the power system adequacy reflects the status as of July 2013 and does not include the planned closure of the 3 GW coal-fired power capacity.

per interruption has also fallen substantially over the period from around 65 MWh per interruption in 2009 and 2010 to around 20 MWh lost per interruption in 2011 and just below 16 MWh per interruption in 2012. Only 4 of the 56 recorded interruptions between 2009 and 2012 occurred in the transmission system, representing a combined loss of 53 MWh, or around 2.2% of all losses recorded over the period. The vast majority of electricity not supplied occurred as a result of problems in the distribution system.

Improved performance may reflect a combination of factors, including: improved power system management; improved generation and network resource adequacy; improved resilience of infrastructure; and more effective regional market integration. Demand response appears to play a relatively small role at present but also has the potential to make a significant contribution to improving power system resilience and adequacy, especially during peak periods, if it can be more effectively harnessed into the future.

TenneT is responsible for monitoring and advising on electricity security trends, including generation adequacy, in the Netherlands, with an annual review of power system security – the *Security of Supply Monitoring Report* – prepared for the Ministry of Economic Affairs. However, this review does not address network adequacy.

TenneT produces a separate biennial Quality and Capacity Plan to support integrated development of the transmission and distribution systems to maintain network adequacy in response to expected generation, consumption and regional trade developments. Consideration could be given to developing a more integrated approach reflecting the interrelated nature of generation and network adequacy issues. Accordingly, the government and TenneT are encouraged to align the monitoring and assessment of generation and network adequacy, where possible, for instance by extending the annual security of supply report to cover network adequacy, including the availability of interconnections.

GENERATION ADEQUACY

As shown above, the Netherlands currently enjoys a large surplus in generating capacity and a comfortable generator reserve margin reflecting the substantial net increase in thermal generating capacity which has occurred over the last few years, with planned new investment and proposed expansion of interconnector capacity expected to deliver very high levels of generation adequacy in the medium term.

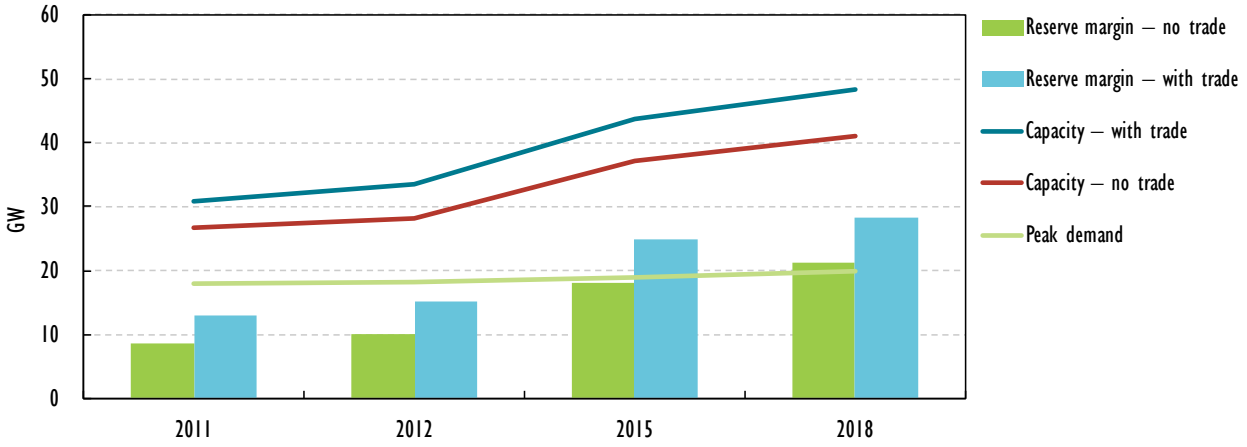
Figure 5.13 shows the very healthy levels of generation adequacy at present which are to grow in the medium term. The maximum generation reserve was around 10 GW in 2012, a maximum reserve margin of over 55%. Strong regional market integration serves to substantially strengthen effective generation adequacy. When maximum potential import capacity is added to domestic generation, the maximum reserve increases to 13 GW, which represents a reserve margin over peak demand of around 84%.

Moderate projected medium-term demand growth and substantial net additions to domestic generating and interconnection capacity are projected to increase this margin substantially through to 2018. By 2015, the effective generation reserve with trade will be more than twice the projected peak demand, while by 2018 domestic generation alone is expected to be more than twice peak demand.

However, this analysis probably overstates the actual level of generation adequacy in practice as it includes all sources of variable renewable generation which, because of their inherent intermittence, are generally excluded from these calculations. In 2012, variable renewable generation accounted for around 2.75 GW, or just below 10% of

installed domestic capacity. Excluding this capacity from the calculations would imply an effective domestic generating capacity reserve of around 7.25 GW, and a still substantial reserve margin of nearly 40% of peak demand.

Figure 5.13 Generation adequacy indicators for the Netherlands, 2011-18



Source: IEA, 2013.

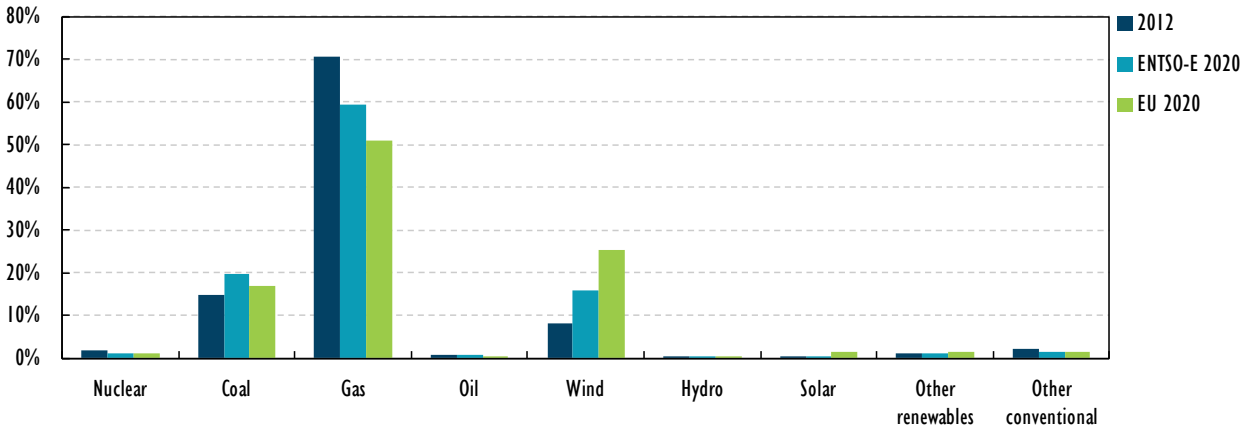
It is expected that generation adequacy would remain strong even under the most ambitious medium-term scenario for expansion of variable renewable generation in the Netherlands, which incorporates a fourfold increase in wind and solar generation capacity to over 12 GW by 2020. Under this scenario, there would still be a substantial dispatchable generation reserve margin of nearly 11.4 GW, or around 56% of projected peak demand in 2020. Similarly, the most ambitious longer-term scenario which includes around 21 GW of variable renewables by 2030, representing around 40% of the forecast generation stock, results in a robust dispatchable generation reserve margin of around 4.8 GW, or just over 20% of projected peak demand.

Generation adequacy will also be increasingly affected by the nature of available resources and reserves, especially where liberalisation, more effective regional market integration and the large-scale deployment of variable renewable generation results in more dynamic real-time power flows over time. In general, a more diversified generation fleet which incorporates a range of technologies and fuel sources is likely to be more resilient and able to adapt more effectively to these more dynamic market conditions.

Figure 5.14 shows that the electricity sector in the Netherlands is dominated by gas-fired generation. In 2012, around 70% of domestic generating capacity was gas-fired. Forecast substantial investments in onshore and offshore wind generation and coal-fired generation to 2020 are expected to reduce the dominance of gas-fired plants in the domestic generation mix to some degree. However, even under the most ambitious scenario, gas-fired plants are expected to continue to dominate domestic generation, representing nearly 60% of total domestic generating capacity in 2020.

By contrast, efficient regional market integration and cross-border trade has the potential to substantially improve domestic diversity of supply. In 2012, interconnection net transfer capacity (NTC) into the Netherlands stood at around 5 200 MW, with proposed projects expected to increase that transfer capacity to around 8 100 MW by 2020. Revised calculations taking this capacity into consideration reduce the effective dominance of gas-fired plant from 70% of production capacity to just below 60% today, and from between 51% and 59% in 2020 to between 44% and 51% under the EU and ENTSO-E 2020 scenarios.

Figure 5.14 Generation diversity indicators for the Netherlands, 2012-20



Sources: ENTSO-E; IEA, 2013.

By contrast, efficient regional market integration and cross-border trade has the potential to substantially improve domestic diversity of supply. In 2012, interconnection net transfer capacity (NTC) into the Netherlands stood at around 5 200 MW, with proposed projects expected to increase that transfer capacity to around 8 100 MW by 2020. Revised calculations taking this capacity into consideration reduce the effective dominance of gas-fired plant from 70% of production capacity to just below 60% today, and from between 51% and 59% in 2020 to between 44% and 51% under the EU and ENTSO-E 2020 scenarios.

The high level of exposure to gas-fired plants does not necessarily imply a generation adequacy problem. On the contrary, generation adequacy will be increasingly affected by the degree to which resources can be flexibly deployed to manage the inherent intermittence associated with the large-scale deployment of variable renewable generation. Gas-fired power plants are among the most flexible generation technologies available and could serve to improve the power sectors' resilience and capacity to support the large-scale introduction of variable renewable generation.

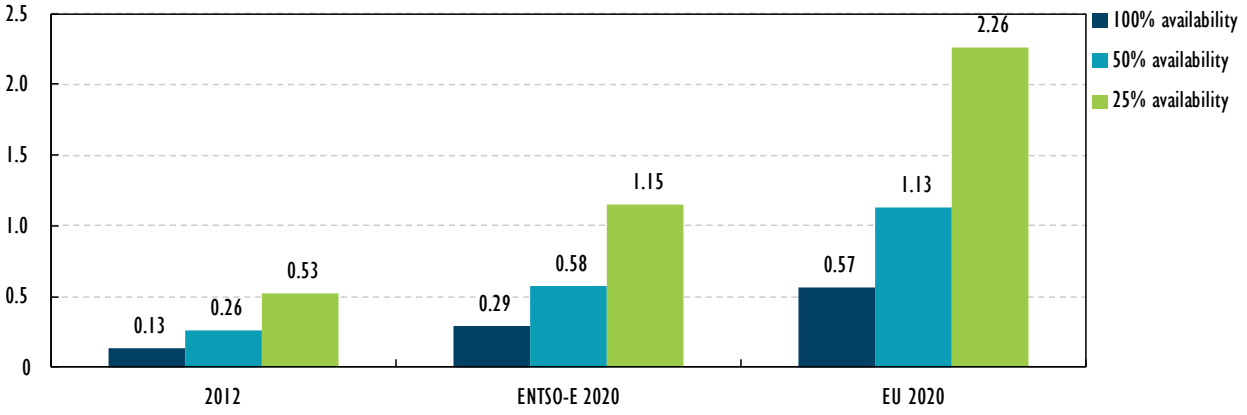
Figure 5.15 presents a simple measure of power system flexibility which is calculated by dividing the total volume of variable renewable generation by the total volume of flexible conventional power generation available to provide backup generation if required. Under this measure, a result of less than or equal to one would suggest that sufficient flexible conventional generation exists to meet power system flexibility requirements, while a result greater than one would suggest that there may be insufficient flexible generation to meet power system flexibility requirements. The magnitude of the difference between potential flexible conventional generation and flexibility requirements would give a very rough indication of the magnitude of "spare" flexibility that may exist and, hence, the capability of the power system to absorb more variable renewable generation.

This measure is a broad indicator and does not take into account potential practical deployment constraints such as plant availability, network congestion, ramp rates or contractual restrictions, which could be expected to reduce the potential to deploy power system flexibility in practice.

It also excludes other sources of domestic flexibility, like demand response and storage. Availability factors have been presented to help reflect these limitations. The 50% availability factor shows the flexibility ratio assuming that 50% of the total flexible conventional

generation is not available for deployment, while the 25% availability factor shows the flexibility ratio assuming that 75% of the total flexible conventional generation is not available for deployment.

Figure 5.15 Power system flexibility indicators for the Netherlands, 2012-20



Sources: ENTSO-E; TenneT; IEA, 2013.

Sensitivity analysis based on these indicators suggests that the Dutch power system has substantial flexibility to support considerable expansion of variable renewable generation without unduly jeopardising generation adequacy. In 2012, the electricity sector recorded a maximum power system flexibility ratio of 0.13, which suggests that there is already considerable flexibility to support existing variable renewable generation and further large-scale deployment. Even with the substantial variable renewable generation deployment envisaged under ENTSO-E and EU 2020 scenarios, any related intermittence could be comfortably managed with the flexibility provided by the current fleet of gas-fired generation if its flexibility can be fully harnessed.

Even if only half the gas-fired plant was available to provide flexible backup, it is unlikely that generation adequacy concerns will occur till 2020. Under a 50% availability rate, sufficient flexibility would remain to meet requirements up to 2020 in all but the most ambitious scenario. However, under a 25% availability, the volume of variable renewable generation may be approaching or exceed the capacity of the power system to absorb by 2020, especially under the more ambitious EU 2020 scenario.

More effective regional market integration has the potential to substantially add to the level of flexibility, in particular with the introduction of flow-based market coupling and more effective intra-day markets across the CWE region. This will strengthen price-based incentives for timely regional power flows to help address variable renewable generation management in the Netherlands and beyond. Given the Netherlands strategic location as a nexus for power flows across the CWE region, it would be well placed to offer increasing flexibility and resilience needs in a more effectively integrated regional power system.

However, current strong levels of generation adequacy and their continuation into the medium term should not be taken for granted. Weak economic conditions across Europe have undermined the business case for new conventional generation projects in several jurisdictions. The large-scale deployment of variable renewable generation and its associated

"merit order" and "compression" effects[23] are eroding the economics of conventional generation. The combination of these factors may result in significant investment delays and deferrals, and "mothballing" or premature closure of some existing plants, which together could substantially reduce levels of generation adequacy in the medium term.

In response, several governments within the CWE region are considering regulatory mechanisms, including various forms of capacity payments, to address concerns about resource adequacy and timely investment responses. Capacity payments have been used in various IEA jurisdictions in the past and have proven useful where price caps have created "missing money" problems or in small and/or isolated power systems that are energy-constrained, and experience weakened investment incentives. However, they also raise some substantial concerns. They effectively replace market-driven investment with central planning, which has the potential to add considerable regulatory risk and cost for investors and consumers alike.

Current investment and supply-demand balance trends suggest that the Netherlands does not need a capacity mechanism to secure sufficient and timely generation investment to maintain resource adequacy. However, the application of disparate capacity regimes among neighbouring jurisdictions within the CWE could create additional risks for investors in the Netherlands, which may delay or defer conventional generation investments, and this can reduce the level of generation adequacy in the long term.

Policy and regulatory responses to address resource adequacy need to be developed in close co-operation between all jurisdictions within the CWE to avoid undue distortions that could jeopardise market efficiency, electricity security and cost-effectiveness. The Netherlands has the opportunity to play a leading role in developing a more consistent policy and regulatory framework for resource adequacy issues across the CWE through its participation in the Pentalateral Energy Forum, particularly in the context of progressing the recently endorsed market integration and security of supply initiatives.[24] At the same time, the Netherlands should strongly support initiatives at EU level, including through the activities of the Electricity Coordination Group.

As neighbouring countries have started implementing capacity mechanisms (Germany, the United Kingdom and France), the Netherlands could benefit from pooling a cross-regional winter reserve capacity in CWE, fully integrated into the wholesale market design, including participation of demand bids, similar to the Nordic strategic power reserve. Such a mechanism should be viewed as a temporary measure in a regional market. Several other possibilities could also be examined in this context, including programmes to more effectively harness demand response; requiring large-scale variable renewable generation to manage all balancing costs and to bid for dispatch; examining the potential to emerge day-ahead and intra-day markets; and moving gate closure closer to real time.

However, if in the coming years such regional engagement fails to deliver a satisfactory outcome, the Netherlands may need to consider alternative regulatory arrangements to ensure security of electricity supply in the longer term. At present, the Netherlands can

23. The "merit order" effect refers to the impact of self-dispatch variable renewable generation on merit order dispatch whereby large volumes of self-dispatch generation can "crowd out" dispatchable plant at the margin, resulting in a systemic reduction of wholesale spot market prices, which can substantially reduce spot market revenues for generators. The "compression" effect refers to the reduction in operating hours experienced by dispatchable plant as a result of being displaced by self-dispatch variable renewable generation.

24. See Political Declaration of the Pentalateral Energy Forum, Luxembourg, 7 June 2013: www.benelux.int/pdf/pdf/201306_PoliticalDeclarationOfThePentalateralEnergyForum.pdf.

activate a very general "safety net" mechanism whereby the Minister of Economic Affairs may direct the TSO to contract for additional power supplies for several years so as to address a looming shortage in generation resource adequacy, based on the annual security of supply report. This mechanism has not been used to date and many of the key details, such as criteria for decision making, trigger events, and administrative procedures, are to be defined. Although the Netherlands has no immediate need for such a mechanism, it may be prudent to test and develop existing safety net arrangements so that they can be smoothly and efficiently implemented, if required in the future.

NETWORK ADEQUACY

Network adequacy in the present reflects the volume of available network resources and how effectively they are deployed to maximise efficient power flows in real time, subject to technical network requirements. In the longer term, network adequacy will largely be determined by the timing, size and location of new network investments and how well network capacity is deployed to meet changing patterns of use. More dynamic real-time and regional power flows resulting from policies to promote regional market integration and decarbonisation bring about new and less predictable patterns of congestion and in increasing volumes of unscheduled power flows. There are many new challenges for maintaining network adequacy and security.

The Netherlands has a relatively meshed transmission system that provides multiple flow paths. It is also well served by several interconnectors. In 2012, total interconnector NTC represented around 17% of total domestic generating capacity and is expected to rise to around 20% of total domestic generating capacity by 2020. The Dutch transmission network appears to have sufficient capacity from a resource adequacy perspective at present, with a meshed national system complemented by regional interconnectors that, together, provide a range of flow paths capable of ensuring reliable delivery of electricity to end-users.

However, more dynamic power flows resulting from variable renewable generation imports, combined with substantial new generation investments, including significant planned offshore wind generation, have the potential to significantly increase congestion and reduce network resource adequacy in the medium term. Early indications of stress are already emerging, with increasing periods of intra-regional and inter-regional congestion reflected in falling levels of price convergence with adjacent power exchanges, as previously discussed. TenneT works on the completion of the Randstad ring to enhance East-West transmission capacity in the Dutch system.

Holistic and co-ordinated regional network planning, supported by effective information and modelling, is needed to facilitate timely and appropriate investment. As previously discussed, TenneT participates in the biennial ENTSO-E Ten-Year Network Development Plan (TYNDP), which provides a co-ordinated strategy for integrated regional network development. The 2012 TYNDP proposed several priorities for network augmentation to maintain network adequacy under several scenarios to 2030.[25] TenneT is considering several additions and augmentations to existing interconnector capacity, including a new 400 kV double circuit interconnector with Germany, a second interconnector with Norway and the 320 kV COBRA interconnector with Denmark, to strengthen interconnector resource adequacy to 2018.

25. *Ten-Year Network Development Plan 2012*, European Network of Transmission System Operators for Electricity, 5 July 2012.

TenneT also produces a biennial Quality and Capacity Plan to support the integrated development of the domestic transmission and distribution network. The 2010-16 Plan confirmed the need for the major 380 kV and 220 kV intra-regional grid upgrade projects currently under construction. It also identified two potential capacity constraints which could emerge, depending on how power flows associated with new generation investment and regional market integration develop into the medium term. Overall, TenneT considers that the existing intra-regional transmission network will be sufficient to ensure network adequacy into the medium term.

TenneT is co-operating with neighbouring TSOs to improve network management, with a view to improving regional electricity security and network adequacy by increasing available transfer capacity (ATC) on interconnectors with the Netherlands. Since 2009, TenneT has co-ordinated system operations with neighbouring TSOs in the CWE region and beyond through the Transmission System Operator Security Cooperation initiative (TSC). TenneT is also pursuing bilateral projects with neighbouring TSOs to help improve congestion management, increase ATC on the interconnectors and strengthen effective network adequacy. In 2014, TenneT and Amprion SSC co-operate to increase the intra-day capacity on the Dutch-German border by additional 100 MW per hour. In 2012, TenneT and Belgian TSO Elia achieved an effective increase of the NTC on the Dutch-Belgian border of up to 300 MW by adopting more effective congestion management arrangements.

Box 5.5 Regional co-operation on network security

The TSO Security Cooperation Initiative (TSC) provides a consistent framework for information-sharing and improved co-ordination of system operation, which can help system operators to more effectively manage congestion and unscheduled power flows, enabling them to increase effective net transfer capability and resource adequacy within the CWE regions.

Along with market coupling CWE, TSOs in the region have put in place co-ordination for network reliability and system stability. Today, there are different bilateral and multilateral platforms of TSOs, including the Transmission System Operator Security Cooperation (TSC) with 12 TSOs: from Germany (50Hertz, Amprion, TransnetBW, TenneT Germany), the Netherlands (TenneT B.V.), Denmark (Energienet DK), Austria (APG, VKW-Netz), Switzerland (swissgrid), Hungary (Mavir), Poland (PSE), Czech Republic (ČEPS), Slovenia (ELES) and Croatia (HEP); and also the CORESO co-operation by TSOs from Great Britain (National Grid), France (RTE), Belgium (Elia), North-East Germany (50Hertz) and Italy (Terna). It would be beneficial to integrate those separate efforts into a larger regional Central-West/North-West Europe co-operation platform for security co-operation, in particular as the Netherlands and Germany ideally need to contribute to two platforms.

In June 2013, the Pentalateral Energy Forum renewed its commitment to the implementation of the implicit flow-based market coupling in 2014. The Forum also committed to resolve the barriers between the regional markets and further integrate the Nordic borders, Austria and Switzerland. Forum members called for a strengthened governance and co-operation on security of supply, importantly on adequacy and network development, in the context of the energy transitions taking place in the region.[26] The Pentalateral Forum

26. Political declaration of the Pentalateral Energy Forum of 7 June 2013: www.benelux.int/pdf/pdf/201306_PoliticalDeclarationOfThePentalateralEnergyForum.pdf.

expects proposals for a reinforced exchange and co-ordination process for risk management in black outs (D-1 and D-2 situations), as well as in an intra-day time in order to cope with the massive integration of renewable energy.

Distribution network adequacy appears to be sufficient according to TenneT's latest Quality and Capacity Plan. However, the Plan notes the increasing volumes of decentralised generation and its potential to raise new challenges for maintaining distribution network adequacy into the future.

ASSESSMENT

The Netherlands has successfully implemented the comprehensive liberalisation of its electricity sector over the past decade. Key achievements have included wholesale structural reform, the creation of an effective wholesale spot and forward market and intra-day trading, and the introduction of open access and incentive-based economic regulation of transmission and distribution networks. At the same time, the government has pursued a policy of regional market integration supported by key network investments linking it to the Nordic market and to the United Kingdom. Wholesale market reforms combined with improved market integration have delivered a more competitive electricity sector that has attracted considerable generation investment, while greatly improving electricity diversity and security of supply at least cost. The implementation of market coupling across Central and North-West Europe, including intra-day capacity trading, decreased the volatility of the Dutch wholesale price considerably, compared to other markets in the CWE area, and the future flow-based allocation and integrated regional intra-day trading have the potential to multiply these benefits, including facilitating new export opportunities for Dutch generators.

However, a combination of factors are emerging which create new challenges for Dutch wholesale electricity markets and for maintaining electricity security. Dutch policy makers have set ambitious goals for new renewable generation investment in response to binding European Union 2020 targets, which imply an increase in renewable generating capacity of up to 7 GW by 2020. This new investment is planned at a time when domestic demand is subdued and levels of excess generating capacity are already over 40%, with over 3 GW of new coal-fired generation capacity to be commissioned over the next two years. Given current spark spreads,[27] efficient and flexible gas-fired plants could become unprofitable, possibly resulting in mothballing and premature plant closures, which could substantially reduce power system flexibility at a time when it will be required to absorb large amounts of variable renewable generation.

The economics of Dutch gas-fired plants is coming under further pressure as subsidised imports of renewable generation from Germany continue to depress spot prices in Germany and the Netherlands, further reducing operating hours while reducing the potential for Dutch power exports. Pressures are building among other jurisdictions within the North-West European electricity market to adopt a range of regulatory interventions to address these problems – such as capacity payments − which have the potential to further distort efficient regional market operation and development.

27. The spark spread describes in energy trading markets the possible gross margin of a gas-fired power plant from selling a unit of electricity, having bought the fuel required to produce this unit of electricity, and the ability to cover operation and maintenance, capital and other financial costs.

An integrated approach with national and regional dimensions will be needed to effectively address these challenges in a way that maintains the integrity of the Dutch and North-West European wholesale electricity markets while addressing investment, reliability and decarbonisation goals in a timely and least-cost manner. Increasing reliance on nationally focussed policies will not be sufficient to meet the challenge and could magnify regulatory risks and distortions that may jeopardise the development of an efficient, innovative and cost-effective regional outcome. As the European electricity industry association, Union of the Electricity Industry (Eurelectric), recently noted:

> "Europe is not facing a 'simple' problem of technical capacity but a larger one of energy policy and market integration. Grid reinforcement via PCIs [projects of common interest] should therefore go hand in hand with broader efforts to integrate wholesale markets, remove regulated end-user prices, integrate renewables into the market, and develop flexible gas markets."[28]

At a North-West electricity market level, opportunities exist to enhance energy-only markets, including more effective harnessing of demand response and incorporation of large-scale remotely located renewable generation into a regional balancing and market-based dispatch. Similarly, opportunities may exist to improve harmonisation and co-ordination of system operation and network regulation. The Dutch government is also encouraged to continue its engagement with neighbouring jurisdictions within the North-West European electricity market and more broadly across the European Union, with a view to building support for greater harmonisation of renewable subsidy schemes to support more efficient and secure regional market operation and development.

At a national level, efficient and timely network development will have a crucial role to play in supporting the deployment of new renewable generation while serving to help maintain electricity security and effective regional market integration. A range of measures could be considered in this context, including adopting an *ex ante* regulatory regime to reduce network investment risks and explore the potential to enhance co-ordinated approval processes for new offshore network investments. Monitoring of electricity security could be enhanced by aligning the assessments of network adequacy and TenneT's annual report of generation adequacy.

Commendably, the Dutch government streamlined permit granting procedures through a one-stop-shop approach. While the durations and co-ordination between different phases and authorities in the permitting process increased, the involvement of the public at the local level will be fundamental to ensure future infrastructure development, create local ownership and employment. Enhancing environmental impact assessments in that regard will deliver a better understanding and ownership of the citizen for the needed infrastructure development.

Capacity levels are more than sufficient to ensure generation adequacy into the medium term without need for regulatory interventions, such as capacity mechanisms. However, neighbouring countries (the United Kingdom, Germany, France) are currently discussing the implementation of reserves or capacity markets in their constituencies. The co-ordination of regional reserves will become a greater priority with German and UK markets implementing capacity arrangements. If a regional solution does not materialise or interconnection capacity is not available, the Netherlands may need to reassess its generation adequacy and consider alternative solutions. In the Netherlands, a safety net capacity

28. *EURELECTRIC welcomes go-ahead for grid infrastructure projects,* Eurelectric, Press release, 14 October 2013.

provision exists today. However, it has never been used and many of its key operational details are not clear. It would be prudent to review the safety net capacity provision in the future to ensure that it can be deployed in a timely and efficient manner, if needed.

The IEA, in the 2008 in-depth review of the Netherlands, raised a lack of competition in the retail market as a cause for concern, particularly noting low supplier switching rates. The Dutch government has made significant progress in promoting competition in retail markets since that time, as demonstrated by the adoption of legislation through Parliament for a new market model in February 2011. The new market model benefits from the unbundling of distribution and supply activities and is intended to empower consumers by improving transparency in the energy supply chain through, for example, greater standardisation of energy offers. After a first attempt to establish a competitive metering market in the Netherlands, the government and Parliament are to decide in the first half of 2014 on the mandatory large-scale roll-out of smart meters, to commence from January 2015 to all households in the Netherlands. The availability of smart meters will be a fundamental prerequisite to develop innovative energy products and services, which will be a driver for energy efficiency measures. Given this important aspect, the wider economic and social benefits, notably from energy savings, should be taken into account when deciding on the large-scale roll-out of smart meters, the stimulation of demand-side response and dynamic pricing structures.

There is also evidence that competition is improving in the retail markets, as demonstrated by the 12.7% supplier switching rate in 2012, the highest level yet recorded. However, competition could be further improved in the retail market to allow the development of more innovative retail products and to support the roll-out of smart meters. The steady improvement of competition in the retail market further suggests that the role of the ACM in controlling retail tariffs may no longer be necessary. The removal of this approval role should be replaced by the role of stimulating further demand-response measures and innovative tariffs, including time-of-use tariffs, through retailers in support of the roll-out of smart meters. The focus on lowering energy unit prices needs to be shifted to the need of lowering consumer energy costs. The IEA further notes that the recent reform of the national regulatory and competition authority into the creation of ACM with an independent budget has meant that consumer issues are considered by the same authority which regulates energy markets and safeguards competition. The implementation of the measures should be closely monitored to ensure that customers are able to access appropriate retail offers, and also for the government to evaluate their success. The government, on the basis of that monitoring, should then consider whether further means of empowering consumers are appropriate, particularly if the tariff approval function is removed.

RECOMMENDATIONS

The government of the Netherlands should:

- ☐ *Consider measures to strengthen efficient and timely network investment and to improve electricity security, including:*
  - *by adopting an appropriate* ex ante *regulatory regime to reduce network investment risks*
  - *by reviewing co-ordinated investment approval processes to identify options to further streamline arrangements, especially in relation to both onshore and offshore generation and network facilities*

- *by incorporating assessments of network adequacy into TenneT's annual report monitoring power system adequacy.*

- *In the medium term, in case regional solutions do not materialise or if interconnection capacity is insufficiently available, the "safety net" capacity provision could be reviewed to ensure that it can be deployed, if required, in a timely and efficient manner that minimises distortions to markets.*

- *Complement efficient permit granting procedures by facilitating public participation and local ownership of the new energy infrastructure projects.*

- *Remove ACM's* ex ante *price monitoring function in retail markets and foster the development of more innovative retail products; support the roll-out of smart meters, while ensuring that consumers continue to benefit from competitive markets.*

- *Continue to monitor competition in retail energy markets, particularly with regard to evaluating the implementation of the new market model against the objectives of completing the smart meter roll-out through increased transparency for business and consumers and thus increasing consumer empowerment.*

- *At a regional level, continue to actively engage with North-West European electricity market jurisdictions, in particular through co-operation in the Pentalateral Energy Forum and at an operational level between TSOs, including through SSC, CORESO and TSC, and more broadly across the European Union, to build support for the development of efficient, competitive and innovative power markets, including:*

  - *by exploring options to enhance the functioning of energy-only markets to more effectively harness demand response and incorporate large-scale remotely located renewable generation into balancing and market-based dispatch*

  - *by leading efforts to strengthen co-ordination of system operation and network regulation, and to harmonise renewable support programmes to promote efficient regional market development.*

6. RENEWABLE ENERGY

Key data (2012)

Share of renewables: 5.3% of TPES and 14.1% of electricity generation (IEA median: 9.7% of TPES and 21.7% of electricity generation)

Biofuels and waste: 4.7% of TPES and 8.7% of electricity generation

Wind: 0.5% of TPES and 4.9% of electricity generation

OVERVIEW

The Netherlands has renewed its ambitions to support the cost-effective deployment of renewable energy sources as a pillar of its 2013 National Energy Agreement for Sustainable Growth (hereafter the Energy Agreement). Next to reaching its EU target to achieve a share of 14% of renewable energies in gross final consumption, the country aims to raise it to 16% by 2023.

In 2013, the Netherlands considerably lags behind its targets and the pace of renewable deployment in neighbouring countries. Since 2005, the share of renewables in the Dutch final electricity consumption has doubled, from 2.4% in 2005, to 4.3% in 2011 and to 4.5% in 2013.[1] Starting from low levels, growth was highest in electricity generation with additions from biofuels and waste,[2] and wind.

In 2013, the government reformed its support policy, the Sustainable Energy Incentive Scheme (SDE+), towards a cost-efficient, technology-neutral and market-based scheme. Delivery of the ambitions remains challenging, given the priority given to cost and the pace of deployment in neighbouring countries. The Netherlands will need to adopt a more comprehensive renewables policy, integrating economic opportunities, innovation and scaled up actions to reduce non-economic barriers.

RENEWABLE ENERGY SUPPLY

Energy from renewable sources totalled 4.2 million tonnes of oil-equivalent (Mtoe) in 2012, comprising 5.3% of total primary energy supply (TPES). Over the past decade, energy from renewables has increased by 98.5%, up from a share of 2.8% in total supply in 2007, when the last IDR was carried out.

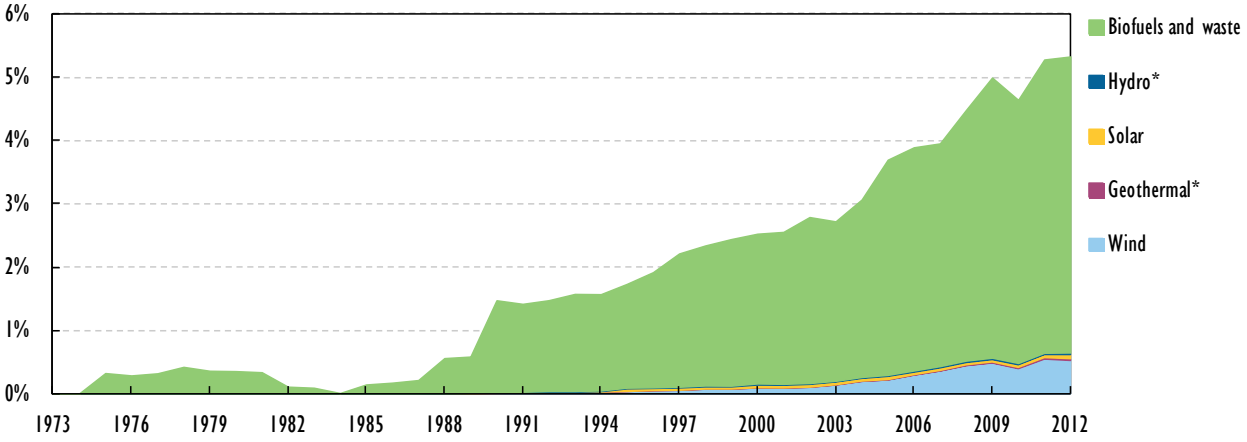
Biofuels and waste are the main sources of renewables in the Netherlands, amounting to 4.7% of TPES in 2012. Growth in biofuels and waste has spurred since the mid-1980s, increasing by 85.6% in 2002 alone. Energy from wind power has also boomed, growing by 427.2% from negligible levels in 2002 to 0.5% of TPES in 2012. Solar energy has increased by 60% but is still at quite negligible levels, equal to geothermal. Hydropower is very small. The Netherlands ranks sixth-lowest with regard to the share of renewables

1. *Renewable energy progress report*, European Commission, COM(2013)175 final: and country submission.

2. Biofuels and waste = solid and liquid biofuels, biogases, industrial waste and municipal waste.

in TPES among IEA member countries, slightly above the shares of the United Kingdom, Australia, Japan or Luxembourg. The share of biofuels in TPES is the tenth-lowest.

