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# The great Dutch gas transition

## Introduction

The Natural Gas Programme at OIES has produced a significant amount of research over the past three years on the issue of the decarbonisation of the gas sector in Europe. We have highlighted the challenges that this poses for traditional players across the gas industry in the region, as it has been made clear that gas has a limited future in the EU unless it can show how it will contribute to achieving a net zero emissions target by 2050. We now examine the strategy of a specific country, the Netherlands, which relies more on natural gas than any other country in the EU but which has embarked on an energy transition intended to lead to a complete phaseout of unabated natural gas consumption and production by 2050. This provides an excellent case study of the challenges, risks and costs that will be faced by the gas industry as a whole in the EU over the next three decades.

The prospects for natural gas in the Netherlands changed dramatically between 2012 and 2018 due to rising concerns over climate change and induced earthquakes in the gas-producing province of Groningen, leading to a shift in policy focus from financial to environmental and safety concerns. In October 2017 the newly elected government adopted ambitious greenhouse gas emission reduction targets implying that consumption of unabated natural gas must cease completely by 2050. In March 2018 the government announced that production from the giant Groningen field, for over 50 years the mainstay of Dutch gas production, will be phased out as quickly as possible and no later than 2030.

At the instigation of the government, civil society organisations negotiated a detailed Climate Accord which indicates how the government-set greenhouse gas emission reduction targets in five economic sectors (electricity, industry, built environment, transport and agriculture) are to be reached. The final version of the Climate Accord, which entails a complete conversion from gas-fired to 'sustainable heating' of all buildings in the Netherlands, 100 per cent renewable power production, and a conversion to 'sustainable' (net zero emission) industrial heating processes by 2050 (with intermediate targets for 2030), was sent to Parliament in June 2019.

Despite the political consensus on climate policy goals, and the speedy realisation of a Climate Accord, there is still a great deal of uncertainty as to what shape the energy transition in the Netherlands will take. Progress has been slow, particularly in the buildings sector and industry, and surrounded by controversy. It is also unclear to what extent the Dutch energy system will be electrified, and what role there will be for hydrogen.

In response to the political and public opposition to natural gas, the Dutch gas industry developed a strategy based on the continued use of 'molecules' in the energy system in the form of 'sustainable gases' (hydrogen, biogas, biomethane). In this system it sees a future role for itself as a producer, trader and transporter of sustainable gases, while developing new activities in areas in line with its expertise, such as offshore energy activities, 'deep' geothermal, transport and storage of CO<sub>2</sub>, and construction of district heating networks. For most of these alternative activities, the industry prepared

'roadmaps' in 2017 and 2018, but to date few concrete projects have been undertaken and it is unclear whether the industry will succeed in its self-imposed transformation.

We conclude that, although the Dutch gas industry has responded proactively to the challenges with which it is confronted and the goal to phase out natural gas faces technical, political and economic limitations, the transition to a zero-emission energy system is likely to continue and could represent a serious threat to the future of the Dutch gas industry.

## 1. Natural gas in the Netherlands

- **Historical and current role of natural gas**

The discovery of the giant Groningen natural gas field in 1959 had a profound impact on the Dutch – and North West European – energy system. With initial recoverable reserves of about 2800 - 2900 billion cubic metres (Bcm)<sup>1</sup>, Groningen is one of the largest onshore gas fields in the world. By late 2018, some 2220 Bcm had been produced from the field<sup>2</sup>.

Operator NAM (a Shell-ExxonMobil joint venture) quickly ramped up production in the 1960s. At the same time, Gasunie, a public-private joint venture between the Dutch State and oil companies Shell and ExxonMobil, built a national gas transport grid enabling Dutch households and industries to make a rapid transition from coal to gas<sup>3</sup>. Gasunie, which was also responsible for the sales of gas, signed a number of gas export contracts to neighbouring countries (Germany, Italy, Belgium, and France) and pipelines to these countries were built.

