R&Dialogue

THE DUTCH ENERGY SECTOR:
AN OVERVIEW

MELANIE PROVOOST
STIJN SANTEN, RON OVERGOOR

TRIARII
Strategy, Innovation, Implementation

TABLE OF CONTENTS

Acknowledgement

This report ‘R&Dialogue - the Dutch energy sector: an overview’ is a part of the European Commission Framework Programme 7, a consortium of 15 partners in the field of energy (scientists, NGOs, industry, consultants and policy advisors) in 10 European countries. The project started in June 2012 and lasts 3,5 years will result in a European event at the end of 2015.

The report is written to provide the consortium partners and the stakeholders in the project R&Dialogue a clear overview of the Dutch energy sector. It arose from a personal need to have a better understanding of the complexity and segmentation of the energy sector and the transition, with all its effects and influences, in the Netherlands and abroad. The author want to thank Otto Swertz (CBS) and the colleagues Stijn Santen and Ron Overgoor from Triarii for their comments and feedback on earlier drafts.

Abstract

In June 2012, the Dutch national R&Dialogue team started this project by investigating the Dutch energy sector for the project deliverable called national inventory. In this national inventory, all country teams explained the energy situation and dialogue on technology implementation in their countries. While drafting this report, the Dutch team realised that the Dutch energy situation is complex and segmented.

The report aims at describing relevant themes in the energy sector in order to show its complexity and segmentation. These themes – energy aspects of the Netherlands, gas, electricity, heat, transport – show the importance of the energy sector for the Dutch state, economy and its citizens. One chapter describes the National Energy Agreement for Sustainable Growth of the Social Economic Council (SER) and its partners to show the direction Dutch government and partners involved in the energy sector tend to move to. The reports aims at creating a broad and overall view for better understanding of the energy sector and its transition. In the final chapter a short conclusion is given.

The report aims at providing factual based information, creating a level playing field in knowledge and understanding, to be able to compare, analyse and draw conclusions. The information in this report is input for the dialogue of stakeholders involved in the energy transition towards a low-carbon, economic viable and sustainable future. The dialogue will be held by the National Council for R&Dialogue and all involved and interested stakeholders in the energy sector and beyond.

1 INTRODUCTION

R&DIALOGUE: RESEARCH AND CIVIL SOCIETY DIALOGUE TOWARDS A LOW-CARBON SOCIETY

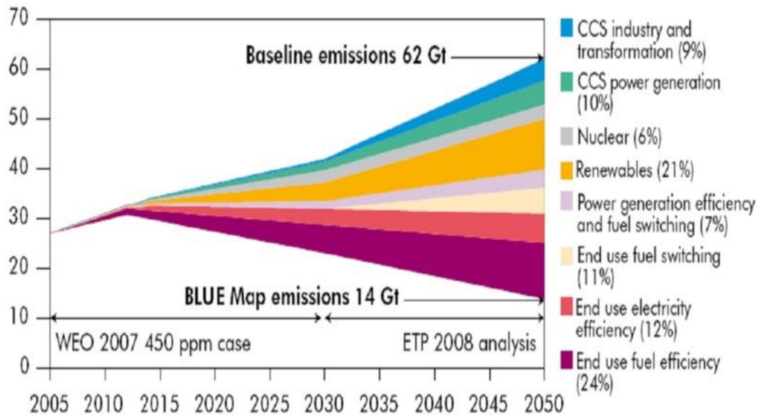
This introduction is used to explain the R&Dialogue project, its importance and added value. R&Dialogue is a European initiative to bring forward a dialogue between research and civil society towards a low-carbon society. In the field of energy, as in many other fields, science and society have a challenging relationship. R&Dialogue aims to improve this relationship, to co-create and develop solutions together.

1.1 WHY R&DIALOGUE

1.1.1 European vision

Many scientists and policy makers agree that man-made climate change caused by greenhouse gases is a threat to society. It needs to be prevented or at least mitigated. This has prompted the European Commission (EC) to adopt the “Energy Roadmap 2050”. The European Union (EU) aims to reduce its greenhouse gas emission to 80-95% below 1990 levels by 2050. To achieve this reduction, we need to build a wide range of sustainable energy solutions. Such solutions require collaboration at all levels of society. To achieve it, we should improve the low-carbon dialogue by participation of all stakeholders, especially civil society.

Roadmaps towards low carbon society give us a view of our future and options to shape that future. They include improvement of energy efficiency, the deployment of renewable energies and underground storage of CO_2. The roadmaps are being developed mainly by research organisations, industry and policymakers.



Source: International Energy Agency

For example, the image above shows the energy technology scenarios of the International Energy Agency. It gives an idea of which roles the different low-carbon technologies have to play in reduction of CO_2-emissions.

1.1.2 The transition to a low-carbon society by means of dialogue

The implications for specific parts of society are large. Transition to a low-carbon society as mapped out in the roadmaps is a total turnaround of the energy generation which affects specific parts of society. This goes particularly for deployment of wind turbines, underground storage of CO_2, production of biomass and biofuels, solar energy and for energy related infrastructure.

This dialogue is important as there is often large disagreement within organisations, society and states on the importance of this issue and the strategy to deal with it. Often low-carbon energy technologies are implemented with a focus on policy and technology. Societal concerns are noticed only when people affected take to the streets in protests. Delays and even cancellation of low-carbon energy projects are the results. R&Dialogue proposes a dialogue that takes societal concerns seriously from the start. A dialogue that shows the consequences of a low-carbon future compared to business as usual.

A dialogue between research and civil society, including industry, non-governmental organisations (NGOs) and public authorities, is essential in the transition towards sustainable low-carbon energy production.
This dialogue is needed for shared and sustainable solutions, which could thus significantly accelerate the transition. It helps to understand viewpoints and interests for the actual implementation of low-carbon energy technologies and higher energy efficiency. The R&Dialogue project initiates this dialogue in an inclusive, democratic and transparent way: all stakeholders that are willing to engage and commit to a dialogue are welcome to join.

all stakeholders that are willing to engage and commit to a dialogue are welcome to join.

1.1.3 The bigger picture: science and society dialogue to co-create a low-carbon future

The European Commission has set out to support a low-carbon dialogue between science and society. Currently a suitable space for such a dialogue is missing. R&Dialogue builds such dialogues in 10 European countries to find out what works and what does not work. With 17 partners, R&Dialogue actively engages researchers and Civil Society Organisations (CSOs) in this dialogue. R&Dialogue is learning by doing.

Traditionally energy choices are made by the government, industry and a limited number of stakeholders. The traditional process to realise projects is often focused on legal procedures and obtaining permits. Public communication often starts when the process derails and focusses on damage control. Citizens can, by using different communication tools, effectively express their opinion and delay or block projects. Therefore, another process is required that leads to more public engagement like including citizens in an early stage explaining the relevance of a certain project.

In the effort to find more satisfactory decision making processes the value of interaction and dialogue, as a way of creating more support and shared interests and potentially even a joint and mutual construction of reality, has come to the fore. Dialogue has the potential to create shared meaning and a shared view, stimulating unforeseen collective creativity. It is a practical move for diagnosing potential problems, exploring alternatives, averting a crisis mentality. Dialogue can help construct a safe environment for relation building between stakeholders which allows for development of visions that can subsequently might accelerate and improve decisions that are widely supported. In the end this process has to increase trust and therefore leadership.

Dialogue, with a different set of stakeholders that are not necessarily a part of the project, is nevertheless new to most organisations in our society and can feel strange in comparison to business as usual analysis and problem solving procedures. It is a fluid and open end process. The principles and practices of dialogue entail communication dynamics that are different from the controlled participation to which many are used. These are some of the reasons why there is no pre-formulated recipe we can use in the project to make dialogue happen. Because of the nature of dialogue itself and because there is limited experience in deploying dialogue processes in the energy domain. But we have taken an approach that can help us understand where people stand, what problems they can encounter and how we can support them; an approach that allows us to tailor the development of the dialogue action to suit the different realities of 10 European countries.

1.2 THIS REPORT

The aim of this report is to give a clear insight in the Dutch energy sector focusing on policy, economic impact and technology. This report focusses on information that can be used during the dialogue phase. By aiming at a rational, factual based dialogue policy, economics and technology are placed in the same level playing field, been better able to compare, to analyse and to draw conclusions.

This report is a baseline study on the Dutch situation and links this to the European perspective together with the national inventories of the other nine participating countries in the R&Dialogue consortium.

2 ENERGY ASPECTS OF THE NETHERLANDS

2.1 INTRODUCTION

This chapter introduces the energy aspects of the Netherlands with respect to production, transport and consumption in the different sectors such as the energy sector, industry, households and transport. The role and added value of the fossil, chemical and energy intensive industry is discussed. Energy prices, like whole sale and retail prices, taxes and employment. It provides information and data on the energy sector and current situation.

The approach of this chapter is factual and tries to provide insight on the role of energy for the Netherlands.

2.2 ENERGY USAGE PER SECTOR PER SOURCE

The following table contains information of the CBS (Dutch Statistics Bureau) (2013) and gives an insight in the total energy balance in PJ over four years: 2000, 2005, 2010 and 2011 per energy source. Five sectors are identified: energy sector, industry, transport, households, agriculture, fishery and services. The negative numbers of electricity and heat in the energy sector indicate the consumption minus the production (the losses). The negative number shows the sales of electricity and heat to the grid.

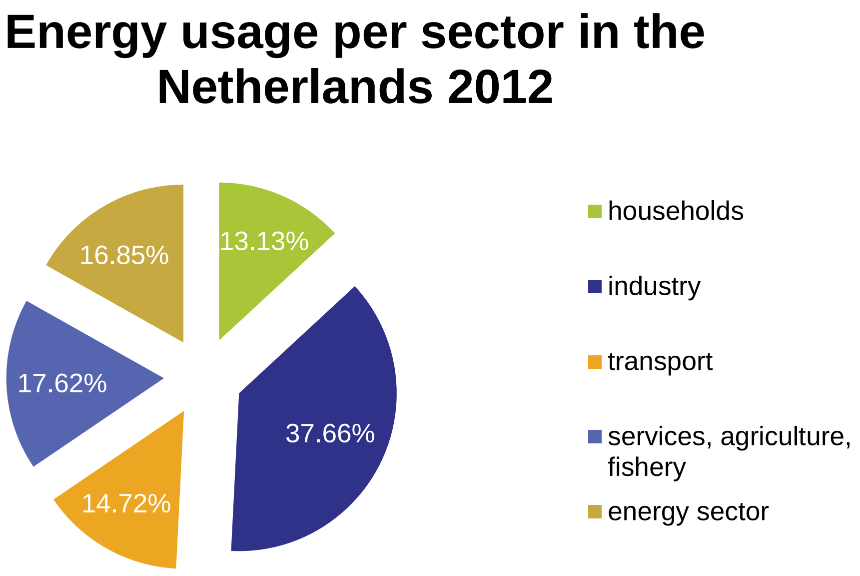
Energy usage per sector per source

	PJ	2000	2005	2010	2011
Energy sector	Total	556	610	608	582
	Coal and related products	224	247	234	223
	Oil and related products	190	184	117	123
	Gas	443	495	560	506
	Renewables	9	40	51	52
	Nuclear energy	41	41	38	40
	Waste	0	1	0	0
	Electricity	-247	-268	-300	-276
	Heat	-123	-130	-92	-85
	PJ	2000	2005	2010	2011
Industry	Total	1113	1260	1293	1213
	Coal and related products	83	95	84	90
	Oil and related products	386	539	664	596
	Gas	415	375	339	323
	Renewables	4	5	5	5
	Nuclear energy	-	-	-	-
	Waste	5	6	5	5
	Electricity	124	129	124	123
	Heat	95	111	72	71
	PJ	2000	2005	2010	2011