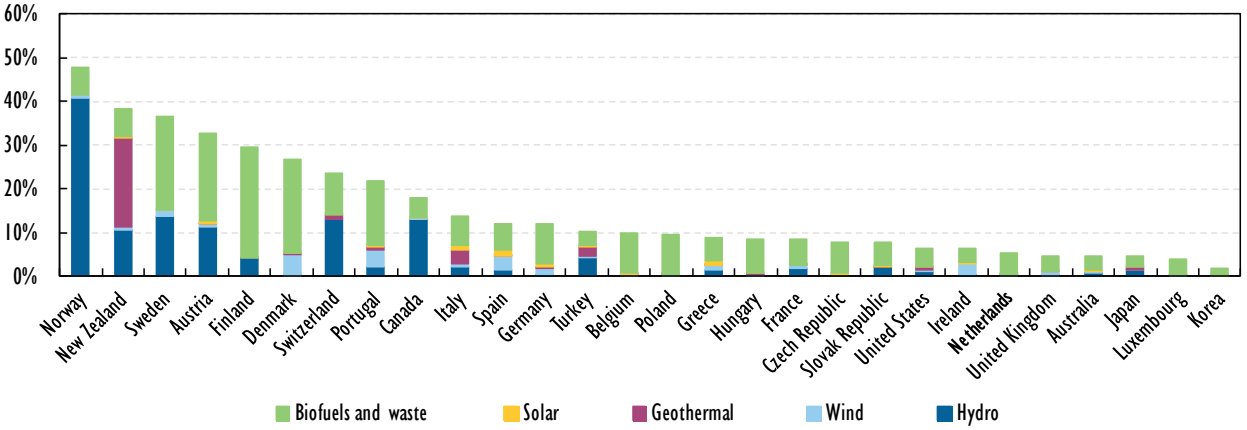
Figure 6.1 Renewable energy as a percentage of TPES, 1973-2012



* Negligible.

Sources: *Energy Balances of OECD Countries*, OECD/IEA, Paris, 2013; country submission.

Figure 6.2 Renewable energy as a percentage of TPES in IEA member countries, 2012



Note: data for the Netherlands and Austria are actual and estimated for other countries.

Sources: *Energy Balances of OECD Countries*, OECD/IEA, Paris, 2013; country submissions.

RENEWABLES IN ELECTRICITY GENERATION AND HEAT

Electricity from renewable sources in the Netherlands has experienced significant growth over the past decade, increasing from 5.2 terawatt hours (TWh) in 2002 to 14.4 TWh in 2012. As a share of total electricity output, renewables are up from 5.7% in 2002 to 14.1% in 2012. As a comparison, the IEA average was 21.7% of renewable energies in the electricity generation in 2012.

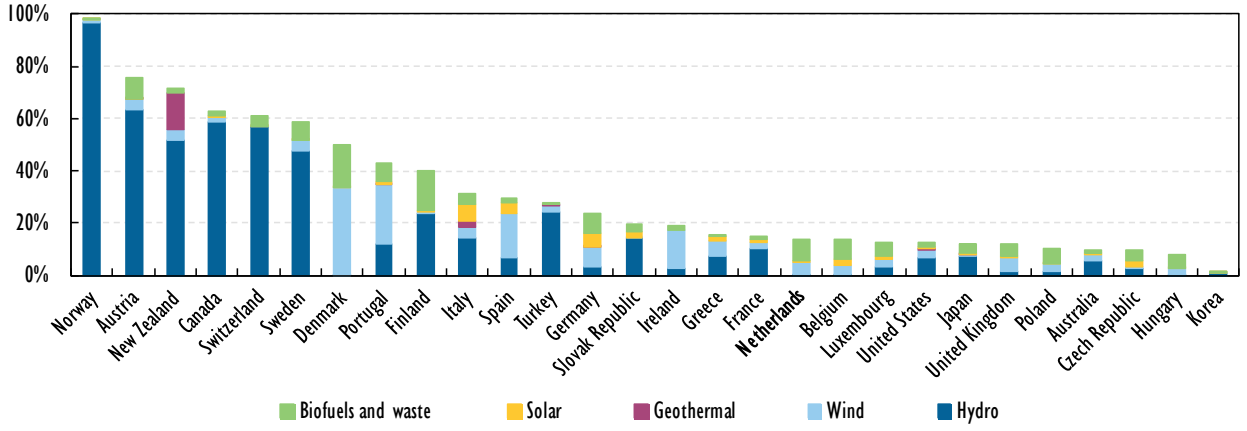
Biofuels and waste are the largest source of renewable energy in electricity generation, accounting for 8.7% of output in 2012. Wind power represented 4.9%, solar 0.3% and hydro 0.1%. Electricity from wind has experienced the strongest boom over the past decade, increasing more than fivefold since 2002. The use of biofuels and waste has doubled over the same period, while energy from solar saw a more moderate increase of 43.4%. Electricity from hydropower has reduced by 3.6% since 2002.

Among IEA member countries, the Netherlands ranks eleventh-lowest with regard to the share of renewables in electricity generation, thanks to biomass and wind. However, its share of biofuels and waste in electricity is third-highest, behind Denmark and Finland, mainly owing to biomass co-firing in the coal-fired power and CHP plants.

The use of biofuels and waste in heat generation doubled since 2000, reaching 11.8% of total generation in 2012, up from 4.2% in 2002. This has been at the cost of natural gas, the use of which declined by 30% over the same period.

The share of renewables in the heat sector is still very marginal. Natural gas remains the predominant fuel. However, since 2012 heat is encouraged in the SDE+. Many renewable heat options are relatively cost-effective and are highly valued in the renewable heat sector. Since the introduction of heat in the SDE+ in 2012, the greatest part of the energy budget is allocated to renewable heat projects, mainly biomass and geothermal projects. It is to be expected that the share of renewables in heat production will increase in the coming years with a view to meet the targets.

Figure 6.3 Electricity generation from renewable sources as a percentage of all generation in IEA member countries, 2012



Note: data for the Netherlands and Austria are actual and estimated for other countries.

Sources: *Energy Balances of OECD Countries*, OECD/IEA, Paris, 2013; country submissions.

INSTITUTIONS

The **Ministry of Economic Affairs** (*Ministerie van Economische Zaken*) has the overall responsibility for Dutch energy policy, including renewable energy, energy transition and bio-based economy. The Ministry is also the lead authority for the State Co-ordination Programme for the planning of large-scale energy projects, including onshore and offshore wind farms above 100 MW. Provinces are responsible for the integrated planning process of onshore wind farms between 5 MW and 100 MW and municipalities for onshore wind farms below 5 MW.

The **Ministry of Infrastructure and Environment** (*Ministerie van Infrastructuur en Milieu*) is responsible for climate and environmental policies and the administrative procedures under the Dutch Environmental Management Act. Together with the Ministry of Economic Affairs, it co-ordinates the environmental impact assessments and permits for the zonal planning (*structuurvisie*). Construction permits are issued by ***Rijkswaterstaat,*** the executive arm of the Ministry of Infrastructure and Environment.

The **Environmental Assessment Agency (PBL)** has a key role in implementing environmental policy. In co-operation with the **Energy Research Centre of the Netherlands (ECN)**, the PBL monitors the implementation of national energy and climate objectives and develops long-term scenarios. As an authority under the Ministry of Economic Affairs, the **Netherlands Enterprise Agency** (*Rijksdienst voor Ondernemend Nederland,* **RVO**), implements policy and funding programmes with a focus on sustainability, innovation, and international co-operation. RVO helps market parties and specific organisations to establish training and certification facilities for installers and installations of renewable energy production. Innovation in energy is supported through innovation contracts between private companies, universities, research and development (R&D) institutes.

POLICIES AND SUPPORT SCHEMES

LEGAL FRAMEWORK AND TARGETS

As a member state of the European Union, the Netherlands adopted a legal framework for renewable energy within the context of the EU Renewable Energy Directive 2009/28/EC (*Kaderwet EZ-subsidies and Besluit stimulering duurzame energieproductie SDE*). The directive requires each EU member state to increase the share of renewable energy in its gross final consumption, in order to achieve an EU-wide 20% renewable energy share by 2020.

In the first National Renewable Energy Action Plan (NREAP) of 2010, all the instruments needed to achieve the national target are specified.[3] The Netherlands agreed to achieve a share of renewable energies of 14% by 2020 under the Renewables Directive.

Having evaluated progress of EU member states towards the 2020 targets, the European Environment Agency (EEA) notes that the Netherlands stood at a 4.3% share of renewable in 2011 and has not reached its interim targets of 5.1% set out under the National Renewable Energy Action Plan (NREAP) (5.1%) and of 4.7% set out in the Directive for 2011-12, as was the case in a number of other countries (see Figure 6.4).[4] The European Commission's progress report noted that the Netherlands also falls behind the indicative 2010 transport target of 5.75%.[5]

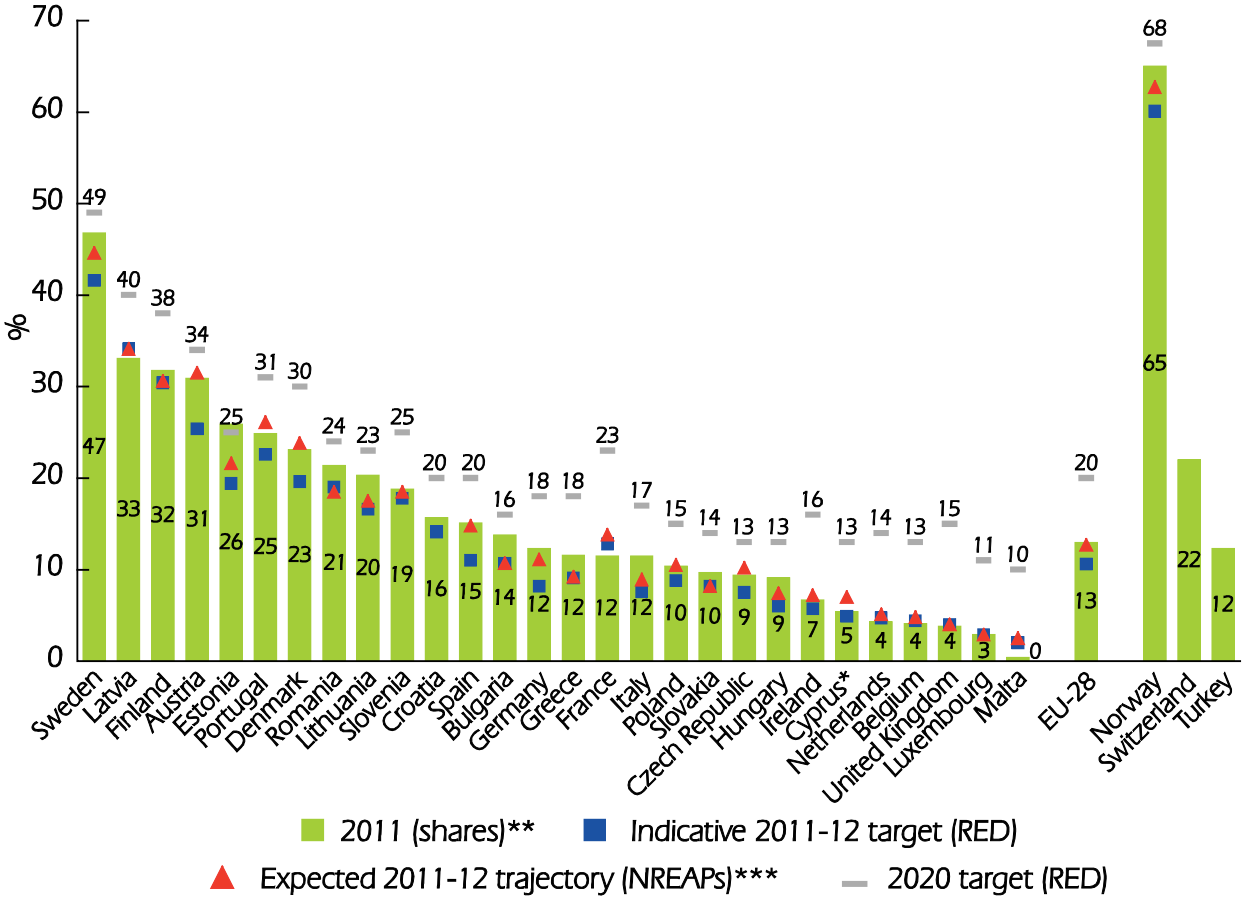
Regulatory stability is of key importance to secure investment in renewable energy sources. The Netherlands has been characterised by relative instability and at times criticised for its increasing policy discontinuity. Before 2003, renewable energies were supported through tax exemptions. Then the first feed-in premium scheme (*Environmental Quality Electricity Production, MEP*) was put in place for the period 2003-06. Under the Clean & Efficient Programme of 2007, the government had the ambition to reach a share of 20% renewables in TPES by 2020. However, the government suspended the scheme as it did not perform towards the realisation of the ambitious targets. In 2008, it introduced a feed-in tariff scheme, the so-called *Stimulering duurzame energieproductie* or SDE, that was still financed by the public budget until 2011. Then, the same year, the SDE was reformed into a market-based, cost-effective premium scheme, financed by a surcharge on the final consumer's bill, and renamed SDE+.

3. National Renewable Energy Action Plan 2010.

4. *Trends and projections in Europe 2013 – Tracking progress towards Europe's climate and energy targets until 2020*, European Environment Agency, October 2013.

5. Renewable energy progress report, European Commission, final staff working paper COM(2013)175, 2013.

Figure 6.4 Progress towards 2020 renewables targets in EU member and non-member states



* 1. Footnote by Turkey:
The information in this document with reference to "Cyprus" relates to the southern part of the Island. There is no single authority representing both Turkish and Greek Cypriot people on the Island. Turkey recognises the Turkish Republic of Northern Cyprus (TRNC). Until a lasting and equitable solution is found within the context of United Nations, Turkey shall preserve its position concerning the "Cyprus issue".
2. Footnote by all the European Union Member States of the OECD and the European Union:
The Republic of Cyprus is recognised by all members of the United Nations with the exception of Turkey. The information in this document relates to the area under the effective control of the Government of the Republic of Cyprus.

** Values for Norway and Switzerland are for 2010 shares.

*** Value for EU-28 assumed to be identical to that of the EU-27.

Source: EEA, 2013.

The national target under the directive was calculated on the basis of the already realised renewables potential and GDP per capita in 2008. Cost-efficiency considerations or technology progress did not play a role as the renewable industry was in its infancy.

In autumn 2012, the new Rutte-Asscher government agreed to raise ambitions beyond the EU commitment towards a renewable energy target of 16% by 2020. The Energy Agreement of September 2013 reflects this priority of the scaling-up of renewable energies in the Netherlands but sticks to the EU commitment of 14% by 2020 and aims to achieve 16% by 2023. The Energy Agreement confirms the SDE+ scheme as the main support instrument for renewable energies, which should lead to a more stable stimulation policy.

Wind power in the Netherlands

The Netherlands was among the first leaders, together with Denmark and Sweden, to demonstrate wind power facilities in the 1990s. In 2013, the country has a total of 2 434 MW

of installed wind power capacity.[6] With regard to offshore wind, there were two offshore wind farms operational (228 MW) in 2012. Future expansion of wind power largely depends on public acceptance, financial support, grid development and technology innovation.

Today, total capacity plans put forward by Europe's wind power leaders, in particular in neighbouring countries, outpace the developments in the Netherlands. In comparison in 2012, Denmark had a total accumulated wind (onshore and offshore) capacity of 3.9 GW, while Germany leads the deployment with 29.1 before Spain with 21.7 GW.[7]

The Energy Agreement has a priority focus on wind power. It sets out plans to install additional onshore wind power (6 GW by 2020 and 7 GW by 2023) and offshore wind power (2 GW by 2020 and 3.5 GW by 2023) and supports decentralised renewable production (including 4 GW solar with 1 GW more than the baseline, mainly stimulated by a fiscal system for photovoltaic (PV) projects (new tax breaks for decentralised electricity production near users' premises).[8]

The 2009 National Water Plan, the National Spatial Strategy (*Nota Ruimte*) complemented by the Integrated North Sea Management Plan 2015 (*Integraal Beheerplan Noordzee*) had already foreseen the deployment of around 6 GW wind power by 2020 and designated areas for wind parks (see Chapter 5 on Electricity). The national co-ordination scheme for major energy infrastructure projects includes renewable energy installations.

The Netherlands has supported technology innovation, including the demonstration of joint solutions, for wind power, pumped-storage and tidal power. However, offshore technologies require a new grid design and innovative cabling solutions, if deployed at a larger scale. The Energy Agreement decided to put the Dutch grid operator TenneT in charge of offshore grid development. The government is encouraged to provide full legal clarity and take action on offshore wind development, including siting, permitting and co-ordination of support policies with neighbouring countries, as well as on safety and liability concerns. In addition, the government should reassess the scope for repowering existing wind onshore/offshore installations, with a view to ensure cost-effectiveness.

Opportunities exist to build on the Dutch national co-ordination initiatives on energy infrastructure. However, under Dutch law, TenneT does not have any obligations to build an electricity network offshore, but is obliged to connect an offshore wind park to the electricity network on land.

At transmission level, the current grid planning and approval arrangements will need to be enhanced to support the timely development of offshore installations, especially in relation to co-ordination of environmental and spatial planning approval processes. The legal structure for network expansion also requires development, including in relation to co-ordination of offshore permits and of connections to the grid of new parks, and a stronger regional co-operation with partners in neighbouring Germany, the United Kingdom and Denmark.

6. *The State of Renewable Energies in Europe*, EurObservER, 2013, see at: www.energies-renouvelables.org/observer/stat_baro/barobilan/barobilan13-gb.pdf.

7. European Wind Energy Association (EWEA) 2012 and Joint Research Centre (JRC), 2012 JRC wind status report. The Netherlands. Available at www.recs.org/documents/report--european-commission_2012-jrc-wind-status-report.

8. Biomass co-firing is capped at 25 PJ, linked to the shut-down of five coal-based power plants built in the 1980s. The further scope for expanding the share of (liquid and solid) biofuels will however depend on the final outcome of the EU agreement on sustainability criteria for biomass.

The October 2011 Green Deal with the Dutch Wind Energy Association proposed new legislation for offshore wind development by 2015 to help address these concerns. Key elements of this new legislation will aim to reduce investment risks and costs for proponents including through:

- a one-stop shop for streamlining offshore permitting procedures
- publication of detailed studies into offshore wind resources before tendering blocks
- improved co-ordination of permitting, approvals and subsidy assistance.

Achieving an integrated vision for onshore and offshore wind energy deployment and the reinforcement of the Dutch transmission and distribution grids are major challenges in terms of permitting. Priority needs to be given to adopting and implementing the proposed legislative reforms to reduce administrative barriers to the effective and timely development of the offshore wind resources needed to meet the government's policy objectives.

SUPPORT SCHEME FOR RENEWABLE ELECTRICITY AND HEAT

The Netherlands does not provide for priority dispatch of renewable energy installations, but treats renewable electricity production plants like any other electricity producer. Renewable energy generators thus participate equally to the balancing and congestion management regimes.

The main policy measure stimulating the use of renewable energy is the "SDE+" scheme (SDE for "Sustainable Energy Incentive"), which came into force on 1 July 2011 following the change of the scheme into a market-based support scheme,[9] recognising the limits of the government to set tariffs and allocate budget per technologies.

The SDE+ premium feed-in support scheme promotes renewable energy sources, including for gas production, for electricity and heating purposes in a technology-neutral manner. All technologies compete with one another against one overall budget (instead of technology-specific budgets); this encourages efficient spending of the available budget, competition among technologies and drives down the cost of technology deployment (see Tables 6.1 and 6.2). The sliding feed-in premium encourages the deployment of the most cost-effective technologies and fosters cost reductions. To increase competition between technologies and bring down their cost in line with rapid technology development, the SDE+ has a so-called free category. Projects that produce renewable energy below the calculated support level of a given auction may submit an application in the free category in an earlier phase, where budget is still available, but will receive a lower payment.

The SDE+ is annually reviewed to respond to changing market conditions, with a reduced subsidy when energy prices are high. SDE+ only covers the difference between the price of fossil energy and the price of renewable energy for a long-term period of 5, 12 or 15 years, depending on the technology used. The level of subsidy keeps up with market prices of energy: with high energy prices, the subsidy amount is lower and vice-versa. Only the most cost-effective renewable energy technologies obtain the subsidy. According to the Ministry of Economic Affairs, the new SDE+ costs the taxpayer EUR 1 billion per year less than the former SDE scheme.

It remains to be defined how the promotion of the use of biomass in coal-fired power stations will be supported. In line with the Energy Agreement, as of 2015, support will be provided to biomass in coal-fired power plants, but capped at a maximum of 25 PJ and under stringent Dutch sustainability criteria.

9. The Dutch SDE+ scheme was authorised by the European Commission as state aid under decision SA.34411 (12/N).

With the start of SDE+ scheme on 1 July 2011, a budget of EUR 1.5 billion (15-year subsidy period) stimulated applications of more than EUR 2 billion by 1 September 2011. Almost the entire budget was committed to projects for a maximum support of EUR 0.09 per kilowatt hour (EUR/kWh), minus the relevant energy price. Biogas projects received more than two-thirds of the budget. In addition, a budget for 700 large-scale solar energy projects was committed.

In 2012, EUR 1.7 billion was allocated to projects with a cost price below EUR 0.07/kWh and as much for renewable heat and green gas. Applications amounted to more than EUR 2.7 billion. With a market price of EUR 0.05/kWh, projects for electricity production will receive a SDE+ subsidy of maximum EUR 0.02/kWh. In 2013, the SDE+ allocated a budget of EUR 3 billion to a diverse portfolio of over 438 large-scale solar PV projects, 64 onshore wind farms and 112 renewable heat projects (e.g. biomass combustion, manure fermentation, geothermal), but also several tidal energy, large-scale solar water heating, hydropower and renewable gas projects.

Table 6.1 Competitive tenders driving down technology cost (illustration for electricity options, EUR/kWh)

Tender I	Tender II	Tender III	Tender IV
0.09	0.11	0.13	0.15
Incineration (0.062)	Incineration (0.062)	Incineration (0.062)	Incineration (0.062)
Free (0.09)	Onshore wind (0.096)	Onshore wind (0.096)	Onshore wind (0.096)
	Free (0.11)	Biomass (0.121)	Biomass (0.121)
		Free (0.13)	Fermentation (0.134)
			Free (0.15)

Source: Ministry for Economic Affairs, 2013.

The first results of the SDE+ scheme show that low-cost technologies are adopted and financed first, while very costly technologies are supported later. But, as was the case in 2013, some very costly technologies have a chance of being subsidised. This competition for more cost-effective technologies acted as an incentive to making the project as cost-effective as possible. In case offshore wind is insufficient to be exploited, there will be separate tenders for offshore wind from 2015 onwards. This is necessary because lead times for this technology are long and the ambitions for this technology are high. For all other technologies, the SDE+ provides enough opportunities to develop projects before 2020, as is illustrated by the results of the SDE+ 2013.

The role of renewables in the heat sector remains marginal but has increased over the past decade. District heating is fuelled almost entirely by natural gas; other fuels, including waste, play a negligible role. Only 4.4% of all dwellings in the Netherlands have a district heating connection. In 2011, the share of district heating in the heat market stood at only 4%. There is potential for a further role of renewables in district heating, as the source of natural gas (gas with low calorific value from Groningen) will be depleted in the coming decade.

Given the positive trend in the past decade, CHP and district heating strongly grew in importance in the industry, services and agriculture/greenhouse horticulture sectors. Investment subsidies for solar heating, heat pumps and micro-CHP were available until 2010. Renewable heat is now supported under the SDE+ scheme and it remains to be seen

how the scheme can encourage wider use of renewable heat in the industrial processes. Since the introduction of renewable heat in the scheme, many (the majority) renewable projects were approved under the SDE+, including several industrial projects. The energy investment allowance also supports the deployment of renewable heat infrastructure.

Table 6.2 Results of SDE+ (EUR/kWh)

	SDE+ 2011	SDE+ 2012	Preliminary results SDE+ 2013
Available budget	EUR 1.5 billion	EUR 1.7 billion	EUR 3 billion
Number of committed projects	740	234	600-1 000
Subsidy based on market price of electricity of EUR 0.05/kWh	EUR 0.04 /kWh	EUR 0.02/kWh	First phase: EUR 0.02/kWh Second phase: EUR 0.03/kWh Third phase: EUR 0.04/kWh Fourth phase: EUR 0.06/kWh Fifth phase: EUR 0.08/kWh Sixth phase: EUR 0.10/kWh
SDE+ contribution to renewable energy target	0.4%	0.9%	1.1%

Source: country submission.

OTHER INVESTMENT SUPPORT

Besides the SDE+ scheme, investments in renewable energy technologies are supported via tax incentives, while direct investment grants were short-term and are almost all phased out.

Under the EIA, the purchase of renewable heat infrastructure and net metering, or other distributed generation is supported with tax breaks for technologies with low market penetration.

From 2014 onwards, renewable energy production facilities that are eligible for SDE+ can no longer apply for EIA. Following the 2012 spring agreement (*Lente-akkoord*) a short-term support scheme for solar panels, with maximum subsidy level of EUR 650, was in place for the period 2012-13 with a total a budget of EUR 50.9. A guarantee scheme was in place for geothermal power to cover 85% of the investment in case of complete failure due to geological risk of deep geothermal drillings.

The Netherlands aims to develop decentralised energy generation. Ambitions under the Energy Agreement are high on the deployment of wind power and solar PV. The Energy Agreement contains measures to encourage distributed generation by homeowner associations and co-operatives in the same postal zip code. Local energy or self-consumption of renewable energy within a short distance (within a village or neighbourhood) is expected to flourish with a new fiscal stimulus. Tax incentives for local renewable production were introduced as of 1 January 2014. A tax break of EUR 0.075/kWh is available when energy is produced and used by a co-operative or association of homeowners if their members are located within a given area (a four-digit postal zip code plus adjacent areas).

Consumers with a connection with a maximum capacity of 3x80 amperes and their own renewable generation system may opt for net metering. The part of the electricity that they produce with their own system (such as PV solar), but do not use themselves, goes on the distribution grid. Under the Dutch Electricity Law, the electricity producer is obliged to balance the electricity that the consumer uses from the grid with the part that the consumer passes on to the grid. The consumer only pays the energy tax and value-

added tax (VAT) on the balance of the two. This balance is possible when production and use are at the same location and registered by the same electricity meter.

POLICIES AND MEASURES IN THE TRANSPORT SECTOR

The Netherlands has the objective to achieve a 10% share of renewable in the energy consumption by the transport sector, as committed in the National Renewable Energy Action Plan of 2010. The country made progress, thanks to the biofuel blending obligation but, with a share of 4.6% in 2011, the Netherlands is slightly behind its indicative target (the share of renewable in transport is 5.1% in the Action Plan), despite rising contributions from biodiesel and bioethanol.[10] The Netherlands obliges transport fuel suppliers to ensure that a percentage of fuel is supplied from sustainable renewable energy sources or biofuels (blending obligation). The requirement was 4.5% in 2012, and 5% in 2013. Costs are fully borne by the fuel consumer.

The port of Rotterdam has expanded its biofuel import capacities, as it has become one of the key hubs for biofuel imports from overseas into the European Union.

In the past few years, the Netherlands has seen an increase in the amount of refuelling and recharging points for alternative fuels: 88 natural gas stations, 32 stations offer bioethanol (E85), almost 4 000 electric charging locations (a twofold increase from 2011) were in place in 2012. In addition, a subsidy programme of EUR 2.5 million supported the deployment of around 200 biogas-driven vehicles on the roads.

ASSESSMENT

Since the 2008 in-depth review, the Netherlands has doubled its share of renewable energies (RES), in particular in electricity consumption, starting from low levels, thanks to additions from wind power and biofuels. However, progress was slow towards its EU target of having 14% of renewables in total final energy consumption by 2020. In 2013, the share of renewable energies (RES) in final consumption stood at 4.5%.

The Netherlands is impacted by the pace of renewables deployment in neighbouring EU member states. In 2013, it is behind its EU targets and faces challenges to meet them in the coming years if no major policy change is made.

Commendably, under the Rutte-Asscher government and in the Energy Agreement, provisions are made to speed up the deployment of renewable energy until 2020.

Frequent changes made to the renewables support scheme with different subsidy schemes being replaced over time have weakened visibility for investors. With the SDE+ scheme, a stable support programme has been set up. Renewed policy commitment by the Rutte-Asscher government and the Energy Agreement to reach a 16% share of renewables by 2023 should provide the strategic vision for the years to come in order to gain investors' confidence. For the years beyond 2023, the parties have agreed that the Netherlands will formulate a timely and coherent deployment strategy for the period 2024-30 to assure investment.

10. The Netherlands double-counts biodiesel production, made from used deep-frying oil and animal fats from slaughterhouses (with feedstock from EU member states). The production of double-counted bioethanol is biomethanol from glycerine at the facility of BioMCN.

According to projections, large additional contributions of various sources of renewables will be necessary to achieve this outcome by 2020, in particular from onshore and offshore wind capacity, if the Netherlands is to meet its ambitions. Biomass use in co-generation might be limited by the availability and sustainability of biomass imports.

The IEA considers that the Netherlands can benefit from the current learning curves in other markets, in terms of both technology development and policy design. For instance, the government was right not to pursue the feed-in tariffs scheme without capacity control that led to runaway deployment and too high costs. In recent years, growing deployment has led to cost reductions in key technologies (biomass, hydro, onshore wind and increasingly solar PV) which are already cost-competitive in many markets.

Commendably, the Netherlands modernised its support scheme for renewable electricity, gas and heat (SDE+) to a floating feed-in premium system, fully financed by a surcharge on the energy tax paid by all natural gas and electricity end-consumers. The IEA welcomes the market-based principles, on the basis of competitive tenders for private investment projects depending on the expected cost of various technologies. The SDE+ is in line with the latest guidance of the European Commission.[11] The renewables support scheme, the SDE+, performs well in terms of cost-effective support allocation and is expected to bring down technology cost over time. The first results are encouraging.

The SDE+ subsidy is considered the main means of achieving the renewable energy targets in the Netherlands. However, the SDE+ alone might not be enough. International best practice shows how a portfolio of incentives based on technology and market maturity can be built. A dynamic policy approach based on monitoring of national and global market trends would be able to deliver a comprehensive renewable policy which adapts to the needs of a small but growing renewable market.[12]

In addition to support schemes, the Dutch renewables policy has to address several key non-economic barriers: the time needed to bring new installations to operation and to connect it to the grid, the protection of the environment (permitting procedures) and public acceptance by the legitimately concerned citizens. The total cost of renewables deployment, including grid investment, is estimated at EUR 50 billion. The SDE+ scheme supports above all cost-efficient technologies, but it cannot immediately cater for all innovative and costly technologies by 2020. The Dutch government has rightly recognised that RD&D technology support is a necessary for ensuring market readiness, as it brings down the future operation cost and those the need for subsidies.

As renewables deployment advances, the policy has to adapt over time, moving from clear targets and regulations to adapting market design and ensuring public acceptance.

Technologies and markets are global and the policy needs to be flexible to account for international developments and electricity market changes in the EU context. The renewables policy has to be market-based but comprehensive to cover technology support from mature to less mature technologies.

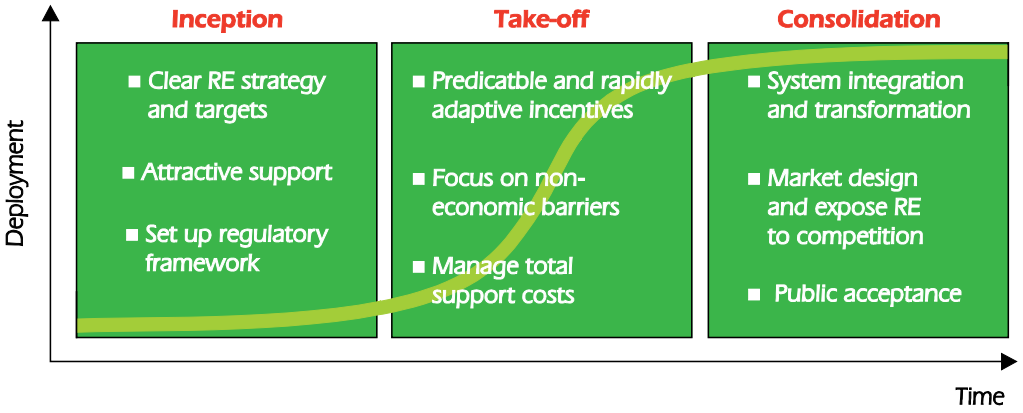
In the current take-off phase of the Dutch renewables policy, the SDE+ scheme alone cannot deliver all the expected results. In addition, changes in the legal framework for grid integration and innovation technology support are needed. In particular for offshore

11. *European Commission guidance for the design of renewables support schemes*, the European Commission, SWD(2013)439 final, Brussels, 5 November 2013.

12. *Deploying Renewables: Best and Future Policy Practice*, OECD/IEA, Paris, 2011.

grid development, issues such as siting, permitting and co-ordination of support policies as well as safety and liability issues need to be solved. Grid integration and market design are essential in consolidating renewables markets. Repowering of existing wind power plants and the creation of an integrated offshore wind network, further away from shore, provide economic opportunities and benefits for energy security and affordability in the medium term.

Figure 6.5 Evidence-based renewable energy policies



Source: IEA, *Deploying Renewables 2011*, OECD/IEA, Paris, 2011.

The Netherland is interconnected within the Central and North-West European energy markets to Norway, Germany and the United Kingdom where growing shares of renewable energy sources are being exploited. A purely national approach to the deployment of RES may prove to be too costly. The country already benefits from imports of renewables. There is a need to find the right balance between the funding of technology innovation and stimulating economic growth while reaping the full benefits from further integrating RES into the EU internal energy market. In the 2020 context, it appears that the renewables policy should be adjusted to the CO_2 price signals under the EU-ETS as this policy is currently unable to bring effective support for renewable deployment in the energy market.

The harmonisation of support schemes and the use of co-operation mechanisms with neighbouring countries should be explored, as it can in fact help to achieve the targets in a cost-efficient manner. The Netherlands may wish to deploy those renewable sources that stimulate economic growth and ensure sustainability at national level. In addition, it may wish to explore all options for deploying joint schemes with neighbouring countries (for example under the North Sea Offshore Grid Initiative) in order to meet its targets.

RECOMMENDATIONS

The government of the Netherlands should:

- ☐ *Maintain a stable and comprehensive renewable energy policy for the delivery of the 16% renewable energy target by 2023, in particular with regard to the realisation of offshore and onshore wind targets and an integrated offshore grid. Complete the legislative and regulatory framework for the deployment of offshore wind and decentralised renewable sources.*

- *Maintain the primary focus on cost-effectiveness and technology-neutrality in supporting projects within a market-based system to deliver its 2020 targets.*
- *Complement the Energy Agreement with a policy that can stimulate technologies with the potential to make a cost-effective contribution to the development of renewables in the medium to longer term through effective R&D and innovation policies.*
- *Strengthen harmonisation of renewables support schemes and make use of such mechanisms as regional co-operation within the Pentalateral Energy Forum, the North Sea Offshore Grid Initiative and bilateral projects, in order to support further market integration and cost-effective integration in the North-West European electricity market.*

7. NUCLEAR ENERGY

Key data (2012)

Plant in operation: one nuclear power plant with one reactor (at Borssele)

Installed capacity:* 482 MW

Electricity generation: 4 TWh

Share of nuclear: 1.3% of TPES and 3.8% of electricity generation

* Source: IAEA.

OVERVIEW

Nuclear plays a small but steady part in the Dutch energy supply, constituting about 1.7% of total generating capacity. In 2012, the one and only nuclear power plant (NPP) produced about 4 terawatt hours electrical (TWh_e), providing about 3.8% of total electricity and 1.3% of total primary energy supply (TPES). Over the period of operation, nuclear power has generated about 132 TWh of carbon-free baseload electricity in the Netherlands.

The only nuclear power plant in operation is located in Borssele, in the province of Zeeland in the south-west part of the country. The pressurised water reactor (PWR), constructed by Siemens, is fuelled with uranium fuel (UOX). Construction started in mid-1969, and the power plant started commercial operations in October 1973 with a reference net electric power of 450 megawatts (MW). Since 2005, the operator was granted the licence for increasing the fuel enrichment, and thus it was possible to reach an average fuel burn-up of 39 gigawatts per day and per tonne (GWd/t). In 2006, following an upgrade of the turbine, the net electrical capacity was increased by about 7%, to the current level of 482 MW.