In addition, a successful 'small gas fields policy' was implemented by the Dutch state, encouraging production from smaller onshore and offshore fields whose operators could sell their higher-cost gas to Gasunie, which sold it with the lower-cost Groningen gas at a single price. This resulted in substantial exploration and development of smaller fields throughout the 1980s and 1990s. From 2000 onwards, the onset of a gradual decline of the production from these smaller fields was compensated by a gradual increase of Groningen production.

The share of natural gas in primary energy consumption in the Netherlands has been relatively constant over the last decade, fluctuating around 40 per cent (2018: 41 per cent<sup>4</sup>, corresponding to about 36 Bcm of gas consumption). This is significantly higher than the EU average of 23 per cent<sup>5</sup>. This high share (the highest within the European Union) is related to a number of factors: large domestic production; the existence of a distribution grid that covers the entire country; the dominant role that gas plays in the heating of buildings (95 per cent), and the historically relatively low cost of gas for large industrial and agricultural users which promoted the use of gas in these sectors<sup>6</sup>.

Natural gas has a relatively large share in the generation of heat in the Netherlands: about 90 per cent for buildings and 40-50 per cent for heat for industrial purposes<sup>7</sup>. District heating networks or heat grids are comparatively rare.

In 2018 total gas demand amounted to 1285 PJ (36.5 Bcm)<sup>8</sup>. About 480 PJ (13.65 Bcm) was used to generate electricity; the remaining demand was mostly for heating purposes (both industrial and

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<sup>1</sup> <https://www.cambridge.org/core/journals/netherlands-journal-of-geosciences/article/geology-of-the-groningen-field-an-overview/9947C006B646623624ADF30D3C6C8CC5>

<sup>2</sup> <https://www.nam.nl/feiten-en-cijfers/gaswinning.html>

<sup>3</sup> [https://www.clingendaelenergy.com/inc/upload/files/Book\\_Natural\\_Gas\\_in\\_the\\_Netherlands.pdf](https://www.clingendaelenergy.com/inc/upload/files/Book_Natural_Gas_in_the_Netherlands.pdf)

<sup>4</sup> <https://www.cbs.nl/nl-nl/nieuws/2019/16/energieverbruik-gedaald-in-2018>

<sup>5</sup> [http://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=nrg\\_100a](http://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=nrg_100a)

<sup>6</sup> Gas-fired greenhouses have greatly contributed to turning the Netherlands into the second largest agricultural exporter in the world by value. See <https://www.nationalgeographic.com/magazine/2017/09/holland-agriculture-sustainable-farming>

<sup>7</sup> <https://statline.cbs.nl/Statweb/publication/?DM=SLNL&PA=83140NED>

<sup>8</sup> <https://www.cbs.nl/nl-nl/nieuws/2019/16/energieverbruik-gedaald-in-2018>. For Groningen gas 1 Bcm = 35.17 PJ.

domestic). Rapidly falling domestic production (about 1162 PJ in 2018) implied that the Netherlands will be a net gas importer from 2018 onwards<sup>9</sup>.

State revenues from all gas production in the Netherlands totals almost € 417 billion since the start of Groningen in 1963 to 2018 (adjusted for inflation), according to figures from the Central Bureau of Statistics<sup>10</sup>. From 1970 to 2015, state revenues from gas production accounted for about 3-10 per cent of state income. In the 1980s, gas revenues reached close to 10 per cent of total state income, associated with a period of relatively low industrial activity and relatively generous welfare payments, which became known as the 'Dutch disease'<sup>11</sup>. In recent years the share of gas revenue in state income has declined to record low levels, as a result of both reduced production and relatively low gas prices since 2014. In 2017 and 2018, gas production contributed less than one per cent of GDP.<sup>12</sup> As a result, the direct financial consequences of the cessation of Groningen gas production are not expected to affect the Dutch economy greatly.