Transport	Total	462	486	492	499
	Coal and related products	-	-	-	-
	Oil and related products	457	481	485	493
	Gas	0	0	0	1
	Renewables	-	-	-	-
	Nuclear energy	-	-	-	-
	Waste	-	-	-	-
	Electricity	6	6	6	6
	Heat	-	-	-	-
	PJ	2000	2005	2010	2011
Households	Total	432	425	479	405
	Coal and related products	0	0	0	0
	Oil and related products	4	4	4	3
	Gas	334	315	362	294
	Renewables	10	10	10	10
	Nuclear energy	-	-	-	-
	Waste	0	1	2	2
	Electricity	78	87	89	85
	Heat	6	8	11	10
	PJ	2000	2005	2010	2011
Agriculture, Fisheries and Services	Total	502	534	620	546
	Coal and related products	1	0	0	0
	Oil and related products	38	46	34	26
	Gas	278	296	382	310
	Renewables	30	33	60	65
	Nuclear energy	-	-	-	-
	Waste	27	36	44	45
	Electricity	107	112	91	95
	Heat	221	11	9	4

Source: CBS 2013

The energy usage can be divided in five sectors: households, industry, transport, services/agriculture/fishery and energy sector. The following chart shows the energy usage per sector.



Source: CBS 2014

2.2.1 The energy-intensive industry

The Netherlands is an ideal country to locate energy-intensive industries because of several often geographically determined reasons:

- Its coastal location, providing low temperature cooling water;
- Direct access to sea harbours (low cost of transport);
- Direct connection to a high capacity transport network infrastructure for chemicals, oil, gas and power extending to a large part of Europe;
- Well-developed logistics to the hinterland for transport of products via sea/river ships, railways and roads.

The role and added value of the energy-intensive industry is often underestimated when it comes to the added value to the Dutch economy, employment and their value to the process and energy sector.

2.2.2 Added value of the energy-intensive industry to the Dutch economy

Compared to industries in other countries, the share of energy-intensive industries in the Netherlands is significant due to the excellent logistics of the ports for handling coal, ores, oil and products. When talking about the process industry the following is accounted: refining, petrochemical, metal, paper and food industry. [1] The industries depend on own produced electricity or heat, or is provided by the energy sector. Note that many industries produce steam and power via cogeneration to meet their demand and to export whatever is most economical. Several industries work together to the extent that waste of

[1] Innovatiecontract energiebesparing in de industrie – februari 2012

one plant can be feedstock for another neighbouring plant. As such there is not always a clear cut distinction between the energy sector and the industry sector at plant level. The following chart, derived from TNO research, shows the energy intensity, added value and energy usage of the energy-intensive industry. The sectors in the graphic have a 12.4 % share to Dutch GDP in 2010. The chemical industry, agriculture, land transportation and the food industry contribute about € 9 to 11 billion to the Dutch economy.[2]

Added value of the energy sector

	Energy / AV	Added value	Energy usage
	€ energy per € added value	Million €	
Air traffic	3.28	468	1,537
Fishery	1.43	126	180
Chemical industry	1.03	11,354	11,650
Transport over water	0.57	1,198	684
Metal industry	0.54	1,796	963
Mining – excluding oil and gas	0.35	353	124
Agriculture	0.26	9,215	2,418
Land transportation	0.25	10,760	2,675
Paper industry	0.22	1,528	330
Waste, water industry	0.20	3,602	711
Electrical equipment industry	0.19	1,039	202
Construction material industry	0.18	2,127	385
Real estate	0.17	4,815	833
Sport and leisure	0.17	1,451	244
Accommodation sector	0.13	2,929	376
Food industry	0.12	10,591	1,257
Rubber and plastics industry	0.11	2,050	235
Total energy-intensive sectors		**65,402**	**24,804**
Total the Netherlands		**525,921**	**92,456**

Source: CBS and TNO 2010

2.2.3 Energy usage of the energy-intensive industry

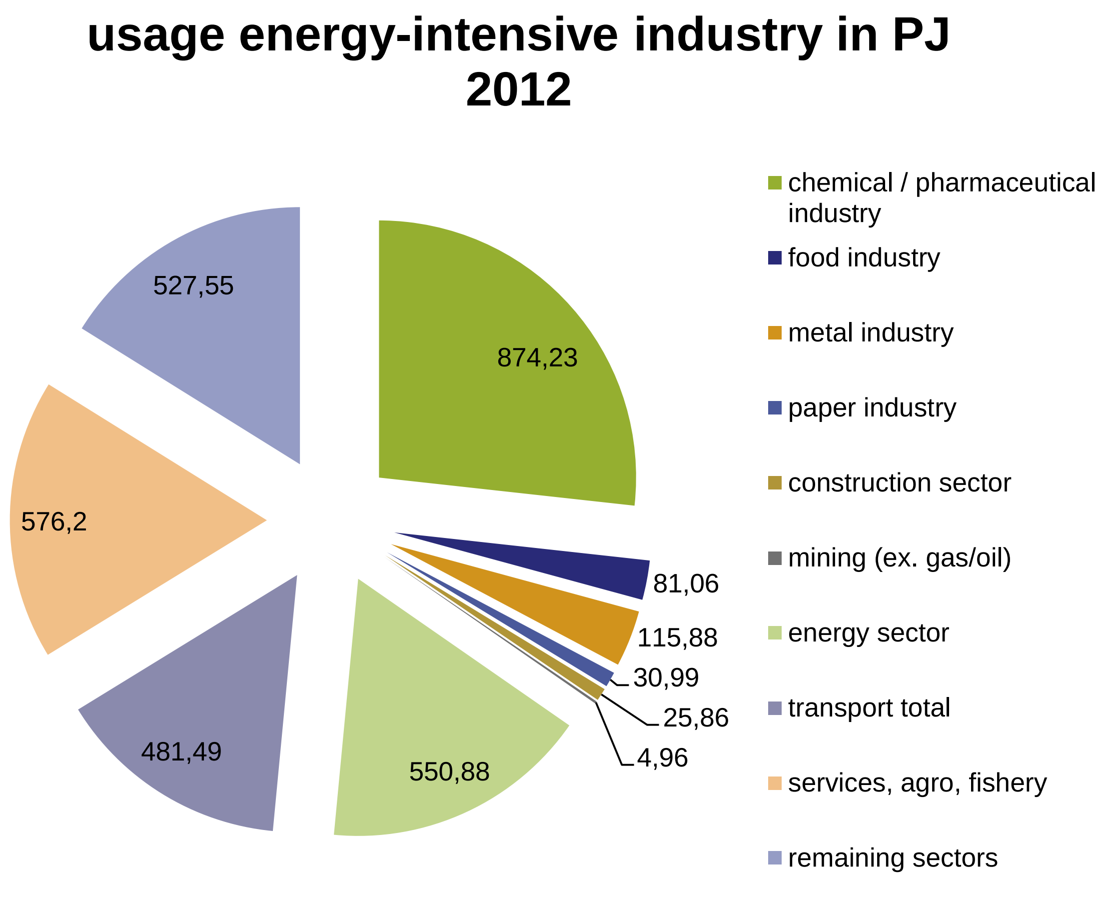
The chemical industry, mainly situated in Dutch ports like Rotterdam port, Groningen seaports, Zeeland seaports, Chemelot and Moerdijk, have a large share in energy usage. The port of Rotterdam shares certain pipelines with the Antwerp port and is a twin port cluster. Together they are a worldwide frontrunner in being an energy efficient petrochemical and industrial cluster in terms of energy production chains and has a significant potential for further energy efficiency improvement. The cluster is the largest petrochemical cluster in Europe.[3] Pipelines, rivers and roads connect the Dutch industry clusters Rotterdam, Moerdijk, Chemelot to the German industrial heartland in North Rein

[2] TNO 2013 – Naar een toekomstbestendig energiesysteem voor Nederland
[3] Haven van Rotterdam – visie2030

Westphalen and Antwerp. The chemical industry is responsible for products like polymers, solvents, detergents, cosmetics and amongst others fertilizers.

The energy usage of the energy-intensive sector is significant. In 2012, the total energy usage in the Netherlands was 3269,10 PJ. The energy sector itself uses 550,88 PJ in that same year and 2718,22 PJ energy was used by other customers.

The energy usage in the energy-intensive industry is divided as follows:



Source: CBS 2014

2.3 ENERGY PRICES AND TAXES

The energy sector is an important sector for Dutch economy. As a part of the energy sector, the output of gas export and production, oil refinery, electricity production and grids, contributes to the Dutch economy with approximately € 36 billion on a yearly basis.[4] [5] Gas and the energy-intensive sector contribute significant to the Dutch economy.

Prices and taxes vary with prevailing policies. The Netherlands has several taxes related to the energy and environmental sector like taxes on tap water, on coal (per 1000 kg the tax rate is: 2013: € 14.03 / 2014: € 14.27), taxes on power connections and storage,

[4] http://www.rijksoverheid.nl/onderwerpen/energie/energiebeleid-nederland

[5] Energy Report 2011

taxes on gas and electricity, excise tax on oils like gasoil, oil fuel and LPG, excise taxes on biofuels and other related topics.

The taxes (accijns) on transport fuels as diesel, LPG, and gasoline together result in state charges of almost € 8 billion in 2012. Environmental taxes like energy tax on gas and electricity (REB) Regulerende Energie Belasting € 144.- / 1000 kWh in 2012), coal tax, water tax and waste tax served as a tax revenue of € 4.9 billion in 2010. Based on preliminary figures of 2010, showing a total of € 13.4 billion state tax revenues. Another example are fiscal benefits for electrical vehicles and higher taxes for cars with high CO_2-emissions per km to stimulate usage of energy-efficient cars and charges on older gasoline driven vehicles to discourage usage of environmental unfriendly vehicles.

The energy sector contributes to the Dutch economy with almost €36 billion on a yearly basis.

Income, corporation or any other taxes and charges play a significant role in the behaviour of companies and consumers. Therefore, government tries to promote fiscal benefits for investments in environmental friendly technologies. Companies, for example, can receive an investment deduction like MIA (milieu Investeringsaftrek) and Vamil (willigekeurige afschrijving milieu-investeringen) when investing in environmental friendly technologies like energy-efficiency measures. [6]

The Dutch energy pricing and taxing system is degressive for consumers (the more a consumer uses the less taxes (percentage) they have to pay). Non-households using more than 1 PJ gas experience a decreasing grid transport in 2012. In the case of electricity, the prices are more fluctuating. In the following chart, the prices - including and excluding taxes - and other costs are shown. Most households can be found in the category between 2.5 and 5 MWh for electricity usage and in category 569-5687 m^3 for gas usage.