The plant is owned and operated by *Elektriciteits-Produktiemaatschappij Zuid-Nederland* (EPZ N.V.), whose shareholders were originally the utilities Delta and Essent, each holding 50% of the shares and owned by local and regional governments. The capital structure of EPZ has changed following the acquisition of Essent by the German publicly owned utility RWE in 2009. Currently, Delta owns 70% of shares in EPZ, and RWE the remaining 30%.

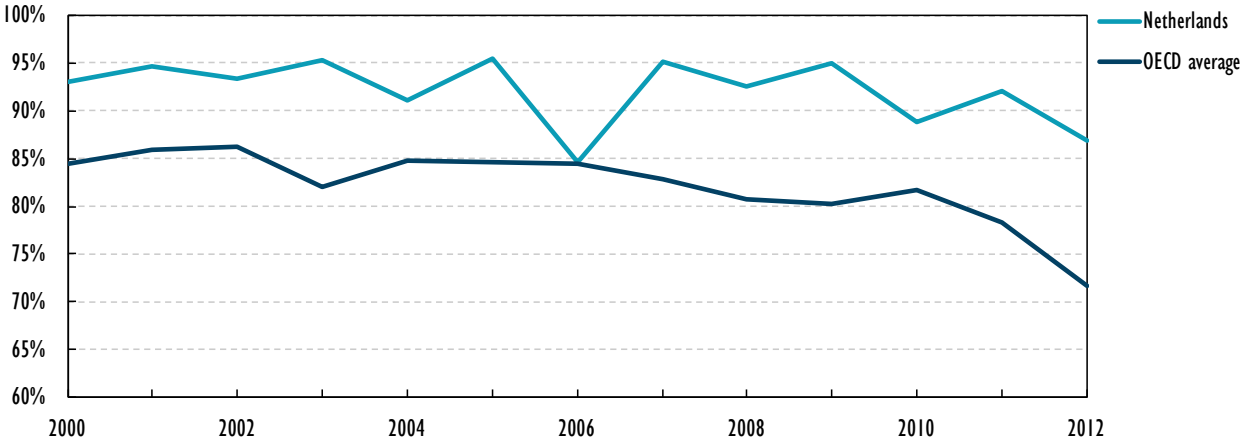
The Borssele power plant was expected to shut down in 2013, at the end of its original lifetime. However, in 2006 the government reached an agreement with EPZ and the two shareholders Delta and Essent, to extend the operational lifetime by another 20 years, provided that the plant continues to meet high safety and operation standards. The agreement has been approved by the Parliament in 2006.

In 2013 the Borssele NPP received a licence for long-term operation to extend its operating life from 2014 to the end of 2033.

Throughout its lifetime, the plant has had an excellent operational record, with a load factor and an energy availability factor of about 85%.[1] In the last ten years the energy availability factor has reached a value above 90%, among the top quartile of NPPs worldwide (see Figure 7.1).

In 1965, the government had decided to build a small nuclear reactor in Dodewaard, with the objective of acquiring experience in construction and operation of NPPs. The single-unit boiling water reactor (BWR) of 55 MW entered in commercial operation in 1969 and was shut down in March 1997 after 28 years of operation. The Dodewaard reactor has been permanently shut down and all the fuel elements have been removed from the nuclear site.

Figure 7.1 Energy availability factor of the nuclear power plant, 2000-12



Source: OECD/NEA, 2013.

Since the last in-depth review, two companies, Delta and RWE, started the procedures to apply for licences to build a second NPP in the Netherlands. However, in February 2012, both these projects were put on hold for an indefinite period because of current overcapacity in the electricity market, forecasted low electricity prices and a tighter investment climate. Given the current conditions in the European electricity market, no new nuclear project can be reasonably foreseen in the Netherlands for the next five to ten years. Besides the Borssele NPP, the Netherlands hosts a uranium enrichment facility located in Almelo, in the east of the country, and a radioactive waste storage facility in Zeeland, near the Borssele power plant.

NUCLEAR POLICY

The Dutch government considers nuclear as an important technology in the transition to a sustainable low-carbon energy system, in combination with renewable energy, energy savings and carbon capture and storage (CCS). The government recognises the role of nuclear energy in reducing the dependence on imported fossil fuels and in increasing the security of energy supply.

1. The load factor for a given period is the ratio of the electricity that a power plant has effectively produced over that period divided by the electricity it would have produced under continuous operation at its reference power capacity over that period. The energy availability factor over a specified period is the ratio of electricity that available capacity could have produced during that period, divided by the electricity it would have produced under continuous operation at its reference power capacity over that period.

In 2009-10, the government of the Netherlands initiated a comprehensive consultation among energy experts and the public to assess the potential role of new nuclear in the Dutch power system after 2020. To this end, the experts compared three basic scenarios with different levels of nuclear capacity installed. They concluded that the introduction of a larger share of nuclear power would lead to a small reduction in wholesale electricity market prices but would contribute positively to the security of supply. Nuclear power would also contribute to a reduction of carbon emissions as well as emissions of other pollutants such as nitrogen oxide (NO_x), sulphur dioxide (SO_2) and particulates.

Nuclear energy is considered an option for electricity production in the future, provided that the power plant meets the conditions set for safety and complies with strict environmental standards. Rutte-I and the current Rutte-II governments have taken the necessary steps to facilitate the planning and the licensing procedure for new nuclear capacity. The government is currently working on an update in nuclear legislation to provide more clarity for investors on environmental and safety standards for current and new capacity. The government considers that any investment in new nuclear capacity should be driven by the market within the liberalised electricity market and without any public intervention or financial support.

INSTITUTIONS

All nuclear facilities, including the NPP of Borssele, operate under a licence granted after a safety assessment has been carried out. The **Directorate for Nuclear Installation and Safety (NIV)** within the **Ministry of Economic Affairs** is the principal authority responsible for conducting the regulatory process under the Nuclear Energy Act. Its main activity encompasses preparing legislation, formulating policies, issuing licences and thus regulating nuclear safety, security and safeguards. NIV sets no limit on the duration of the licences. Licensees of nuclear installations perform a comprehensive safety review every ten years, resulting in modifications to the installation or organisation so as to comply with the state of the art and science in nuclear safety and radiation protection. Before implementing modifications, licensees issue an application for a licence change to the regulatory body. A separate entity, the **Department for Nuclear Safety, Security, Safeguards and Radiation Protection (KFD)** is responsible for the supervision, inspection and assessment of nuclear facilities. The KFD is part of the **Ministry of Infrastructure and Environment**, and carries out its activities independently under the responsibility of the Ministry of Economic Affairs (see Figure 7.2).

The licensing procedure for a nuclear facility includes a requirement to carry out an environmental impact assessment. The draft decision to award a nuclear licence or to change an existing licence is published in the *Government Gazette* and in the local and national press, and copies of the draft decision and of the environmental impact assessment are made available to the general public, for comments and public debate.

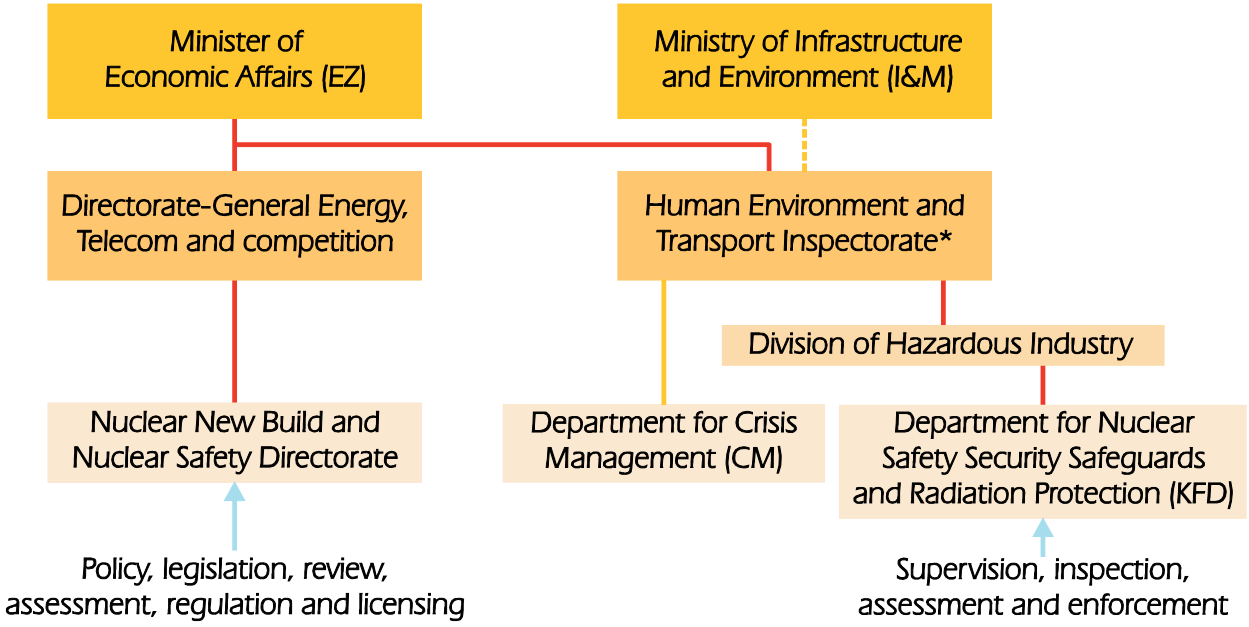
Both the International Atomic Energy Agency (IAEA)[2] and the Nuclear Energy Agency (NEA)[3] recommended that the government establishes an independent regulatory authority that is responsible for nuclear safety. The nuclear safety regulator should effectively be independent of the licensee and of any other body, as well as of the government

2. IAEA Safety Standards – Fundamental safety principles. Safety Fundamentals N° SF-1, IAEA, Vienna, November 2006.

3. Characteristics of an effective regulator, presented at the 27th meeting of the OECD/NEA Committee on Nuclear Regulator Activities (CNRA), Paris, 4-5 June 2012.

departments that are in charge of nuclear energy. In March 2013, the Dutch Parliament passed a resolution supporting the creation of a single independent nuclear safety authority for the Netherlands. On 24 January 2014, the Cabinet of the Netherlands approved the establishment of an authority for nuclear safety and radiation protection, thus implementing the recommendations of IAEA and NEA for an independent regulatory body.

Figure 7.2 Regulatory structure of the nuclear sector in the Netherlands



* The KFD is part of the organisation of the Ministry of I&M and carries out its activities independently under the political responsibility of the Minister of EZ.

Source: Ministry of Economic Affairs, 2013.

NUCLEAR SAFETY

The Dutch NPP has been continuously monitored, maintained and improved since the beginning of operations. The operator EPZ has continuously upgraded the equipment of the nuclear installation in order to maintain safety standards at the level of the modern nuclear plants. In 1997 the Borssele NPP underwent a significant refurbishment. Over the course of the operational life, it is estimated that the operator invested more than EUR 100 million in safety-related measures, and about EUR 40 million will be employed to implement the safety measures identified following the post-Fukushima stress tests.

INCIDENTS OF NOTE

Since the last in-depth review in 2008, one nuclear event of level 2 on the INES scale was reported to the IAEA. A fault in a safety analysis detected by the Nuclear Research and Consultancy Group (NRG) was reported in 2013 and was classified as a level 2 event.

According to a licence condition, every nuclear facility is obliged to inform the Department for Nuclear Safety Security and Safeguards (*Kernfysische Dienst*, KFD) of any event related to nuclear safety. KFD informs the Parliament on the reported events every year. In the last annual report on events in nuclear facilities in 2012, KFD reported five events, rated as INES-1 ("anomalies or disturbances"), one at Borssele NPP and four at the other

nuclear facilities (enrichment plant, waste management facility, two research reactors and nuclear research labs). Classification of one event at Borssele NPP is in progress.[4] Four INES-0 events (below-scale or "deviations") were reported in 2012, one occurred at the NPP of Borssele and three at the other nuclear facilities.[5] During the last 15 years, 18 INES-1 events were reported at the Borssele NPP and 25 in the other nuclear facilities.

Box 7.1 Results of EU stress tests

Following the severe accident at the Fukushima Daiichi NPP on 11 March 2011, the European Council requested that a comprehensive safety and risk assessment, including stress tests, of operating reactors and spent fuel storage facilities be performed, under the co-ordination of the European Commission and the European Nuclear Safety Regulators Group. The stress tests focussed on lessons learned from the accident in three main areas: natural external hazards (including earthquakes, tsunamis and extreme weather); the loss of safety systems/design issues (loss of electrical power, including a station blackout, and loss of the ultimate heat sink); and severe accident management (means to protect against and to manage the loss of core or spent fuel storage cooling functions and containment integrity). A key issue was the ability to maintain cooling without either off-site electricity supply or on-site backup power.

The stress tests are carried out in a three-step process: *i)* operators perform an assessment of their NPP's response to extreme situations and make proposals for safety improvements*; ii)* national regulators conduct an independent review of the operators' assessments and *iii)* regulators prepare national action plans describing the action to be taken, planned or implemented to improve the safety of the NPP. A Europe-wide peer review of the national reports submitted by regulators took place in Brussels from 22 to 25 April 2013. The European Commission intends to report on the implementation of the stress test recommendations in June 2014.

All 15 EU countries with nuclear power plants, as well as Switzerland and Ukraine (a total of 165 nuclear reactors) conducted stress tests and were subjected to the peer review. Although the peer review concluded that all countries had taken significant steps to improve the safety of their plants, with varying degrees of implementation, recommendations were made in order to further strengthen safety at a number of operating reactors, including lengthening risk calculations of extremely severe events to 10 000 years, installing (or improving) on-site seismic instruments and filtered venting systems, storing equipment earmarked for severe accidents in secure, easily accessible locations and installing a backup emergency control room.

The Netherlands performed stress tests on its unique NPP in Borssele and required the licensee to undertake a stress test of all other nuclear facilities (enrichment plant Urenco, waste management facility COVRA, the two research reactors and nuclear research laboratories) to assess their robustness.

4. *Report on events in Dutch nuclear facilities during 2012*, the Ministry of Infrastructure and Environment, 9 September 2013, available at: www.ilent.nl/Images/.

5. The INES scale was introduced by IAEA and NEA in 1990 and comprises 7 levels of severity, from 1 (anomaly) to 7 (major accident), each level representing an accident approximately ten times more severe than the previous level. Level 0 indicates events with no safety significance. When originally conceived, the INES scale was constructed so that about one INES-1 event and ten INES-0 events would occur per year in a "normal" nuclear power plant. Note that the IAEA requires a report for events of level 2 or above on the INES scale.

Box 7.1 Results of EU stress tests (continued)

The results confirmed the high safety levels of the Borssele NPP and compliance with the current licence requirements for all the events within the scope of the stress tests. The operator NTZ has however identified a series of additional measures, procedures and further studies that would improve the overall robustness of NPP. Those measures can be related to the review of some operational procedures and surveillance programmes, improvements in the availability of existing safety provisions in case of flooding or seismic events, and improvements in the field of accident management of basic situations going beyond the design. The safety authorities and the licensee agreed to implement those measures before the end of 2017.

Finally, the peer review emphasised the role of a probabilistic safety analysis (PSA) as a tool to identify areas for safety improvements and the importance of periodic safety reviews (PSR) for continuous improvement of the plant's safety. In this respect, the Borssele NPP has implemented a full-scale PSA which is updated yearly to take into account plant modifications and updated failure rates; this positions the Netherlands as one of leaders in Europe.

Note: detailed results of the EU stress tests can be accessed at: www.ensreg.eu/EU-Stress-Tests.

The investigation shows that, in 2012, the number of events reported and their severity has not differed statistically from previous years. Admittedly, few events have been recorded in 2013 and the total number of INES level 1 events is higher than in previous years, but there is no reason to assume that there is a trend. For the Borssele NPP, no special developments can be reported. In 2012 there have been few disturbances. The KFD commends the licensee for having given special attention to reducing the number of disturbances by improving the internal communication and operating processes and by implementing various investments intended to improve the functioning of the plant.

NUCLEAR FUEL CYCLE, RADIOACTIVE WASTE AND DECOMMISSIONING

Uranium enrichment is the most important fuel cycle activity in the Netherlands. The government holds one-third share of the company Urenco, one of the leading enrichment companies worldwide, holding about 25% of the market share of enrichment services; other shareholders are the British state and the German utilities RWE and E-ON. The Urenco enrichment facility was founded in 1970 in the town of Almelo, in the east of the country, and currently employs about 260 people.

The enrichment capacity at the Almelo facility stood at 5 000 tSWU/year[6] in 2011, about 30% of the total capacity of Urenco Group. The company is planning to gradually increase the enrichment capacity up to 6 200 tSWU/year, after a licence was granted in 2011. In addition to uranium enrichment services, Urenco uses its centrifuge technology to separate other isotopes for medical and industrial applications; in particular, Urenco is the world's largest supplier of depleted Zinc-64.

6. Separative work (SW) stands for the effort necessary to separate U235 and U238. It is measured in kilograms of separative work (kg SW). The capacity of uranium enrichment plants is measured in tonnes SW per year (tSWU/yr). A large nuclear power station with a net electrical capacity of 1 300 MW requires annually about 25 tonnes of enriched uranium with a concentration of 3.75% U235. This quantity is produced from about 210 tonnes of natural uranium using about 120 tonnes separative work. An enrichment plant with a capacity of 1 000 tSWU/yr is, therefore, able to enrich the uranium needed to fuel about eight large nuclear power stations.

The site of Almelo hosts the main operation of the Enrichment Technology Company (ETC), a joint venture company established in 2006 by Areva and Urenco, which designs, develops and manufactures gas centrifuges.

In the Netherlands there is a single general policy for all types of radioactive waste, including those from natural origin. The general radioactive waste policy requires the licensee to minimise, to the extent possible, the amount of radioactive waste produced. The entities that generate radioactive wastes are responsible for all costs associated with their conditioning, storage and disposal.

A policy of reprocessing spent fuel has been established since the beginning of the Dutch nuclear programme and, until 2006, spent fuel from the Borssele power plant was sent to the reprocessing plant of Areva in La Hague. This practice was stopped between 2006 and 2011 owing to changes in environmental law in France; the spent fuel was temporarily stored at the Borssele plant. Then, in 2012 a new contract was signed by the French and Dutch governments that allows for treating all spent nuclear fuel from Borssele at the reprocessing plant of La Hague. In 2011, a licence was granted to EPZ for the use of MOX (mixed oxide) fuel at the Borssele power plant. The first MOX load is expected for 2014.

All radioactive wastes (low-, intermediate- and high-level wastes) are transferred to the Central Organisation for Radioactive Waste (COVRA), a non-profit company fully owned by the Dutch government. Any company in the Netherlands licensed to work with radioactive materials has the legal obligation to transfer all radioactive waste to COVRA, except those with half-lives less than 100 days. COVRA takes over all liabilities from the generator and charges the generators of the waste for all costs, including the costs for disposal. After transferral, COVRA takes care of the conditioning of the waste, if necessary, and stores the waste for a period of at least 100 years. The choice of a centralised interim storage allows for collecting a sufficient amount of waste and reduces the decay heat of waste before final disposal.

In the future, new techniques or more effective and cheaper management options could become available. After this storage period, the waste will be disposed of in a single geological disposal facility. The Netherlands has not yet taken a definitive decision about final underground storage of radioactive waste, but efforts are currently ongoing in defining a national programme, as required from all EU member states. However, it has been decided that it must be possible to retrieve radioactive waste once stored.

The vitrified high-level waste from reprocessing Dutch fuel and from Dutch research reactors is stored in a special interim facility (HABOG) which was built during 1999-2003 at the COVRA waste facility, close to the Borssele site. The present capacity is 70 canisters for non-reprocessed fuel and about 270 canisters for reprocessed fuel, which is sufficient to contain all spent fuel arising from Borssele to 2015. The capacity of HABOG facility will be extended in order to store all the waste from spent fuel arising from prolonged operation of the Borssele plant up to 2033.

In the Netherlands, the capital set aside for the long-term management of radioactive waste is kept in an account at the Ministry of Finance which is responsible for its growth. Every five years, after a reassessment of cost estimates, COVRA has the possibility to re-evaluate and adjust the fee charged to the waste producers if the amount of funding is considered insufficient. COVRA and the government are ultimately responsible in case of a shortage of funds that could be arising if the total costs for the storage facility have been mis-estimated or if the licence holder goes bankrupt. Some countries have addressed this issue by adding an extra risk fee or margin to cover this eventuality.

Concerning decommissioning, the Nuclear Energy Act requires the licensee to provide financial provisions for the costs of decommissioning of its installation and to ensure that adequate funding is available at the moment of dismantling. Agreements have been made with all active and inactive nuclear reactors in the Netherlands, with the exception of the NPP of Dodewaard with which discussions about the costs of dismantling are still ongoing. For all new build it is required to cover the costs of dismantling before production starts, but for existing reactors a reasonable timeframe to save for the costs had to be taken into account. The way an operator provides the necessary financial security is different for each reactor.

The power plant in Borssele is operated by a commercial company that puts money into a separate dedicated fund that should be sufficient to cover all the costs of dismantling by the time the plant ceases operation in 2033. On the other hand, the research reactor in Delft is operated by the university. There is a mortgage on buildings as collateral. For the high-flux reactor (HFR) the situation is different, as it is owned by the European Commission which has pledged to cover the costs of decommissioning. The agreements have been discussed and verified, and are periodically reviewed by the government to check if the expected costs have changed and if the provisions are sufficient.

RESEARCH AND DEVELOPMENT, OTHER NUCLEAR INFRASTRUCTURE

The Netherlands continues to play an active role in nuclear R&D, mainly via NRG (the Nuclear Research and Consultancy Group) which is involved in national and international research projects. The main areas of activity are in the field of materials, nuclear fuel testing, radiation protection, safeguards and nuclear fusion. The main research centre in the Netherlands is located in Petten, in the north of the country. Petten hosts the NRG as well as one of the Joint Research Centres of the European Commission. Research infrastructure includes two research reactors, in Petten and in Delft. The Higher Educational Reactor in Delft is owned and operated by the Technical University of Delft. A research reactor of 45 MW of thermal capacity (HFR) located in Petten is owned by the European Commission and operated by NRG. HFR is used for material irradiation and testing, and for medical radioisotope production. With a market share of 30%, HFR is the second-largest supplier of medical radioisotopes in the world after the NRU in Canada.

Over the past years, he Netherlands has taken important steps to maintain its nuclear expertise and upgrade its national nuclear research infrastructure: the Dutch government has decided to finance an upgrade of the research reactor at the Delft Technical University (OYSTER project) and to make a first step towards building a new research reactor in Petten (the PALLAS reactor). About EUR 80 million have been allocated to ensure the design, tendering and licensing of PALLAS, which aims to replace the ageing HFR. This first step should provide a solid foundation for investments in the project, intended to be on a commercial basis. At the moment, however, no private investors have yet agreed to take over the project, mainly because of its economics.

ASSESSMENT

In the last 40 years, nuclear power has played a small but important role in the Dutch energy supply, providing a safe, reliable and economic source of baseload electricity. The operational track record of NPPs in the Netherland is among the best in the world. Nuclear power has contributed to achieving the energy goals of the country in terms of carbon emissions reduction and energy sources diversification.

Since the last in-depth review in 2008, the government has increased efforts to create a transparent framework for investors interested in building new nuclear capacity. Commendably, this includes policies for nuclear waste and requirements on safety standards which take into account the lessons learned from the Fukushima Daiichi accident and from the outcomes of the European stress tests. However, current electricity market conditions and overcapacity in Dutch generation do not provide a favourable environment for future investments in nuclear capacity. Recently, two applications for new nuclear construction have been put on hold for an indefinite period. If the government is committed to pursuing the nuclear energy option after 2033, it should take action in the coming years to support new investments in nuclear capacity, in line with experience of other IEA jurisdictions, such as Finland or the United Kingdom.

The Netherlands has taken a pragmatic approach concerning the management of radioactive waste, transferring all liabilities to a governmental organisation according to the "polluter pays" principle. In this respect, the government should continue to ensure that the financial provisions set aside are sufficient to cover the future liabilities associated with the conditioning, storage and final disposal of all radioactive waste. Also, given the awareness of the public on issues related to radioactive waste, the government should set out its programme for its management and final disposal.

In 2014, the Dutch government created a single nuclear safety authority, the Authority for Nuclear Safety and Radiation Protection (*Autoriteit Nucleaire Veiligheid en Stralingsbescherming,* or ANVS), as independent administrative authority under the responsibility of the Minister of Infrastructure and Environment, and independent from the licensee, as recommended by both IAEA and NEA. This is commendable.

Since the last in-depth review, the government has taken important measures to strengthen Dutch nuclear research infrastructure and maintain the current high level in education, research and development. In this respect, the IEA welcomes the decision to invest in an upgrade of the research reactor in Delft and to provide the first investment for a new materials irradiation facility in Petten (the PALLAS reactor); these are important signals of the willingness to maintain the necessary competences in the Dutch nuclear sector.

RECOMMENDATIONS

The government of the Netherlands should:

- *Continue to ensure that adequate financial provisions are set aside by the operator to fund future liabilities arising from storage and long-term disposal of the nuclear fuel and from the dismantling of the Borssele nuclear power plant in 2033.*
- *Complete the establishment of the new regulatory body for nuclear safety and ensure its independence.*
- *Building on the experience in other countries, ensure timely action for encouraging new nuclear power plants in line with the longer-term vision for 2050 and the energy transition to a low-carbon economy.*

8. NATURAL GAS AND OIL

Key data (2012)

NATURAL GAS

Production: 80.2 bcm, +5.9% since 2002

Share of natural gas: 41.7% of TPES and 54.4% of electricity generation

Natural gas net exports: 34.3 bcm, +33.3% since 2002

Inland consumption: 46.1 bcm (power generation 30%, industry 21.1%, residential 22.6%, commercial and public services 20.7%, energy own use and other transformations 5.5%)

OIL

Crude oil production: 1.1 Mtoe, -50.3% since 2002

Share of oil: 39.4% of TPES and 1.1% of electricity generation

Crude oil imports: 49.3 Mtoe, +7.3% since 2002

Inland consumption: 30.9 Mtoe (industry 49.3%, transport 35.1%, energy own use and other transformations 11.6%, commercial and public services 2.3%, power generation 1.4%, residential 0.3%)

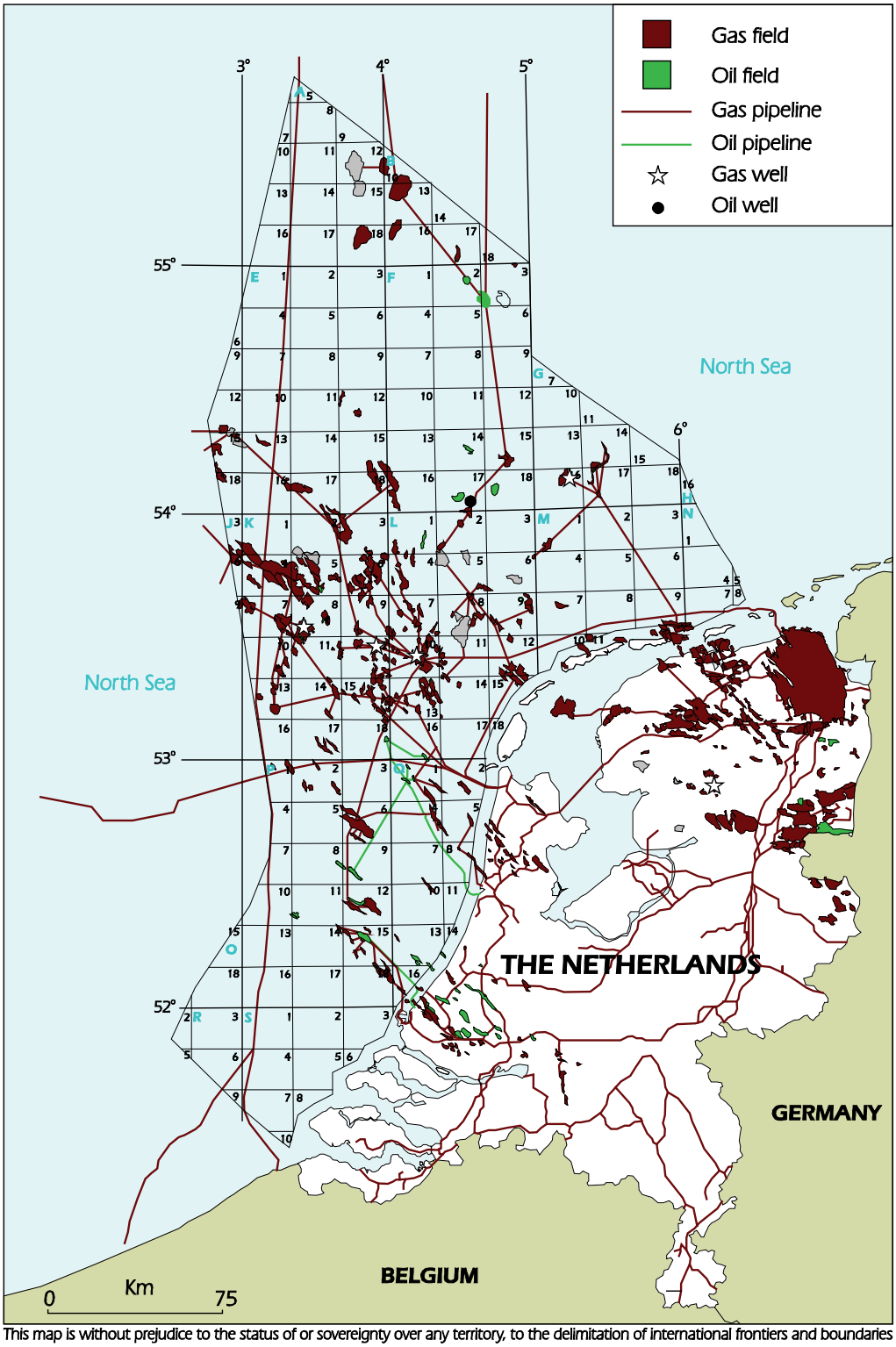
OVERVIEW

The Netherlands remains Europe's second-largest gas producer and is a net exporter of natural gas and refined oil products.

Since its discovery in the 1950s, natural gas dominates the electricity supply, domestic heating and industry feedstock, in particular in the petrochemical industry. Almost 98% of Dutch households use gas for heating. Government revenues from the gas sector amount to EUR 13 billion in 2013 (see Figure 8.4), and the sector plays an important role in the Dutch economy, as it also secures around 70 000 jobs. Amid declining indigenous production and unclear outlook for unconventional gas, the Netherlands is expected to shift from a net exporter to a net importer of gas in the period 2020 to 2025.

Despite new discoveries being made, notably offshore, oil production has been on the decline by 50% since 2002. However, the country has a strategic position in the European oil supply chain, as a leading importer, exporter of oil products (63%) and refiner of crude oil, and host of major oil storage capacity for the European region. The Dutch refining industry has invested in energy efficiency and process innovation and is well integrated with the petrochemical sector, which makes it competitive. Rotterdam has become the energy hub of Europe, with oil refineries and storages, GATE LNG terminal and large coal import facilities as well as major power generation and chemical industries which use oil and oil products and natural gas as feedstock.

Figure 8.1 Map of oil and gas fields in the Netherlands



This map is without prejudice to the status of or sovereignty over any territory, to the delimitation of international frontiers and boundaries and to the name of any territory, city or area.

Sources: TNO; Ministry of Economic Affairs, 2013.

NATURAL GAS SUPPLY AND DEMAND

PRODUCTION AND SUPPLY

Natural gas is the largest source of energy in the Netherlands, accounting for 41.7% of total primary energy supply (TPES) in 2012. Energy from natural gas amounted to 32.8 million tonnes of oil-equivalent (Mtoe) in 2012, declining by 8.4% since 2002. Total supply peaked at 39.2 Mtoe in 2010, before contracting for two consecutive years.

Estimated natural gas reserves amounted to 1 230 billion cubic metres (bcm) on 1 January 2012[1] and have been declining over the past four decades, peaking in the 1970s. The remaining resources are estimated at 740 bcm in the Groningen field. In addition, in 2012, there were 235 small fields in production.

Between 2006 and 2015, the production limit on the Groningen field is set at 425 bcm (Groningen-equivalents) or 35.17 megajoules per cubic metre (MJ/m^3). A second limit of 425 bcm was set in 2011 until and including 2020. An average annual production of 42.5 bcm from 2006 until and including 2020 is possible with certain production flexibility, as long as the cap of cumulative 425 bcm is not exceeded. However, the flexibility role for the Groningen field necessarily implies some uncertainty as to its annual output. This implies an annual production cap of 42.5 bcm (Geq) up to 2020 after which production will start declining to about 10 bcm per year by 2035. The recent re-evaluation of the production has abolished flexibility and introduced an annual cap for the next three years, as outlined below.

Production of natural gas was 80.2 bcm in 2012, 47.2 bcm alone from the Groningen field, much more than the cap. On the average, the Netherlands produces 45 bcm of natural gas annually from onshore gas fields and 25 bcm from offshore gas fields. Natural gas production exhibits volatile annual trends, mitigated by the swing function of the Groningen field, as most gas is used for heating, which follows the seasonal heating demand.

Future production levels are linked to a Dutch gas policy provision, which sets a maximum allowance for Groningen total output to ensure that the Groningen field can provide long-term security of supply. Larger offshore gas fields currently in production are expected to be exhausted in 10 to 15 years. The government expects a production decline to 49 bcm in 2023 and 20 bcm in 2033, with 10 bcm from Groningen. As indigenous gas production is expected to decline around 2020, the Netherlands prepares for the shift from being a net-exporter to a net-importer of gas.

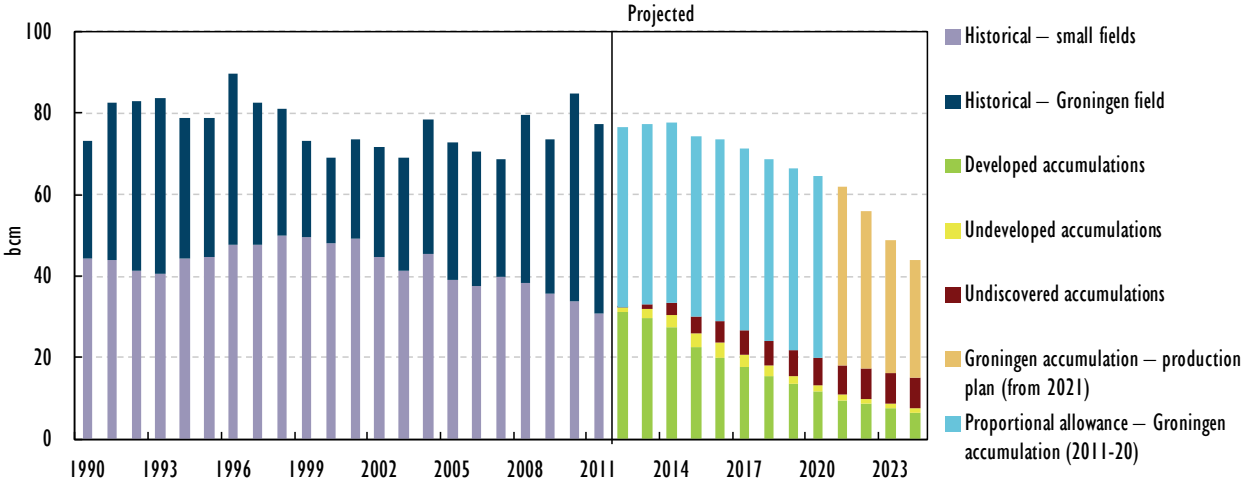
However, stronger earthquakes than expected in the area of the Groningen field in 2012 prompted an evaluation of the safety of gas production and the actual decline. In 2013, the government asked the company *Nederlandse Aardolie Maatschappij* (NAM) to elaborate a revised production plan, setting out how to reduce the risk of larger and more frequent tremors through mitigating measures, such as the preventive structural upgrading of housing and other buildings. On the basis of the studies and recommendations of the steering group, the assessment of NAM's production plan by the State Supervision of Mines (SodM) and the Technical Committee on Soil Movement, the government evaluated NAM's production plan by the end of 2013 and presented its decision in January 2014. The government outlined three main measures to tackle the situation: *i)* a targeted reduction of gas extraction for reasons of safety; *ii)* large-scale preventive reinforcement

1. Statistics Netherlands, CBS, 2012.

of houses, other buildings and infrastructure, and adequate settlement of damage claims; and *iii)* improving the economic perspective of the region by encouraging economic activity. The package of measures for Groningen will amount to EUR 1.18 billion for the entire period 2014-18 and is largely funded by NAM and the state which will pay for the claim settlement and preventive measures and the liveability programme through reduced natural gas revenues, estimated at EUR 144 million per year. The decision is to scale down production from Groningen, notably the Loppersum clusters, to 42.5 bcm, 42.5 bcm and 40 bcm respectively over the years 2014, 2015 and 2016, and a new production plan by NAM shall be presented before 1 July 2016.[2] This has an impact on the state revenues which will see cuts of EUR 0.7 billion and EUR 0.6 billion in 2014 and 2015 respectively. For 2016 revenues are expected to be cut by some EUR 1.0 billion.