- **Prospects for the future**

Since 1991, Groningen gas production has resulted in earthquakes which have gradually increased in number and magnitude over time. The 3.6 magnitude earthquake in 2012 near the village of Huizinge (the largest earthquake so far) was a turning point. Following Huizinge, Groningen gas production started encountering more and more public resistance<sup>13</sup>. People with damaged houses having trouble getting compensated received widespread sympathy in the Netherlands. For policymakers, environmental and safety considerations started to outweigh financial and economic considerations.

Electurally, by 2018 it had become very difficult to defend continuation of Groningen gas production. The developments bore some similarity to the Atomausstieg (nuclear phase-out) in Germany, where the resistance of the German population against nuclear power led the Merkel government to decide, in 2011, to phase out nuclear power generation.

As a result of a ruling in 2015 of the Raad van State<sup>14</sup> (the Council of state; the Dutch supreme administrative court), stating that people in Groningen should not be subjected to risks greater than those deemed to be the maximum acceptable, for example people living in flood prone areas, and the government was forced to implement a series of gradually lower production caps for the field. The maximum production was gradually lowered to about 19.4 Bcm in 2019 (for comparison: production in 2013 was still over 50 Bcm<sup>15</sup>), the minimum level needed to meet local demand and export contracts.

When another earthquake occurred in the village of Zeerijp on 8 January 2018 with a magnitude of 3.4, the government announced its decision to stop natural gas production from the Groningen field altogether (as soon as demand for Groningen gas allows) on 29 March 2018<sup>16</sup>. This decision implies that production will stop by 2030 at the latest, and that no more than about 2300 Bcm will be produced out of the field. In other words, no more than some 80 Bcm will be produced from the Groningen field between 2019 and 2030. (The figure could even be lower, if production stops earlier, by 2025, as some would like to see.)<sup>17</sup>

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<sup>9</sup> <https://opendata.cbs.nl/statline/#/CBS/nl/dataset/83140NED/table?ts=1556359002966>

<sup>10</sup> <https://www.cbs.nl/nl-nl/nieuws/2019/22/aardgasbaten-uit-gaswinning-bijna-417-miljard-euro>

<sup>11</sup> Mulder, M. and Perey, P. (2018). 'Gas production and earthquakes in Groningen: reflections on economic and social consequences', Centre for Energy & Economics Research, University of Groningen. [https://www.rug.nl/research/portal/publications/groningen-gas-field-in-the-european-gas-market\(3e92079b-2018-4f26-b809-3a6e0e92e09f\).html](https://www.rug.nl/research/portal/publications/groningen-gas-field-in-the-european-gas-market(3e92079b-2018-4f26-b809-3a6e0e92e09f).html)

<sup>12</sup> <https://www.cbs.nl/nl-nl/nieuws/2019/22/aardgasbaten-uit-gaswinning-bijna-417-miljard-euro>

<sup>13</sup> <https://hcss.nl/report/groningen-gas-loss-social-license-operate>

<sup>14</sup> <https://www.raadvanstate.nl/pers/persberichten/tekst-persbericht.html?id=790>

<sup>15</sup> Figures for Groningen production can be found on the website of NAM: [https://www.nam.nl/feiten-en-cijfers/gaswinning.html#iframe=L2VtYmVkl2NvbXBvbmVudC8\\_aWQ9Z2Fzd2lubmluZw](https://www.nam.nl/feiten-en-cijfers/gaswinning.html#iframe=L2VtYmVkl2NvbXBvbmVudC8_aWQ9Z2Fzd2lubmluZw)

<sup>16</sup> <https://www.rijksoverheid.nl/documenten/kamerstukken/2018/03/29/kamerbrief-over-gaswinning-groningen>

<sup>17</sup> New earthquakes in May and June 2019 have prompted the government to investigate whether the decrease in production from the Groningen field can be accelerated. Minister of Economic Affairs Eric Wiebes announced on 17 June 2019 that the production level in 2020, now set at 15.9 Bcm, may be reduced to 12.8 Bcm and possibly to 12 Bcm. Wiebes promised the