[6] http://www.rvo.nl/subsidies-regelingen/introductie-miavamil

Electricity prices for end-users of electricity 2012

€ per kWh	Households between 2.5 – 5 MWh	Non-households under 2000 MWh	Non-households above 150.000 MWh
Including taxes and other costs	0.375	0.231	0.143
Excluding taxes and other costs	0.27	0.166	0.117

Source: CBS 2014

Gas prices for end-users of gas 2012

€ per GJ or 28.43 m^3	Households between 569-5687 m^3 of 20-200 GJ	Non-households between 10-100 TJ or 0.01-0.1 PJ	Non-households above 1 PJ
Including taxes and other costs	43.878	24.266	17.923
Excluding taxes and other costs	27.196	16.599	14.572

Source: CBS 2014

The scope would become too broad if all taxes related to the energy and environmental sector are included. No matter, they play an important role in stimulating and creating awareness and behavioural change of both producers and consumers of energy. It is suggested to take this into account when investigating the energy sector.

2.4 EMPLOYMENT

To identify the number of people working in the different sectors relevant for the energy sector the following chart shows the number of employees in a specific sectors and industries. The chart shows the importance of the energy-intensive industries on employment, looking at the metal industry and the chemical industries and refineries. Looking at the number of people employed in the energy sector, it shows that with a significant small number of people energy can be provided to large sectors as industry and trade, transport and catering industry.

Employment rate per sector

	2010	2011
Total number of people employed	**8,233,000**	**8,232,000**
Industry total (no construction and energy)	859,500	866,300
Industry	749,600	797,100
Food sector	127,500	126,900
Paper industry	18,400	18,100
Water and waste companies	32,300	34,000
Total in refineries and chemical industries	96,700	98,300
Refineries	4,900	4,900
Chemical industry	44,000	46,600
Oil industry	5,800	5,800
Metal industry	108,400	109,200
Energy sector (production / distribution	24,900	26,500
Trade, transport and catering industry	2,058,400	2,144,000

Source: CBS 2014 based on SBI 2008

2.5 CO_2-EMISSIONS

The EU aspires to reduce the amount of CO_2-emissions in the atmosphere towards a low-carbon economy in 2050 by reducing CO_2-emissions with 80-95% compared to the 1990 baseline. The EU and its Member States have set targets for the medium term as 20 % CO_2-reduction, 20 % renewables in the mix, 20 % energy savings in 2020 compared with the baseline of 1990. The Dutch government focusses on a 20% reduction of CO_2-emissions for 2020. One of the strategies to reduce CO_2-emissions is the EU-ETS: European Union Emissions Trading System – system for trading greenhouse gas emission allowances with a ‘cap and trade’ principle for more than 11,000 power stations, industrial plants and airlines in 31 countries (EU28 and Iceland, Liechtenstein, Norway). The ‘cap and trade’ principle sets a cap on the total amount of greenhouse gasses that can be emitted, companies can buy or trade emission allowances with other companies in order to reduce their total emissions. The price on carbon gives a financial value to each emitted tonne of greenhouse gas. The current price for CO_2 is relatively low (around €6,-- per tonne).

Despite several rules and regulations to reduce the amount of CO_2 in the atmosphere, the chart below shows that only some types of consumers / producers are able to reduce their emissions compared to the 1990s. Especially households and industries were able to reduce their output. The energy sector, mobile sources and transport sector have not been able to decrease their output. The increasing energy demand (electricity and heat) and the intensified transport park – both in cars as public transport, are a reason for the increase in amount of CO_2.

The following chart shows the amount of CO_2 in the Dutch atmosphere. It is argued that the economic crisis plays a factor in the decrease in total million kg when comparing the numbers of 2012 with 2010.

Amount of CO_2 in the Netherlands

	1990	2000	2005	2010	2012	2012 compared to 1990
Total CO_2 in million kg	**167.700**	**179.710**	**188.210**	**197.330**	**182.770**	**108.98%**
Households	21.050	20.490	19.600	22.390	19.560	92.92%
Chemical and pharmaceutics industry	20.960	15.470	15.590	17.110	15.570	74.28%
Industry (excluding energy sector)	40.050	33.620	33.730	34.330	31.820	79.45%
Energy sector	52.770	62.950	69.540	68.560	61.580	116.69%
Oil industry	11.040	12.120	12.310	10.620	10.490	95.01%
Mobile sources	32.980	39.170	40.850	40.990	41.070	124.53%
Transport	29.390	35.220	37.290	37.830	37.950	129.12%

Source: CBS 2014

2.6 CONCLUSION

The relevance and importance of the energy sector and energy-intensive sector is not often broadly communicated. With this chapter, the energy aspects of the Netherlands are, as data shows, moreover focused on fossil energy like gas, oil and oil related products. The Netherlands has committed to European goals on climate change and energy policies. The goal is to move towards a low-carbon economy in 2050 with standards set for 2020. These standards are 20% CO_2-reduction in 2020 compared with the level of 1990, 14% renewables in the energy mix in 2020 and 16% in 2023, and 20% energy savings. With the SER Energy Agreement, the signing parties want to reach these targets in time.

The advantageous location of the Netherlands for industries needing e.g. cooling water in their production process, like companies in the energy sector and energy-intensive industries, create a relatively large cluster of energy-intensive industries. Energy -

electricity and heat - is vital for industry and consumers to operate and function. The energy sector and the energy-intensive industries contribute highly to the Dutch economy and level of employment – as previous figures showed. Local energy prices have a big influence and impact on the competitiveness of energy intensive companies situated in the Netherlands, operating globally. This explains the degressive tax system for energy. Large globally competing industries can only survive (let alone contribute to society) when their energy prices are not too high compared to elsewhere in the world. Therefore end consumers and less energy intensive companies pay relatively more tax.

3 GAS

3.1 INTRODUCTION

Gas is an important energy source for and in the Netherlands. It is used in the industry, for heating, for import and export means and as feed stock. The impact of gas production and the gas sector is irrefutable. Before discussing the current role of gas, the development of gas in the Netherlands is discussed.

3.2 THE DISCOVERY OF GAS

Coal was the primary energy source before the discovery of gas. Coal was gasified in local gas plants, called town gas. This town gas was distributed on a small scale, mostly at municipal level, and used for heating and cooking devices. Due to a growing society and innovations in the gas sector, gas distribution and usage increased. The benefits of gas is that town gas plants compared to coal plants need less workforce, have smaller relative production costs, attract gas using industry and facilitate higher economic growth, export revenues and a higher production volume is attainable. Local town gas plants emerged, making it possible for Dutch people to use cooking devises and heating.

With the first discovery of an onshore gas well in 1947 gas was introduced. The Dutch government decided to switch from coal to gas after the discovery of the Slochteren field in 1959. Slochteren is, with almost 3,000 billion m^3 the biggest gas reservoir in Europe and one of the ten biggest gas reservoirs in the world. [7] A small group of people designed the gas grid and the governance structure for the gas value chain. Ten years later all Dutch coal mines were shut down by the government for the following reasons:

- The production costs of gas were lower than those for coal.
- The Dutch gas reserves were much higher than the Dutch coal reserves.
- The gas production rate was far higher than the coal production rate.

This was the first government imposed energy transition in the Netherlands, than already in a very industrial development phase. The discovery of gas provided the NAM (Nederlandse Aardolie Maatschappij B.V.) a concession to drill and exploit the gas and was obliged to sell gas to Gasunie, fully controlled by the Ministry of Economic Affairs.

[7] www.nam.nl

The current gas production, import of gas and LNG, export and usage of gas is shown below:

Gas in the Netherlands

Gas in million m^3	2000	2005	2010	2011	2012
Supply# in the Netherlands	46,346	46,770	52,024	45,426	43,626
Production# in the Netherlands	69,180	74,460	83,944	76,429	76,020
Import of gas	16,500	21,747	24,408	21,812	23,769
Import of LNG	-	-	-	-	961
Export of gas	39,329	49,445	56,433	52,945	57,263
Stock*	-5	8	-19	-2	-115
Total usage in the Netherlands	46,346	46,770	52,024	45,426	43,626

Source: CBS 2013

supply is the primary gas available for usage in the Netherlands and production is the gas that comes from Dutch reservoirs - both onshore as offshore reservoirs.

* positive means decrease in stocks, negative means increase in stocks

Currently approximately one third of the import and export of gas is traded on a virtual trading point - the TTF (Title Transfer Facility) and two third comes forth out of bilateral agreements. The main export countries for gas are Algeria, Norway and Russia and of import are Germany, Belgium, United Kingdom and Italy. [8] Only a few years ago the majority of gas contracts were long term bilateral agreements with gas prices linked to the oil price, a difference compared to the situation in the US.

3.3 THE ECONOMIC CONSEQUENCES OF GAS

The profit of the exploitation of the wells is used for general funds of Dutch state. In the 70's and 80's this was called the Dutch disease: a negative impact of anything that gives rise to a sharp inflow of foreign currency. Due to revenues from natural gas resources the national currency became stronger compared to currencies of most countries resulting in relatively expensive export products and resulted in a decline of the competitiveness of the Dutch industry.

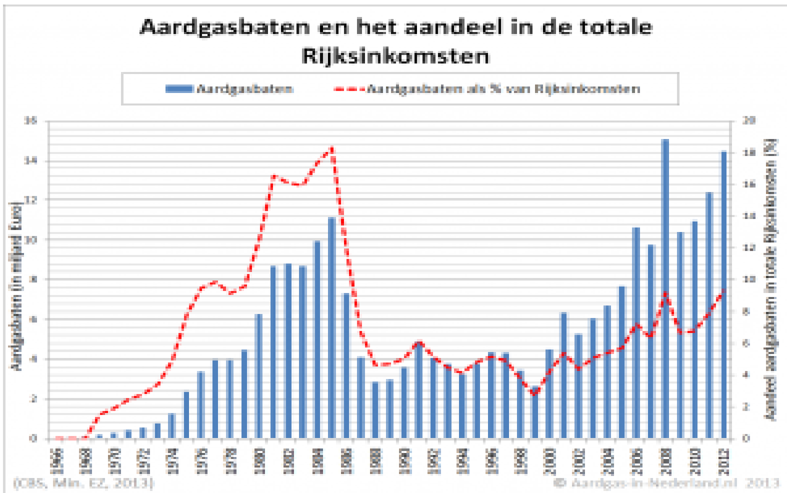
The past few years
€ 12 billion gas revenues

[8] CBS 2013

3.3.1 Gas revenues

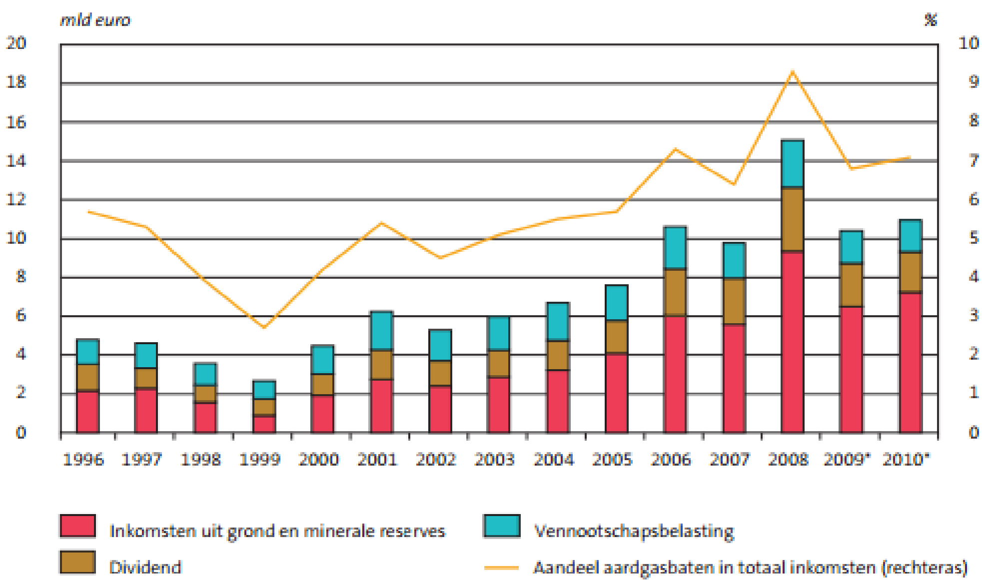
The gas revenues were part of general funds and used for government purposes since the abolishment of Economic Structure Enhancing Fund (Fonds Economische Structuurversterking) in 2011. The fund, established in 1995, was filled with 42% of the gas revenues and used for investments in infrastructure and since 2005, for investments in the knowledge industry. The fund was managed by the Ministries of Finance and Economic Affairs. In 2010, the Economic Structure Enhancing Fund had an expenditure of € 2.3 billion. In 2011, 2012 and 2013, the gas revenues was around €12 billion. For 2013, the share of gas revenues to the national income budget is 4.85%.