A follow-up study is to be performed as a basis for the preparation of the decision on future gas extraction after 2016 that will be discussed with the region.

Figure 8.2 Natural gas production from the Groningen field, 1990-2024



Note: the graph does not consider the new cap imposed in 2014 for the production of the next three years.

Source: *Dutch Oil and Gas Portal*, 2013.

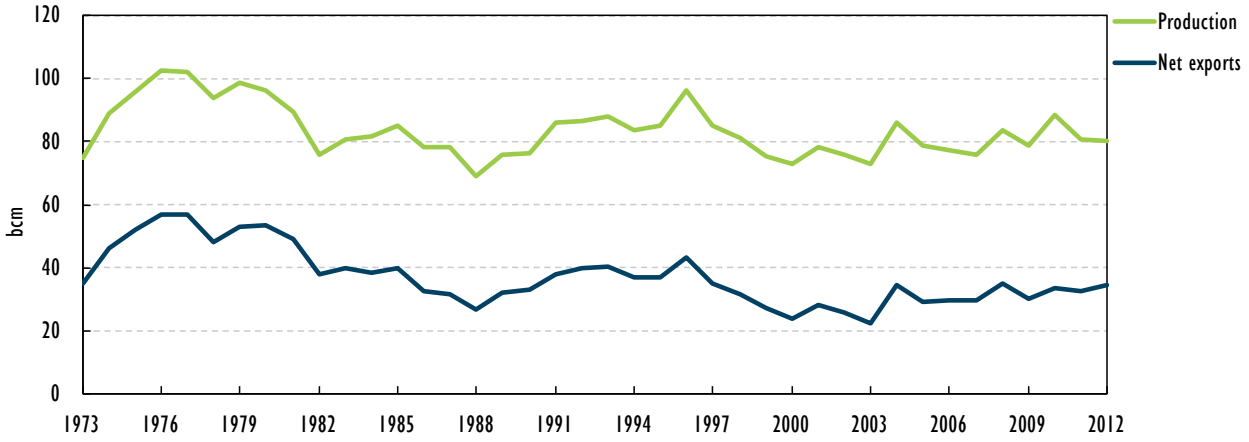
IMPORTS AND EXPORTS

The Netherlands remains the second-largest gas producer in the European Union. Domestic production of natural gas is almost double the level of domestic demand, and thus the Netherlands has a high concentration of gas trade. Thanks to the country's location and its high level of gas market integration in the North-West of Europe and investment in infrastructure for cross-border trade, trade flows have been increasing.

In 2012, gas exports amounted to 60.4 bcm and imports to 26.1 bcm. The Netherlands is a net exporter of natural gas, with net exports increasing by 33.3% from 25.7 bcm in 2002 to 34.3 bcm in 2012. In 2012, gas exports were mainly destined for Germany (38.8%), Belgium (18.4%), Italy (15.6%), France (13%) and the United Kingdom (13%). Imports were mostly from Norway (63.3%), the United Kingdom (16.8%), Russia (11.2%), Denmark (5%) and Germany (2.2%).

2. Letter by Minister Henk Kamp to the Dutch Parliament, "Decision-making on gas production in Groningen", 28 October 2013 and letter by Minister Henk Kamp to the Dutch Parliament, "Gas extraction in Groningen", 17 January 2014. All information on the Groningen research and decisions can be found at: www.rijksoverheid.nl/aardbevingen-in-groningen.

Figure 8.3 Natural gas indigenous production and net exports, 1973-2012



Sources: *Natural Gas Information*, OECD/IEA, Paris, 2013; country submission.

UPSTREAM LICENSING AND TAX REGIME

The objective of the Dutch government is to promote the exploitation of the country's natural gas and oil reserves to ensure the security of supply, economic growth and energy independence. Targeted measures were taken to ensure companies can invest in exploration over time, to explore and extract oil and natural gas, in particular from small, marginal gas fields.

Since the discovery of natural gas in a field near the village of Slochteren in the northern province of Groningen in 1959, and the opening-up of offshore production from small gas fields in the 1970s, the Netherlands has been a significant gas producer. An extensive gas network was developed in the area linking the Dutch gas market and networks with neighbouring markets in Belgium, France and Germany.

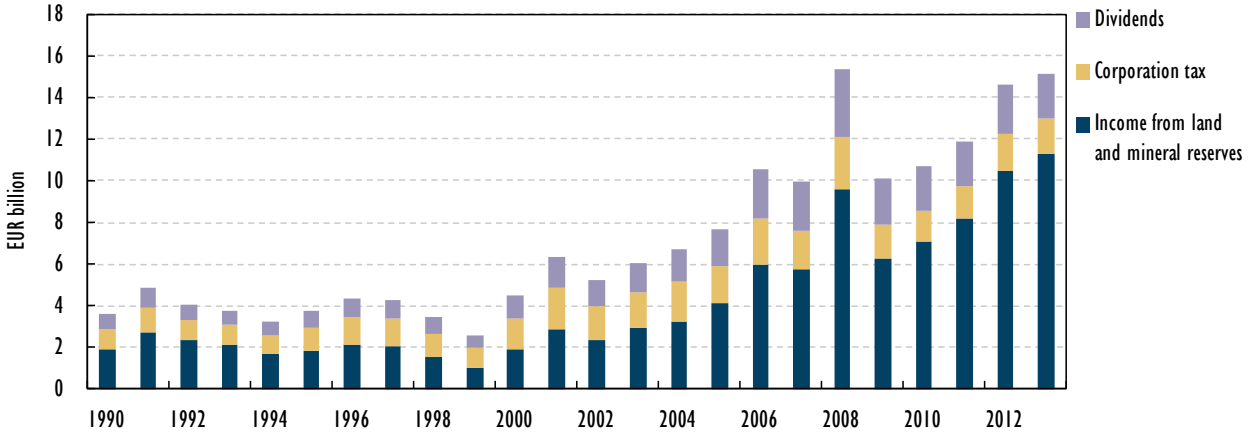
Since then, the Dutch gas policy focussed on the stimulation of exploration and production from small gas fields and on the development of the potential of unconventional gas and biogas. The strategic management of the Groningen field ensures its availability as swing supplier.

The Dutch state takes equity stakes in production and exploration licences through *Energie Beheer Nederland* (EBN), the largest acreage holder in the Netherlands, followed by NAM, as it holds in general a 40% share and a 50% share for licences agreed under the 1976 Royal Decree. Production from small fields attracted gas producers which had the obligation to sell their gas to the state-owned gas trading company GasTerra (today the obligation does no longer exist).

In 1973, the Netherlands introduced the small fields policy ("*het kleine velden beleid*") which enabled gas-producing companies to come into the Dutch production.

In 1995, the Netherlands opened up its licensing regime for exploration in the Dutch Continental Shelf. The government uses one set of concession agreements; licences are granted by the Ministry of Economic Affairs. Since 1995, all unlicensed acreage is available for competitive allocation. Today, the Dutch legal framework is governed by the 2003 Mining Act. The favourable taxation policy with an average onshore marginal tax rate of 72% and marginal offshore tax rate of 71% encouraged investment in new oil and gas development.

Figure 8.4 Government revenues from natural gas, 1990-2012



Source: country submission, 2013.

The remaining scope for the recovery of natural gas lies partly in demonstrated gas fields that are not (yet) in production (stranded fields) and partly in prospects, which are fields still to be demonstrated by drilling. These oil and gas fields are limited in size and generally marginal, particularly in a global context.

In 2013, EBN outlined that profit margins from Dutch small fields are still attractive and that the volume of technically recoverable gas is increasing. Around EUR 20 billion of investment in small and marginal fields would be required to prevent production level from declining.[3] However, the production decline is already a reality. In addition, offshore platforms and infrastructure will be dismantled and removed, if no new fields are developed. Without these platforms and infrastructure, these small fields cannot produce profitably in any event and substantial quantities of natural gas (and related government revenue) will remain underground. Onshore, the situation is less urgent because the gas infrastructure and extraction opportunities remain to exist in the long term.

In 2010, the Dutch government introduced two new measures to encourage further upstream development, the Marginal Fields tax incentive and the Fallow Acreage Covenant.

In September 2010, an investment deduction for marginal gas accumulations on the Continental Shelf (*Regeling investeringsaftrek marginale gasvoorkomens continentaal plat*) entered into force. The deduction aims to encourage the mining industry to develop marginal gas fields on the Dutch Continental Shelf which otherwise would not have been drilled. Licence holders may charge 25% of the amount of investment for the appointed marginal fields or prospects against the result, subject to legal payment of the State Profit Share under the Mining Act. The applications for marginal fields are reviewed against three parameters: technically producible volume of gas, well productivity and transport distance to a platform. Up to now, 19 applications have been filed for eight different licences; 13 out of 14 applications have been approved, one has been rejected. Five applications are under consideration. The 13 approved cases expect to discover and develop 22 bcm of natural gas.

In 2010, the Fallow Acreage Covenant was agreed between the government and most exploration and production (E&P) companies with operations in the Dutch offshore. This

3. EBN, Focus on Dutch Oil & Gas, 2013.

covenant is a non-binding agreement that aims to stimulate the exploration for and production of oil and gas reserves in the Dutch part of the Continental Shelf. It seeks to ensure that if an operator has been insufficiently active for an extended period, a license holder can voluntarily return licensed acreage to the authority granting the permit.

The remaining North Sea offshore potential could be harnessed with new technologies and investment in maintaining the current infrastructure facilities. Experience in the United Kingdom and Denmark suggest considerable benefits of such an approach. The government may need to review, in line with global experience, if the current taxation scheme and ownership structure is still sufficient to attract investment in the future.

Unconventional gas development

There has been international interest in the exploration of unconventional gas in the Netherlands, including by international players, BG, Cuadrilla Resources and Hexagon Energy, who acquired onshore acreages.

The unproved wet shale gas of technically recoverable resources (TRR) is estimated at 26 trillion cubic feet (tcf),[4] which is similar to the TRR of the United Kingdom and Romania, but considerably less than in Poland (148 tcf) and France (137 tcf).

A study by Witteveen+Bos, Arcadis and Fugro[5] assessed conditions and impacts of exploration of shale gas and coal-bed methane in the Netherlands. The report outlines the need to clarify the Mining Act and to carry out specific environmental impact assessments for the exploration of shale gas.

The Dutch E&P sector has experience with hydraulic fracturing which is part of well construction or well maintenance. Up to now, the State Supervision of the Mines (SSM) can only request information on special activities, including fracturing, from mining companies.

Exploratory drilling for shale gas was put on hold, amid opposition by the public and environmental organisations at local government level. The Netherlands will conduct further research to define the best locations where to drill for unconventional gas. Consequently, shale gas explorations and test drilling are on hold depending on the outcome of the impact assessment study which is to be completed by end-2014.

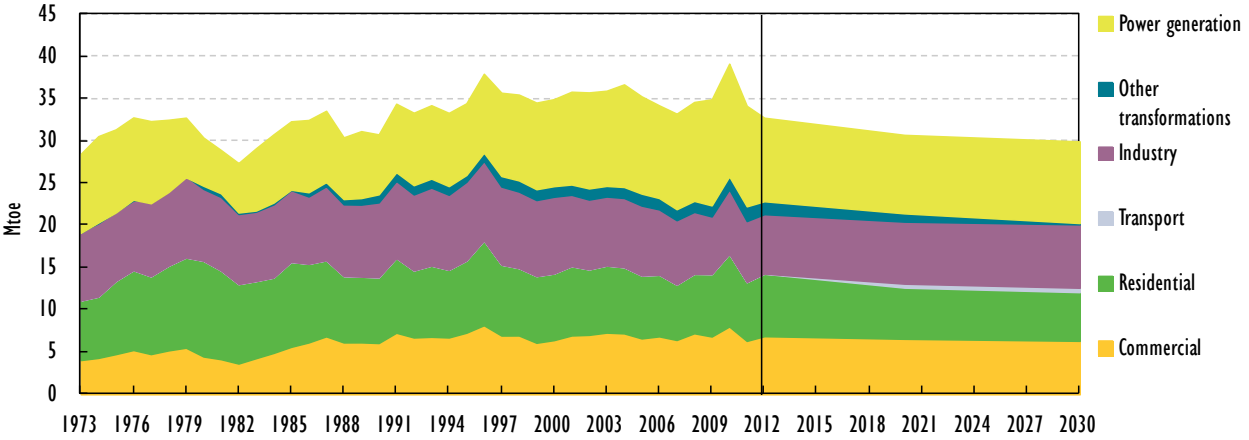
DEMAND

Total natural gas demand in the Netherlands reached around 46.1 bcm in 2012. The share of power generation in the total natural gas supply was 30%, marginally down from 31.8% in 2002; natural gas dominates, with 54.4%, the Dutch electricity mix in 2012. Almost all households are connected to the gas network. Industry and the residential sector account for 21.1% and 22.6% of demand, respectively, while commercial and public services amount to 20.7%. Demand for gas from all three sectors has fallen since 2002, declining by around 14% for industry and around 3.5% for both commercial and households. Transport is at a negligible level of less than 0.1%. Energy sector own use accounts for 5.5% of natural gas consumption. The Netherlands has a strong seasonal and daily pattern in gas use which is mainly driven by temperature.

4. *Technically Recoverable Shale Oil and Shale Gas Resources – An Assessment of 137 Shale Formations in 41 Countries Outside the United States*, US Energy Information Administration (EIA), June 2013. The Dutch research organisation TNO uses an estimate of 10 tcf to 20 tcf.

5. A public summary of the shale gas report by Witteveen+Bos, Arcadis and Fugro is available at: www.government.nl/documents-and-publications/reports/2013/09/02/summary-shale-gas-report.html.

Figure 8.5 Natural gas demand by sector,* 1973-2030



Note: *Other transformations* includes other transformation and energy sector consumption. *Industry* includes non-energy use. *Commercial* includes commercial, public services, agriculture/ forestry, fishing and other final consumption.

* TPES by consuming sector; actual data to 2012.

Sources: *Natural Gas Information*, OECD/IEA, Paris, 2013; country submission.

Since 2012, gas demand in the power sector has been affected by lower economic growth and the relative price of gas and coal. Following the US shale gas revolution and low carbon prices in Europe, cheaper US coal has become available to the global market and has fostered the switch from gas to coal in power generation. This trend is likely to persist in the coming decade. The government expects gas demand to average around 40 bcm till 2030. IEA data indicates 30 bcm. The demand will largely depend on the future power generation, GDP growth, the growth of renewable energy supply in the Netherlands and neighbouring countries and the relative competitiveness of natural gas against coal at the margin. Only a slow decline in gas use in the residential sector is foreseen, as insulation of homes increases.

NATURAL GAS INFRASTRUCTURE

TRANSMISSION AND DISTRIBUTION

The Dutch transmission system of around 12 000 km of high-pressure natural gas pipelines is operated by transmission system operator (TSO) Gasunie Transport Systems B.V. (GTS). GTS operates a decoupled entry-exit system with 53 entry points to the gas grid (36 points from Dutch gas fields and 17 points from neighbouring networks) and over 1 000 domestic delivery points as well as 25 cross-border points. The gas interconnector between Bacton (United Kingdom) and Balgzand (the Netherlands) is operated by BBL Company V.O.F., which is owned by Gasunie BBL B.V. (60%), Fluxys BBL B.V. (20%) and E.ON Ruhrgas BBL B.V. (20%).

The Netherlands has almost 100 000 km of low-pressure (distribution) networks to which all households are connected. Gas with high calorific value (H-gas) and gas with low calorific value (L-gas) are transported on separate high-pressure networks. In order to interconnect these networks, the Dutch TSO operates so-called conversion facilities where H-gas can be converted into L-gas by adding nitrogen. GTS has the legal obligation to deliver gas in the required quality. Quality conversion is a so-called system service whose costs are socialised.

GAS QUALITY

The Netherlands has a differentiated natural gas network for two type of gas qualities, L-gas and H-gas. Groningen gas (G-gas),[6] originating from the Groningen field, has no H-gas in its gas composition, but L-gas which is exported to Germany, Belgium and France. (Blending H-gas with nitrogen is also used to produce L-gas.) Small gas fields produce H-gas which is directly linked to exports. Both residential and commercial gas users in the Netherlands burn Groningen-quality L-gas, while industry (chemical industry and power generators) and exports use mostly H-gas. Two network systems avoid the dilution of H-gas to L-gas.[7]

With the decline of the Groningen field, the L-gas market in Europe will be phased out and replaced by new gas sources, at a pace determined by the limits and needs of switching to new appliances, where adequate, to adapt to different gas qualities. Neighbouring countries consuming Groningen gas have started looking for alternative supplies and infrastructure switching in their markets. GTS, the national gas network operator, has conversion installations in place to serve the Dutch market. These however are of limited capacity and expansion in the short term is not an option. Since September 2011, the new GATE LNG terminal for liquefied natural gas feeds new gas qualities into the Dutch grid, adjusted when necessary by the GTS nitrogen-mixing installation. In the longer term, the import of LNG in the Netherlands is to cover also domestic demand which will require more conversion facilities.

In 2010, the government launched a long-term strategy together with the manufacturing industry, gas producer NAM and gas consumers with regard to the changing gas composition in the Netherlands by 2020.[8] A plan has been put in place for the phase-out of the existing appliances which cannot use new gas qualities and to phase in new appliances, capable of dealing with the new calorific value of imported gas.

Before this, in January 2011 the project bureau "*Nieuw Aardgas*"(New Natural Gas) was created with the task of ensuring a smooth transition from L-gas to H-gas and new H-gas qualities, first for the industry but also for small consumers. The project bureau monitors the situation, including network safety, changing gas composition and the ability of companies to adjust to the new gas qualities.[9]

In the Pentalateral Gas Forum, the Netherlands is working together with its neighbouring consumers (France, Belgium and Germany), TSOs and industry. It plans to start the conversion of the domestic market after 2030, while the transition and phase-out of Groningen supplies would start in Germany in 2020, and around 2025 in Belgium (60% of households) and France.

CROSS-BORDER INTERCONNECTIONS

The Netherlands has a total of 53 bcm of firm transmission capacity available for imports of H-gas at the border points with Germany (Oude Statenzijl and Emden) and Belgium (Zelzate). The Dutch gas grid has the capacity to export almost twice as much H-gas, up

6. The Groningen as equivalents is calculated relative to the heating value of 35.08 megajoules per normal cubic metre (MJ/Nm^3), before 2011, a value of 35.17 MJ/Nm^3 was used. Normal cubic metres can be converted to standard cubic metres by multiplying them by 1.055.

7. To ensure safety and reliability in the use of gas, the Dutch network codes foresee that the share of H-gas in the L-gas network must not exceed 5%.

8. Kamerstukken 29023, nr. 117.

9. Rapportage Projectbureau Nieuw Aardgas, April 2012.

to 117 bcm, to Germany, Belgium and the United Kingdom (BBL). The lion's share of export capacities is L-gas from the Dutch Groningen field to Germany and Belgium.

LIQUIFIED NATURAL GAS

The Netherland's first liquefied natural gas (LNG) terminal, Gas Access to Europe (GATE), came into operation in 2011 at the Maasvlakte facility in Rotterdam with a capacity of 12 bcm (possible upgrade to 16 bcm) The terminal has three storage tanks, two jetties and a regasification facility. Nederlandse Gasunie N.V. (Gasunie) and Koninklijke Vopak N.V. (Vopak) operate the GATE terminal on the basis of an exemption from tariff and third-party access regulation by the Ministry of Economic Affairs for a duration of 20 years. Initial contracts were signed with five major European energy suppliers, Dong Energy, EconGas OMV International, RWE Supply & Trading, Eneco and E.ON Ruhrgas.

While the North-West European gas market benefits from diversified imports through GATE, its utilisation is affected by low gas demand in Europe, rising gas trade flows to Asia and thus higher international LNG prices.

STORAGE

In relation to its natural gas system and its natural gas consumption, the Netherlands has a rather small working gas storage volume of 5.7 bcm from existing storages, mainly depleted gas fields (Norg, Grijpskerk, Alkmaar). Against this background, a new large storage facility in Bergermeer is under construction which will add 4.1 bcm in 2014/15. A salt cavern in Epe (Germany), a former salt mine, is also used by Nuon as gas storage. The main system flexibility, however, is provided by the production swing from the Groningen field and some peak-shaving LNG capacity. With the production decline of Groningen, the country will need to increase its storage capacities to ensure flexibility and security of supply.

Flexibility has increased thanks to investment in fast-range storage with the salt cavern of Zuidwending, which has been expanded in October 2013 to a fifth cavern. TAQA and EBN are developing the new large-scale seasonal Bergermeer storage which is to double the Dutch storage capacity to 10 bcm when coming on stream in April 2014 (partially) and fully in April 2015.

Table 8.1 Underground gas storage facilities, 2013

Facility	Working volume (bcm)	Withdrawal rate (mcm per day)	Company
Norg	3*	50-80	NAM
Grijpskerk	1.5	55	NAM
Alkmaar	0.5	1.5	TAQA
Epe	0.5	20.88	Nuon
Zuidwending (G-gas)	0.2	43.2	Gasunie/Nuon
Maasvlakte	0.078	31	Gasunie/LNG peak shaving
Bergermeer	4.1	57	TAQA, EBN, Gazprom (operational in 2014/15)

* NAM will increase the working volume of Norg from 3 bcm to 7 bcm within the next two years. The withdrawal capacity will be increased from 55 mcm/day to 76 mcm/day.

Sources: *Natural Gas Information*, OECD/IEA, Paris, 2013; country submission.

Access to storage is ensured on the basis of negotiated third-party access (nTPA). Permits and approval for new gas storage sites can be obtained from the government. There are no criteria established by the government defining which storage sites shall be subject to TPA and which not.

REGIONAL GAS GRID DEVELOPMENT

The Dutch gas network was created in the 1960s following the discovery of the Groningen field. Priority was to create a gas network close to consumers. Today's priority for the network development has changed and market integration moved to the forefront.

As part of the Dutch Gas Hub Strategy, launched in 2005, Gasunie has expanded investment in gas infrastructure, with participations in the gas interconnection with the British BBL, in the Nordstream and NEL pipelines in Germany, following the purchase of the German BEB transport network by the Dutch state, and operation through Gasunie Deutschland and the new GATE LNG terminal. Various interconnections with neighbouring countries were enhanced, including the import capacity of Norwegian gas in Emden, and new underground storages were built. During the past decade, three open-season processes were organised in the Netherlands (see Table 8.2) which resulted in an extensive investment programme by Gasunie and Energie Beheer Nederland (EBN), amounting to EUR 8.2 billion during the period 2005-14, with a maximum of EUR 9.6 billion in total.[10] In the near future (expected in 2014), the interconnection capacity with Germany and Belgium will be further increased.

As required under the Dutch Gas Act, GTS publishes a biannual national Quality and Capacity Report but has no obligation to submit a gas investment plan, as it is fully ownership-unbundled. As a member of the European Network of Transmission System Operators for Gas (ENTSO-G), GTS co-operates with European gas TSOs on the elaboration of the EU-wide TYNDP and the Gas Regional Investment Plan 2013-2022 for the North-West gas region consisting of Belgium, Denmark, France, Germany, Ireland, Luxembourg, the Netherlands, Sweden and the United Kingdom.

Table 8.2 Gas network expansion in the Netherlands, 2005-14

Period	Project	Additional capacity (bcm/year)	Total cost (EUR million)
2005-11	1st open season	Entry: 30; exit: 13	1 070
2007-13	2nd open season	Entry: 25; exit: 25	546
2010-14	3rd open season (Dutch part)	Entry: 10; exit: 20	495

Source: country submission.

Managing a regional gas network, GTS has been working on market integration together with German affiliate Gasunie Deutschland. GTS promoted the EU-wide introduction of auctions for cross-border capacity in a pilot project and, in April 2013, launched together with other TSOs a single European transport capacity platform (PRISMA) for the auctioning of cross-border gas transmission capacity. As a result of this early implementation of the European Network Code Capacity Allocation Mechanism (NC CAM) by seven countries,

10. Algemene Rekenkamer. Gasrotonde: nut, noodzaak en risico´s; Nederland als Europees knooppunt van gastransport. Tweede Kamer, vergaderjaar 2011-2012, 33 292, nr. 1, The Hague, 2013.

23 network operators will contribute to a more efficient use of cross-border capacity and harmonisation, and better functioning of North-West European gas markets. The successful implementation of the NC CAM should solve the current capacity congestion at the German and Belgian borders in the future.

In the medium term, up to 2020, GTS considers the management of the decline of the Groningen field and the related decline of L-gas as a priority which requires increasing import flows and investment in flexible storage (L-gas caverns at Epe and Zuidwending), the expansion of Norg and storage peak quality conversion (Heiligerlee) as well as expanded quality conversion capacity. GTS plans to make H-gas capacity from new Russian supplies via Nord Stream available by gradually "converting" the L-gas exit points into H-gas exit points if there is a market need.

In a longer-term future, the Dutch gas infrastructure could also serve other purposes. The Dutch government expects to increase the use of biogas and set a target of 3 bcm (2030) and 20 bcm (2050) which is to be achieved by gradually increasing the production of synthetic gas. That is also why the future role of gas will depend on innovative uses of natural gas and natural gas infrastructure, providing options for decarbonisation of transport and energy storage. The role for natural gas (liquefied and compressed) in shipping and freight transport, as well as its perspectives to store renewable offshore power in the gas networks, so-called power-to-gas, are expected to grow. The Netherlands implemented green gas many years ago and is well positioned to explore synergies from such an integrated concept of renewables and natural gas.

NATURAL GAS MARKET STRUCTURE AND REGULATION

MARKET STRUCTURE

The Dutch gas market has been fully liberalised at wholesale and retail levels.

Market concentration on the production and trading side remains high. There are some incentives for new entrants and newcomers are entering the upstream business. The structure of the Dutch gas market largely remains intact since the creation of the Dutch *Gasgebouw*, the Dutch Gas Building (see Figure 8.6).

The Dutch Ministry of Economic Affairs is the sole shareholder of EBN, while the Ministry of Finance is the sole shareholder of Gasunie. NAM, EBN and Gasunie and other companies are involved in the operation of gas storages in the Netherlands. The government participates for 40% in almost all E&P activities through EBN which is 100% state-owned, and in trading of GasTerra which is owned 50% by the Dutch state (40%-points via EBN holding company), and 25% by Royal Dutch/Shell and 25% by ExxonMobil.

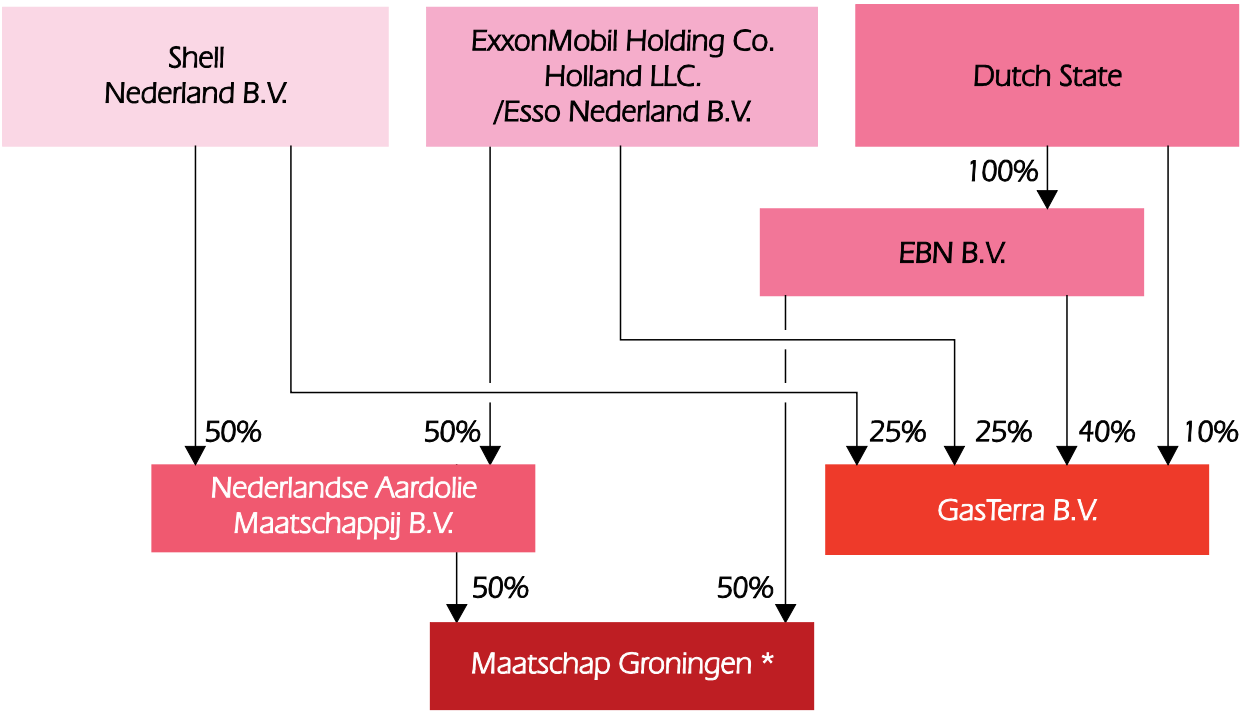
On the upstream side, the largest producer is NAM, the *Nederlandse Aardolie Maatschappij*, a 50/50 joint venture of Royal Dutch/Shell and ExxonMobil. Shell is the operator within this joint venture (see Figure 8.6). NAM produces gas from the Groningen field, which represents two-thirds of total production, and also produces almost half of gas from small fields. In recent years, a number of other companies moved into the Dutch market. Other producers include Wintershall, Total, GDF Suez, Chevron. These gas producers can market the gas by themselves. If they do not want to, they can also decide to offer their gas to GasTerra. In this case GasTerra has the legal obligation to purchase the gas at a price that is reasonable and reflects its market.

On the Dutch wholesale market, shipping, trading and sales of natural gas are handled through GasTerra as well as through E&P companies, retail companies, and financial institutions. ICE Endex is the Dutch gas exchange which trades spot and futures contracts.[11]

Gasunie Transport Services B.V. (GTS) is the national transmission system operator in the Netherlands. Gasunie, the mother company of GTS, also operates the gas storage facilities (Gasunie Zuidwending), the pipeline to England (BBL) and the LNG GATE terminal at Maasvlakte. In addition, there are nine gas distribution system operators (DSOs).

The retail gas market is supplied by three large companies: RWE/Essent, Vattenfall/Nuon and Eneco. By January 2012 their combined market share was 83%; the HHI[12] was 2344, which is higher than in 2009. Major retail clients are large industries (steel, chemicals), such as Tata Steel, Dow Chemicals and DSM.

Figure 8.6 The Dutch Gas Building



* With 60/40 NAM/EBN financial participation.

Source: country submission, 2013.

REGULATION

The **Ministry of Economic Affairs** has the prime responsibility for the Dutch energy policy, including the policy on natural gas from upstream to downstream as set out in the Mining Act and the Gas Act. The **State Supervision of Mines** is the supervising authority for mining activities, including gas production. It is responsible for ensuring the safety of humans and the environment. If necessary, it can carry out investigations,

11. On 1 March 2013, APX-Endex has separated into two companies: the power spot exchange APX and the gas spot, gas derivatives and power derivatives exchange ENDEX. As of 27 March, Intercontinental Exchange (ICE) is the majority shareholder of ENDEX, from now on referred to as ICE Endex.

12. The Herfindahl-Hirschman Index (HHI) is a measure for competition taking into account the size of firms in relation to the industry.

impose administrative penalties or advise the Minister of Economic Affairs. The **Dutch regulator ACM** monitors network operations, issues licences for gas supply, approves tariffs for gas transmission, upon proposals by the operators, and monitors gas market functioning. Both the State Supervision of Mines and ACM fall under the competence of the Minister of Economic Affairs. Their independence has been set by the necessary provisions in the Mining Act and the Gas Act.

Several secondary laws and regulations are designed to ensure a stable regulatory environment for the natural gas sector and to secure supplies to the consumers. The Mining Act sets out basic terms and conditions for E&P activities (including storage). The Gas Act sets out basic terms and conditions for the functioning of the gas market (responsibilities of the TSO and DSOs, the regulator, access regime network, storage sites, LNG facilities and others). With the transposition of the Third Energy Package, the Gas Act was amended in 2012. In addition, several ministerial decisions govern the delivery of gas to small consumers (below 40 cubic metres per hour); the Security of Supply Gas Act and ministerial regulations on the quality aspects of network management, electricity and gas tariff structures and conditions, all guarantee the quality of gas supplies. The Ministry of Economic Affairs introduced a range of measures to improve the functioning of the gas market by amending the Gas Act with a view to integrate different gas qualities; by simplifying the balancing regime for the gas transmission network; by improving the use and capacity of the gas transmission network; by merging many small delivery locations into one, and by providing for new allocation rules for cross-border transmission.

GAS TRANSMISSION AND DISTRIBUTION NETWORKS

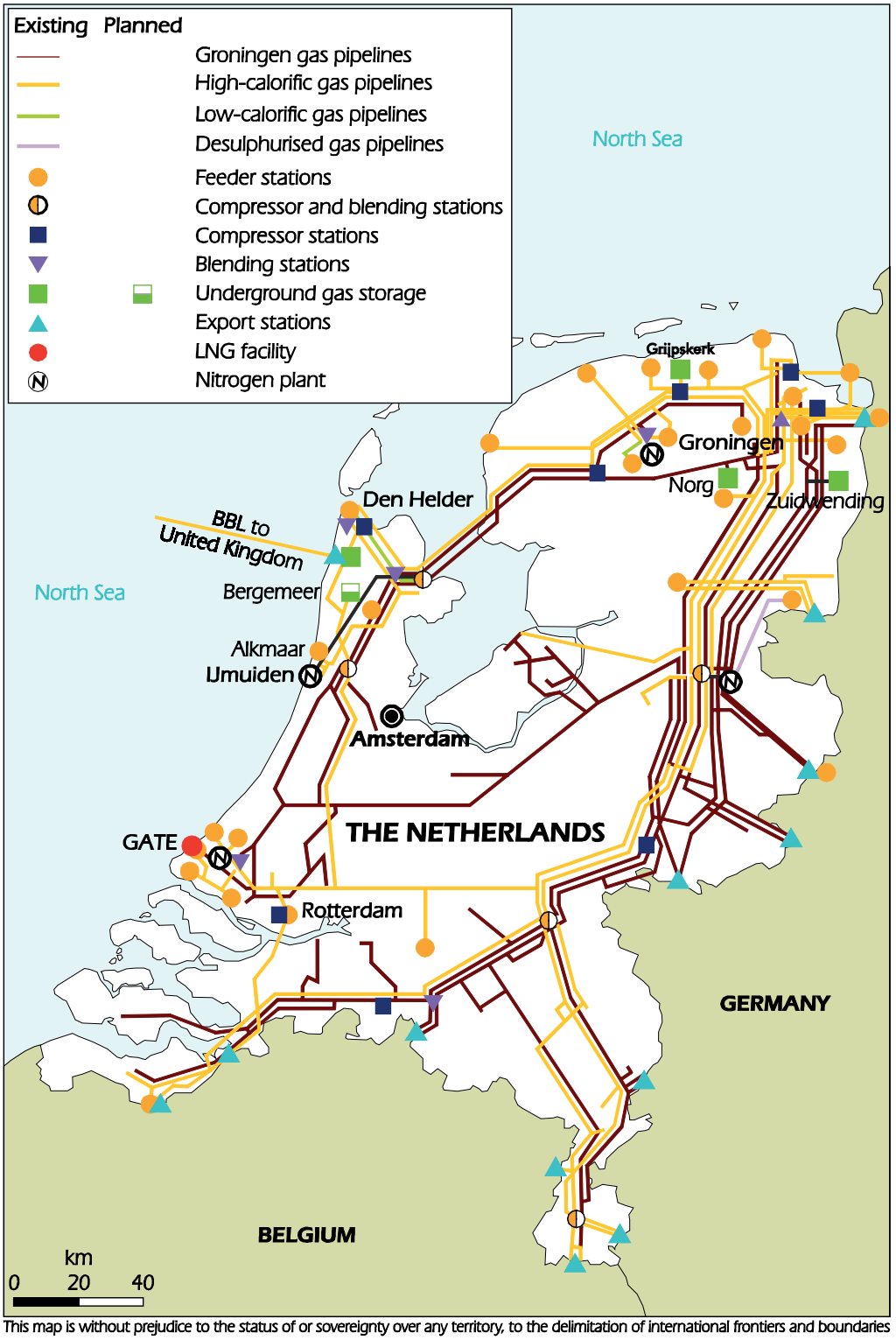
GTS is wholly owned by the Dutch state, its shareholding is administered by the Ministry of Finance. GTS has been certified as a fully ownership-unbundled TSO by ACM following opinion decision by the European Commission in 2013.