In order to rapidly reduce the demand for Groningen gas and make a cessation of production possible a number of measures were taken:

1. A new mining law, published in June 2018<sup>18</sup> and approved by both Chambers of Parliament in July and October 2018<sup>19</sup>, will transfer full, unilateral control over Groningen production levels to the government<sup>20</sup> (before this law was adopted, the government and NAM would consult about production levels, although the government had final say).
2. The government has also decided to build an additional nitrogen plant to increase the capacity to convert imported gas to Groningen specification L-gas with high nitrogen content<sup>21</sup>. Groningen gas has a relatively high nitrogen content of about 14 per cent (and is being referred to as low-calorific or L-gas), which sets it apart from most other sources of natural gas. As a result, the Netherlands has two gas systems: one for Groningen gas (L-gas) and one for high-calorific gas (H-gas), with a low nitrogen content, produced from small Dutch fields or imported. Heating of houses is done exclusively with L-gas, complicating a rapid phase-out of Groningen gas. The nitrogen plant is expected to be ready by 2022. Pressure has been exerted on large industrial users to switch from L-gas to other sources of energy no later than 2022 (in practice this will usually be H-gas). Heating by gas in new houses is, in principle, no longer permitted and requires an exemption<sup>22</sup>.

On 3 December 2018, the Minister of Economic Affairs and Climate (EZK), Eric Wiebes, informed Parliament that the Groningen phase-out was proceeding according to plan<sup>23</sup>. He expected gas production from Groningen to be less than five Bcm by 2023 and to be completely ended soon thereafter.

It should be noted that, at the time of writing (June 2019), the measures curtailing Groningen production are leading to a switch from Groningen gas to imported (primarily Russian) gas rather than a decrease of gas consumption. The Netherlands became a net importer of gas in 2018<sup>24</sup>. Within the EU, the decrease of Dutch gas production since 2014 has been of similar magnitude to the increase of Russian gas imports (both roughly 40 Bcm).

The production from Dutch small gas fields is expected to decline over the coming decade and to virtually cease in the 2030s<sup>25</sup>. This decline is being caused by a combination of factors: geology; a relatively unattractive tax system; complex and time consuming regulations to obtain permits under the new mining law, and the growing resistance in Dutch society against gas production from small fields. Exploration and development drilling activity levels are about 20-30 per cent of what they were a decade ago<sup>26</sup>.

The clear-cut measures taken to stop Groningen gas production stand in sharp contrast to the much broader and far-reaching climate policy measures which are still being formulated and have hardly been implemented yet.

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government would take the necessary measures to make this possible.

<https://www.rijksoverheid.nl/actueel/nieuws/2019/06/17/gaswinning-groningen-volgend-jaar-mogelijk-al-richting-12-miljard-kuub>

<sup>18</sup> <https://zoek.officielebekendmakingen.nl/kst-34957-3.html>

<sup>19</sup> <https://www.rtvnoord.nl/nieuws/200144/Eerste-Kamer-stemt-in-met-Mijnbouwwet>

<sup>20</sup> <https://www.internetconsultatie.nl/groningenveld>

<sup>21</sup> <https://www.gasunie.nl/en/news/gasunie-prepares-new-nitrogen-plant-to-facilitate-gas-extraction>

<sup>22</sup> <https://zoek.officielebekendmakingen.nl/kst-34627-39.html>

<sup>23</sup> <https://www.rijksoverheid.nl/onderwerpen/gaswinning-in-groningen/documenten/kamerstukken/2018/12/03/kamerbrief-tussentijdse-voortgangsrapportage-maatregelen-afbouw-gaswinning-groningen>

<sup>24</sup> <https://jaarverslag2018.gasterra.nl/>

<sup>25</sup> <https://energypost.eu/wake-call-production-dutch-small-gas-fields-rapidly-declining/>

<sup>26</sup> <https://kennisbank.ebn.nl/focus-2018-energie-in-beweging/>

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## 2. Dutch climate policy and the implications for natural gas

- **Energy Accord (2013)**

Until 2012-2013, the role of natural gas in the Dutch energy system was rarely questioned in public and political climate and energy debates<sup>27</sup>. The existence of a large gas sector and infrastructure was mostly seen as a blessing, although some critics did point out that the prominent position of gas was a major reason why the Netherlands was slow in ramping up its share of renewable energy compared to other EU member states, such as Germany.