The figure below shows the gas revenues in billion € in blue and governments' share in red.



Source: Initiatief Aardgas in Nederland

This figure shows that gas contributes significant to Dutch economy. With the possibility for own production and the development of a gas roundabout the Netherland seeks to be the gas hub for Northwest Europe. National government developed the concept of the gas roundabout (a large interconnected cross border gas pipeline network) based on the vision that the income from (imported) gas transport would partially compensate for a future in which Dutch gas production, and its revenues, would become much smaller. Another example of the relevance of gas, is the share of dividend and income tax to the Dutch economy. In 2010, the share of gas revenues was almost 7% as the figure below shows.



Source: CBS 2010

The following chart shows that the relevance of gas revenues and taxes are significant for Dutch state and its GDP. Due to variations in the gas price – mainly the increasing gas price, the contribution of gas revenues on Dutch GDP has doubled in ten years' time.

Gas revenues and its percentage of GDP

Billion €	2000	2005	2010	*2011
Gas revenues	4,490	7,579	10,670	12,391
GDP	480,825	513,407	549,265	554,543
% of GDP	1.07 %	1.47 %	1.81 %	2.05 %

Source CBS 2014

* provisional data

3.4 ORGANISATION AND LIBERALISATION

With the discovery of gas in the Netherlands a clear organisation involved with gas production emerged. The Dutch state made an agreement with the NAM (Dutch exploration and production company of oil and gas (Nederlandse Aardolie Maatschappij - Shell (50%) and ExxonMobil (50%)). The NAM is the only concessionaire of the Slochteren well, the smaller wells are operated by different concessionaires. Note however, that EBN (Dutch exploration, production, storage and trading company) (Energie Beheer Nederland – Ministry of Economic Affairs (100%)) is entitled to take a 40 % equity stake in the production of these different concessionaires. Therefore the Dutch state also gets dividend revenues from these companies beyond the tax revenues.

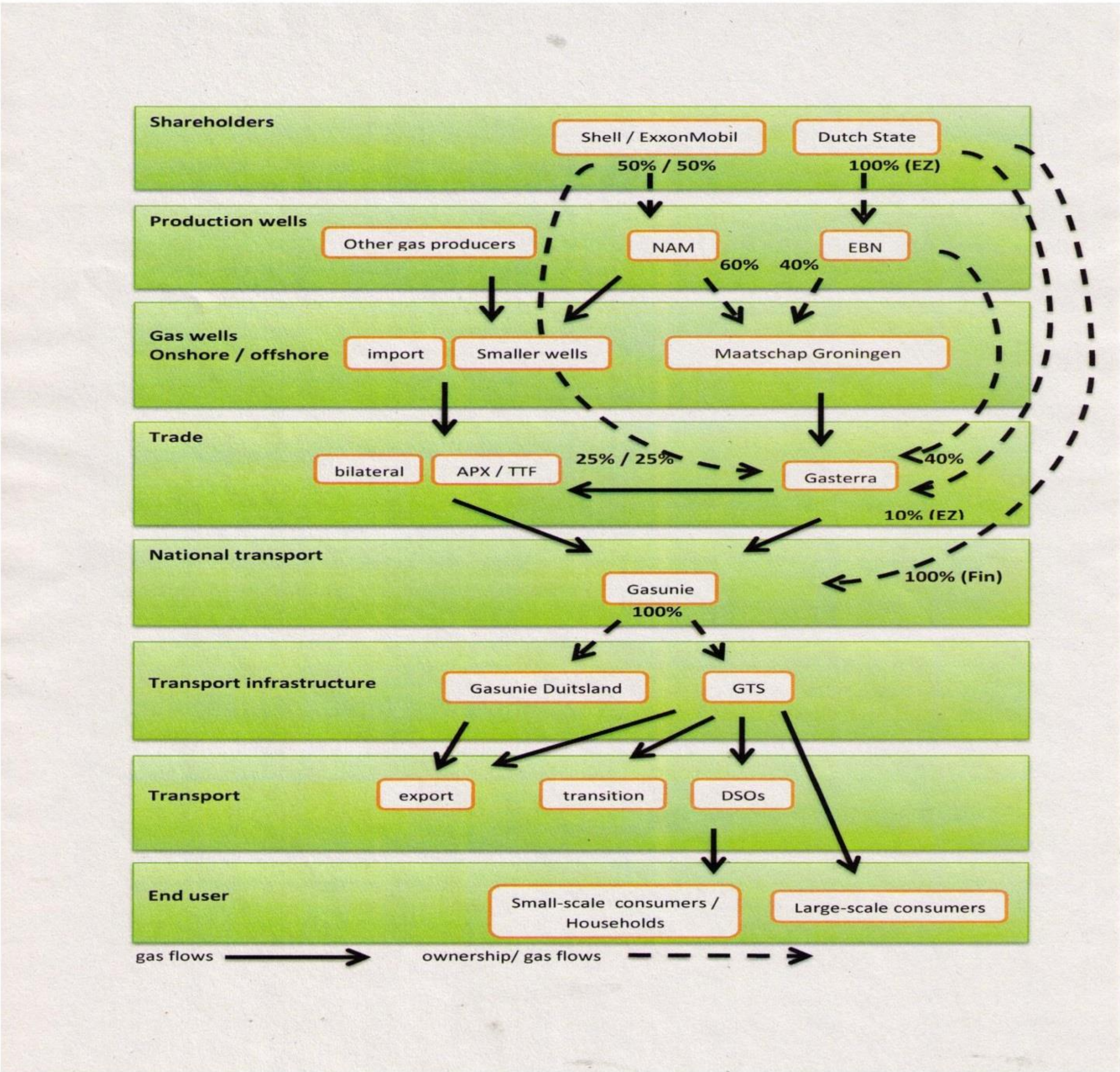
3.4.1 Liberalisation

Due to the European energy liberalisation strategy, the relations in the energy sector changed. In 1995, the Netherlands made its first move to take part in the liberalisation process and was one of the first European countries to start unbundling the gas and electricity sectors. The unbundling meant a separation of transport and production. Gasunie was separated in a (inter)national transport, sales and trade, administration and foreign contracts division. By 2002, the market was open for competition and for large- and mid-scale consumers to choose the supplier of their interest. By 2004 small-scale consumers could do the same. The TSO (Transmission System Operator) and DSOs (Distribution System Operators) are placed under supervision of DTe / Service Execution and Supervision Energy of the Authority Consumers and Market (ACM).They analyse and supervise the sector, the position of industries and consumers in terms of quality, prices and rules and regulations.

3.4.2 Situation since 2005

Since the liberalisation of the gas market, the institutes active in the gas market had to adapt to the new situation. An outline of the current situation is showed in the next figure.

Chart of the organisation of the gas sector



Source: Gasunie, Gasterra, Ministry of Economic Affairs, Ministry of Finance, EBN, NAM, DSOs

The following figure shows the DSOs of the gas grid. The companies in the figure are the ones responsible for gas distribution in that region.[9]

Gas grid the Netherlands

1. RENDO Netwerken
2. Cogas Infra en Beheer
3. Liander
5. Liander
6. Stedin
7. Westland Infra
8. Stedin
9. Delta Netwerkbedrijf
10. Intergas Netbeheer
11. Endinet Groep B.V.
12. Endinet Groep B.V.
13. Enexis
14. Enexis

3.5 GOVERNMENT POLICY ON GAS

The Dutch government focusses on gas since the discovery of the Slochteren field. With the large amounts of gas under Dutch soil, Dutch economy benefits from this. Dutch government aims at maintaining and growing Dutch economy and prosperity level. Gas has a significant role. A specific Dutch gas policy is the small field policy where the large Groningen field is used as swing producer and all the small fields operate at maximum production. This policy also entails continuous investments in exploration and production of existing and new fields.

With the forecasted decline in gas production, the Slochteren field and the smaller fields will generate less revenue. Current forecasts state that in 2030 Dutch gas production has decreased to a level equal to Dutch gas consumption. The government wants to maintain the 2030 production level after 2030 by increasing efforts in the development of non-

[9] Netbeheer Nederland 2013

conventional gas. In the Energy Report of 2008, Dutch government introduced the gas roundabout strategy; the Netherlands as gas hub for Northwest Europe. [10]

The Dutch government considers gas as a transition fuel towards a sustainable energy system as it has the following advantages (Energy Report 2005, 2008, 2011):

- The CO_2-emission rate is lower than coal;
- Overcapacity of electricity might be converted into hydrogen (power to gas) and serve as storage in the future when this technology matures;
- Gas can be used to balance the grid as peak load capacity for both the Dutch and German market;
- Gas that is produced from biodegraded materials - green gas;
- Gas can be liquefied (LNG (Liquefied Natural Gas)) and is easier to transport;
- Gas is seen as a peak load source for power generation in combination with biomass and wind energy and with coal as base load for electricity production.

This vision is now partly outdated as the current market and regulatory conditions lead to a displacement of gas by coal in power production. Coal power plants, contrary to expectations, turn out to be flexible enough in dealing with intermittent power supply from wind and solar while the power prices are too low compared to the gas price to enable gas to power generation. As a net result CO_2-emissions do not decrease as a result of more renewable power as is shown in Germany.

3.6 SHALE GAS

Shale gas is a topic in the Netherlands due to alleged plans to frack for shale gas. Shale gas is natural non-conventional gas that can be found in shale layers. The shale gas revolution in the United States induced a decrease in gas and coal prices. The low US gas price caused an industrial renaissance in the US energy intensive industry causing a change in investments from Europe to the US. As gas is now primarily used for power generation in the US, the excess coal is exported for lower prices, creating a more profitable operation for some coal fired power plants in Europe. Gas fired power generation is on the whole no longer profitable in the Netherlands. This is not directly related to US shale gas but to the following factors:

- Decreasing power demand due to recession;
- Higher operating costs than coal fired power plants;
- Excess supply of wind and solar power;
- Linking of gas contracts to oil prices in Europe;
- Low prices of EU-ETS CO_2 as a results of the factors above.