BBL Company V.O.F. was jointly certified as TSO by two regulators – ACM in the Netherlands and Ofgem in the United Kingdom – with the approval of the European Commission. BBL maintains a partial exemption from third-party access and tariff regulation for 80% of its forward-flow capacity authorised under Article 22 of Directive 2003/55/EC by both the Dutch and British authorities until its expiry in 2016 and 2022. The non-exempted part of the capacity in BBL and the capacities becoming available as of 2016 have to be marketed independently from the supply interests of its shareholders, in line with EU gas laws and network codes (use-it-or-lose-it regime, virtual reverse flows, capacity allocation mechanisms, balancing).

The Netherlands has a fully de-coupled entry-exit system with regulated access to the network. ACM approves the terms, conditions and access tariffs (TOTEX tariff regulation with a CPI-X method for both operational and capital expenditure) and ensures compliance with the provisions of the Gas Act, the Network Code and the Dutch Transmission Service Conditions (TSC) by GTS and credit worthiness.

In 2011, ACM introduced new rules and guidelines for the transmission regulation of GTS. These rules and guidelines were challenged by some market participants. The Dutch Trade and Industry Appeals Tribunal upheld the tariff methods.

Figure 8.7 Natural gas infrastructure in the Netherlands



This map is without prejudice to the status of or sovereignty over any territory, to the delimitation of international frontiers and boundaries and to the name of any territory, city or area.

Sources: IEA, 2013.

In line with the companies' articles of association, investments by Gasunie above EUR 100 million must be submitted for approval by the Minister of Finance and investments by EBN above EUR 200 million require approval by the Minister of Economic Affairs. The latter also decides if the proposed expansion of the national gas grid and investments by EBN and Gasunie are useful and necessary, in line with the national co-ordination procedure for large-scale energy infrastructure projects. In practice, this complex investment decision-making process may lead to conflicts of interest between the competences of the state as policy maker and shareholder in the network companies, and the independent decision making of ACM on the transmission tariff-setting, when the Ministry of Economic Affairs approves the efficiently incurred costs, including a reasonable return on investment.[13]

The 2006 Network Unbundling Act (*Wet onafhankelijk netbeheer*) required full ownership unbundling of electricity and gas distribution networks from supply activities by 1 January 2011. It also prohibits network companies from being part of a vertically integrated group, from engaging in other commercial activities and from being privatised. Six operators have been fully ownership-unbundled since 2010, while two DSOs still form part of a vertically integrated company. The requirement for distribution unbundling has been challenged by Eneco, Essent and Delta and annulled by the Dutch Court of Appeal in 2009. The Ministry of Economic Affairs challenged the decision at the Supreme Court of the Netherlands which requested a preliminary ruling from the European Court of Justice (ECJ) in 2012. Following the opinion of the attorney-general in April 2013, the ECJ ruled in October 2013 that the Dutch Unbundling Act is in line with EU law, as the restrictions to the free movement of capital can be justified as long as there are overriding reasons in the public interest (competition, market transparency and combating cross-subsidisation). It is now up to the Dutch Supreme Court to take a final decision on the necessity of ownership unbundling at DSO level in the Netherlands.[14]

GAS BALANCING REGIME

The Dutch entry-exit regime forms one market area and one balancing zone. The balancing regime is operated by GTS to ensure the balance within a portfolio between the volume of gas injected and the volume withdrawn. DSOs are carrying out operational balancing of the regional grids without any imbalance settlement imposed on suppliers or consumers at the distribution grid.

As of 1 April 2011, the Netherlands switched to a new balancing system in which market parties (instead of GTS) are responsible themselves for keeping the national gas transmission network in balance. The new balancing fosters gas trade and liquidity on the Title Transfer Facility (TTF), as parties can either buy or sell gas on the TTF.

The Netherlands uses an hourly cumulative and market-based balancing regime. The TSO GTS provides all grid users, on an hourly basis, with information on the overall system balance,

13. In 2010, the Trade and Industry Appeals Court ruled that by ruling on the transmission regulation in 2008, the Minister of Economic Affairs violated the Dutch Competition Authority's statutory duties and independence.

14. Joined cases C-105/12, C-106/12, C-107/12, Staat der Nederlanden v Essent and others, Judgement available at: http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:62012CJ0105:EN:HTML, 22 October 2013. Opinion of AG Jääskinen of 16 April 2013, at: http://curia.europa.eu/juris/document/. The AG and the Court argued that the EU Treaties (Art. 345 TFEU) do not prejudice the member states' rules governing property ownership. While group prohibition and side activities prohibition restrict the freedom of capital, such unbundling requirements can be justified under the economic objectives of the EU Treaties to achieve the goals of energy market transparency and to prevent distortions of competition.

the portfolio imbalance and the position of the user for the preceding hour. If the market participants cannot reach system balance, GTS is obliged to resolve the imbalance.

The TSO establishes a so-called bid-price ladder in case of imbalance, which encourages grid users to balance their positions and thus the Dutch gas network. Only grid users who are in imbalance will need to pay imbalance charges to the TSO. Additional balancing services are provided to grid users by GTS to account for daily deviations (nomination flex). These services are contracted by GTS on an annual basis by a tender procedure.

NATURAL GAS PRICES

WHOLESALE

The Dutch wholesale gas price is formed at the virtual trading point, the TTF, which is owned and operated by GTS. At the TTF, market participants transfer the gas that is already in the GTS system ("entry-paid gas") to another party. The TTF trades within-day (24/7), including gas for balancing requirements, and day-ahead products. In 2012, over-the-counter (OTC) trade represented 85% of total trade, while bilateral contracts account for 10% and the gas exchange for 5%.[15]

When assessing the liquidity of the TTF, there are several factors to consider, including physical trade, OTC-traded volumes, the number of market participants and the size and length of contracts. The integration of the gas balancing regime and new capacity allocation rules enables the TTF to function more efficiently. The additional 12 bcm per year regasification capacity of the GATE LNG terminal and the interconnection capacity from the BBL pipeline have further increased the liquidity of the Dutch wholesale market.

In the domestic gas trade, the Netherlands experienced the phase-out of oil-based gas-pricing in favour of pricing based on hub (TTF) trading prices. Nowadays, also long-term contracts often include TTF futures indexation. Also gas exploration and production is now linked to the TTF and no longer based on oil-price indexation.

The use of short-term gas contracts has increased in the Dutch domestic market, where the number of monthly and quarterly contracts is increasing. Traded volumes (see Figure 8.8) and number of participants have been on the rise since 2009. The number of registered TTF users in 2013 was above 100.

An important indicator of liquidity is the churn rate, the average number of times that a physical cubic metre of natural gas is traded. Hubs with a churn rate of at least 10 to 15 can be considered to be liquid. Bilateral OTC volumes make up the bulk of the gas trade at the TTF. The churn ratio of the TTF in 2013, as the ratio of traded OTC volumes (187 bcm) to physical gas deliveries (38 bcm), reached NBP churn rate levels and beyond (see Figure 8.9). TTF has a very high churn rate.[16] Liquidity at TTF is also high if measured as the physical trade against the gross inland consumption. In recent years, more and more consumption in the Netherlands has been physically delivered at the TTF.

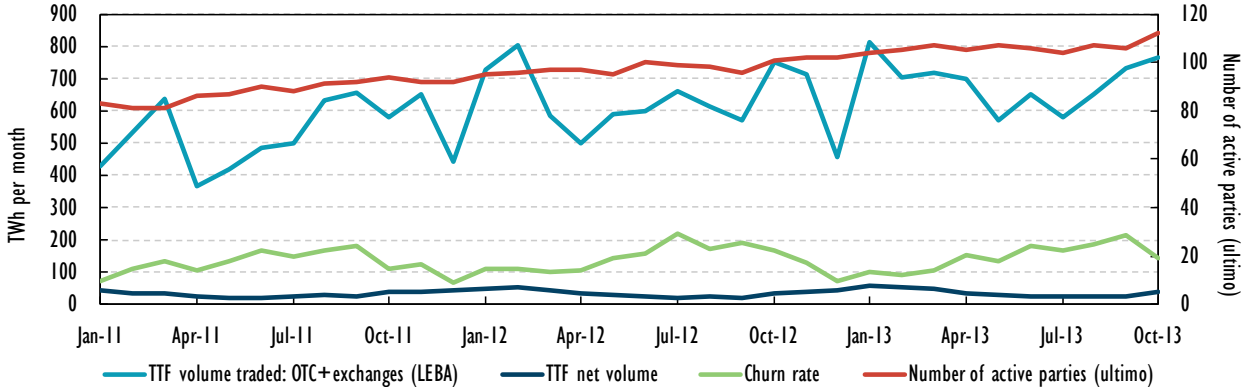
Throughout 2013, the TTF monthly hub price was consistently at or below the average gas price at other major European hubs, around EUR 26 per MWh to EUR 30 per MWh.

15. *ACM Annual Report 2012*, The Hague, 2013.

16. All trades, via the exchange, OTC and bilaterally, contribute to the total liquidity of the hub. As of January 2013 the Dutch TSO GTS only reports total traded volumes, including OTC trades. As other TSOs still report the nominated volumes, an equal comparison between TTF and the other European hub could not be made with the data currently available.

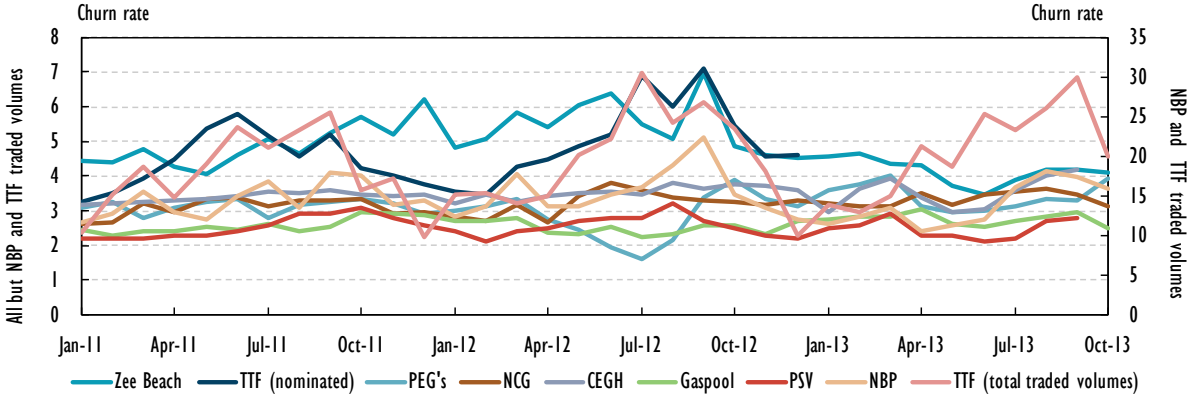
Over the past two years, the wholesale gas price experienced a general upward trend with some seasonal fluctuations (price peaks in winters 2012 and 2013) (see Figure 8.10).

Figure 8.8 Monthly volumes of the Dutch Title Transfer Facility, January 2009 to October 2013



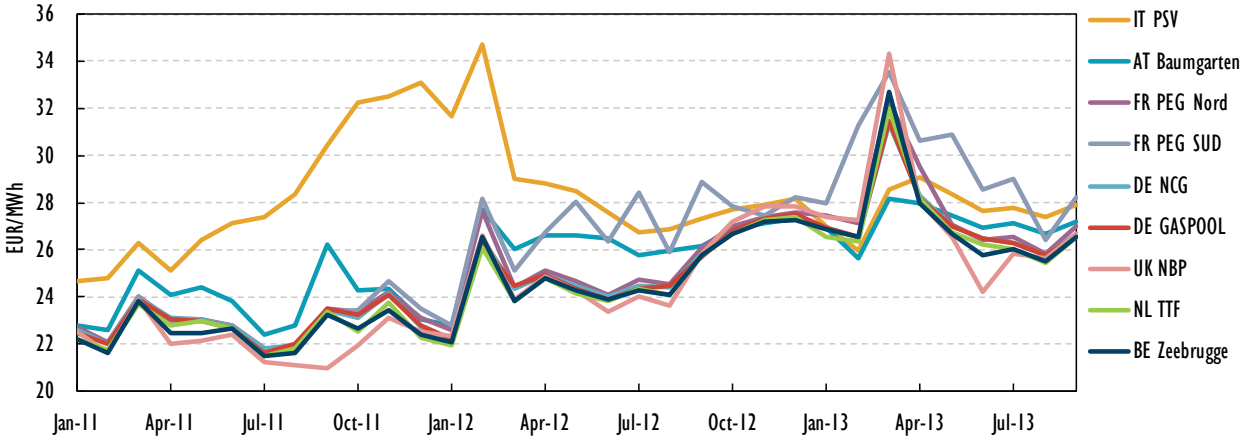
Sources: GTS, 2013.

Figure 8.9 Liquidity of major European gas hubs, January 2011 to October 2013 (based on OTC)



Source: *Medium-term gas market report*, OECD/IEA, Paris, 2013.

Figure 8.10 Converging monthly EU gas hub prices, January 2011 to September 2013



Source: Platts, September 2013.

RETAIL

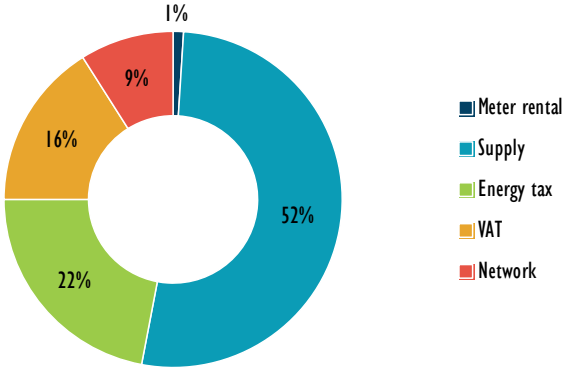
There is no retail price regulation in the Netherlands, as retail gas prices are set by the suppliers. However, suppliers have the obligation to deliver electricity and gas against fair prices and conditions. The regulator monitors prices and can check whether the prices of the suppliers are fair and has the last-resort authority to force suppliers to lower their tariffs (so-called safety net regulation *vangnetregulering)*. In the course of the revision of the Electricity and Gas Act (STROOM project), it is planned to phase out the safety net regulation in the coming years, as it has not been used. The obligation for suppliers to deliver against fair prices is to remain in place.

ACM uses other measures to ensure the protection of consumer interests. In 2012 it published a step-by-step guide for switching suppliers; it imposed fines on Dutch energy supplier and approved an easy-to-read and comparable standard energy contract. The switching rate in the Netherlands was 12.3% in 2013.[17] In case of bankruptcy of a supplier or when a supply permit is withdrawn and the supplier can no longer deliver to its clients, there is a supplier of last resort (GTS) to ensure security of supply.

According to Ministry of Economic Affairs, the annual 2012 gas bill of a Dutch household (see Figure 8.11.) is dominated by the cost of gas supply (52%), followed by the energy tax accounted (22%) and VAT (16%), while the remainder of network cost (9%) and meter rental (1%) have only small shares in the bill. By international comparison, there is a strong difference between household and industry prices. Gas prices for households were above the IEA average and for industry, well below the IEA average.

The difference between industry and households can be explained by the exemption of energy products and fuels used to generate electricity from the energy tax (except coal), the exemption of energy-intensive industries from the energy tax (equal to EUR 2 billion per year) and the exemption of the use of natural gas in efficient CHP generation and in the horticultural sector. The tax component of 39% imposed on Dutch household gas prices was the third-highest among IEA member countries in 2012, after Denmark and Sweden.

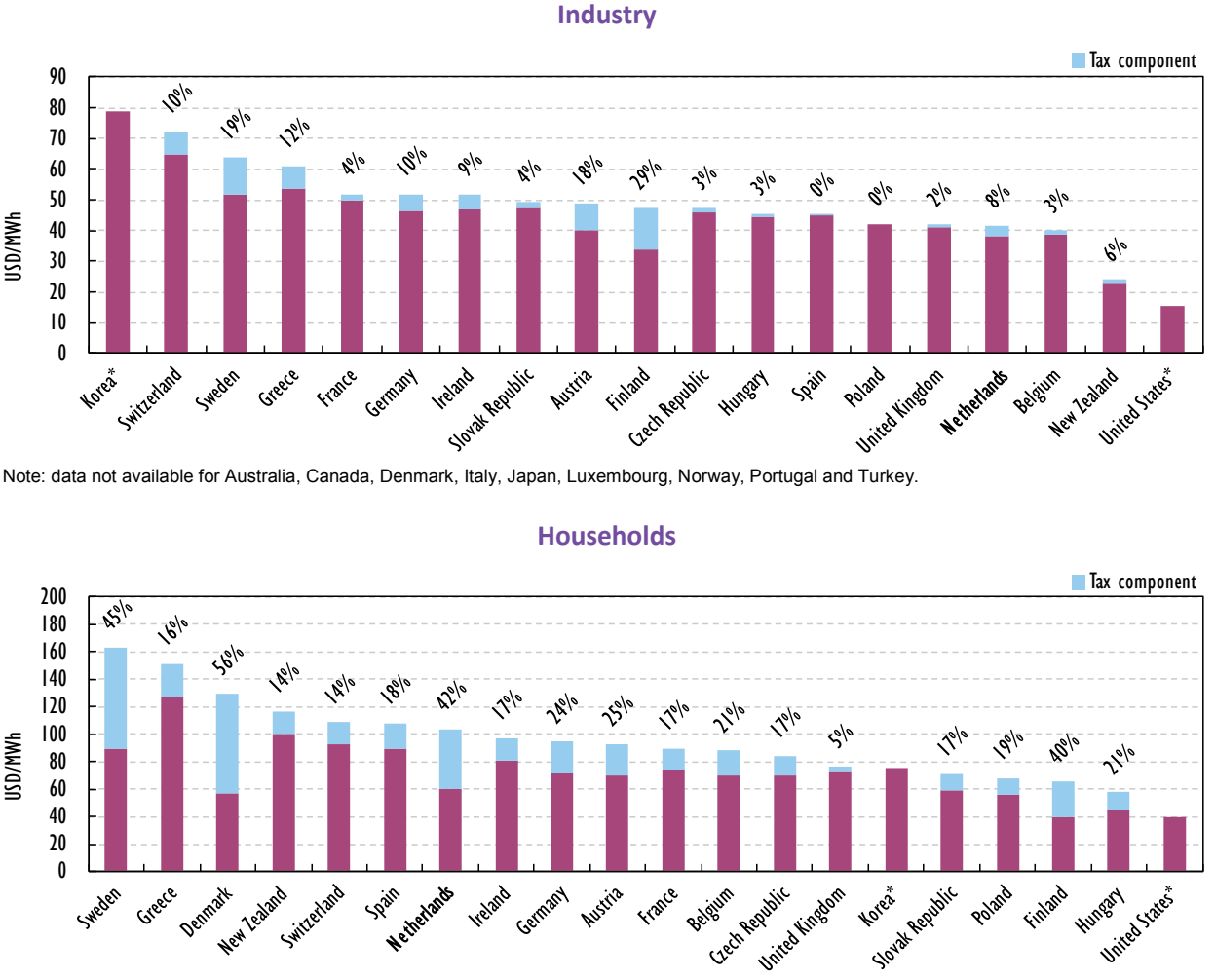
Figure 8.11 Breakdown of the annual gas bill of a Dutch household, 2011



Source: Ministry of Economic Affairs, 2012.

17. *Report on retail market functioning and consumer confidence*, ACM, 2013, available at: www.acm.nl/nl/publicaties/publicatie/.

Figure 8.12 Gas prices in IEA member countries, 2013



Note: data not available for Australia, Canada, Denmark, Italy, Japan, Luxembourg, Norway, Portugal and Turkey.

Note: data not available for Australia, Canada, Italy, Japan, Luxembourg, Norway, Portugal and Turkey.

* Tax information not available.

Sources: *Energy Prices and Taxes*, OECD/IEA, Paris, 2013; country submissions.

SECURITY OF GAS SUPPLY

As a natural gas producer and net exporter, the Netherlands is less vulnerable to disruptions of gas supplies than importing countries. Given the high dependence of the Dutch residential, power generation (CHP) and industrial consumption on natural gas, which is exposed to weather fluctuations and thus requires supply flexibility, the country is however exposed to higher risks than other countries with lower shares of natural gas.

With investments of around EUR 8.2 billion during 2005 and 2014 by Gasunie and Energie Beheer Nederland, the country is able to complete its gas hub strategy with the GATE LNG terminal coming online and further large gas storages under construction.

The Dutch gas network has also shown important flexibility to deal with gas supply shortages in recent winters in neighbouring Germany and the United Kingdom. In February 2012, as southern Germany faced an unforeseen high gas demand due to a cold snap and thus a shortage in gas supplies, TSOs from Belgium (Fluxys) and the Netherlands (GTS) supported

additional flows from North-South through the Netherlands and Belgium to the German border points. In March 2013, the United Kingdom faced the coldest winter in 50 years and relied heavily on supplies from the continent.

The Netherlands is currently in the middle of the transition to becoming a net importer, amid fast decline of Dutch gas production from Groningen. Despite the recent state decision on the Groningen field, uncertainty remains over the medium-term prospective gas production from Groningen. As earthquakes in the region are growing, implications for security of gas supply and safety have become key priorities for the government.

Importantly, the transition to a net importer will have a strong impact on the development of government revenues and the cost of Dutch gas to consumers (at home and in Germany, Belgium and France). Growing imports and cross-border trade will increase, as opportunities from the development of remaining small fields and unconventional gas remain uncertain. Security of supply will need to be increasingly ensured by a liquid TTF hub, underpinned by increasing market integration and flexibility from the availability of short-term contracts, new physical infrastructure, high volume of underground storage and the GATE LNG terminal. While these elements will contribute to further diversification and flexibility as well as the overall supply situation, the use of growing amounts of H-gas in the grid is limited in the short term by the technical capacities of the conversion installations by GTE.

The security of gas supply in the Netherlands is stipulated in the Dutch Gas Act since 2004 and specified in the *Decision in Relation to Security of Supply Pursuant to the Gas Act*. On the basis of the new EU regulation about the security of natural gas supply (Regulation 994/2010 concerning measures to safeguard security of gas supply), a risk analysis of the Dutch natural gas sector has been undertaken and subsequently preventive actions and emergency plans[18] established according to the requirements of the regulation. The main conclusion is that the Dutch gas infrastructure is of a high quality and capable of dealing with unforeseen disruptions in gas supply, even in the event of the disruption of the largest infrastructure, the Grijpskerk storage. The risk assessment and action plans should be reviewed in light of the assessment of the new Groningen production plan in 2014 in consultation with neighbouring countries.

In line with EU Regulation 994/2010, the national gas TSO, GTS, has been given additional tasks and responsibilities by law to make arrangements regarding security of supply. In its security of supply report of 2013, GTS considers the demand/supply balance adequate for the years to come, but notes the lack of visibility on the supply situation for the years after 2020 to satisfy rising gas demand.

The Netherlands has now a new security of gas supply framework in place which rests on three main pillars.

First, there is a licensing system for suppliers of protected customers, households and small and medium-sized enterprises (SMEs). A supplier can only receive a licence when he can prove his ability to supply his customers in the circumstances stipulated in the licence. Suppliers of protected customers must meet standard requirements concerning the supply of gas as well as on their organisation, finances and technical abilities. NRA, the regulatory authority for energy, is responsible for licensing suppliers in the Netherlands.

18. *Risk assessment: the Netherlands by GTS*, Ministry of Economic Affairs, 2 December 2011; *Emergency plan for security of supply of natural gas*, Ministry of Economic Affairs, 3 December 2012.

Secondly, GTS, the Dutch TSO, is statutorily responsible for the uninterrupted supply of gas to protected customers in case of a bankruptcy of a supplier, by guaranteeing the payment to producers and by the co-ordination of the redistribution of protected customers of the bankrupt supplier among the remaining suppliers. Bankruptcy of a supplier does therefore not imply a shortage of gas towards the protected customers.

Thirdly, under severe conditions, the obligation for security of supply is allocated to the Dutch TSO. GTS has to be able to provide protected customers with the surplus of gas needed. The surplus is the amount of gas exceeding the amount of gas delivered on a day with an average effective temperature of -9 degrees Celsius (°C). This surplus has to be provided up to an average effective temperature of -17°C. This puts requirements not only on gas production (in which the LNG peak shaving plays an important role: 1.3 mcm per hour), but also on the transmission system to ensure that all gas can be transported. Depending on the seriousness of a possible crisis, GTS will primarily use market-based measures, which can be done through the balancing system. In case of a very serious crisis, GTS can give shippers a specific instruction with the aim to restore the balance within the network.

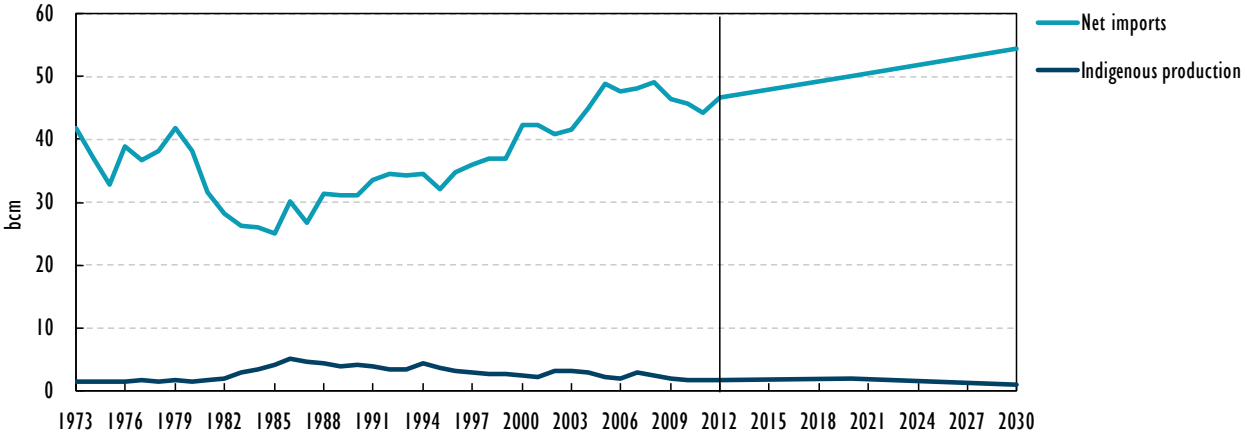
OIL

PRODUCTION, SUPPLY AND TRADE

Oil plays a significant role in the energy mix in the Netherlands, accounting for nearly 40% of TPES. In 2012, total supply of oil (including crude oil and oil products) was 30.9 Mtoe which is 14.7% higher than ten years earlier.

The Dutch domestic oil production started with the discovery of the oilfields near Schoonebeek in 1943. Oil production – crude oil, natural gas liquids (NGL) and non-conventional oil – from onshore fields around Rotterdam and the Dutch North Sea oilfields was added to the earlier production in the 1980s and 1990s. In 2012, crude oil production in the Netherlands had decreased by 50.3% since 2002.

Figure 8.13 Oil indigenous production and net imports, 1973-2030



Source: *Oil Information*, OECD/IEA, Paris, 2013.

Oil net import has been on an upward trend since the mid-1990s, exhibiting some volatility in the past decade and peaking in 2006. Total oil production outside Schoonebeek oilfield,

which was redeveloped with enhanced oil recovery (EOR) in 2010, is expected to decline. In the coming years, the Netherlands is expected to become fully dependent on oil imports[19] and net imports are to grow considerably in the medium to long term. Since 2002, crude oil imports have already surged by 7.3%, notably destined to the production of oil products.

In general, when imports and exports of crude oil decrease, imports and exports of oil products increase. The total transit volumes flowing through the Netherlands have been rising strongly (up to four times Dutch oil demand), thanks to the large port and storage infrastructure in the Netherlands.

Crude oil

The expected oil reserves were estimated at 40.4 million cubic metres (mcm) at the end of 2011, which is a reduction of 12% compared to 2010. In 2012, the production of crude oil in the Netherlands reached 1.1 Mtoe, increasing slightly compared to 2011, yet it was half of that in 2002.

Production at Schoonebeek had been suspended in 1996, as it was becoming more and more difficult to extract the viscous oil, but the field was reopened for production in 2011. Thanks to new techniques, such as low-pressure steam injection in combination with horizontal wells, it became again economically feasible to produce. Production is expected to be around 14 000 barrels (kb) per day up to 2040, but is refined across the border in Germany. Oil production outside Schoonebeek is expected to decline.

Domestic production accounts for 2.2% of intake in refineries, and therefore the Netherlands depends heavily on crude oil imports. These have increased by 7.3% since 2002, while exports have declined by 38.3%.

In 2012, imports amounted to 49.3 Mtoe, with just over 0.5 Mtoe in exports. Russia supplied 30.9% of imports, the United Kingdom 13.8%, Saudi Arabia 12.5%, Nigeria 11.5% and Norway 10.8%. Other countries of origin include Kuwait, Iraq, Algeria, Kazakhstan and Angola. At negligible levels, the Netherlands exports crude oil to Germany, the United Kingdom, Sweden and Denmark.

Oil products

Refineries in the Netherlands produced 57.2 Mtoe of oil products in 2012. Over the past decade, refinery output has been on a decline, after a peak of 84.9 Mtoe in 2005. Since 2002, output has fallen by 27.4%. This is in line with the general decline of refineries in Europe, as regional oil demand has fallen. However, the Netherlands has been able to maintain its regional refining leadership, thanks to demand from the chemical industry and growing trade in oil products (in particular growing demand for diesel in Europe). The Rotterdam oil hub is the main port for the European market and consequently the volumes of oil products transiting through the Netherlands are substantial. The Netherlands is a net exporter of oil products.

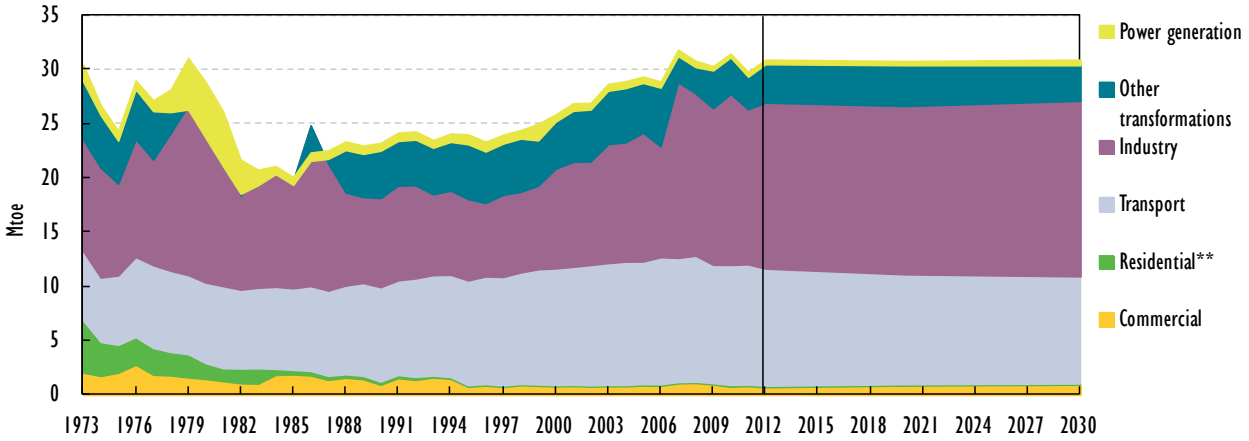
Total imports amounted to 90.5 Mtoe in 2012, from a variety of countries including Russia (18.4%), Belgium (11.3%), the United Kingdom (9.2%), the United States (6.2%) and Germany (5.8%). Imports have increased by 76.8% since 2002. Exports of oil products were higher at 101.8 Mtoe in 2012, increasing by 55.6% since 2002. Exports were destined for Germany (19.5%), Belgium (18.1%), Singapore (13.1%), the United States (7.6%) and others.

19. *Emergency Response Review of the Netherlands*, OECD/IEA, Paris, 2012.

DEMAND

The industry sector is the largest consumer of oil products, with a share of 49.3% of total consumption in 2012. The petrochemical industry and other chemical industries consume oil for further refining/processing. The transport sector used to be the largest consumer of oil products; however, demand for oil from industry has grown substantially since the late 1990s. Oil consumption in the industry sector has increased by 60% since 2002, as the Dutch petrochemical industry was expanding. It is stagnating in the transport sector. In 2012, transport accounted for 35.1% of demand, down from 41.4% in 2002.

Figure 8.14 Oil demand by sector,* 1973-2030



Note: *Other transformations* includes other transformation and energy sector consumption. *Industry* includes non-energy use. *Commercial* includes commercial, public services, agriculture/ forestry, fishing and other final consumption.

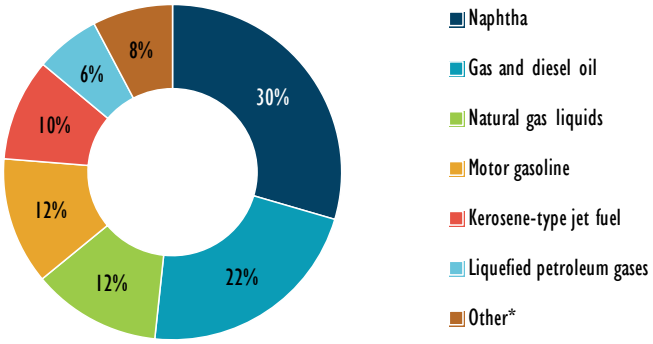
* TPES by consuming sector. Last actual year is 2012.

** Negligible.

Sources: *Energy Balances of OECD Countries*, OECD/IEA, Paris, 2013; country submission.

Energy sector's own use and other transformations account for 11.6% of demand, while the commercial and residential sectors had a smaller share of 2.3% and 0.3%, respectively. Power generation is not reliant on oil, and only 1.4% of total consumption is for electricity and heat generation. In line with the developments in the rest of Europe, the Netherlands expects that demand for motor fuels will decline over time with improved fuel efficiency and alternative fuels, including biofuels, and electric vehicles.

Figure 8.15 Oil consumption by product, 2012



* *Other* includes paraffin waxes, bitumen, lubricants, fuel oil, refinery gas, other kerosene, white spirit and aviation gasoline.

Sources: *Oil Information*, OECD/IEA, Paris, 2013; country submission.