These developments stimulate a dialogue on the use of shale gas in Europe and the Netherlands and the transitions in the market. Shale gas, together with other non-conventional sources, could potentially compensate the lower future gas production in the Netherlands after 2030. This is part of the Dutch strategy developed by EBN. If requirements are met, the exploitation and production of shale gas can be investigated in

[10] Energie Rapport 2008 – Ministerie van Economische Zaken

test drills, to assess its commercial and technical viability. Currently, government investigates the risks and opportunities of test drills.

3.7 CONCLUSION

International and geopolitical circumstances have a big influence on and consequences for the Dutch gas position. The shale gas revolution in the United States and international events and circumstances can have influence on the dialogue on the energy transition the energy mix in Europe. At national level, gas is an important fuel for energy production, the export sector and the Dutch economy. The Dutch government considers the gas roundabout a method to secure itself with imported gas when Dutch gas production decreases while creating revenues based on gas transport tariffs. Therefore, gas is seen as a transition fuel towards 2030.

Dutch industries and consumers rely on gas in production and heating processes. In the power sector gas as feedstock is currently marginalized. Large new buildings are nowadays supplied by geothermal heat pumps for heating and cooling eliminating the need for gas. Currently, a large scale alternative for gas heating in the industry is missing. Gas as transition fuel (LNG) is currently developed for large ships and trucks displacing diesel.

Gas contributes significantly to the Dutch economy. A transition in the energy sector away from gas is considered a challenge since gas revenues are used for government general means and to keep the Dutch prosperity at a certain level.

4 ELECTRICITY

4.1 INTRODUCTION

Electricity provides lightning and power for devices, equipment and heat. It is an important part of daily life and still so unknown. This chapter discusses the role of gas versus electricity and the organisation of the electricity sector and its liberalisation process. Furthermore, it discusses the connectivity of electricity, and electricity at central and decentralised level and smart grids.

In 2011, 15 % of the total inland gas consumption and 63 % of the total inland coal consumption was used for power generation

4.2 GAS AND ELECTRICITY

It is important to make a distinction between gas and electricity. In the Netherlands, gas is meanly used in the industry sector, for heat and electricity. Figures of Energie-Nederland show that 50 % of the electricity is produced by gas and 33 % by coals. In 2011, 15 % of the total inland gas consumption was used for power generation and 63 % of the total inland coal consumption was used for power generation. The usage of gas for power generation has decreased due to a variety of factors, amongst others the weather condition and the large scale production of wind and solar power in Germany.

The following charts show this.

Gas

Million m^3 gas	2000	2005	2010	2011
Total supply	46,346	46,770	52,024	45,426
Production from Dutch reservoirs + biogas	69,180	74,460	84,068	76,561
Used by gas power plants	6,242	8,837	10,244	8,796
Used during production	1,023	724	721	751
Consumption large scale consumers	22,003	24,312	26,095	24,228
Consumption small scale consumers	23,320	21,734	25,208	20,447

Source: CBS 2013

In 2011, the small scale consumers – mostly households used 45.0 % of the total gas supply. Large scale consumers like the energy-intensive industry used 53.3% of the total gas supply. In households gas is mostly used for heating. Note biogas contributes only 0.1 % to the Dutch gas production and is not likely to increase beyond 1 %.

Coal

Million kg coal	2000	2005	2010	2011
Total supply	12,901	13,017	11,901	11,711
Import	22,296	20,469	20,468	24,481
Export	9,123	7,438	5,870	12,611
Used by coal power plants	8,722	8,267	7,876	7,398
Coke fabrics (for steel and iron industry)	3,006	3,157	2,933	2,959
Iron and steel industry	1,036	1,530	1,019	1,286
Other users	139	63	73	68

Source: CBS 2013

Together with import and export, coal is also in stock. The stocks are not included in this table. Coal is mainly used in coal power plants to produce electricity and to manufacture steel from iron ore. In the 2011, roughly 63 % of the total inland coal consumption was used for power generation. The energy-intensive industry - like coke fabrics, iron and steel industry and other industries - used roughly 37 % of the coal for their production.

Electricity

Million kWh	2000	2005	2010	2011	2012
Total production	108,342	118,719	120,926	122,057	118,678
Centralised production	89,426	100,424	118,150	112,966	101,568
Decentralised production	32,880	31,216	42,326	42,411	63,685
Import	22,947	23,693	15,584	20,621	32,155
Export	4,031	5,398	12,808	11,530	15,045
Total consumption	108,342	118,719	120,926	122,057	118,678
Transported by public grid	92,766	101,989	103,788	104,757	101,890
Transported by private grid	11,918	12,790	13,357	13,407	13,253
Consumption during production	3,658	3,940	3,781	3,893	3,535
Grid losses	4,082	4,478	4,464	4,609	4,490

Source: CBS 2013

4.3 ORGANISATION AND LIBERALISATION

TenneT is the national grid operator in the Netherlands and a part of Germany, and responsible for the transport of electricity via high voltage lines; they manage the 110 kV-, 150 kV-, 220 kV-, and 380 kV grid. TenneT, as TSO, is responsible for the transmission. The Dutch state - Ministry of Finance is the sole owner of TenneT. The legal task of TenneT is to regulate, manage and maintain the transport network and the energy balance. This implies investments in interconnections and capacity. The tariffs, and thereby the return on capital, is regulated by the Dutch state. These legal tasks are executed by TenneT TSO B.V., some tasks are executed by subsidiary CertiQ B.V. (certifies energy generated by sustainable sources like solar, wind, water and biomass in Certificate of Origin). In Germany TenneT TSO GmbH and TenneT Offshore GmbH are the executive company.

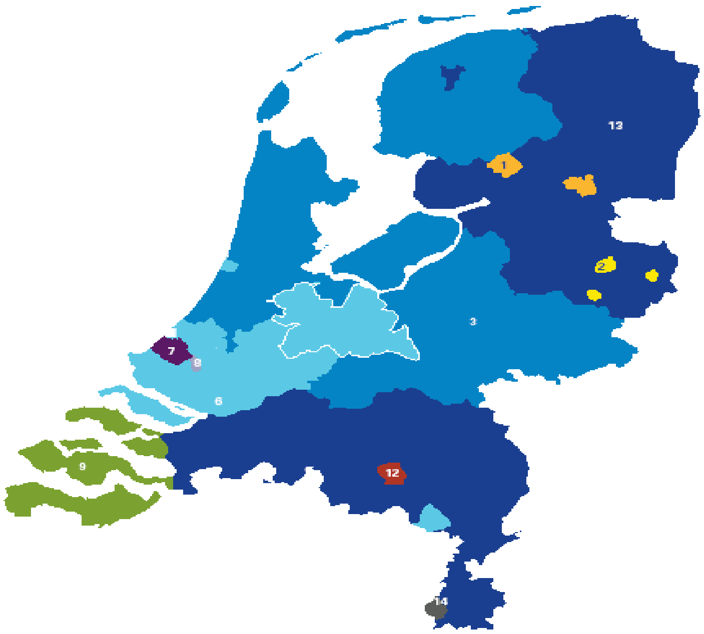
There is a strict separation between the national grid, executed by TenneT as government owned party, and regional grid operators owned by lower government bodies. TenneT transports electricity via the high voltage grid to regional parties or imports or exports electricity. These regional parties or regional operators are the grid operators of low voltage grids. Low voltage grids are grids below 110 to 150 kV. TenneT is responsible for the transmissions on these grids; from high voltage to low voltage. TenneT has the responsibility to cope with the surplus and shortage of electricity and the transport. Involved parties - programme responsible parties (programma verantwoordelijke partijen) as commercial parties e.g. industry, electricity companies, inform TenneT on a daily basis on their expected production and supply of electricity. Every fifteen minutes TenneT checks whether the grid is in balance. If irregularities occur TenneT needs to regulate the grid and either demand programme responsible parties to decrease their electricity demand or the electricity production. If there is more supply of electricity on the grid than electricity demand companies receives a lower price for the electricity as expense allowance or the electricity is exported. In case of a (possible) black out, the Netherlands has emergency capacity (noodvermogen). In other words, TenneT pays the parties to maintain the balance. Besides this regulated system there is also a commercial system whereby producers, consumers and traders buy and sell power contracts on the power exchange APX that supports a price that satisfies demand and supply at any point in time.

4.3.1 Regional grid operators

There are 8 regional grid operators active in 10 regions for electricity, so-called distribution system operators (DSO). For gas, there are 9 DSOs operating (see above) in 14 regions and the operators for electricity and gas are responsible for the construction, maintenance and transport of electricity and gas in their region. Consumers cannot chose the operator of their preference and therefore DSOs have a monopoly. Regional grid operators are obliged to provide grid connections, both for supply from large producers as reversed supply from consumers/small producers. Grid operators are independent parties and have public shareholders like provinces and municipalities. Due to the Electricity Act of 1998 and the Gas Act of 2000 the prior regional utility companies were legally split in a public owned regional grid operator and a commercial production and trading company. Before that period, regional gas operators were (mostly) part of electricity or gas companies like e.g. Eneco, NUON, Delta, Essent. The figure below shows the regions where the grid operators are responsible. [11]

[11] Nethbeheer Nederland 2013

Electricity grid the Netherlands



1. Rendo Netwerken
2. Cogas Infra en Beheer
3. Liander
6. Stedin
7. Westland Infra
8. Stedin
9. Delta Netwerkbedrijf
12. Endinet Groep B.V.
13. Enexis
14. Enexis

4.3.2 Legislation

Since the liberalisation of the energy sector the Energy Board (Energiekamer) of the Authority for Consumers and Markets (Autoriteit Consument en Markt (ACM)) has the legal task to monitor, supervise and audit the market. The Energy Board controls the effects of liberalisation in the energy sector. They supervise the national, regional and European grid system. The Energy Board creates market forces for suppliers of electricity and gas, controls the quality and prices for the national and regional grid operators, provides supply licences and have to be informed by the grid operators on quality and capacity every two years.

The Energy Board mediates when consumers or companies have a conflict with the grid operator. The Energy Board also monitors the market in order to create a trustworthy, sustainable and affordable electricity and gas grid. The Electricity Act of 1998, the Gas Act of 2000 and the Construction Decree of 2003 obliged the energy sector to liberalise and privatise. Before the liberalisation, public utilities (nutsbedrijven) were responsible for gas and electricity supply and had both public and private shareholders. Since the liberalisation, some provinces and municipalities sold their shares in the utilities Nuon (sold to Vattenfall) and Essent (sold to RWE) and made mergers possible for private companies. However, the Duch energy companies Delta and Eneco are still publicly owned and not unbundled unlike RWE, E.ON, Vattenfall and GDF Suez. The highest legal authority in the Netherlands will decide whether the unbundling of Eneco and Delta will be enforced. [12]

4.4 CONNECTIVITY

Electricity in Europe is connected by means of grid and market. The electricity grid has an interconnectivity across Europe and in case of the Netherlands this means that the Dutch grid is physically connected to its surrounding countries. Virtually the market is connected on the APX-Endex. This is a virtual market for both spot and long term electricity / power contracts.

Electricity and gas cannot be controlled by national borders. Due to the interconnectivity, the domestic markets are linked. A simple example is the situation between Germany, the Netherlands and Poland. Sunny and windy days in Germany cause overcapacity on the grid. The German regulation imposes priority on the grid for wind and solar power (feed-in tariff). The German overcapacity in electricity will flow to e.g. the Dutch grid. Poland has installed reverse transformers at their borders to block import of German power as this would erode the profitability of their state owned coal fired power plants. Ironically, despite the renewable developments Germany experienced higher CO_2-emissions in 2013 than before. [13] Electricity producing companies responsible for electricity demand see their margins decline due to the overcapacity on the market – as an increasing percentage over the whole year.

10.5 % renewable electricity generation in 2013

The interconnectedness of the electricity market and the very fast development of wind and solar power generation set the so-called *Energiewende* in Germany in motion – which mainly focusses on electricity. The conflict between a partly European power grid and a European trading system and market on one hand, in combination with different national and often regional rules and policies create large barriers to the energy transition. The Netherlands is very vulnerable in this respect due to its large interconnectivity with its neighbours, its large energy intensive industry and gas sector with a large state owned interest. The following issues are important in this respect:

- Improved grid interconnectivity throughout Europe (first priority with Germany);

[12] European Court
[13] http://data.worldbank.org/indicator/EN.ATM.CO2E.PC/countries/DE--XS?display=graph

- Level playing field in policies for power generation irrespective the region and the fuel source;
- A common view on energy transition instead of a sole focus on renewable power;
- Adaptations to the EU-ETS.

From a Dutch perspective, these are the important themes for cross border cooperation and sharing opportunities. The focus mainly lies at cooperation with Germany, Belgium, United Kingdom, Norway.

4.4.1 Centralised versus decentralised generation

Since the liberalisation, the Dutch electricity market is controlled at a centralised level by European and international energy companies owning gas and coal power plants responsible for Dutch energy demand e.g. the Dutch NUON and Essent were bought by Vattenfall and RWE respectively. Governments consider power production and demand as a domestic activity and governments traditionally award contracts to fulfil the domestic demand of electricity and gas, and to use the opportunities to trade gas. The TSO (responsible for centralised generation) and DSOs (responsible for decentralised generation) are responsible for balancing the grid and provide consumers electricity and heating. For all involved parties this is business as usual whereupon they create their business case.

The current percentage of renewables is not sufficient to create a shift in the energy sector yet.

With the transition in the energy sector - the opportunity for households and corporations to generate their own electricity - a shift in production and balancing occurs. The share of renewables in the electricity generation mix has a yearly average of 10.5 % in 2013. This seems small but is in fact already very large as power for households is only a small % (22 %) of the Dutch energy consumption. The share of renewables in the mix of 4.2 % is the average of electricity, heat and transport.[14] This is without the share of renewable certificates. Energy suppliers (like NUON, Eneco etc.) can purchase green certificates from electricity and gas producers (mainly abroad) and use this in their sales portfolio on green energy. The more green energy consumers purchase, the more renewable energy needs to be generated or green certificates have to be purchase by energy suppliers. In the Netherlands, approximately 2/3 of all households (almost 2 million households) chose a green energy supplier.

The Dutch energy-intensive industry need base load power which cannot be provided by wind and solar alone. Of all renewables biomass and wind have the biggest share in the energy mix. Government policies like the SDE+ programme, stimulate and subsidise co-firing of biomass in coal power plants that allows continuation of the traditional centralised energy companies. The traditional power companies are still the largest investors in renewable energy. E.On, for instance, is one of the the largest investor in wind power in

[14] CBS 2014

Europe. [15] [16] However, mainly solar power has a large production growth coming from small companies and households.

The renewable power production growth is purely dependent on subsidies and on the regulatory environment.
Exemplary is Spain, where the removal of subsidies for solar PV stopped the growth immediately, although intrinsic profitability of solar PV in Spain is twice as high as in Northwest Europe. This is a vulnerable element of the energy transition. The growing interests of households to generate own or shared electricity via solar panels or participation programmes in windmill farms create a change in the electricity production and demand profile of households. Decentralised initiatives like corporations in neighbourhoods and municipalities or shared renewable energy sources like windmill farms have an effect on the attitude and behaviour of the end-user towards energy and their direct environment. The current percentage of renewables is not sufficient to create a shift in the energy sector yet. Still, it is a first attempt at micro level to create a bottom-up transition in the energy sector where, just like in Germany, an electricity transition at micro-level occurs creating opportunities and threats. Costs of production, purchasing, governance and compliance decrease with larger scale. This conflicts with small scale decentralised power production. Also central fossil fuel based power generation will still be necessary as back-up when there is no wind or sun.

These back-up power generators will demand a business model (for instance capacity based as proposed by the Magritte Group [17] [18]) where they are compensated for the lower number of operating hours of their plants. These costs are also part of the energy transition. The challenge will be to satisfy societal demands for low-cost energy while stimulating initiatives that increase involvement and support of citizens in the energy transition.

An increase in decentralised electricity generation has a direct effect on the balancing of the grid. The balancing of the grid and the changing business models for all players in the field needs to be merged. This includes a shift in players in the field, an increasing competition, a different business model for both the intermittent renewable and the fossil based electricity generators and different behaviour of the end-users. The ideal future situation would be a European energy system that is intertwined and interlinked without under- and overcapacity, without increasing societal costs and distortion by regional policies. Decentralised generation and usage of electricity might stimulate the level of awareness amongst the direct involved ones on energy production and usage.

[15] Dutch Energy Day 2013
[16] E.On Offshore Wind Energy Factbook 2012
[17] Magritte Group consists of CEOs from 10 European and international utilities companies like GDF Suez, Enel, E.ON and Iberdrola.
[18] http://www.gdfsuez.com/wp-content/uploads/2014/03/press-kit-magritte-group-call-for-immediate-and-drastic-measures-to-safeguard-europe-s-energy-future-march-19th-2014.pdf

The balance between centralised and decentralised electricity generation is in transition. Policy measures and incentives, bottom-up initiatives and a changing level playing field at European and international level have a significant influence on the developments at macro- and micro-level.

4.4.2 Smart grids

The energy sector is aware of the transitions. Energy transitions have an effect on the grid and on the behaviour of the end-users. Smart grids are a tool to monitor the changes on the grid. Smart grid is a container term that might comprise the following elements:

- A software system that monitors consumers demand profile and gives consumers control over switching equipment on and off in time;
- A business model whereby consumer get power contracts that incentivise them to use more power when the wholesale price is low and less when the wholesale price is high;
- A hardware system that stores electrical energy in batteries or flywheels;
- A system that matches power demand and supply at neighbourhood level;
- A high capacity grid (e.g. with superconductors);
- Technical solutions that convert excess electricity in hydrogen that can be transported in the natural gas pipelines network.

Currently, end-consumers have a small and very inflexible power demand profile compared to the total energy sector. This might change once electric vehicles gain a large market share. At that point in the future smart grids will gain much more importance. Currently, smart grids are used in the monitoring phase to measure impact of consumer behaviour on power consumption. This might in the future lead to less costly investments in capacity increase of the power networks. These investments may be circumvented by lower cost IT solutions. Monitoring is important for DSOs and energy producing companies in order to change their own behaviour and adjust their operations as to be able to change the behaviour of consumers.

In several smart grid projects neighbourhoods, offices and industrial parks the intelligent energy systems are investigated to map different communities, locations and their behaviour. As an example, in smart grid projects households have a solar panel on their rooftops, distribute their generated power to each other and smart devices like washing machines start operating at moments when the electricity supply is at its high. The demand of electricity is (partly) controlled. In some projects, the 'all electric' system is investigated whereby for example the electrical vehicle serves as battery for the high amount of capacity in the grid. [19] The business model for back-up and storage facilities of electricity is still under development and in the research and innovation phase.

4.5 CONCLUSION

The connectivity of electricity markets is becoming an increasing European activity. National capacity, shared generated electricity and interlinked grids have consequences for the under- and overcapacity on the grid. The transition in the energy sector moving towards an increase in generated power and an increasing decentralised generation of power can create tensions on the grid amongst the players in the field. Investments and developments in grid and architecture are important to be prepared for the transition and new developments.

The supply side of electricity and the business case for fossil fuel based power plants is a topic of discussion. On the one hand, fossil fuel based power plants are not based on part-time operations for back-up. On the other hand, renewable power production cannot be sustained on long term subsidies, either by direct or indirect payments from e.g. the grid owner when power prices approach zero or become negative. Centralised and decentralised generation provide base- and peak-load, centralised generation is available on demand, decentralised intermittent renewable power generation depends on the conditions e.g. weather and is only part-time available. The demand side is important in the transition and can improve in adaptability, providing opportunities for smart grids, local energy corporations, changing behaviour and attitude of consumers.

In order to create opportunities for transition shared choices of all relevant parties in the energy value chain should be taken into account. Technology and innovation, behavioural change, dialogue and better communication are important factors in the energy transition.
.

[19] Enexis and Alliander

5 HEAT

5.1 INTRODUCTION

As the *Energiewende* in Germany suggests, there is a shift in the energy sector. Contrary to what the *Wende* suggests, this shift mainly takes place in the electricity sector and not in the energy sector as a whole. Often the role of heat is forgotten or taken into account in the energy dialogue. This chapter describes the role of heat in the energy value chain in different sectors mainly the industry sector and households. The role of gas, electricity and cogeneration in the production of heat, policy and sustainability measures are discussed.

5.2 WHAT PRODUCES HEAT?

In the early days, coal was gasified in local gas plants and used as town gas to provide domestic heat. Due to the discovery of natural gas, its innovations and fast implementation, the usage of natural gas for heating and cooking devices increased. Nowadays, most households and the industry use gas for their heat.

There are several sources that can create heat, of which gas is most used. Other sources can be steam or warm water (<100 degrees Celsius), electricity, fossil fuels, coal or wood. Industries and heat grid can be connected. There is a high potential of waste heat in the Botlek area that can provide parts of Zuid-Holland with heat. The steam pipe is a pipeline network, developed by DSO Stedin, that connects industrial suppliers and users with medium pressure steam. A network is developed supplying industrial waste heat to buildings in the city. Much older are the district heating networks in Amsterdam, Rotterdam and The Hague supplied by hot water from cogeneration units.

5.2.1 Alternative sources

Besides gas, electricity can be used to heat the built environment. Alternative sources for gas in heat are biogas or other fuels, geothermal heating and solar thermal collectors. Most of these alternative sources are in the innovative phase and cannot be implemented at centralised, meso- or macro-level (yet). An alternative for heating and cooling large buildings are geothermal heat pumps (underground storage of cold and warm water). Government decided, after negotiations with the construction and housing sector, that new houses have to be almost energy neutral in 2020, following European policy. In the last 10 years, most new large buildings are equipped with geothermal heat pumps focusing on becoming energy neutral houses in the future. This development is foreseen to grow further and can lead to a drastic reduction of gas demand to heating large buildings.

Cogeneration, is the combined generation of electricity and heat from the combustion of a fuel – like (bio)gas. Heat can also be generated by waste and solar. Waste heat is the process of recovering waste heat and using it to generate power with no combustion and no emissions. Solar heat collectors collect heat by absorbing sunlight and can warm water or generate electricity. Geothermal heating is a central heating and cooling system that transfers water from warm layers in the ground (e.g. in the Netherlands about 80 degrees Celsius) to the consumer and transfers cool water to cooler layers in the ground. The water can be used as tap water and to heat the built environment.