The five major oil products consumed in the Netherlands in 2012 were naphtha (30%), gas and diesel oil (22%), natural gas liquids (12%), motor gasoline (12%), and jet kerosene (10%). Demand for naphtha has experienced strong growth since 2002, increasing by 206%, as naphtha is used in the industry sector (petrochemicals). Exports of naphtha were rather stable, at around 12 Mtoe per year over the last decade, but because of international trade differentials, import and consumption fluctuate strongly, resulting in big swings in the Dutch stockholding obligations. Consumption of other oil products has also increased, albeit at a slower rate. Almost all residual fuel oil goes to international marine bunkers, fuelling international sea-going ships.

OIL MARKET AND INFRASTRUCTURE

Dana Petroleum and NAM, joint ventures of Shell and ExxonMobil, are the main domestic crude oil producers. Unlike other EU member states, the Dutch oil market has a strong and international performance with oil trade, storage and refining as well as important petrochemical clusters.

The Netherlands has five refineries and a total distillation capacity of around 1.2 million barrels (mb) per day. This represents 1.4% of the worldwide capacity and the fifth-largest installed capacity in Europe. Shell's Pernis refinery and BP's Europoort are the country's two largest refineries, followed by refineries operated by ExxonMobil and Kuwait Petroleum (KPC). All four refineries are located in the Rotterdam area. The fifth is Zeeland Refinery in Vlissingen, which is jointly operated by Total and Lukoil Benelux (holding a 45% share).

There are nine main companies operating the Dutch oil upstream, retail and wholesale oil markets, including stockholding of crude oil, the refining process in the five refineries, the stockholding and transport of petroleum products and the wholesale of motor fuels and other products in tank stations. These nine companies are Argos North Sea Group, BP Europa SE-BP Nederland, Esso Nederland B.V., Kuwait Petroleum (Nederland) B.V., Shell Nederland B.V., Delek Nederland B.V., Total Nederland N.V., Gulf Nederland and Tamoil. They represent 99% of the production and 80% of the oil products sold in the Netherlands.

In contrast to other European countries, the Netherlands has been able to maintain leadership in product export, also thanks to the strong petrochemical industry. The Dutch refining sector is impacted by declining regional demand and by increased competition from other global players (United States, Asia, Russia). New EU environmental legislation is adding further pressure on European refineries in comparison to other global market places. In the shipping industry, the envisaged sulphur limits imposed on refineries as well as legislation for the international shipping community (IMO) to de-sulphurise bunker fuels, have important implications for the competitiveness of the export-oriented Dutch oil sector, which is a global business. The competitiveness of the Rotterdam bunker market is likely to be impacted, as it processes refinery residues which are used to blend shipping bunker fuels, both those sold to ships and those exported to other harbours.

The Dutch refining sector, one of the energy-intensive industries under ETS, predicts in a 2011 study, commissioned by the Ministry of Economic Affairs, a stronger margin squeeze and potential refinery closures.[20] The new IMO sulphur specifications for the marine bunkers are expected to have a large impact on the Dutch refining industry which annually produces about 8 Mt of refinery residues (fuel oil), mainly used for international bunkers.

20. *Enterprise under restraint – A transition perspective for Dutch refineries towards 2030*, MEE, October 2011. Since the economic downturn in the European Union in 2008, 15 European refineries have closed.

The Energy Research Centre of the Netherlands[21] points out that it is technically possible to convert all residues into lighter products, but the process is expected to cost additional energy use of about 1 Mt of crude oil and 3.5 Mt of related CO_2 emissions. The investment costs for the Netherlands are estimated at about EUR 1.5 to 2 billion. The European Commission is carrying out fitness checks of refineries and the impact of environmental legislation on the closure of EU refineries.

STORAGE

The Netherlands has vast oil storage with a total storage capacity of 30 mcm, mostly located around Rotterdam, but also in Amsterdam and Vlissingen. One of the world's largest tank storage is the Maasvlakte Olie Terminal (MOT) at Rotterdam with crude oil storage of 4.4 mcm. It is a joint venture of BP, ExxonMobil, Kuwait Petroleum, Shell, Total and Vopak. New salt caverns for diesel stockholding are being developed near Hengelo.

Dutch companies may hold reserved stocks under bilateral agreements, supporting international oil companies to optimise their stockholding obligations in other European countries.

VOTOB is the Dutch association of independent tank storage operators who store liquid products for customers without owning the products (Oiltanking Amsterdam B.V., Oiltanking Terneuzen B.V., Vopak Oil Logistics, Euro Tank Amsterdam, Euro Tank Rotterdam, Koole Tankstorage Pernis, LBC, Vesta Terminal Flushing, Vopak Chemicals Logistics, Tank Storage Beheer B.V., Nustar, Botlek Tank Terminal B.V. and Rubis Terminal B.V.).

Additional storage capacity will be created thanks to the planned new Shtandart oil terminal the construction of which is expected to start in 2014 and receive crude oil from Russia.

PIPELINES

Every year, about 370 Mt of oil, oil products and chemical products are transported through the Netherlands. About 35% of this volume is transported via pipelines.

Around 25 companies own Dutch oil pipelines – a network which extends to around 20 000 km of pipelines inside the Netherlands, including 15 000 km high-pressure pipeline for gas transport and 5 000 km for long-distance transport of crude oil, oil products and other chemicals for inter-regional transportation (not distribution).

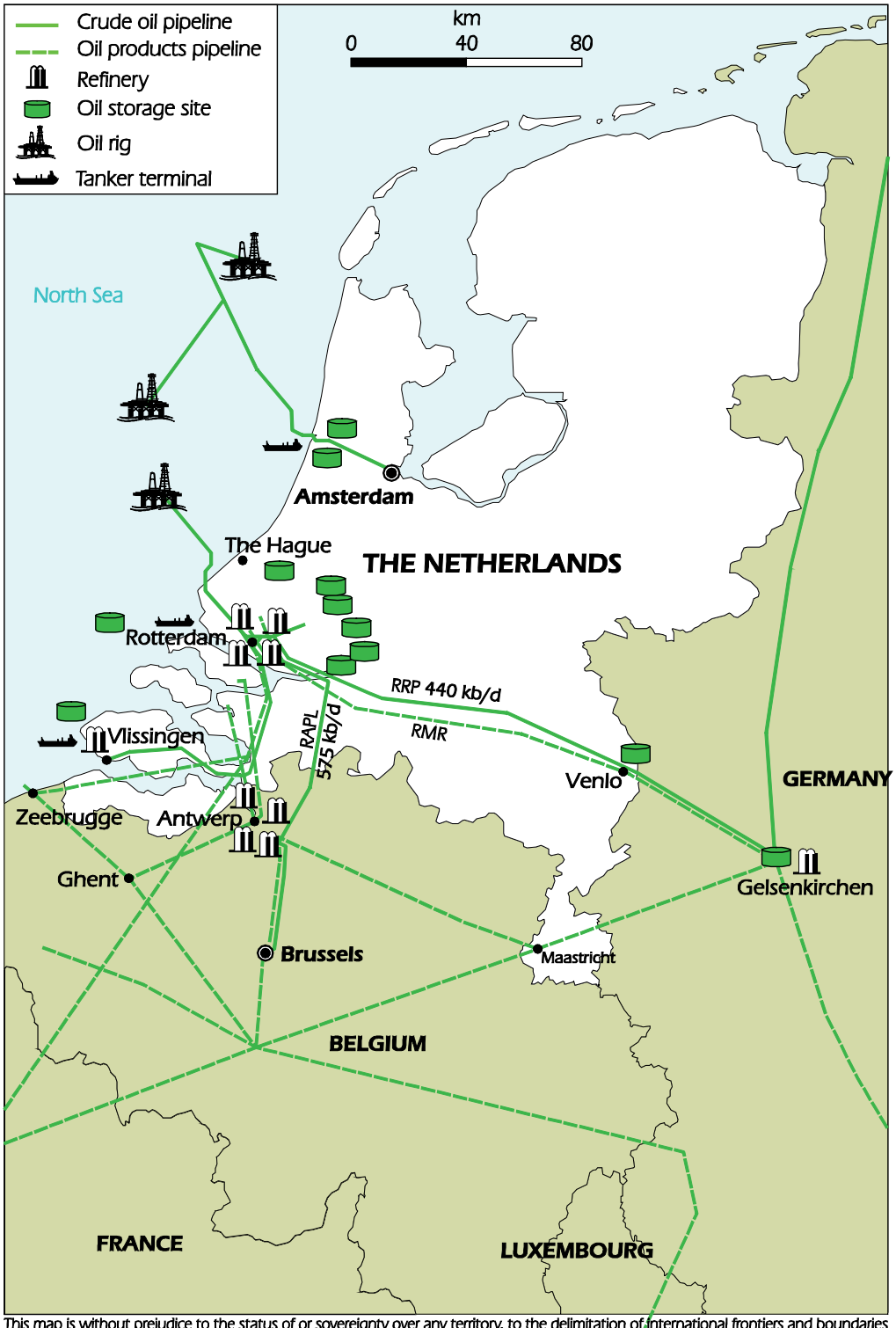
The two major crude oil pipelines are the Rotterdam-Rhine pipeline (RRP) (400 thousand barrels per day [kb/d]), linking the Netherlands to the German Ruhr area, and the Rotterdam-Antwerp pipeline (RAP, 600 kb/d) to Antwerp area in Belgium. In addition, the Rhine-Main (RMP) (250 kb/d) links to Germany, and two pipelines to Schiphol airport, one from Amsterdam and one from Rotterdam which has an extensive network of pipelines to connect terminals, depots and refineries.

COMMERCIAL AND RETAIL MARKET

NOVE (*Nederlandse Organisatie voor de Energiebranche*) is the organisation serving independent companies, active in trade and retail, transport, stockholding and wholesale of liquid and gaseous fuels, and lubricants and bunker deliveries to waterway shipping, fishery and sea-going vessels. NOVE has 185 members representing 75% of independent fuel trade by volume. Out of the 105 bunker boats (inland waterways) 95 are owned by NOVE members.

21. *A Quick Scan of the Economic Consequences of Prohibiting Residual Fuels in Shipping*, Wilde, H.P.J. de, Kroon, P., Mozaffarian, M., Sterker, Th., ECN Netherlands, 2007.

Figure 8.16 Oil infrastructure in the Netherlands



This map is without prejudice to the status of or sovereignty over any territory, to the delimitation of international frontiers and boundaries and to the name of any territory, city or area.

Source: IEA, 2013.

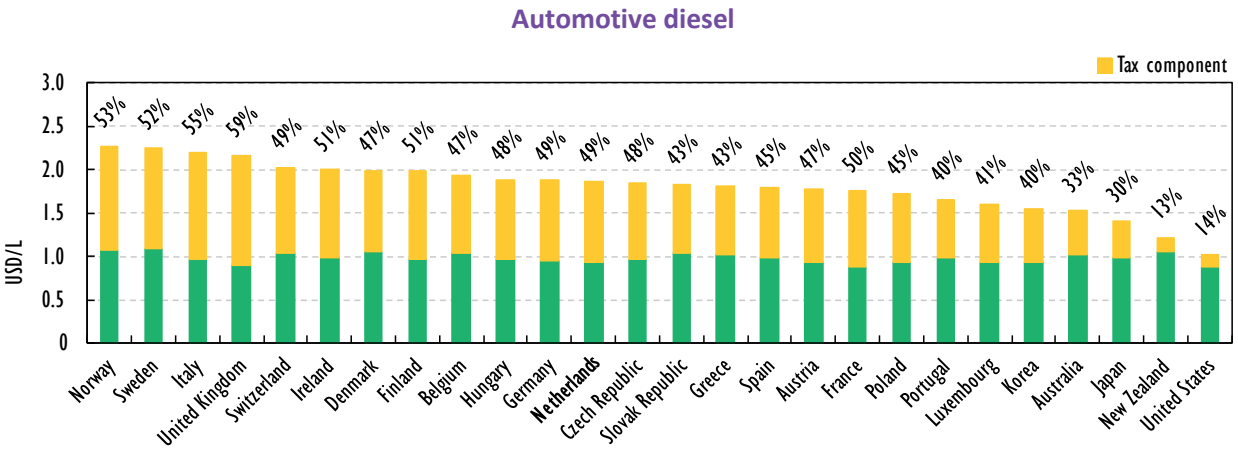
PORTS

The ports of, Rotterdam, Vlissingen, Amsterdam and Delfzijl/Eemshaven, play a leading role in the global oil trade. Rotterdam is world's third-largest sea bunker harbour, after Singapore and Shanghai. The Rotterdam port area is well connected to the land by river and pipeline. The harbour has the ambition to become the Energy Harbour of the future, including for bio-based industries and biofuel production and stockholding. Amsterdam is focussed on oil products and is one of the most important gasoline stockholding sites in the world. Vlissingen port is strategically located between the major consumption and production areas, the Antwerp and Rotterdam ports. Delfzijl/Eemshaven has developed new strategic and biofuel stockholding capacity. The Netherlands is the leading inland waterway bunker in Europe.

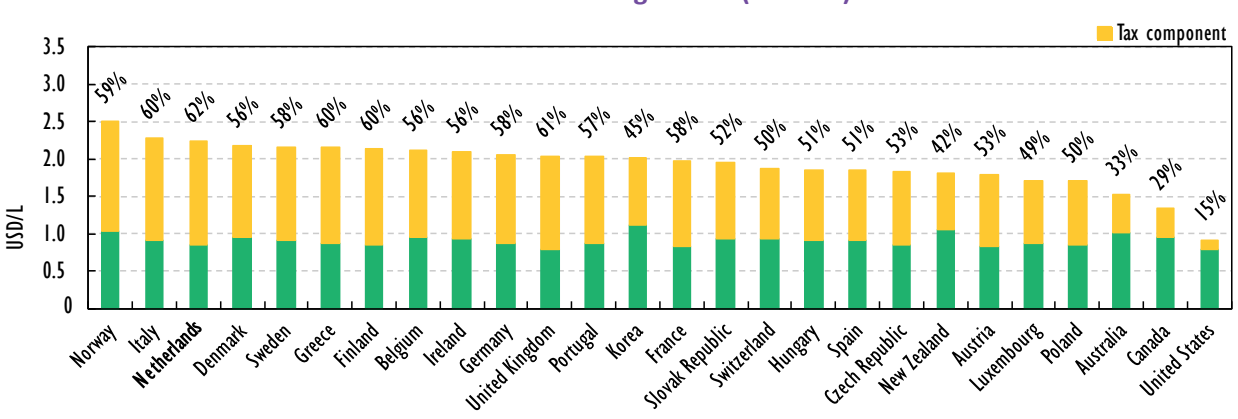
OIL PRICES AND TAXES

The Netherlands has an open and competitive market where the wholesale price of oil products is based on supply and demand dynamics in the market. There is no price control or interference in the trade and/or transport margins. In the past years, because of competition, refinery and trader margins have been under pressure in the European markets, as in the Netherlands.

Figure 8.17 IEA fuel prices and taxes, fourth quarter 2013



Note: data not available for Canada and Turkey.



Note: data not available for Japan and Turkey.

Sources: *Energy Prices and Taxes*, OECD/IEA, Paris, 2013; country submissions.

The government influences retail prices for consumers solely through taxation. Compared to other IEA member countries, premium unleaded gasoline (95 RON) prices in the Netherlands are the fourth highest, after Turkey, Norway and Italy (Figure 8.17). Retail automotive diesel prices are among the IEA average. The differences are explained by differences in fuel taxation across countries.

As in most IEA member countries, taxes on transport fuels are a major source of government revenue in the Netherlands. Overall, in 2011, the government collected EUR 19.6 billion in environmental taxes, beyond the excise duties alone. Revenues from environmental taxes have more than tripled over the last two decades. The Dutch government imposes environmental taxes, especially in the energy and transport sectors, with excise duties on petrol and other motor fuels, motor vehicle tax and energy tax.

Revenues from excise duties on petrol were EUR 4 billion and other motor fuels EUR 3.6 billion in 2011. Revenues of annual road tax amounted to EUR 3.6 billion and registration tax for EUR 2 billion.

Income from the energy tax dropped by 3.8%, which was caused by a decrease in energy use in 2011 compared to 2010. Income from registration tax on passenger cars and motorcycles dropped by 5.6% to EUR 2.0 billion. This substantial decrease in the revenues from the import or sales tax on motor vehicles was partly due to the popularity of BPM-exempted cars. On 1 January 2009, the Dutch government introduced a BPM exemption policy for fuel-efficient cars. In 2008, the year before the introduction of the exemption, the government levied EUR 3.2 billion in tax on passenger cars and motorcycles, which was nearly 40% more than in 2011. Only excise duties on petrol and other mineral oils showed growth for 2011, as the tax increased by 1.1%.

SECURITY OF OIL SUPPLY

STOCKHOLDING REGIME

The Netherlands meets its IEA stockholding obligations by a mixture of compulsory stockholding requirements imposed on companies and public emergency stockholdings owned by the independent stockholding agency COVA. Thanks to abundant industry stocks on top of the obligatorily held stocks, the Netherlands has been consistently holding excess stocks, well above IEA and EU requirements.

In 2012, the Netherlands started transposing and implementing new EU Oil Stocks Directive 2009/119/EU and changed its stockpiling regime. The new Oil Stockpiling Act (*Wet voorraadvorming aardolieproducten*, Wva) 2012 was approved by the Dutch Parliament, officially published (Stb.2013 15) and, following secondary rulings from the National Legal Council, it entered into force on 1 April 2013.

A legal obligation of 100 days of net oil products imports was put in place, of which 75% to 80% is to be held by the central stockholding entity COVA and 20% to 25% by the refineries and the traders. The percentage is different every year, depending on the volumes released to the inland market, and is not a fixed percentage. The effective share of government stocks did not increase under the new law, but decreased.

In the Monthly Oil Statistics (MOS) reporting, all the agency stocks are presented as public stocks, including the commingled stocks held for COVA. In the past, they were partly presented as industry stocks.

With the slight increase in the obligation for industry, the Dutch government seeks to cover a bigger part of the national stockholding obligations with stocks held by the companies to reduce the risks for the security of supply in the Netherlands. Only the rest of the available stocks may be used by companies for the optimisation of their stockholding requirements by trading tickets with other European and IEA member countries.

In an emergency, the Minister of Economic Affairs is responsible for oil emergency policies and has the power to instruct COVA and companies to draw down compulsory stocks. The Dutch National Emergency Stockholding Organisation (NESO) advises the Minister of Economic Affairs and/or the Cabinet on the implementation of oil emergency measures.

The Netherlands is in the process of updating the *Oil Emergency Policy Handbook*. In 2013, the Dutch Administration also started modernising the general emergency laws, in combination with the evaluation by the Commission Hoekstra of Legislation on Safety Regions (*Wet Veiligheidregio).*

OIL DEMAND RESTRAINT

As an IEA member country, the Netherlands has measures to reduce oil demand during oil supply emergencies. The Dutch demand restraint programme relies on voluntary measures first, before proceeding to mandatory ones. NESO aims to reduce private and recreational use of oil products, before requesting appropriate refinery action, leaving economic activities as much as possible untouched.

Given the limited use of oil in the power and residential (heating) sectors, fuel switching is not considered an emergency response measure. The Dutch oil production is operated at full capacity, which also means that there is little potential for increasing indigenous production in an emergency.

Oil is mainly used in transportation and petrochemical industry. There is no assessment being made on the possible oil demand restraint from petrochemical production, but there is on the contribution from the transport sector.

According to an ECN study of 2010,[22] the transport sector offers significant opportunities to reduce oil demand with relatively limited impact on the overall economy. Demand restraint measures in the transport sector include three measures: Sunday driving ban, work-trip reduction and car-pooling. The shares of passenger road transport (20%) and freight road transport (12%) in the national oil demand are comparatively low. As a consequence, an oil demand reduction in road transport of at least 20% to 30% is required to meet the national oil demand reduction target of 7% to 10% agreed within the IEA.

Price effects during an oil crisis are uncertain given limited research, and estimated to reduce oil demand from passenger road transport by 15% to 35% and oil demand from freight road transport by 10% to 25%. Given the uncertainty, this effect was halved to obtain a conservative estimate of 2% to 4% of national oil demand reduction as a result of price effects. A Sunday driving ban can lead to reductions of 50% to 80% of passenger travel on Sundays, leading to savings of 1% to 1.5% of national oil demand. Work-trip reduction policies can reduce work trips by 10% and lead to reductions of 0.5% to 1% of total oil demand. Car-pooling has the greatest potential, reducing work trips up to 30% and leading to 0% to 2.5% savings of national oil demand. The broad range of the latter estimate is due to the limited options available to influence motorists to share their vehicles with others.

22. *Optimaal Rantsoeneren bij oliecrisis*, ECN, 2010.

Millions of euros of cost would be relatively modest compared to the loss of excise duty income during an oil supply emergency, which is expected to be at least EUR 137 million for a three-month supply emergency, in which oil demand is reduced by 7%.

ASSESSMENT

Natural gas

The Netherlands remains Europe's second-largest gas producer, a major gas supplier to the North-West European markets but is also a major consumer of gas in its domestic market.

After 50 years of gas sector development, and with the fast decline of Dutch domestic gas production around 2020, the country will experience the start of the transition to becoming a net gas importer. Indigenous production levels from the Groningen and smaller fields are falling and the decision making on the possibility to explore new unconventional resources, including shale gas, is slower than expected.

Amid declining indigenous production and an uncertain outlook for unconventional gas, the Netherlands should seize all opportunities to develop remaining gas reserves and adapt its policies to its future role as net importer. The management of natural gas exploration and production activities in the area of Groningen, where seismic tremors are frequent, will be an important task during this transition phase, knowing that there is public opposition to the exploration of unconventional gas.

On the basis of the "small fields policy", the government aimed to attract further investment into the Dutch Continental Shelf before the existing infrastructure becomes aged and obsolete. A new licensing and taxation regime has been created to stimulate the development of the fields within a certain timeframe. The government should make the most of the small gas and oil fields before the opportunity is lost. As the government expects an important role for gas in the long-term future, it should therefore seize the opportunity to develop small gas fields and shale gas in a timely manner. Thanks to the good environmental performance of natural gas as the fossil fuel with the lowest carbon emissions, its role in heat and power generation as well as its flexibility in a world of increasing intermittency mean that it can continue to play an important role in the transition towards a low-carbon economy.

The role of the Groningen field as the largest source of Dutch gas production and swing producer will change in the coming years. Dutch domestic gas consumption in power generation and heating is high. The future Dutch gas market will play a role in connecting gas supplies to North European markets, like Denmark and Sweden faced with a rapid decline.

The Netherlands is preparing for this transition with the Dutch Gas Hub Strategy that was launched in 2005. It is well on its way to complete the planned investment in the Dutch gas hub. Thanks to the development of a robust gas infrastructure, gas market integration in North-West Europe is rapidly taking place. The introduction of a market-based balancing regime and the commissioning of the GATE LNG terminal, increased storage and pipeline capacity, all added flexibility to the robustness of the gas market. Gasunie Transport Services (GTS) has made investments in further diversifying supplies by bringing online new interconnection capacity with Germany. With the addition of the Bergermeer storage in 2014, Dutch gas storage capacity will nearly double. The Title Transfer Facility has developed into the fastest growing gas hubs in Europe.

With the gradual harmonisation of gas markets in Europe, the government should assess implications for the Dutch transport system and gas market and explore further potential for market integration through market coupling, integration of balancing regimes or market zone mergers. The government should map these new opportunities to underpin the longer-term role of the Netherlands as gas hub and the role of gas in the North-West European energy market.

The transparency of gas market data, including on transmission by entry/exit point for market participants, has significantly increased; however, this does not apply to gas storage levels or LNG flows by country of origin. The IEA encourages the Dutch Administration to further increase availability of gas market data with a view to improve the transparency of the Dutch gas market. The IEA also encourages the Administration to include volume units in their natural gas data collection.

On the basis of a first safety and environmental risk assessment, a new production plan for the Groningen field has been approved by the Minister of Economic Affairs in January 2014 to secure stable gas production for three years (2014-16), while keeping the risk of further earthquakes at a minimum. Subject to further studies, the production plan by NAM will be revisited before the end of 2016.

Under EU Regulation 994/2009, the Netherlands carried out a risk assessment and adopted a preventive action and an emergency plan, and developed a robust framework for gas emergency policies. The government has assessed all risks, including the disruption of the largest infrastructure (Groningen). It should also revisit these plans, assess the resilience of the Dutch gas system, including the flexibility that gas storage sites provide, and consult the regional assessments in light of the new developments.

There is a potential for shale gas in the Netherlands which has attracted international investors. The north of the Netherlands is not densely populated and water supplies are good. However, shale gas explorations are on hold, depending on the outcome of the impact assessment which is currently under preparation and expected to be completed by end-2014. A full assessment of all technical circumstances for the development of shale gas in the Netherlands will be a basis for engaging with the public and stakeholders concerned. The future of shale gas in the Netherlands will depend on the ability of the government to involve all parties concerned, in particular the citizen and industry.

The IEA has set out the principles needed in a future framework for shale gas, in *Golden Rules for a Golden Age of Gas*, including full transparency, measuring and monitoring environmental impacts and engagement with local communities; careful choice of drilling sites and measures to prevent any leaks from wells into nearby aquifers; rigorous assessment and monitoring of water requirements and of waste water; measures to target zero-venting and minimal flaring of gas; and improved project planning and regulatory control.

The decline and subsequent end of L-gas exports to neighbouring Germany, France and Belgium around 2020-29 will require gas quality conversion, infrastructure replacement and new gas supply contracts. The transition in gas composition will need to be carefully managed by all relevant stakeholders, including the neighbouring countries.

Commendably, the government started to discuss the process in 2010 together with NAM and the manufacturing industry. In this context, intensified regional co-operation within the Pentalateral Gas Platform needs to be complemented with co-operation on security of supply and gas qualities. The government should establish a gas quality co-ordination group within the Pentalateral Gas Platform on gas transition, which includes manufacturers of appliances, consumers and other stakeholders.

Next to new gas production and conversion, the future role of gas in the Netherlands can also evolve with innovative uses of natural gas and natural gas infrastructure, providing options for decarbonisation of transport and energy storage. The role for natural gas (liquefied and compressed) in shipping and freight transport, as well as its perspectives to store renewable offshore power in the gas networks, so-called power-to-gas, are expected to grow. The Netherlands should explore synergies from such an integrated concept of renewables and natural gas in a revisited integrated offshore strategy.

Oil

The Netherlands has a strategic position in the European oil market; it is a large importer of crude oil, it has a refining and petrochemical industry hub which has large oil products exports and secures emergency stocks of oil for several EU member states.

The port of Rotterdam is a major trading and storage hub for crude oil and petroleum products in Europe, with large refineries essential for global trade and oil products exports. With total refinery output well beyond domestic demand, the Netherlands is a net exporter of refined products, mainly to the United States and European countries. Additional storage capacity is being developed with the new Shtandart terminal, which will start construction in 2014 to receive crude oil from Russia.

While European refining of crude oil is on the decline and trade in oil products on the rise, the Netherlands maintains its export strength thanks to the strong Dutch industry sector, in particular the petrochemical sector and trading hub. Transport sector consumption is expected to decline owing to improved fuel economies and alternative fuel uses such as electricity and biofuels, subject to EU sustainability criteria.

National and European environmental legislation imposes strict sulphur limits on Dutch refineries. Legislation for the international shipping community (IMO) requires further desulphurisation of vessel fuels (bunker fuels). Worldwide, the 4.5% sulphur content is to decrease to 0.5% in 2020.[23] In the Baltic and North Sea areas, sulphur content will drop to 0.1% by 2015. More stringent future product specifications may jeopardise the competiveness of the Dutch refining industry as big investments are needed to comply with regulations. The Dutch refining industry, a member of the Netherlands Petroleum Industry Association, estimates that at a European level, an investment of EUR 20 billion will be necessary to be able to meet marine sulphur fuel specification changes. The IEA encourages the government to participate fully in the EU fitness checks so as to maintain the competitiveness of the industry.

Commendably, the Netherlands consistently holds strategic oil stocks well above its IEA obligation and has a leading role in harmonising the monitoring procedures for bilateral strategic oil stocks in Europe. However, amid changes to the stockholding regime, bilateral agreements have become subject to changes. The government should take the lead in ensuring that regional stockholding obligations can also be ensured by storage in the Netherlands in the future.

The Netherlands made progress since 2008 in the quality and reporting of its oil stocks in certain areas; however, some issues remain, for example the availability of real monthly trade breakdown information and the new reporting requirements that came up under the new stockpiling law. The Netherlands is putting in place an automated data system

23. This target is subject to review by 2018 by the international shipping community IMO with regard to a possible postponement until 2025.

to this end. The legal changes have a significant impact on data reporting under the IEA oil stocks MOS methodology, as the partial reporting of COVA stocks under industry has been a major challenge. Given the importance of the Netherlands as a refinery and trading hub in Europe and globally, the government should continue to work on data quality and reporting methodology to the IEA. Quality of trade-related data has to be consistently improved.

RECOMMENDATIONS

The government of the Netherlands should:

Natural gas

- ☐ *Seize the economic opportunities from the development of the remaining natural gas production potential in the Netherlands by encouraging investment into small gas fields and unconventional gas.*
- ☐ *Subject to the outcome of the impact assessment on shale gas, ensure a robust and transparent decision-making process on the future of shale gas, involving all stakeholders, in line with international best practice, as set out in the* Golden Rules for a Golden Age of Gas *by the IEA.*
- ☐ *Intensify the discussion with neighbouring countries on the security of gas supply and depletion of resources from Groningen fields to facilitate a smooth transition from low-calorific to high-calorific gas. In the context of conversion, the government should consider other efficient and innovative uses of natural gas.*
- ☐ *Continue to support the development of a liquid North-West and EU gas market with a view to strengthen competition, transparency of gas market data and promote innovation in the gas sector.*

Oil

- ☐ *Continue to facilitate the strategic role of the port of Rotterdam as a major trading hub for crude oil and refined products.*
- ☐ *Continue to play a leading role in developing strategic stockholding arrangements, facilitating efficient stock management practices and ensuring oil data availability across EU member states and IEA member countries.*
- ☐ *Encourage the industry to evaluate EU environmental regulation on the competitiveness of the Dutch oil industry and actively participate in the EU fitness checks.*

9. COAL

Key data (2012)

Production: none

Share of coal: 10.4% of TPES and 26.6% of electricity generation

Coal net imports: 10.6 Mt of hard coal, -19.7% since 2002

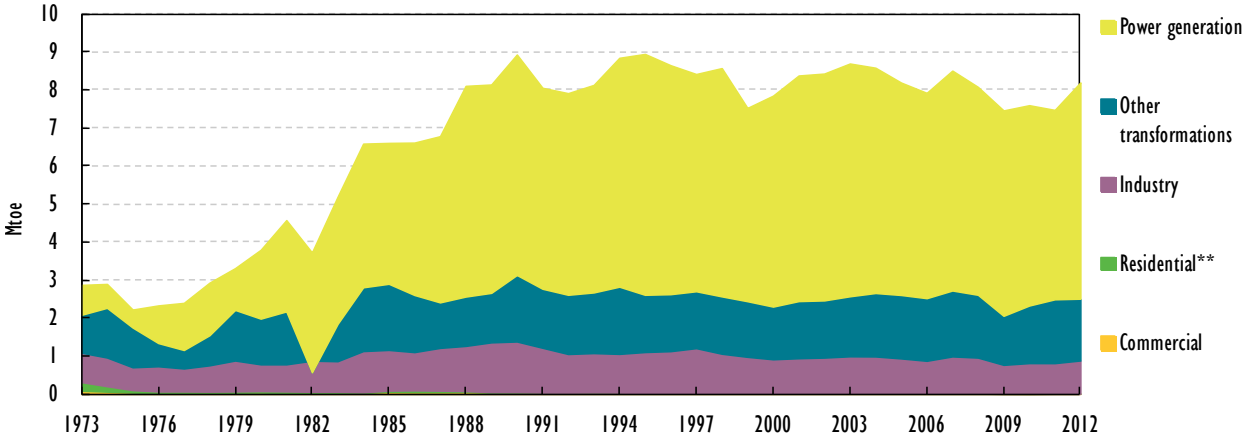
Inland consumption: 8.2 Mtoe (power generation 70%, energy own use and other transformations 16.8%, industry 13.2%)

SUPPLY AND DEMAND

SUPPLY AND TRADE

Total supply of coal was 8.2 million tonnes of oil-equivalent (Mtoe) in 2012, representing 10.4% of total primary energy supply (TPES). This is mainly hard coal, with only negligible levels of lignite. The total supply of coal in the Netherlands has been on a downward trend over the past decade (see Figure 9.1), decreasing by 3% since 2002, as its role in industry (iron and steel) and in combined heat and power (CHP) generation has been on the decline.

Figure 9.1 Coal supply by sector,* 1973-2012



Note: *Other transformations* includes coke ovens and energy sector consumption. *Industry* includes non-energy use. *Commercial* includes residential, commercial, public services, agriculture/forestry, fishing and other final consumption.

* TPES by consuming sector.

** Negligible.

Sources: *Energy Balances of OECD Countries*, OECD/IEA, Paris, 2013; country submission.

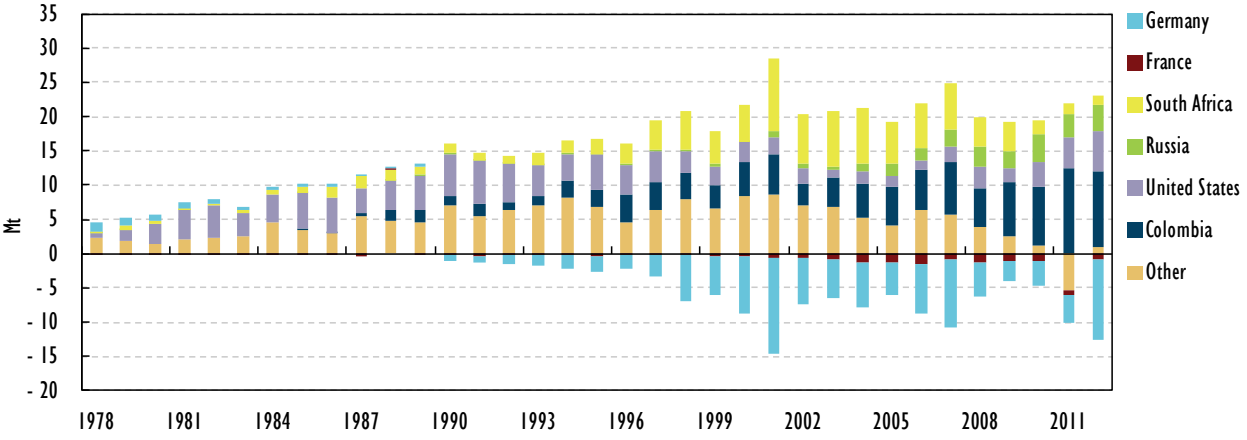
The Netherlands has no indigenous production of coal and relies on importing all its needs on the international market. The Amsterdam-Rotterdam-Antwerp (ARA) area is the major entry point for coal in Europe and sets the benchmark price for the main coal grades in North-West Europe. The port of Rotterdam hosts the Europees Masasgoed

Overslagsbedrijf (EMO) for coal and iron ore, which is the largest importing terminal in Europe and in the world, with flexible connections to sea-going vessels, inland waterway barges and rail cars. As lignite is normally uneconomic for transport, all the coal imported is hard coal, including steam coal and coking coal. Total net imports amounted to 10.6 million tonnes (Mt) in 2012, mainly steam coal, but total imports have been on the rise owing to the role of the Netherlands as major coal hub.

Around 45% of the hard coal imported in 2012 came from Colombia, 24.2% from the United States (most of it coking coal), 15.6% from Russia and 5.8% from South Africa. Deliveries from the United States and Colombia have increased significantly since 2011 as supplies, set aside from the North American power generation markets, became available in Europe at a competitive price.

The Netherlands resells imported coal to the European market. During 2012, 85.3% of hard coal exports were destined to Germany, 6.3% to France and 2.2% to Belgium. Imports and exports fluctuate in line with global price developments. Over the past ten years, hard coal exports have averaged 7.8 Mt per year, with considerable volatility in the past five years.

Figure 9.2 Hard net coal imports by country, 1978-2012



Sources: *Coal Information 2013*, OECD/IEA, Paris, 2013; country submission.