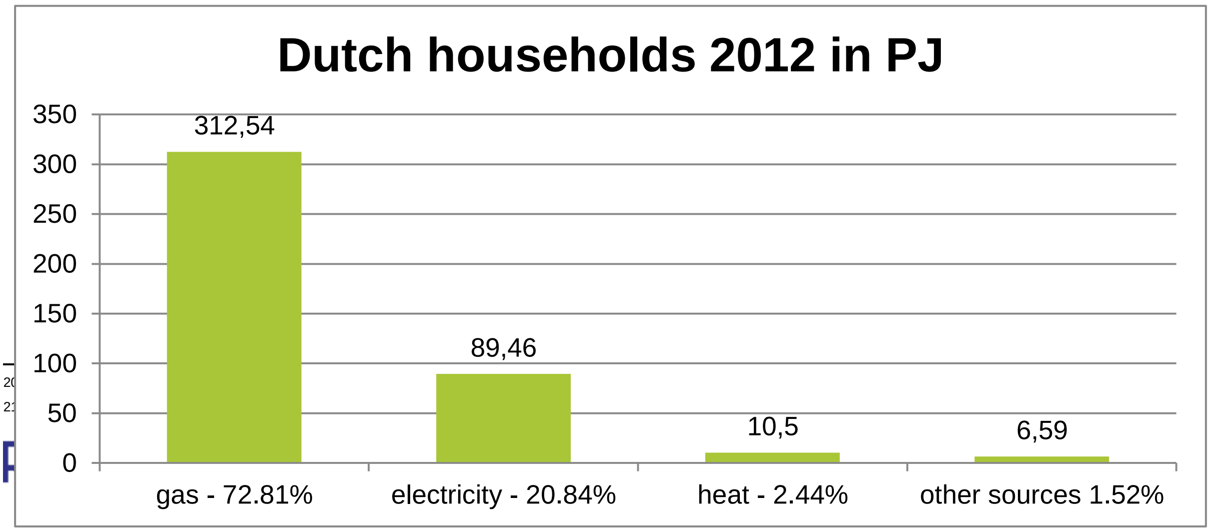
5.3 HEAT IN THE SECTORS

Though there is limited information on the usage of heat sources in different sectors two sectors are defined: households and agro sector. Households have a share of 13% in energy usage. [20] Households are an important component in the energy transition but have less short term improvement potential compared to industry and big buildings. Policy incentives and measures for energy savings, renewable energy in the mix and creating awareness and engagement should therefore be tailored to the application.

5.3.1 Households

The figure below shows that in Dutch households gas is the most used source of energy with 72% – this mainly for heating (and for cooking devices). During one of the interviews, it was mentioned that 96 % of the households have a connection to the gas grid. [21] A pilot project operative, connects newly built houses only to the electricity grid and provide the houses with electrical or alternative heating e.g. using heat pumps. For alternatives like this, the Niet Meer Dan Anders (NMDA (Not More Than Usual)) policy is operative. The NMDA policy means that the maximum price of heat is based on the price of gas. Consumers with an alternative heat system do not pay more for their connection than households with a gas connection as agreed upon in the Heat Act (Warmtewet). However, power grids on local level are 5 to 8 times more expensive than gas grids. These costs are socialized over the whole Dutch population and are not yet part of calculations on cost-effectiveness of energy efficiency and CO_2-reduction.

The figure shows the energy sources used in Dutch households in 2012 in PJ. Heat - for buildings - is also known as district heating. Other sources like diesel and other oil products are mainly used by households that are not connected to the grid. Heat and gas are used for heating the built environment and electricity is used for electric devices and machinery or can be used to generate heat.

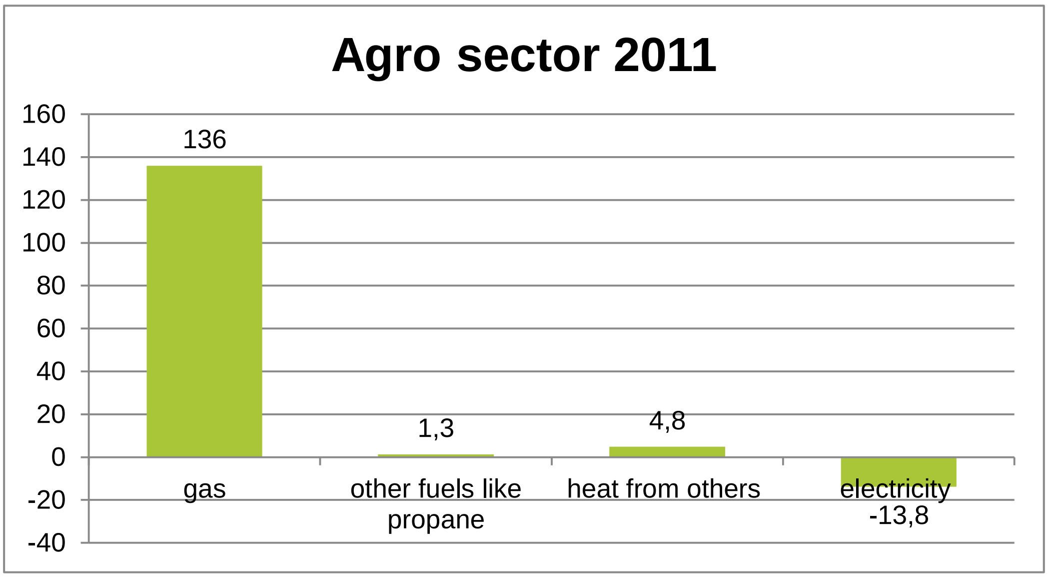


Source: CBS 2014

5.3.2 Agro sector

In the agro sector – greenhouses and agricultural sector are included like e.g. the kennel and mushroom industry. Of the agro sector, greenhouses have the biggest share in energy usage. There has been a transition towards an increasing usage of biofuels and cogeneration. The Netherlands was very large in cogeneration leading to high energy efficiency. Currently, many cogen units are now standing idle due to the current gas and power market conditions. In the graph, electricity has a negative number. Due to cogeneration, the agricultural sector can generate its own power. When consumed less than produced, the number for electricity turns negative. Excess production is delivered to the grid.

Heat grids in the industrial sectors are not always connected or linked to each other which means that the potential of both the industrial sector and the agricultural sector are not as efficient and optimally used. A major limitation is the necessity to find a few large consumers and producers in a small area due to the heat losses at large distance. Dutch industrial clusters have many pipeline networks that exchange waste products or heat from one plant to become feedstock at another plant like NUON, ENCI and Tata Steel in IJmuiden or E.ON and LyondellBasell in Rotterdam. [22] [23]



Source: CBS 2014

5.4 POLICY AND SUSTAINABILITY MEASURES

While heat is an often forgotten topic in the energy dialogue, it can be an important part of the energy transition. With Europe goals focussing on energy saving measures, reducing CO_2-emissions and renewables in the mix, most attention goes out to electricity instead of

[22] http://www.tatasteel.nl/news-and-media/persberichten/tata-steel-verlengt-contract-nuon.html
[23] Port of Rotterdam 2013 - facts and figures

heat. Policies are developed to reduce the energy and heat demand. Examples are energy saving measures like insulation in the built environment and energy integration of industry clusters.

Since the liberalisation, the market is open for private investors to invest in or buy heat grids. Transport and production of heat are not legally separated, as is the case with electricity. Heat grids are not always interlinked in the industry. Dutch ports try to coordinate industries in terms of supply and demand by using a coal power plant with warm water as residual next to an industry that benefits and uses warm water like E.ON and Gate LNG terminal and DSO Stedin, who have completed the steam pipe project in Rotterdam and develops biogas pipeline projects in e.g. Friesland. [24] [25]

There are several policy incentives to promote investments in and exploitation of heat and heat grids. Government implemented taxes on production, transport and usage and developed subsidies as SDE+ to promote investments and exploitation of for example biomass, biogas and cogeneration. As agreed upon in the SER Energy Agreement, policy measures like loans to invest in insulation, high efficiency glass and solar panels, subsidies like a lower VAT rate to renovate or restore housing older than two years, promote smart metering in housing and sustain the energy labels for energy efficient housing, all have to contribute to reach the goals set towards a low-carbon society.

5.5 CONCLUSION

Since most focus goes out to electricity, heat is an often forgotten topic in the energy transition discussion. Heat is used in the built environment and in industrial sectors. Cooperation between sectors and companies could improve operating efficiencies and energy savings. This potential has not yet come to its highest level. In order to reach the goals set for climate and energy, government provides different funds and subsidies to stimulate energy savings. Different than the electricity sector, the heat sector not unbundled in transport and production. The market is liberalised giving private investors the opportunity to participate in heating grids.

Gas is the most used source to provide heating. Alternative technologies and innovations are biofuels, geothermal, solar heating but not efficient and effective enough to provide heating at centralised scale.

[24] Port of Rotterdam 2013 - facts and figures
[25] Eneco 2011 – annual report

6 TRANSPORT

6.1 INTRODUCTION

Transport – either by air, rail, road or water needs energy. Goods and persons are transported on a daily basis creating trade and employment on the one hand, environmental challenges on the other hand. Innovation in the transport sector can have positive and negative effects. For example, the introduction of electrical vehicles on the market creates opportunities to store energy and create a shift in supply and demand of electricity. This chapter shortly introduces the relevance of transport for the energy sector and the transition it experiences.

6.2 WHAT IS TRANSPORTED?

Goods and persons can be transported by different modes of transport. When we look at freight, most goods enter the Netherlands either by road transport or at one of the Dutch ports – Rotterdam, Eemshaven, Amsterdam etc., as the table below shows. The transport of goods increased over the past 10 years in terms of tons and estimated value. The import and export of goods is important for the Dutch economy.

Transport of goods

In million ton	2000	2005	2010
Total	1447	1639	1646
To Dutch ports	424	487	568
By inland shipping	275	279	263
By road	614	711	670
By rail	28	34	33
By air traffic	1	2	2
Crossing border pipelines	104	126	110

Source: CBS 2014

> **The transport sector uses 14.72 % of the total energy usage in the Netherlands**

The estimated value of the total freight was € 486.9 billion in 2010, with an estimated import of total freight of € 331.6 billion and export € 371.1 billion. In 2010, the imported products with the highest estimated value are machinery and vehicles. The highest estimated value of export products is on chemical products, oil products and the food sector.

In 2012, an average of 80.5 % of the total Dutch population commute (one or more times) on a daily basis (approximately 13 million people daily). The passengers commute 28.3 km per day and the average travel a day is an hour. Most passenger transport is by car, followed by bicycle or walking. In 2012, both Dutch and foreign freight and passenger transport commuted 127 billion km. Transport has an added value of 4.5 % on the Dutch economy, with a production and added value of respectively € 51975 million and € 23496 million, and involved 427.000 jobs in 2011. [26]

6.3 ROLE OF TRANSPORT FUELS

In order for passengers or freight to translocate (leaving travel by foot or bicycle aside) energy is needed. The table below shows the usage of transport fuels in PJ. The table distinguishes road traffic, shipping, air and rail traffic.

Usage of transport fuels

In PJ	2000	2005	2010	2012
Total	1148,3	1334,7	1215,2	1196,8
Road traffic	434,2	463,6	472,9	463,2
LPG	25,6	16,2	13,6	12,9
Benzene	177,3	180,2	184,1	180,8
Diesel	231,3	267,1	274,7	268,7
Gas	0,0	0,0	0,5	0,7
Electricity	0,0	0,0	0,0	0,1
Shipping*	564,8	708,5	589,6	581,6
Air traffic**	141,8	155,5	145,0	144,7
Rail traffic***	7,4	7,2	7,6	7,5

Source: CBS 2014

* oil fuel most used source

** kerosene most used source

*** electricity most used source

As chapter 2.5 CO_2-emissions shows, transport contributes to the amount of CO_2 in the atmosphere. When discussing emissions, it is important not only to focus on CO_2, as European and national policies do, but also look at emissions like NO_x and CH_4 and fine particles. It is a part of Dutch and European policy to reduce the amount of CO_2-emissions in the atmosphere. Particular filters and higher taxes and charges on environmental unfriendly transport vehicles, or stimulation measures for energy-efficient cars have to decrease the amount of CO_2.

[26] CBS 2013 – Transport in Nederland

6.3.1 Contribution of transport fuels to the economy.

The average price of respectively benzene, diesel and LPG in March 2014 was € 1.704, € 1.435 and € 0.793 per litre. The prices includes taxes and VAT. For transport fuels taxes and charges have to be paid which serve the Dutch economy.

Charges and taxes on transport fuels

In € / 1000 litre	2000	2012	2014
Benzene	599.32	736.40	767.24
Diesel	352.95	436.70	485.76
LPG	119.34	173.44	330.17
CNG	-	63.90	128.00

The taxes and charges on transport fuels resulted in an increase of state income over the past years. In 2000, transport fuels contributed with € 3.1 billion to the Dutch state income, in 2012 this increase to almost € 8 billion.

6.4 ELECTRICAL VEHICLES AND OTHER INITIATIVES

The transport sector is changing. With the introduction of electric vehicles and policies stimulating the use of hybrid or electric cars the amount of electric vehicles increased up to more than 30.000 cars, still being a non-significant share in the car park but rapidly growing. As described before, the usage of electric vehicles in a smart grid system can increase the power demand profile of end-consumers. The possibility to store electricity in the electric vehicle, using it as a battery at moments of overcapacity on the grid, can create flexibility and raise awareness on the supply and demand side of electricity.

Discussions in society currently focus on other ways of transporting – stimulating carpooling, rail transport or other ways of public transport, and decreasing the number of commuters by promoting working at home.

6.5 CONCLUSION

The transport sector has a 14.72 % share in energy usage in the Netherlands (in 2012) and is the fourth (out of five) energy using sectors. Using oil and related products, road traffic and shipping have the biggest share in transporting goods and people. The transport sector itself – the transport of goods – has a 4.5 % share in Dutch state economy and with taxes and charges transport fuels contribute almost € 8 billion to the Dutch economy. Developments and innovations in the transport sector, like electric vehicles, different ways of manufacturing making transport unnecessary, etc. can contribute significantly in reaching the goals set for climate and energy in 2020 and for 2050.

7 NATIONAL ENERGY AGREEMENT

7.1 INTRODUCTION

In October 2012, the Social and Economic Council (SER) (an advisory board of Dutch government and parliament) initiated negotiations for a national energy agreement with different stakeholders in the field of energy: from policy makers to industry, from environmental organisations to employers' and employee unions. Together they tried to come to an agreement on how to reach the goals set by national governments in the European Union for the Netherlands to reach 20% CO_2-reduction, 14% renewables in the mix and 20% energy saving measures in 2020.

The SER, traditionally an advisory board of the Dutch government and parliament on national and international socio-economic issues, aims to help create social consensus in the energy agreement process. The creation of social consensus decision-making is considered typically Dutch, been successful in the past and called *polder model*. The *polder model* is based on 'cooperation despite differences' and 'a pragmatic recognition of pluriformity' originally in the field of employment and wages. It was a first that the SER was involved in seeking social consensus in a national energy agreement.

This section discusses the process towards the realisation of the agreement, as far as it is public, and will outline the outcomes of the agreement.

7.2 PROCESS

In September 2012, the grassroots movement *Nederland Krijgt Nieuwe Energie* together with the SER initiated the start of the process by asking political support for an energy agreement with majority support, which they got. *Netherlands Krijgt Nieuwe Energie* is a foundation of stakeholders directly or indirectly involved in the energy sector. They have agreed to facilitate a network to work towards a sustainable, secure and affordable energy supply and production in the Netherlands; a network to make an energy transition possible.

For six months, the stakeholders participating in *Nederland Krijgt Nieuwe Energie*, the SER and other participants cooperated and brainstormed on how to achieve the goals set for 2020. First they brainstormed as a total, later they formed groups and discussed topics as 1. energy savings and renewables, 2. Industry, centralised production and ETS,

3. Innovation and clean tech., 4. Mobility and transport. The dialogue between the stakeholders was held behind closed doors and along the process, new developments and negotiation topics leaked to the media.

Before the start of the political recess, the end of June 2013, a provisional agreement was send to Cabinet and with the knowledge of stakeholders adjusted on some points by the Ministry of Economic Affairs in order to come to an agreement.

By the beginning of September 2013, Minister Kamp announced that the participating stakeholders have reached an agreement and announced that stakeholders will sign the agreement. Half September the agreement was discusses in parliament and the SER appointed a Committee for Assurance of the SER Energy Agreement to insure targets and evaluations, and a staff to help implement, test and facilitate.

7.3 OUTCOMES

In the agreement, the stakeholders committed themselves in reaching goals, both on short and long term towards sustainable growth as common ground for a future-proof energy and climate policy. The goals are as follows:

- Saving of an average of 1,5% final energy consumption per year;
- In 2020, 100 PJ saving of final energy consumption in the Netherlands;
- 14% renewables in the mix by 2020;
- 16% renewables in the mix by 2023;
- Creating at least 15.000 full-time jobs in the next few years.

The agreement focusses on ten issues namely:

- Energy savings: on a yearly basis 1.5% reduction of the final energy consumption aiming at 100 PJ saved by 2020. Energy saving measures focus on the built environment and the increase of energy efficiency measures in the industry, agriculture and service and business sectors. By the end of 2016, 35% of the 100 PJ and by 2018 65% of 100 PJ has to be reached. If the energy saving measures are not on schedule or if it does not seem likely to reach the goals set, additional measures come in place, fiscal and / or obligatory. The energy saving measures focus on the energy user and not on the energy supplier.
- Scaling up renewable energy sources: implementation of 14% in 2020 and 16% in 2023 in the form of 4450 MW wind offshore operational in 2023 and 6000 MW

wind onshore in 2020. TenneT is responsible for the connection to the grid. Coal power plants can co-fire biomass up to 25 PJ.

- Decentralised generation: stimulus for citizens to generate electricity and heating on a decentralised level. In 2014 a tax reduction of €0.075 per kWh is in place for decentralised generation at local level that can be used in a well-defined area (postcoderoos).
- Grid: the grid will be adjusted for future usage and purposes.
- ETS: a joint lobby is set up to change the ETS working towards 80/95% GHG emissions in 2050, assured position for carbon-leakage companies and compensation for indirect (electricity)costs.
- Fossil generation: coal power plants are an important part of the energy production. To reduce GHG emissions three power plants constructed in the 1980s will be closed down from 2016 and two from 2017 onwards. The closing of three coal plants will introduce an exemption from coal tax. Gas power plants are an important form of production during the transition. [27]
- Efficient mobility: 60% CO_2-reduction in 2050 compared to 1990 and 25 Mton (-17%) in 2030. It is expected that the transport sector will contribute with 15 / 20% energy reduction of the 100PJ expected in 2020.
- Increasing employability and create employment gains of at least 15.000 full-time jobs moreover in the construction and installation sector. This combined with trainings and retrainings pilots, internships and educational institutes.
- The Netherlands as energy innovative and exporting country focussing on a top 10 position on the CleanTech Ranking by 2030.
- Funding programme organised by umbrella organisations like the Dutch Banking Association and Pension Federations to create a funding programme for renewable energy and decentralised energy production.

The implementation of all these measures is bound to a few strict financial criteria:

- Maximum 3 % national budget deficit;
- No changes fiscally;
- Minimum 40 % cost reduction for offshore wind.

The SER Energy Agreement is an ambitious set of outcomes. Some outcomes will be harder to reach than others. Tax reduction for decentralised generation at local level in a well-defined area (postcoderoos) is a topic of discussion, the closing down of coal power plants is under investigation of the ACM. Other outcomes, as for wind power, are harder to reach as it should be noted that wind turbines have grown significantly in size and power generation capacity over time but over decades the investment cost per MW has never come down. The scaling up of wind power offshore and onshore is a significant investment for Dutch society. [28]

7.4 WHAT'S NEXT?

Former Minister Ed Nijpels is in charge of the implementation and consistency of the agreement, policy and execution measures as chair of the Committee for Assurance of

[27] ACM is currently investigating the conditions under which coal power plants can be closed down.
[28] Kivi Niria Work Group investigating wind power

the SER Energy Agreement. The signing parties are all equally responsible of the success of the agreement. In 2016, a first progress evaluation will take place.

8 CONCLUSION

The aim of this report is to give a clear insight in the Dutch energy sector focussing on policy, economic impact and technology. The report provides as objective as possible factual based information, creating a level playing field to be able to compare, analyse and draw conclusions. The information of this report is input for the dialogue of stakeholders involved in the energy transition towards a low-carbon, economic viable and sustainable future.

From this overview the following conclusions can be drawn:

- A dialogue can help construct a safe environment for relation building between stakeholders which might improve the process towards decisions that are widely supported by the public.
- A dialogue can contribute to more public support and public engagement, inclusion of citizens in an earlier stage of a project can contribute to the development of a project.
- The SER National Energy Agreement was a dialogue amongst stakeholders focussing on achieving the European goals set for CO_2-reduction (20% in 2020), energy savings (20% in 2020) and renewable energy in the mix (14% in 2020).
- The Netherlands is a frontrunner in Europe when it comes to unbundling of energy production / trading and transport allowing public and private ownership.
- The Netherlands is a large investor in cross border gas and power networks – essential for facilitating renewable energy in Europe and the interconnectivity of the grids.
- The Netherlands has an energy-intensive industry, with an export oriented economy due to its location, logistics and well-developed transport sector.
- The energy-intensive industry, whereof the largest sectors the energy, chemical / pharmaceutical, services / agro / fishery, has a significant impact on the economic state and employment rate in the Netherlands.
- The discovery of gas in the Netherlands is of high importance for the Dutch economy, mainly the gas revenues, the energy-intensive industry and heat system.
- Dutch government and public owned companies focus nationally and internationally on gas as transition fuel providing gas for Northwest Europe with the development of a gas roundabout.

- Decentralised generation like local energy cooperation's and private generations is an upcoming trend in electricity production having influence on the market for centralised generation and the traditional energy producers and suppliers.
- The main energy using sectors in the Netherlands are respectively: industry (37.66%), services / agro / fishery (17.62%), energy sector (16.85%), transport (14.72%) and households (13.13%). [29]

[29] CBS 2012