DEMAND

The inland consumption of coal was 8.2 Mtoe in 2012. This represents a slight decrease from the level recorded in 2002 (8.4 Mtoe) and similar to the level of consumption in 2005.

The main uses of imported coal remain power and heat generation for steam coal and iron and steel industry for coking coal. Steam coal is one of the major sources of electricity generation in the Netherlands; all the imported steam coal is used in electricity plants and CHP plants, namely 70% of total coal supply. This accounts for 26.6% of all electricity generation. In 2012, 36% of coal used for electricity and heat generation went into CHPs. Over the past decade, demand for steam coal has fallen by 5.8%, from 9.2 Mt in 2002 to 8.6 Mt in 2012.

The industry sector (iron and steel) amounts to 13.2% of total coal consumption, while commercial and residential uses are negligible. Also the industry sector consumption of coal has remained relatively unchanged compared to 2002.

COAL INDUSTRY POLICY

In 2012, coal-fired power plants accounted for around 27.3 terawatt hours (TWh) of electricity and 1.6 TWh of heat, which represents about 27% of gross generation of electricity in the Netherlands. However, the share of coal in power generation decreased from the level recorded in 2002 (30.2%).

In 2013, the Netherlands had a fleet of eight coal-fired power plants, which were built between 1980 and 1994, with combined capacity of 4.2 gigawatts (GW), which represents 15.5% of total installed capacity. The design efficiency varies from 39% to 43% for the newer plants (operational efficiency may be lower, depending on fuel and production patterns such as co-firing and others).

Due to the ideal conditions in the Netherlands, with good access to international coal imports and cooling water at the North Sea, the Netherlands attracted substantial investment into new coal-fired capacity from German utilities, as today's economics favour the export of electricity over the transportation of coal.

Three additional coal plants with combined capacity of 3.5 GW are being developed (see Table 9.1). The new E.ON-owned plant at Maasvlakte has a design efficiency of 47%. This development contrasts with wider European Union trends, where investment in new coal-fired power plants is scarce (except in Germany where investments are significant) and most countries are reducing their coal-fired capacity (such as France, Italy, Spain and, especially, the United Kingdom where around 8 GW of coal-fired capacity is scheduled to close by 2015).

Table 9.1 Planned new coal-fired capacity in the Netherlands

Name of the new plant	Company	Capacity
Maasvlatke 3	Energieleverancier E.ON	1 110 MW
Eemshaven A	RWE Energy Nederland N.V.	800 MW
Eemshaven B	RWE Energy Nederland N.V.	800 MW
Maasvlakte Electrabel 1	Electrabel Nederland	800 MW

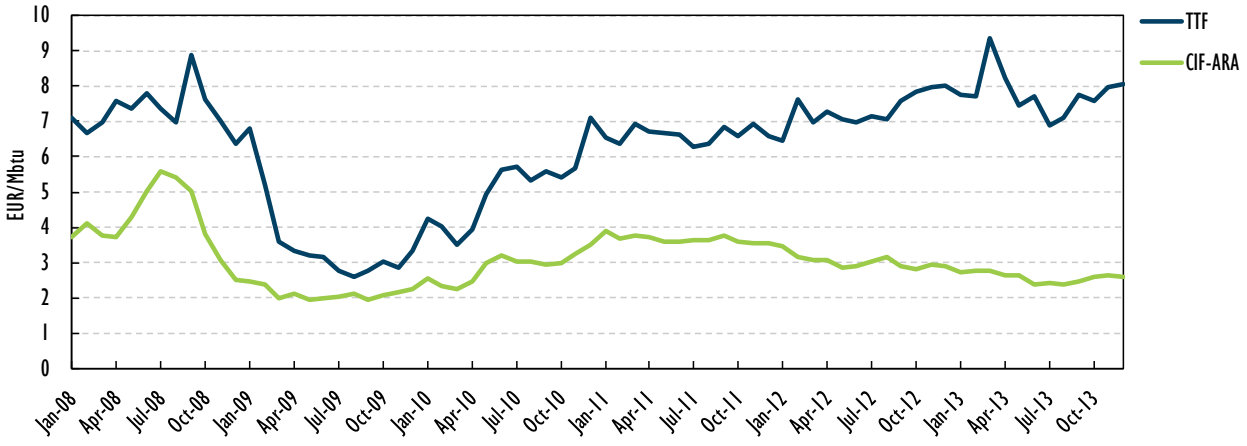
Source: IEA, 2013.

As in other European countries, power generation fuel economics currently favour consumption of coal over gas (see Figure 9.3). In the Netherlands, there is an increasing gap between gas (Title Transfer Facility) and coal prices (CIF ARA) which is the reverse picture of the US market, where the spread between coal and gas prices is in favour of gas. Current price trends in coal, natural gas and CO_2 allowances point to a continued use of coal over the coming years. At the same time, the current coal-fired power fleet in the Netherlands emits more greenhouse gases (GHGs) and it would be a considerable improvement to renew the fleet.

However, the investment climate in the Netherlands has recently changed, putting at risk any new investment in clean and efficient coal-fired power generation. As a general rule, fuel use in power generation is exempted from the energy tax in the Netherlands.

In 2012, the government abolished this exemption of coal use in power generation (while keeping gas exempted) and imposed a tax of EUR 14 per tonne of coal. The tax could undermine investors' confidence in the stability of the regulatory framework in the Netherlands and discourage investment in new efficient coal power plants.

Figure 9.3 Coal versus gas price trends in the Netherlands, January 2008 to December 2013



Source: IEA, 2013.

The reform of the European Union Emissions Trading Scheme (EU-ETS) – inclusion of aviation, back-loading in 2014/15 and proposed lower cap after 2020 – together with a possible 40% EU-wide GHG reduction target for 2030, is expected to stabilise the EU carbon market and provide market-based incentives for the operation of low-carbon generation.

Since 2011, there are tighter requirements for pollution control in the European Union, notably those from the Large Combustion Plant Directive (LCPD) and Industrial Emissions Directive (IED), which in practice may lead to the closure of older plants, if these are unable to upgrade their emission control equipment. LCPD aims to reduce acidification, ground-level ozone and particulates by controlling the emissions of sulphur dioxide, nitrogen oxides and dust from large combustion plants. All combustion plants built after 1987 must comply with the LCPD emission limits Amer 8, Borssele and Gelderland-13 were constructed before 1987 and Maasvlakte 1 and 2 units date from 1988. The older power plants concerned can either choose to install emission abatement equipment or reduce operating times in line with a national emission plan or opt out of the LCPD. If the latter option is chosen, the plant has to reduce its operation hours after 2007 and close by end of 2015. Merged under the IED, which is in force since 2011, the LCPD further tightened emission requirements for sulphur dioxide and nitrogen oxides for all plants.

In 2013, the Social and Economic Council (SER) introduced the National Energy Agreement for Sustainable Growth (hereafter the Energy Agreement). The parties to the agreement agreed to phase out the capacity of the five oldest coal-fired power plants. The three oldest would close down on 1 January 2016 and the two others (Maasvlakte 1 and 2) on 1 July 2017. The exemption of electricity production from the energy tax for coal would be reintroduced as of 1 January 2016, as compensation for the closure of:

- Amer 8 (Essent), capacity 645 MW, to be closed down on 1 January 2016
- Borssele (Delta), capacity 406 MW, to be closed down on 1 January 2016
- Gelderland-13 (GDF), capacity 602 MW, to be closed down on 1 January 2016
- Maasvlakte 1 (E.ON), capacity 520 MW, to be closed down on 1 July 2017
- Maasvlakte 2 (E.ON), capacity 520 MW, to be closed down on 1 July 2017.

Energie Nederland, the Dutch energy industry trade association, requested the Dutch Authority for Consumers and Markets (ACM) to examine the agreement, whether it would constitute a restriction to competition.[1] According to ACM, the agreement to withdraw production capacity from the market harms consumers and does not offer sufficient environmental benefits to justify the closure of the plants. Benefits do not outweigh the negative impact of limited competition for the Dutch consumer, as the benefits of reduced GHG emissions do not necessarily accrue to the Dutch consumers. The parties to the SER are currently assessing alternative solutions.

Existing coal- and gas-fired capacity is used in highly efficient CHP mode, but new coal power plants will operate in power generation-only mode. Local heat transfer and biomass co-firing could increase the efficiency further. The plants could be complemented with carbon capture and storage (CCS) equipment under the North Sea. The Rotterdam carbon capture, use and store demonstration project (ROAD) is awaiting a final investment decision.

ASSESSMENT

Commendably, the Dutch port of Rotterdam plays a key role in Europe as the largest import hub for hard coal, providing access to diverse and global coal supplies. The ARA area sets the benchmark price for the main coal grades in North-West Europe. As a consequence of international coal market developments, hard coal imports increased in comparison to 2010 levels. This development has been supported by the efforts of the importing terminal EMO to ensure transparency to participants in the physical coal market, providing them with printed information on stock levels and to co-develop innovative derivative products, such as physically settled forward contracts in the ARA area.

The importance of coal in the Dutch industry, steel and iron production and CHP, is on the decline. Since 2002, it has been decreasing by 3% as it was replaced by biomass co-firing and by natural gas.

Thanks to access to internationally competitive coal imports, the Netherlands attracted substantial investment in new, highly efficient coal plants in the country. Coal-fired power plants were among the most competitive suppliers of electricity as input prices for coal and emission allowances declined. Coal power contributed to provide stability and affordability, supplying the Dutch economy and society with cheap energy within the constraints imposed by predefined EU-ETS and EU environmental legislation.

The government should continue to support companies that exploit comparative advantages and seize economic opportunities by providing a stable regulatory environment and investment climate for all. The main focus should be on ensuring a level playing field for power plants in an open and integrated EU internal energy market.

In the Energy Agreement, the parties agreed on the closure of old coal-fired power plants in the Netherlands (by 2016 and 2017) and on the reintroduction of the exemption from the tax on coal for electricity production as of 1 January 2016. While the agreement supports the goals of the EU environmental directives (LCPD, IED, air pollution) and a stable regulatory environment, it is considered in breach of competition rules by ACM. Therefore, the parties are currently assessing other solutions. Recent experience in other jurisdictions, including in the United Kingdom and the United States, demonstrates the value of strengthening emission performance standards to encourage a consistent retirement policy.

1. ACM analysis of closing down five coal power plants as part of SER Energieakkoord, 26 September 2013.

The viability of investment projects in the industrial energy clusters such as the port of Rotterdam should be facilitated by adequate policies. The efforts of the Dutch government to engage other member states and harmonise support schemes (with neighbouring countries), foster CCS and strengthen the EU-ETS reform, and agree on a 40% GHG reduction target at EU level for 2030, are all steps in the right direction.

New and more efficient coal-fired power plants equipped with CCS could be part of a transition path to a sustainable energy future. They could also help the Netherlands reach its targets in the area of renewable energy in a cost-efficient manner by allowing co-firing of biomass, or full biomass conversion of inefficient coal plants. These can provide innovative and future-proof alternatives to the shut-down of existing plants.

RECOMMENDATION

The government of the Netherlands should:

- ☐ *Engage with industry and neighbouring countries to define a cost-effective and innovative strategy for a cleaner use of coal, consistent with long-term GHG abatement goals, in which carbon capture, use and storage can play a major role, together with efficiency improvements from biomass co-firing or retrofitting.*

10. ENERGY TECHNOLOGY RESEARCH, DEVELOPMENT, DEMONSTRATION AND DEPLOYMENT

Key data (2012)

Government energy RD&D spending: EUR 197 million, +40.5% since 2002

Share in GDP: 0.2 per 1 000 units of GDP (IEA median in 2011: 0.39)

Share in GDP (2010): 0.48 per 1 000 units of GDP (IEA median: 0.34)

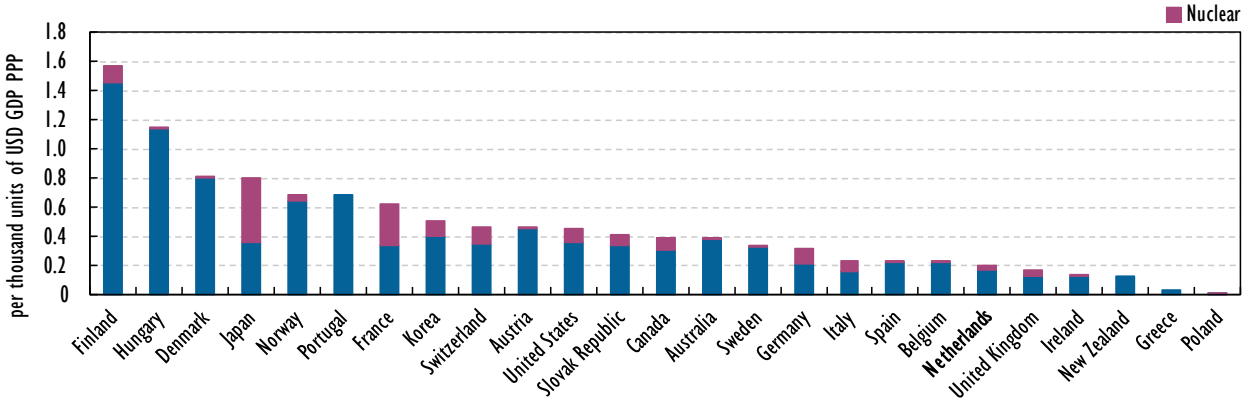
Government energy RD&D spending per capita: USD 7.5 (IEA median in 2011: USD 14)

OVERVIEW

Public investment in energy research, development and demonstration (RD&D) has been on the rise since 2005 in the Netherlands and reached EUR 197 million in 2012, accounting for 0.2 per 1 000 units of GDP. This is an increase from 2011 levels of EUR 150.8 million, but a decrease in spending compared to 2010, when RD&D reached a record high of EUR 350.4 million, a year which stood out with high demonstration funding (EUR 102 million). On average, government spending on energy RD&D has been around EUR 130 million since 2005.

In 2011, the Netherlands ranked sixth-lowest among IEA member countries with regard to the portion of GDP spent on energy RD&D.

Figure 10.1 Government spending on energy RD&D per GDP in IEA member countries, 2011



Note: the latest actual data for most countries is for 2011. Data is not available for the Czech Republic, Luxembourg and Turkey in 2011.

Sources: *OECD Economic Outlook*, OECD Paris, 2012; country submissions.

INSTITUTIONAL FRAMEWORK

On the side of policy setting and funding, the **Ministry of Economic Affairs** has primary responsibility for formulating energy RD&D policy and for the policy for applied research (through publicly funded institutes). The **Ministry of Education and Science** is responsible for fundamental science and research (through publicly funded universities and research institutes).

There are several implementing bodies and intermediary organisations supporting RD&D funding under the energy research programmes and implementation agencies, including the **Netherlands Enterprise Agency** (*Rijksdienst voor Ondernemend* Nederland, **RVO**), the **National Organisation for Scientific Research** (*Nederlandse Organisatie voor Wetenschappelijk Onderzoek*, **NWO**) and the **Technology Foundation** (*Stichting Technische Wetenschappen,* **STW**). There has been continuous restructuring of the work of the agencies, merging parts of their activities. As of 2014, the NL Agency was transformed into the **Netherlands Enterprise Agency**.

RVO is the key intermediary agency for implementing the government policy on energy RD&D. The Agency works to promote sustainable development and innovation, both within the Netherlands and abroad. It is also the primary energy RD&D liaison for multilateral co-operation, including within the European Union, within the IEA and its Implementing Agreements (IA) and in bilateral programmes with foreign governments. The RVO also acts as an intermediary between energy users and governing bodies in the implementation of voluntary long-term agreements with industry to implement energy efficiency improvements.

Private companies, universities and institutes, including the **Energy Research Centre of the Netherlands (ECN)**, the **Netherlands Organisation for Applied Scientific Research (TNO)**, the **Knowledge Centre for Wind Turbines, Materials and Constructions (WMC)**, and the **Foundation for Fundamental Research on Matter (FOM)** are the main beneficiaries.

The **Energy Research Centre of the Netherlands (ECN)** is the largest research centre in the Netherlands in the field of energy, with about 750 employees. In addition to carrying out dedicated research programmes, ECN also partners with outside academic and research institutes in the Netherlands and abroad.

A new institutional governance has been introduced under the new Energy Top Sector approach. The energy research and innovation activities are guided by a Top Team Energy that oversees the entire energy innovation portfolio and seven Top Consortia for Knowledge and Innovation (*Topconsortia voor Kennis en Innovatie*, TKI).

These **Top Consortia for Knowledge and Innovation (TKI)**, formed in 2012, are public-private partnerships to accelerate innovation in seven areas where the Netherlands has a competitive advantage in both science/RD&D and economics. Each TKI is comprised of representatives of industry and knowledge institutes, with government representatives participating as "observers", supported by RVO. The task of each TKI is to programme the necessary research and demonstration projects and to organise their funding, from both private companies and public resources through the Top Team. The Top Team steers the programmes of publicly funded institutes, guides RD&D efforts of private interests in the relevant sector, and helps to profile the sector in international markets. The **Top Team Energy** was established in 2011.

ENERGY RESEARCH POLICY, PROGRAMMES AND FUNDING

POLICIES

In the context of the financial and economic crisis, the Dutch government aligned its public energy RD&D policy within the new innovation agenda, in order to strengthen the contribution of public R&D funding to economic growth, competitiveness and innovation. In 2011, Dutch energy RD&D policy was reshaped from the Energy Transition Framework in

the context of a wider re-evaluation of Dutch innovation policy, the so-called "Top Sector" approach (*topsectorenbeleid*). The new strategy – "To the top: Towards a new enterprise policy" – identifies key economic sectors in which the Netherlands has a comparative advantage and can seize opportunities from globalisation and new emerging markets.[1]

The Top Sector policy and funding became effective in 2012. The three overarching objectives of the new RD&D policy are: *i)* to be in the top five of the Global Competitiveness Index of the World Economic Forum (2010: 8, 2011: 7, 2012: 5); *ii)* to achieve an overall R&D intensity (R&D per unit of GDP) of 2.5% (currently at 1.8%;, and *iii)* to intensify collaboration between industry and research centres through public-private partnerships.

The "Top Sector" policy approach

In 2011 nine priority economic sectors were selected as the "Top Sectors", including water, high-technology systems and materials, creative industries, agriculture, and energy.

Each of the nine priority sectors was chosen on the basis of the following criteria:

- the contribution to the societal goals for 2020 and 2050, and sustainability
- the proven demand and willingness to invest from the business community
- the knowledge and training potential
- the position and contribution of (sub)sectors to GDP and employment
- the availability of clustering of industries to reinforce each other and related sectors
- geographic advantages and disadvantages: solar intensity, water depth, wind supply, availability of cooling water, mineral resources, ports, logistics centre, and the proximity to international markets.

The Energy Top Sector

The Dutch energy sector is strong, drives exports, innovation and economic growth. In 2010, the Dutch energy sector reached almost EUR 55 billion or 10.9% of Dutch GDP, generated around EUR 15 billion worth in exports and a net value-added of EUR 26.74 billion. There were around 1 270 firms and 47 000 people (full time equivalents) working in the energy industry.[2]

With regard to energy, the seven priority areas were chosen with a view to move towards a competitive and zero-carbon energy sector. They are:

1. natural and bio-based gas (e.g. upstream, liquefied natural gas, biogas, the role of gas in the system operation)
2. offshore wind (design and engineering, support construction, wind power plants, power network, maintenance, and more)
3. solar photovoltaics (e.g. physical and electrical integration, thin film, crystalline)
4. energy savings in industry (e.g. processes and systems, utilities, separation and drying)

1. "To the top: Towards a new enterprise policy", Letter by Minister Verhagen about the key objectives of the government's new business policy, 4 February 2011.

2. *Monitor topsectoren: uitkomst eerste meting*, CBS, 2013, The Hague.

5. energy use in buildings (installations, buildings and neighbourhoods)
6. smart grids (e.g. products and services, physical infrastructure, and virtual infrastructure)
7. bio-based resources (e.g. energy, chemistry, biorefining, and aquatic biomass).

Of these, the bio-based resources and the energy savings consortium are actually cross-sector consortia, integrating the activities across different sectors. Recently, the Energy Top Team recommended to the minister to take an energy system approach and to add a cross-cutting priority that focusses on flexibilisation of the energy system in order to successfully integrate renewable energy sources.

For the Energy Top Sector, a public-private "Top team" was established comprising four representatives from utilities, small and medium-sized enterprises, academia and government. The tasks are to:

- increase the level of organisation and co-operation: initiation of Top Consortia (TKIs)
- initiate the drafting of a common research and innovation agenda through innovation contracts between industry and research centres
- manage the overall portfolio and advise ministers on the use of the energy innovation budget
- initiate the drafting of a human capital agenda to address education and labour market issues
- start the drafting of an international agenda: economic missions, strategic acquisition, R&D co-operation
- identify obstructing rules, regulations and ICT bottlenecks and come up with solutions.

The **multi-annual innovation programme** in each consortium outlines the priorities for RD&D, innovation valorisation, international market approaches, and human capital development. The Top Team, together with the consortia, steers activities of the publicly financed research institutes towards industrial relevance, and strives to align private RD&D activities with publicly financed R&D priorities. The key "success indicator" for all Top Sector innovation policies is economic performance.

However, there are two important differences between the Energy Top Sector and other Top Sectors. First, in addition to economic performance, the mission of the Energy Top Sector includes energy policy aims, such as the reduction of CO_2 emissions, the deployment of renewable energies (RES), and improvements in energy efficiency. In addition, compared to earlier energy innovation policies, spin-offs from economic targets (i.e. export potential, growth of the manufacturing sector, or increase in employment) have grown in importance. The addition of (expected) added value to the economy is a new criterion which is introduced for the management of the research and innovation portfolio/agenda.

Secondly, the amount of specific allocations to the energy sector is larger than in other Top Sectors. Approximately EUR 120 million (in 2012) is available to fund promising energy innovation projects through specific funds. These additional amounts are not available for most of the other Top Sectors, as they do not address the combined policy aims of economic development and the transition towards sustainability.

Even if it is too early for a full evaluation, the Top Sector approach seems promising for a number of reasons. It covers the entire innovation chain from fundamental research to market introduction; it stimulates a bottom-up approach with the initiative coming from

entrepreneurs and scientists/researchers in charge; it encourages work in communities (Top Consortia) with common objectives and agendas for R&D and human capital; and it reinforces international positioning and results in new and intensified contacts and enthusiasm.

The Top Sector approach is a long-term investment for the period 2011 to 2025 with the following expected milestones:

Start of the programme 2011-12:

- focus on mobilising partners, notably from industry, and organising the projects
- open tenders for a broad portfolio to address market opportunities in many areas.

Full operation 2013-16:

- fostering stronger links between partners from industry and research
- adjusting portfolios for the innovation areas.

Delivery and results 2017-25:

- substantial contribution to economic growth (jobs and GDP) and energy targets
- Dutch leadership in the Union (and the world) in a number of areas in the energy sector
- reinforcing the strong industrial base of the Dutch energy sector.

Focus on clean energy technologies

The Energy Agreement makes energy innovation and commercialisation for export one of its key priorities. It sets out the ambition of the Netherlands to be ranked in the top ten countries of the Global Cleantech Innovation Index by 2030 and to quadruple the economic value of the clean energy technology chain by 2020 compared to 2010. In 2012, the Netherlands ranked 14th in the WWF Global Cleantech Index.[3]

In addition, the Energy Agreement supports the use of parts of the Sustainable Energy Incentive Scheme (SDE+) revenues for the demonstration of renewable energy technologies in order to increase the cost-effectiveness of deployment. In addition, public funding is to be made available in 2014 for the demonstration of cleantech projects to accelerate the commercialisation of cleantech activities for export in the range of EUR 25 million in 2014 and EUR 50 million as of 2017.

Green technology patent applications among the total Dutch applications to the European Patent Office (EPO) rose from 4% in 2000 to 8.5% in 2009 (numbers increased from 157 in 2000 to 396 in 2009) and related to biomass, waste, wind power and geothermal power.[4]

EVALUATIONS

The previous Energy Transition Framework was supported by two main programmes: the *Energie Onderzoek Subsidie* (EOS) programme, which was in place until end 2010 and evaluated in 2011,[5] and the *Innovatie Agenda Energie* (IAE) programme, which is currently being phased out and evaluated. As both programmes stopped funding new projects in

3. World Wide Fund for Nature, Global Cleantech Innovation Index; see http://wwf.fi/mediabank/4676.pdf.

4. CBS Statistics Netherlands: Green Growth in the Netherlands 2012, November 2013.

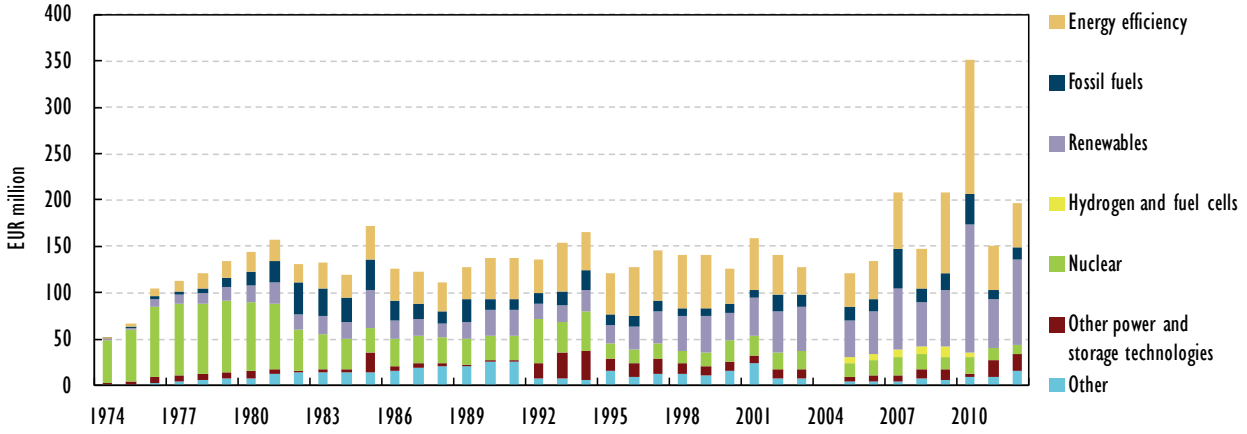
5. Hamelink/Ecofys: Ex post evaluatie DEN-A en EOS, in opdracht van: Ministerie van Economische Zaken, Landbouw en Innovatie, December 2011.

2011 and as the Top Sector approach became effective only in 2012, public energy RD&D funding levels plummeted in 2011 (see Figure 10.2). The results of both EOS and IAE are collected in the Energy Innovation Catalogue, an online database at project level, which shows the progress from a few hundred projects.[6]

For the Energy Top Sector, a portfolio management system for programme funding and project management was developed. The system assesses, among others things, the Technology Readiness Levels (TRL) of each energy technology in the TKI programme portfolio. Each year the Energy Top Team evaluates the progress of the entire research and innovation portfolio of the TKIs and draws up advice to the Minister of Economic Affairs for the future allocation of public funding.

FUNDING

Figure 10.2 Government spending on energy RD&D, 1974-2012



Note: data are not available for 2004. Data for hydrogen and fuel cells are not available from 1974 to 2004.

Source: country submission.

There have been constraints in public funding in 2011, amid the economic and financial crisis and the change-over from the Energy Transition Framework to the new Top Sector approach. However, as of 2012, the overall public energy RD&D spending levels are maintained at the average levels of previous years. Under the new Top Sector approach for energy, the budget for the TKIs is expected to amount to EUR 200 million from 2014 onwards, and to increase in 2015 to close to EUR 500 million, out of which 40% are to be provided by the private sector.

There has been a general shift in moving away from direct subsidies to tax incentives, loans, fiscal support and other instruments. For instance, while funding of RES had been a large share in the public energy budget in recent years, the reform of the subsidy scheme, the SDE+, entails the shift away from public subsidies to taxes, as the SDE+ is now being financed as a surcharge on consumers' bill.

Despite maintaining public funding for energy RD&D, greater focus is now placed on commercialisation and less on fundamental research. In the Energy Agreement of 2013, the government is to increase demonstration funding from EUR 25 million in 2014 to a continuous contribution of EUR 50 million from 2017 onwards, with a view to accelerate the commercialisation of energy cleantech activities for export.

6. http://applicaties.agentschapnl.nl/energie-innovatiecatalogus.

Specific subsidies for innovation in the private sector have been reduced, while at the same time fiscal support for in-company RD&D was increased, for those activities which are contracted out to research institutes. The fiscal support includes the Research and Development (Promotion) Act (WBSO) and the Research and Development Allowance (RDA).

The WBSO, introduced in 1994, provides support for staff costs associated with R&D projects. Entrepreneurs may offset the costs of R&D against their taxable income[7] with an extra tax allowance for start-up companies and entrepreneurs.[8] The WBSO budget for 2013 amounted to EUR 700 million. In 2012, the coalition agreement implemented, the RDA to supplement the WBSO. Whereas the latter is used for staff costs associated with R&D projects, RDA covers the other costs associated with such projects. The 2013 budget for the new scheme amounted to EUR 375 million.

The Green Fund Scheme and the Venture Capital Scheme (TechnoPartner SEED facility) provide tax rebates for investing in authorised green funds. Other instruments such as the innovation programmes and the innovation vouchers programme will be phased out or stopped.[9]

As a new element introduced in 2013, each of the TKIs can benefit from the "TKI allowance". For every euro a private company invests in PPS research by a TKI, the government adds a bonus of EUR 0.25. For the first EUR 20 000, the bonus is 40%. The charge is given not to the company but to the TKI.

Through the guidance of the Top Teams, it may be expected that this fiscally supported RD&D contributes significantly to the Top Sectors. At the same time, fiscal support is generic, so that innovations outside the key economic sectors also receive support.

The Top Consortia for Knowledge and Innovation

In early 2012, for each of the seven priority areas, the Top Team and the Top Consortia drew up an innovation programme, often with a horizon of several years, but in all cases with an outline of activities to be committed in 2012.

Approval of the programming proposals of the TKIs is done by the Energy Top Team. The Top Team in turn advises the Minister of Economic Affairs on the allocation and proper use of public funding.

When TKI programmes were accepted, and the TKIs were asked to translate the plans into concrete projects (with significant private contribution), funding by the government could take place (administered by RVO). RVO acts in various roles, always including the organisation of funding for selected projects.

Some TKIs opted for a tendering system: the programmes were translated into tender criteria, and a call for tenders was placed. Other TKIs took a more programmatic approach, and established a list of projects in consultation with stakeholders and consistent with the agreed programmes.

7. The tax benefit is a reduction in the payroll tax to be paid over the labour costs of these employees.

8. Self-employed entrepreneurs who spend at least 1 500 hours in a calendar year on R&D are eligible for a fixed income tax deduction. This deduction in 2013 amounted to EUR 12 310. For starting entrepreneurs, there is an additional deduction of EUR 6 157. A self-employed entrepreneur who has staff employed may qualify for the deduction on payroll tax, as well as the fixed deduction on income tax.

9. Source: www.rathenau.nl/en/web-specials/the-dutch-science-system/policy-and-advice/innovation-policy.html.

Taken together, in 2012 approximately EUR 120 million of public funds were committed.[10] When matching funds from private stakeholders are taken into account, total funding amounted to approximately EUR 200 million for all TKIs.

The publicly funded research carried out by universities is further aligned with each Energy Top Sector programme, contributing a further EUR 30 million to 50 million over two years to the energy TKI allocation.

Box 10.1 Integrating R&D and the support to renewable energy deployment

The Energy Agreement for Sustainable Growth has the ambition to scale up offshore wind power to 4 450 MW, operational in 2023, from the existing and planned offshore wind power capacity of 1 000 MW. The additional 3 450 MW will be contracted for by means of procurement procedures commencing in 2015 and increasing as follows: 450 MW (2015), 600 MW (2016), 700 MW (2017), 800 MW (2018), and 900 MW (2019).

Such gradual perspective for the development of the Dutch offshore wind sector was coupled with the assumption that the sector is able to reduce the cost of offshore wind power by some 40% over these years. Under the SDE+ tenders, in which this cost decrease is a critical criterion, the starting point is a maximum average of 150 EUR per MWh in 2014, with a cost reduction of around EUR 5/MWh per year. The goal of this project is to achieve the target price of EUR 0.15/kWh in 2015, and to subsequently facilitate a further cost reduction to EUR 0.10/kWh in 2020.

In turn the government will ensure that there is a robust legal framework that makes it possible to scale up offshore wind power. An offshore network will be constructed where it is more efficient than connecting wind farms directly to the national high-voltage network. The ultimate goal is to have wind farms becoming operational within four years once a decision has been taken on funding, and to make use of state-of-the-art technology.

With a view to achieve rapid cost reduction, the Dutch government invites early proposals to demonstrate innovative wind farms already in 2014. The Dutch Wind Energy Association (NWEA) and TKI Offshore Wind under the Energy Top Sector are assigned the task of devising an action plan for a pilot project and present a demonstration wind farm to a working group composed of representatives from the offshore wind sector.

PROJECTS AND PROGRAMMES

For biomass and carbon capture and storage (CCS), the Netherlands has supported small- and large-scale demonstration and deployment projects with different levels of success.

Demonstration projects for biomass are well under way and include a large-scale biomass pyrolysis plant, a large-scale biomass gasification plant, and a bio-based methanol demonstration plant. Each will be built by private enterprises which, in the case of the gasification plant, has benefitted from a grant of EUR 200 million from the European Commission.

Despite the relevance for industry, large-scale demonstration plants for CCS have not been implemented because of current financing and other non-economic barriers, including

10. Due to administrative issues only ca. EUR 80 million of the EUR 120 million of public funding was committed in 2012. The remainder was transferred to 2013 and committed early 2013.

public acceptance and low CO_2 prices, which causes significant funding gaps. CCS has been included under the TKI Gas, but the Top Team has not yet allocated public funding. A positive decision will depend on the go/no-go decision on the ROAD project (large-scale CCS demonstration). The Netherlands is currently discussing this project with the European Commission. The decision on the ROAD project will also impact the future of CCS research in the Netherlands.

INTERNATIONAL COLLABORATION

International collaboration is a key feature of Dutch energy RD&D, both from the perspective of government policy and the activities of the Dutch implementing agencies. Researchers are well integrated in international co-operation.

The Netherlands is a signatory to around 17 IEA multilateral technology initiatives, or Implementing Agreements (IAs). Dutch participation in these international groups is consistent with national RD&D priorities and focusses on the areas of energy efficiency (in buildings, electricity, industry and transport) and renewable energy technologies. The Netherlands is also involved in IAs covering energy technology modelling and oil and gas technologies.

Since 2005, the Netherlands has been holding regular co-ordination meetings designed to strengthen and align R&D policy between the national actors (Ministry of Economic Affairs, the Netherlands Enterprise Agency and the Research Centre of the Netherlands) and the international RD&D efforts carried out through the IEA Implementing Agreements, the IEA Committee on Energy Research and Technology, its working parties and ad hoc groups. The Enterprise Agency currently chairs the IEA Experts' Group on R&D Priority Setting.

The Netherlands and the Enterprise Agency participate in eight energy-related European research area networks, including the ERA-NET activities and ten Energy Technology Platforms, the European Union's Seventh Research Framework Programme (e.g. Joint Technology Initiatives on hydrogen) and Horizon 2020, Euratom and the Strategic Energy Plan (SET).

Strong regional cross-border co-operation has been started, including with some German *Länder* (regions), on solar, hydrogen and biomass.

PRIVATE SECTOR PARTICIPATION

While the Netherlands spends around the IEA average in terms of public RD&D funding, it has large multinationals which substantially invest in private RD&D, innovation and patent development, including in the chemicals, food and petrochemical industries, and manufacturing. In 2010, the Dutch energy sector spent around EUR 645 million.

The private sector also contributes to the financing of Dutch academia and research institutes. Rated among OECD peers, the Dutch science and innovation landscape excels by ease of entrepreneurship, e-government and industry-financed public R&D expenditures.[11]

With a view to encourage innovation into renewable energy technologies in addition to the deployment of mature renewable technologies, part of the funds for innovation are coming from the renewable support scheme SDE+ with an annual contribution of EUR 50 million which is collected through the energy bill. The key function of SDE+ is implementation rather than innovation.

11. Science and Innovation: The Netherlands, OECD, Paris, 2012.

The private sector is actively involved in the Energy Top Sector and its seven priority areas (TKIs). On average, a minimum of 40% of each TKI budget must be matched by private funding. A leverage of private funds of around EUR 1.4 billion is expected to contribute to the total energy RD&D funding of EUR 3.4 billion during the 2012-15 period.[12] For demonstration projects of technologies that are close to market introduction, this share will be larger. The contribution of public funding will in general be larger for more fundamental research projects.

In 2012, public funding of around EUR 120 million was available for the Energy Top Sector, excluding public funding of energy research at the organisations for scientific research ECN and TNO, and public funding via NWO on fundamental research. Together with private funding (in cash and in-kind) a total of EUR 200 million was generated for energy research and innovation. A special effort will be made to involve small and medium-sized enterprises (SMEs) with the Energy Top Sector. This includes a special instrument (*MKB Innovatiestimulering Topsectoren*, MIT) and an SME action plan.

ASSESSMENT

In terms of general R&D spending, the Netherlands aspires to reach a global R&D share of 2.5% of GDP (it is currently 1.8%). Among OECD countries, in 2012 the Netherlands stood out in terms of innovation capacity and ease of entrepreneurship.[13]

Despite the constraints imposed by the economic and financial crisis, the Dutch government maintains funding levels for energy RD&D. In comparison to other IEA member countries, the Netherlands spent less than the average in terms of public energy RD&D funding as a share of GDP in 2011 and it ranked sixth-lowest among IEA member countries. After a change in policies from the Energy Transition Framework to the Top Sector policy in 2012, the Dutch energy RD&D spending slightly recovered to past levels, with EUR 250 million to EUR 300 million generated for energy research and innovation, of which EUR 197 million public funding.

Commendably, the government has integrated energy RD&D policies within an overall innovation and economic growth strategy through the Top Sector approach. The energy sector, as one of the Top Sectors, has the main goal to leverage both societal benefits and Dutch innovation in clean energy technologies, including smart grids, energy efficiency and biofuels, and to foster the export of energy R&D know-how. The seven priority areas reflect well the comparative and competitive edge of the Dutch energy sector, but the government will need to remain open and flexible in the evaluation and priority setting to accommodate new priorities or changing technologies over time.

The new governance structure relies on the good experience the Netherlands has with co-operation between government, industry and academia. A Top Team, composed of a representative from a major industry, from SMEs, from the science community and from government, is well placed to set priorities. Because the steering body and the Top Consortia for Knowledge and Innovation (TKI) are working hand in hand, the funding can be directed to where innovation is deemed necessary and where the Netherlands has a strong position in science, R&D and industry.

12. Rapportage Topsector Energie bij de Innovatiecontracten Energie, Top Team Energie, April 2012.

13. Science and Innovation: The Netherlands, OECD, Paris, 2012.

There are two major shifts in the public RD&D spending. On the one hand, the Energy Agreement makes demonstration and commercialisation a greater priority over fundamental research activities. On the other hand, direct public funding is being shifted to tax incentives, loans and other innovation support. In addition, there has been a restructuring of government agencies dealing with RD&D. Recently, the NL Agency was transformed into the Netherlands Enterprise Agency. But by frequently restructuring the agencies, there is a risk of discontinuity of resources, know-how and evaluation. RD&D policy, however, should take into account the results and benchmarks from fundamental research and RD&D results to foster commercialisation and international technology co-operation. This requires more stringent evaluation of research results and innovation, beyond the project levels.

The Netherlands aims to be among the top ten in the global cleantech ranking by 2030. The reinforced focus on clean energy technologies should allow the country to regain momentum on energy- and environment-related technologies (wind power, offshore, etc.) which have weakened in recent years.

Developing clean technologies for commercialisation and export will require an orientation focussed on the supply chain and on the whole energy innovation cycle, taking account of results from fundamental research and industry. New fiscal programmes support start-up activities and the commercialisation of new technologies by companies and research institutes/universities. It is important to complete the innovation cycle by translating R&D results into commercialisation to overcome the pre-commercialisation gap. However, funding start-ups and commercialisation of university RD&D results remains a challenge. The government is right to offer more R&D tax credits and soft loan programmes, but should also be proactive in creating start-up hubs and remain committed to international exchange of innovation results, patents and technology trends, including through the IEA and the OECD.

A major goal for energy R&D is to lower the costs of renewable energy production and energy efficiency options. However, the significant difference in levels of support between R&D, demonstration and market deployment (e.g. through SDE+) may prevent renewable energy technologies from contributing to sustainable growth and innovation in the longer term. The current focus is on deploying the most cost-effective solutions to meet short-term renewables targets, but there is also a need to lower the cost of emerging technologies so as to maintain sustainable green growth. Clear longer-term outcomes or objectives would better guide R&D, demonstration and deployment efforts. Emerging technologies, such as offshore wind, may still require substantial funding for R&D and innovation before becoming commercially available, as experience in other regions shows.

In light of the forthcoming significant deployment of renewable energy technologies supported via the SDE+ scheme, as well as through a suite of energy efficiency projects, it is important to have programmes in place to train and educate sufficient people to support the skill base necessary to foster the installation of new energy technologies and associated infrastructures.

Amid changing priorities and different levels of success with current demonstration projects (CCS and biomass), the government should evaluate in the medium term the results of the Top Sector and consider expanding demand-side technologies for boosting energy efficiency, which is a priority for the government. A dedicated priority to energy efficiency and an energy system approach will enable cross-sectoral and value-chain improvements in order to accelerate innovation and scale up development and dissemination of solutions for the domestic and international markets.

Commendably, the Netherlands has been able to benefit from the EU Seventh Framework Programme (FP7) with a return of around 7%, while its share in the EU budget stood at 4.7% during the seven-year period ending in 2013. With a view to the future utilisation of EU funds under "Horizon 2020", the IEA encourages the government to support Dutch project promoters to allow them to benefit from those EU-wide research projects, where it contributes to the new Top Sector approach, thus matching EU funds with public funds, as needed.

The country could also benefit from stronger engagement with international funds, such as the European Local Energy Assistance (ELENA) or the European Energy Efficiency Fund (EEEF), through new financing models, Dutch pension funds and private banks.

International co-operation should be focussed on leveraging funds for joint projects on technology development and demonstration, including CCS, with a view to advance key technologies where the Netherlands holds a comparative advantage.

RECOMMENDATIONS

The government of the Netherlands should:

- *Ensure an effective balance between funds directed to research, demonstration and deployment of energy technology to ensure strong contribution from the energy sector to the 2.5% share of RD&D spending in GCP and facilitate energy and climate goals.*
- *Take action to ensure that a sufficient skills base is available to deliver the deployment of new energy technology and related infrastructure and services through fostering Dutch research and technology know-how at global level.*
- *Support the full innovation cycle by enhancing fiscal support and soft loans to start-ups and SMEs, notably for energy efficiency, together with the private sector, banks and pension funds.*
- *Maintain existing support on the exchange of technology innovation results at international level, with regard to patents, evaluation of outcomes and technology developments.*
- *Focus on opportunities for international partnerships with a strong emphasis on joint funding for the development and demonstration of key emerging clean energy technologies.*
- *Develop a long-term energy innovation and RD&D strategy in collaboration with business and other stakeholders to guide programmes and activities, in order to stimulate innovation and to leverage private investment in clean energy technologies, based on an evaluation of the outcomes from the Top Sector policy.*

PART III
ANNEXES

ANNEX A: ORGANISATION OF THE REVIEW

REVIEW CRITERIA

The Shared Goals, which were adopted by the IEA Ministers at their 4 June 1993 meeting in Paris, provide the evaluation criteria for the in-depth reviews conducted by the IEA. The Shared Goals are presented in Annex C.

REVIEW TEAM AND PREPARATION OF THE REPORT

The in-depth review team visited the Netherlands from 8 to 12 April 2013. The team met with government officials, energy suppliers, interest groups and various other organisations. This report was drafted on the basis of these meetings, the team's preliminary assessment of the country's energy policy, the government response to the IEA energy policy questionnaire and other information. The members of the team were:

IEA member countries

Mr Edmund Hosker, the United Kingdom (team leader)

Mr Romain Cailleton, France

Ms Joke Coopman, Belgium

Mr Geoff Whelan, Australia

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Mr Kijune Kim

Ms Vida Rozite

Mr Douglas Cooke

Ms Sylvia Elisabeth Beyer (desk officer)

The team is grateful for the co-operation and assistance of the many people it met during the visit, their kind hospitality and their willingness to discuss the challenges and opportunities that the Netherlands is currently facing.

The IEA team wishes to express its gratitude to Mr Mark Dierikx, Director-General of the Energy, Telecommunication and Competition, for his personal engagement in meeting and briefing the team on current energy policy issues in the Netherlands. The team also

wishes to thank Mr Cees Kieft and Ms Elske van Efferink for their tireless efforts and professionalism in planning and organising the review visit to The Hague and for supporting the team throughout the review week.

The team thanks the staff in the Ministry of Economic Affairs, the Ministry of Infrastructure and Environment, the Ministry of the Interior and Kingdom Relations, the Ministry of Finance and the government authorities, notably the team at the Netherlands Authority for Consumers and Markets, of the Environmental Assessment Agency and of other organisations, including Cogen Nederland and TenneT, for their support in assisting the preparation of the report. In particular, the team wishes to thank Mr Frederik Wisselink, Mr Aart Dekkers and Mr David Kramer from the Ministry of Economic Affairs for their helpfulness in co-ordinating and guiding the review process.

Sylvia Beyer prepared the review and drafted all chapters of this report, except for those which were prepared by Vida Rozite (Chapter 4 on Energy Efficiency), by Douglas Cooke (Chapter 5 on Electricity), and by Dr Marco Cometto (Chapter 7 on Nuclear Energy). Sonja Lekovic provided the analysis on the statistics and data-related sections of the report.

The author is grateful for the fruitful discussions, the comments and input provided by the review team members and IEA colleagues, including Ken Fairfax, Mr Kees van Noort (Shell), Anselm Eisentraut, Paolo Frankl, Toril Bosoni, Dennis Volk, Carlos Fernández Alvarez, Rodrigo Pinto Scholtbach, Ms Anne Braaksma (GasTerra), Anne-Sophie Corbeau, Kijune Kim, Simon Bennett, Nina Campbell, Carrie Pottinger and Erica Robin.

Equally, the author thanks the IEA Secretariat for the support on data, publication and editing. Sonja Lekovic and Bertrand Sadin prepared the new design and supported the report with colourful figures, tables and informative maps. Roberta Quadrelli and Klaus Pedersen provided support on the IEA statistics. Muriel Custodio, Astrid Dumond and Angela Gosmann managed the publication process. Viviane Consoli, Therese Walsh and Rebecca Gaghen provided editorial assistance. Catherine Smith helped in the preparations of the IEA SLT Committee and the logistics of the review visit.

ORGANISATIONS VISITED

During its visit in the Netherlands, the review team met with the following organisations:

- Ministry of Economic Affairs
- Ministry of Infrastructure and Environment
- Ministry of Finance
- Ministry of Transport
- Ministry of the Interior and Kingdom Relations
- NL Agency
- Netherlands Environmental Assessment Agency (PBL)
- Energy Research Centre of the Netherlands (ECN)
- Social and Economic Council (SER)
- Authority for Consumers and Markets
- Amsterdam Power Exchange (APX)
- TenneT

- Netbeheer Nederland
- Energie Beheer Nederland (EBN)
- Shell
- GasTerra
- GTS Gasunie Transport Services
- E.ON
- Netherlands Petroleum Industry Association (VNPI)
- VNO-NCW (Confederation of Netherlands Industry and Employers)
- Energie Nederland
- World Wide Fund for Nature (WWF)
- Port of Rotterdam
- Rotterdam Climate Initiative

ANNEX B
ENERGY BALANCES AND KEY STATISTICAL DATA

Unit: Mtoe

SUPPLY		1973	1990	2010	2011	2012	2020	2030
TOTAL PRODUCTION		**56.8**	**60.5**	**69.8**	**64.4**	**64.7**	**51.0**	**26.1**
Coal		1.1	-	-	-	-	-	-
Peat		-	-	-	-	-	-	-
Oil		1.6	4.1	1.7	1.7	1.8	2.0	1.0
Natural gas		53.7	54.6	63.4	57.7	57.5	43.1	15.9
Biofuels & waste[1]		-	1.0	3.3	3.3	3.9	3.4	5.8
Nuclear		0.3	0.9	1.0	1.1	1.0	1.0	1.0
Hydro		-	0.0	0.0	0.0	0.0	0.0	0.0
Wind		-	0.0	0.3	0.4	0.4	1.2	1.5
Geothermal		-	-	0.0	0.0	0.0	0.2	0.5
Solar/other[2]		-	0.0	0.0	0.0	0.1	0.1	0.4
TOTAL NET IMPORTS[3]		**5.6**	**5.3**	**14.0**	**11.0**	**13.2**	**30.0**	**55.0**
Coal	Exports	1.4	2.3	3.6	7.5	8.1	4.9	4.9
	Imports	2.9	11.7	12.8	15.0	15.0	17.9	15.9
	Net imports	1.5	9.5	9.2	7.5	6.9	13.0	11.0
Oil	Exports	41.8	59.2	103.1	101.2	104.8	115.1	118.6
	Imports	83.5	90.4	148.8	145.4	151.4	165.1	173.0
	Int'l marine and aviation bunkers	-12.3	-12.3	-17.1	-18.3	-16.8	-21.1	-24.4
	Net imports	29.4	18.9	28.6	26.0	29.7	28.8	29.9
Natural Gas	Exports	25.3	25.8	42.7	40.0	43.3	35.9	28.3
	Imports	-	2.0	18.4	16.5	18.7	23.6	42.4
	Net imports	-25.3	-23.8	-24.2	-23.5	-24.6	-12.3	14.1
Electricity	Exports	0.1	0.0	1.1	1.0	1.3	1.2	1.2
	Imports	0.0	0.8	1.3	1.8	2.8	1.7	1.1
	Net imports	-0.1	0.8	0.2	0.8	1.5	0.5	-0.1
TOTAL STOCK CHANGES		**-0.3**	**-0.2**	**-0.4**	**2.0**	**0.6**	**-**	**-**
TOTAL SUPPLY (TPES)[4]		**62.0**	**65.7**	**83.4**	**77.4**	**78.6**	**81.0**	**81.1**
Coal		2.9	8.9	7.6	7.5	8.2	13.0	11.0
Peat		-	-	-	-	-	-	-
Oil		30.5	23.3	31.5	29.8	30.9	30.8	30.9
Natural gas		28.5	30.8	39.2	34.2	32.8	30.7	30.0
Biofuels & waste[1]		-	1.0	3.5	3.6	3.7	3.4	5.8
Nuclear		0.3	0.9	1.0	1.1	1.0	1.0	1.0
Hydro		-	0.0	0.0	0.0	0.0	0.0	0.0
Wind		-	0.0	0.3	0.4	0.4	1.2	1.5
Geothermal		-	-	0.0	0.0	0.0	0.2	0.5
Solar/other[2]		-	0.0	0.0	0.0	0.1	0.1	0.4
Electricity trade[5]		-0.1	0.8	0.2	0.8	1.5	0.5	-0.1
Shares in TPES (%)								
Coal		*4.6*	*13.6*	*9.1*	*9.7*	*10.4*	*16.1*	*13.6*
Peat		-	-	-	-	-	-	-
Oil		*49.1*	*35.4*	*37.7*	*38.5*	*39.4*	*38.0*	*38.1*
Natural gas		*46.0*	*46.9*	*47.0*	*44.2*	*41.7*	*38.0*	*37.0*
Biofuels & waste[1]		-	*1.5*	*4.2*	*4.6*	*4.7*	*4.2*	*7.1*
Nuclear		*0.5*	*1.4*	*1.2*	*1.4*	*1.3*	*1.3*	*1.3*
Hydro		-	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*
Wind		-	-	*0.4*	*0.6*	*0.5*	*1.4*	*1.9*
Geothermal		-	-	*0.0*	*0.0*	*0.0*	*0.2*	*0.6*
Solar/other[2]		-	*0.0*	*0.1*	*0.1*	*0.1*	*0.2*	*0.5*
Electricity trade[5]		*-0.2*	*1.2*	*0.3*	*1.0*	*1.9*	*0.6*	*-0.1*

0 is negligible, - is nil, .. is not available, x is not applicable. Please note: rounding may cause totals to differ from the sum of the elemen

Unit: Mtoe

DEMAND							
FINAL CONSUMPTION	**1973**	**1990**	**2010**	**2011**	**2012**	**2020**	**2030**
TFC	**47.7**	**49.1**	**64.8**	**59.8**	**61.1**	**60.6**	**61.7**
Coal	1.1	1.4	0.8	0.8	0.9	1.7	1.9
Peat	-	-	-	-	-	-	-
Oil	23.5	18.1	27.7	26.3	26.9	26.6	27.1
Natural gas	19.3	22.7	24.2	20.5	21.3	20.4	20.1
Biofuels & waste[1]	-	0.4	0.7	0.8	0.9	0.6	0.9
Geothermal	-	-	0.0	0.0	0.0	0.1	0.3
Solar/other[2]	-	0.0	0.0	0.0	0.0	0.0	0.0
Electricity	3.8	6.3	9.2	9.2	9.2	9.9	10.0
Heat	-	0.3	2.1	2.1	1.9	1.2	1.4
Shares in TFC (%)							
Coal	*2.3*	*2.8*	*1.2*	*1.4*	*1.4*	*2.8*	*3.0*
Peat	-	-	-	-	-	-	-
Oil	*49.2*	*36.8*	*42.7*	*44.0*	*44.1*	*43.8*	*43.8*
Natural gas	*40.5*	*46.2*	*37.4*	*34.3*	*34.9*	*33.7*	*32.6*
Biofuels & waste[1]	-	*0.8*	*1.2*	*1.4*	*1.4*	*1.0*	*1.5*
Geothermal	-	-	-	*0.0*	*0.0*	*0.0*	*0.5*
Solar/other[2]	-	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.1*
Electricity	*8.0*	*12.9*	*14.2*	*15.5*	*15.0*	*16.3*	*16.2*
Heat	-	*0.6*	*3.2*	*3.5*	*3.1*	*2.0*	*2.3*
TOTAL INDUSTRY[6]	**21.1**	**21.1**	**28.6**	**26.8**	**27.2**	**28.6**	**29.7**
Coal	0.8	1.3	0.8	0.8	0.9	1.7	1.9
Peat	-	-	-	-	-	-	-
Oil	10.2	8.1	15.7	14.2	15.2	15.4	16.1
Natural gas	8.1	8.8	7.5	7.2	7.0	7.3	7.5
Biofuels & waste[1]	-	0.0	0.1	0.1	0.1	0.3	0.6
Geothermal	-	-	-	-	-	-	-
Solar/other[2]	-	-	-	-	-	-	-
Electricity	2.0	2.9	3.4	3.4	3.0	3.6	3.5
Heat	-	-	1.1	1.2	1.1	0.1	0.2
Shares in total industry (%)							
Coal	*3.6*	*6.3*	*2.8*	*3.0*	*3.2*	*6.0*	*6.3*
Peat	-	-	-	-	-	-	-
Oil	*48.5*	*38.4*	*54.8*	*53.1*	*56.0*	*54.1*	*54.2*
Natural gas	*38.6*	*41.6*	*26.4*	*26.8*	*25.6*	*25.5*	*25.1*
Biofuels & waste[1]	-	*0.2*	*0.4*	*0.3*	*0.3*	*1.1*	*1.9*
Geothermal	-	-	-	-	-	-	-
Solar/other[2]	-	-	-	-	-	-	-
Electricity	*9.3*	*13.5*	*11.7*	*12.5*	*11.0*	*12.8*	*11.8*
Heat	-	-	*3.9*	*4.4*	*3.9*	*0.5*	*0.8*
TRANSPORT[4]	**6.5**	**8.9**	**11.5**	**11.6**	**11.4**	**10.9**	**11.0**
OTHER[7]	**20.0**	**19.1**	**24.6**	**21.3**	**22.5**	**21.2**	**21.0**
Coal	0.3	0.1	0.0	0.0	0.0	-	-
Peat	-	-	-	-	-	-	-
Oil	6.8	1.2	0.9	0.9	0.8	0.9	1.0
Natural gas	11.1	13.9	16.6	13.3	14.3	12.7	12.1
Biofuels & waste[1]	-	0.3	0.4	0.4	0.4	0.3	0.4
Geothermal	-	-	0.0	0.0	0.0	0.1	0.3
Solar/other[2]	-	0.0	0.0	0.0	0.0	0.0	0.0
Electricity	1.8	3.4	5.7	5.7	6.0	6.0	6.0
Heat	-	0.3	1.0	0.9	0.9	1.1	1.2
Shares in other (%)							
Coal	*1.6*	*0.3*	-	-	-	-	-
Peat	-	-	-	-	-	-	-
Oil	*33.9*	*6.2*	*3.5*	*4.2*	*3.5*	*4.4*	*4.8*
Natural gas	*55.6*	*72.6*	*67.5*	*62.5*	*63.7*	*59.8*	*57.7*
Biofuels & waste[1]	-	*1.8*	*1.7*	*2.0*	*2.0*	*1.3*	*1.8*
Geothermal	-	-	-	*0.0*	*0.0*	*0.0*	*1.4*
Solar/other[2]	-	-	*0.1*	*0.1*	*0.1*	*0.1*	*0.2*
Electricity	*8.9*	*17.5*	*23.1*	*26.9*	*26.8*	*28.4*	*28.6*
Heat	-	*1.6*	*4.0*	*4.2*	*3.8*	*5.2*	*5.6*

Unit: Mtoe

DEMAND							
ENERGY TRANSFORMATION AND LOSSES	**1973**	**1990**	**2010**	**2011**	**2012**	**2020**	**2030**
ELECTRICITY GENERATION[8]							
Input (Mtoe)	12.0	15.1	23.1	21.7	20.3	23.8	23.8
Output (Mtoe)	4.5	6.2	10.2	9.7	8.8	10.7	11.1
Output (TWh)	52.6	71.9	118.1	113.0	102.5	124.2	129.6
Output Shares (%)							
Coal	*6.0*	*38.3*	*21.8*	*21.9*	*26.6*	*36.6*	*26.0*
Peat	-	-	-	-	-	-	-
Oil	*12.3*	*4.3*	*1.1*	*1.3*	*1.1*	*2.6*	*2.6*
Natural gas	*79.5*	*50.9*	*62.8*	*60.6*	*54.4*	*40.4*	*42.8*
Biofuels & waste[1]	-	*1.5*	*7.3*	*7.8*	*8.7*	*5.1*	*8.2*
Nuclear	*2.1*	*4.9*	*3.4*	*3.7*	*3.8*	*3.2*	*3.1*
Hydro	-	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*
Wind	-	*0.1*	*3.4*	*4.5*	*4.9*	*10.9*	*13.6*
Geothermal	-	-	-	-	-	-	-
Solar/other[2]	-	-	*0.2*	*0.2*	*0.4*	*1.1*	*3.5*
TOTAL LOSSES	**15.0**	**16.1**	**17.7**	**17.7**	**17.0**	**20.4**	**19.4**
of which:							
Electricity and heat generation[9]	7.5	8.6	9.5	8.6	8.3	10.9	10.6
Other transformation	2.3	1.5	2.0	2.6	2.2	3.4	3.7
Own use and transmission/distribution losses[10]	5.3	6.0	6.2	6.6	6.5	6.0	5.2
Statistical Differences	**-0.7**	**0.4**	**1.0**	**-0.1**	**0.5**	**-**	**-**
INDICATORS	**1973**	**1990**	**2010**	**2011**	**2012**	**2020**	**2030**
GDP (billion 2005 USD)	292.25	437.83	683.75	690.53	683.93	761.98	878.66
Population (millions)	13.44	14.95	16.61	16.69	16.75	17.23	17.69
TPES/GDP (toe/1000 USD)[11]	0.21	0.15	0.12	0.11	0.11	0.11	0.09
Energy production/TPES	0.92	0.92	0.84	0.83	0.82	0.63	0.32
Per capita TPES (toe/capita)	4.61	4.39	5.02	4.64	4.69	4.70	4.59
Oil supply/GDP (toe/1000 USD)[11]	0.10	0.05	0.05	0.04	0.05	0.04	0.04
TFC/GDP (toe/1000 USD)[11]	0.16	0.11	0.09	0.09	0.09	0.08	0.07
Per capita TFC (toe/capita)	3.55	3.29	3.90	3.58	3.64	3.52	3.49
Energy-related CO_2 emissions ($MtCO_2$)[12]	152.7	155.9	187.0	174.9	173.8	181.1	172.3
CO_2 emissions from bunkers ($MtCO_2$)[12]	39.0	38.6	53.7	57.4	52.8	66.4	76.5
GROWTH RATES (% per year)	**73-90**	**90-00**	**00-10**	**10-11**	**11-12**	**12-20**	**20-30**
TPES	0.3	1.1	1.3	-7.2	1.5	0.4	0.0
Coal	6.9	-1.3	-0.3	-1.6	9.7	6.0	-1.7
Peat	-	-	-	-	-	-	-
Oil	-1.6	1.1	2.0	-5.3	3.7	-0.1	0.0
Natural gas	0.5	1.3	1.1	-12.8	-4.1	-0.8	-0.3
Biofuels & waste[1]	-	6.2	7.2	3.4	2.4	-1.0	5.5
Nuclear	7.0	1.1	0.1	4.3	-5.5	-0.0	-
Hydro	-	5.3	-3.0	-45.7	82.5	4.7	-
Wind	-	30.9	17.0	27.7	-2.3	13.3	2.6
Geothermal	-	-	-	-0.6	56.7	41.9	9.8
Solar/other[2]	-	31.7	2.6	9.4	29.7	11.8	11.4
TFC	0.2	1.4	1.3	-7.7	2.2	-0.1	0.2
Electricity consumption	3.0	2.9	0.9	0.6	-0.9	1.0	0.1
Energy production	0.4	-0.5	1.9	-7.8	0.6	-2.9	-6.5
Net oil imports	-2.6	3.2	1.0	-9.2	14.5	-0.4	0.4
GDP	2.4	3.2	1.4	1.0	-1.0	1.4	1.4
TPES/GDP	-2.0	-2.0	-0.0	-8.1	2.5	-1.0	-1.4
TFC/GDP	-2.2	-1.7	-0.0	-8.7	3.2	-1.4	-1.2

Footnotes to energy balances and key statistical data

1. Biofuels and waste comprises solid biofuels, liquid biofuels, biogases and municipal waste. Data are often based on partial surveys and may not be comparable between countries.
2. Other includes generation from expansion gases and chemical waste gases.
3. In addition to coal, oil, natural gas and electricity, total net imports also include biofuels.
4. Excludes international marine bunkers and international aviation bunkers.
5. Total supply of electricity represents net trade. A negative number in the share of TPES indicates that exports are greater than imports.
6. Industry includes non-energy use.
7. Other includes residential, commercial and public services, agriculture/forestry, fishing and other non-specified.
8. Inputs to electricity generation include inputs to electricity, CHP and heat plants. Output refers only to electricity generation.
9. Losses arising in the production of electricity and heat at main activity producer utilities and autoproducers. For non-fossil fuel electricity generation, theoretical losses are shown based on plant efficiencies of approximately 33% for nuclear and 100% for hydro, wind and photovoltaic.
10. Data on "losses" for forecast years often include large statistical differences covering differences between expected supply and demand and mostly do not reflect real expectations on transformation gains and losses.
11. Toe/thousand US dollars at 2005 prices and exchange rates.
12. "Energy-related CO_2 emissions" have been estimated using the IPCC Tier I Sectoral Approach from the Revised 1996 IPCC Guidelines. In accordance with the IPCC methodology, emissions from international marine and aviation bunkers are not included in national totals. Projected emissions for oil and gas are derived by calculating the ratio of emissions to energy use for 2012 and applying this factor to forecast energy supply. Future coal emissions are based on product-specific supply projections and are calculated using the IPCC/OECD emission factors and methodology.

ANNEX C: INTERNATIONAL ENERGY AGENCY "SHARED GOALS"

The member countries* of the IEA seek to create conditions in which the energy sectors of their economies can make the fullest possible contribution to sustainable economic development and to the well-being of their people and of the environment. In formulating energy policies, the establishment of free and open markets is a fundamental point of departure, though energy security and environmental protection need to be given particular emphasis by governments. IEA countries recognise the significance of increasing global interdependence in energy. They therefore seek to promote the effective operation of international energy markets and encourage dialogue with all participants. In order to secure their objectives, member countries therefore aim to create a policy framework consistent with the following goals:

1. Diversity, efficiency and flexibility within the energy sector are basic conditions for longer-term energy security: the fuels used within and across sectors and the sources of those fuels should be as diverse as practicable. Non-fossil fuels, particularly nuclear and hydro power, make a substantial contribution to the energy supply diversity of IEA countries as a group.

2. Energy systems should have **the ability to respond promptly and flexibly to energy emergencies.** In some cases this requires collective mechanisms and action: IEA countries co-operate through the Agency in responding jointly to oil supply emergencies.

3. The environmentally sustainable provision and use of energy are central to the achievement of these shared goals. Decision-makers should seek to minimise the adverse environmental impacts of energy activities, just as environmental decisions should take account of the energy consequences. Government interventions should respect the Polluter Pays Principle where practicable.

4. More environmentally acceptable energy sources need to be encouraged and developed. Clean and efficient use of fossil fuels is essential. The development of economic non-fossil sources is also a priority. A number of IEA member countries wish to retain and improve the nuclear option for the future, at the highest available safety standards, because nuclear energy does not emit carbon dioxide. Renewable sources will also have an increasingly important contribution to make.

5. Improved energy efficiency can promote both environmental protection and energy security in a cost-effective manner. There are significant opportunities for greater energy efficiency at all stages of the energy cycle from production to consumption. Strong efforts by governments and all energy users are needed to realise these opportunities.

6. Continued **research, development and market deployment of new and improved energy technologies** make a critical contribution to achieving the objectives outlined above. Energy technology policies should complement broader energy policies. International co-operation in the development and dissemination of energy technologies, including industry participation and co-operation with non-member countries, should be encouraged.

7. Undistorted energy prices enable markets to work efficiently. Energy prices should not be held artificially below the costs of supply to promote social or industrial goals. To the extent necessary and practicable, the environmental costs of energy production and use should be reflected in prices.

8. Free and open trade and a secure framework for investment contribute to efficient energy markets and energy security. Distortions to energy trade and investment should be avoided.

9. Co-operation among all energy market participants helps to improve information and understanding, and encourages the development of efficient, environmentally acceptable and flexible energy systems and markets worldwide. These are needed to help promote the investment, trade and confidence necessary to achieve global energy security and environmental objectives.

(The Shared Goals were adopted by IEA Ministers at the meeting of 4 June 1993 Paris, France.)

* Australia, Austria, Belgium, Canada, the Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Japan, Korea, Luxembourg, the Netherlands, New Zealand, Norway, Poland, Portugal, the Slovak Republic, Spain, Sweden, Switzerland, Turkey, the United Kingdom, the United States.

ANNEX D: GLOSSARY AND LIST OF ABBREVIATIONS

In this report, abbreviations and acronyms are substituted for a number of terms used within the International Energy Agency. While these terms generally have been written out on first mention, this glossary provides a quick and central reference for the abbreviations used.

AAU	assigned amount unit
ACM	Netherlands Authority for Consumers and Markets
APX	Amsterdam Power Exchange
bcm	billion cubic metres
CBS	Statistics Netherlands
CS	carbon capture and storage
CDM	clean development mechanism (under the Kyoto Protocol)
CEP	Clean and Efficient Programme
CHP	combined heat and power production
cm	cubic metre
CNG	compressed natural gas
CO_2	carbon dioxide
COVA	Central Organisation for Oil Stockholding
CWE	Central-West Europe
DSO	distribution system operator
EBN	Oil Storage Company
ECN	Energy Research Centre of the Netherlands
EEA	European Environment Agency
EIA	energy investment allowance
E&P	exploration and production
ENTSO-E	European Network of Transmission System Operators for Electricity
ENTSO-G	European Network of Transmission System Operators for Gas
ERU	emissions reduction unit
EU-ETS	European Union Emissions Trading Scheme
G-gas	Groningen gas
GHG	greenhouse gas
GIS	Green Investment Scheme
GTS	Gasunie Transport Services, the national gas network operator
GW	gigawatt
H-gas	gas with high calorific value

IA	implementing agreement
IPCC	Intergovernmental Panel on Climate Change
IAEA	International Atomic Energy Agency (in Vienna)
JI	joint implementation (under the Kyoto Protocol)
kWh	kilowatt hour
L-gas	gas with low calorific value
LNG	liquefied natural gas
LPG	liquefied petroleum gas
LULUCF	land use, land-use change and forestry
mb	million barrels
mcm	million cubic metres
MIA	Green Projects Scheme
Mt	million tonnes
Mt CO_2-eq	million tonnes of CO_2-equivalent
Mtoe	million tonnes of oil-equivalent
MW	megawatt
MWh	megawatt hour
NAP	National Allocation Plan
NEa	Dutch Emission Authority
NEA	Nuclear Energy Agency (OECD)
NEEAP	National Energy Efficiency Action Plan
NGL	natural gas liquids
NMa	Nederlandse Mededingingsautoriteit (former Netherlands Competition Authority)
NPP	nuclear power plant
NRA	National Regulatory Authority for Energy
NREAP	National Renewable Energy Action Plan
NWE	North-West Europe
NWO	National Organisation for Scientific Research
OTC	over-the-counter
PBL	Netherlands Environmental Assessment Agency
PJ	petajoule
PPP	purchasing power parity
PV	photovoltaic
R&D	research and development
RD&D	research, development and demonstration
RVO	Netherlands Enterprise Agency
SDE+	Sustainable Energy Incentive Scheme
SER	Social and Economic Council
SME	small and medium-sized enterprises

t	tonne
toe	tonne of oil-equivalent
TFC	total final consumption of energy
TNO	Netherlands Organisation for Applied Scientific Research
TPA	third-party access
TPES	total primary energy supply
TSO	transmission system operator
TTF	Title Transfer Facility
TWh	terawatt hour
TYNDP	Ten-Year Network Development Plan
UNFCCC	United Nations Framework Convention on Climate Change
VAT	value-added tax
WWF	World Wide Fund for Nature

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Energy Policies of IEA Countries

The Netherlands

Since the last review in 2008, the Netherlands has attracted investment in oil and gas storage; coal, oil and gas import terminals; and efficient power plants. This additional capacity provides flexibility and energy security both in the Netherlands and across EU markets. The Netherlands plays an important role in Europe as a hub for global energy trade, thanks to its open market and integrated supply chains.

However, the outlook for Europe's second-largest producer of natural gas is challenging amid declining production and uncertain prospects for unconventional gas. Developing the remaining natural gas potential, market integration, and ensuring the security of supply and resilience of energy infrastructure during the transition should be top priorities.

The Netherlands stimulates energy efficiency and innovation in energy-intensive industries along the whole supply chain, notably in the Dutch refining, petrochemical and agriculture sectors, a practice that contributes to industrial competitiveness.

Despite successful decoupling of greenhouse-gas emissions from economic growth between 1990 and 2012, however, the Netherlands remains one of the most fossil-fuel- and CO_2-intensive economies among IEA member countries. In September 2013, the Netherlands reached an Energy Agreement with key stakeholders on priority actions to support sustainable economic growth through 2020. In addition to implementing the agreement, the government must set the scene for a stable policy framework up to 2030, which is also crucial for renewable energies.

The Netherlands has accelerated permit procedures for new energy infrastructure and is driving technology cost reduction with reformed renewable support. The country can benefit from further interconnections with neighbouring countries, as renewables become an integral part of wholesale and balancing electricity markets in the EU.

This review analyses the energy policy challenges currently facing the Netherlands and provides recommendations for each sector. It gives advice on implementing the Energy Agreement and how to leverage international opportunities from clean energy technologies.

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