Typical of this 'benign neglect' of natural gas was the Energy Accord<sup>28</sup> ('the Agreement on Energy for Sustainable Growth') presented on 6 September 2013 by the Social and Economic Council of the Netherlands (SER), an official advisory body to the Dutch government. The Accord was the product of nine months of negotiations between 40 NGOs, business associations, local authorities and the energy industry which had been asked by the government to show how the Netherlands could increase its renewable energy share and energy savings. Although the Energy Accord was a key policy document, which still forms the basis of the Dutch energy policy and the subsidy regime for renewable energy, it had very little to say about natural gas. It mentions in passing that biogas and power-to-gas (hydrogen) could play a role in achieving higher shares of renewable energy, but no measures are proposed to boost their production nor are any measures proposed to either encourage or discourage natural gas consumption or production.

- **Coalition agreement (2017)**

By 2017 this picture had changed completely. Following elections in March 2017, a four-party coalition government was formed, which presented a detailed coalition agreement<sup>29</sup> in October 2017 that outlines government policies for the four-year cabinet period. This agreement contains ambitious climate policy targets and devotes considerable attention to natural gas.

In the agreement, the new government sets a greenhouse gas emission reduction target of 49 per cent by 2030 (compared to 1990) – more than the 40 per cent target adopted at EU level.<sup>30</sup> It also announces that the government will initiate the creation of a national Climate and Energy Accord, to show how this 49 per cent target can be reached (see below).

According to the coalition agreement, the 49 per cent target implies an additional reduction of greenhouse gas emissions of 48.7 mt by 2030. This amount was divided over the different sectors as seen in Table 1.

The coalition agreement does not spell out the implications for natural gas of the emission reduction targets, but it does specify a number of measures that will be taken to reduce gas consumption and production.

With regard to the buildings sector, it states that 'at the end of the cabinet period [2021] new houses and other new buildings will as a rule not be heated by natural gas anymore'. It also says that the government wants to make 30,000 to 50,000 existing houses 'natural gas free', which is seen as 'a first step towards making 200,000 houses per year sustainable<sup>31</sup>, a rate that is needed to make the entire housing stock of 6 million in the Netherlands sustainable by 2050.<sup>32</sup>

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<sup>27</sup> The earthquake in the town of Huizinge on 16 August 2012 may be regarded as a turning point.

<sup>28</sup> <https://www.energieakkoordser.nl/energieakkoord.aspx>

<sup>29</sup> <https://www.rijksoverheid.nl/documenten/publicaties/2017/10/10/regeerakkoord-2017-vertrouwen-in-de-toekomst>

<sup>30</sup> The Netherlands reduced its greenhouse gas emissions by 13% in the period 1990-2017

<https://www.clo.nl/indicatoren/nl0165-broeikasgasemissies-in-nederland>

<sup>31</sup> 'Making sustainable' is a term frequently used in the Coalition Agreement as well as the Climate Accord. It is not precisely defined, but it can be inferred from the text that it generally means 'achieving the agreed-upon CO2 reduction targets'.

<sup>32</sup> The figure of six million houses seems to be wrong. According to the Central Bureau of Statistics there were 7,686,178 houses in the Netherlands at the end of 2017 <https://opendata.cbs.nl/statline/#/CBS/nl/dataset/82900NED/table?fromstatweb>

**Table 1: Indicative allocation in terms of the 49 per cent reduction target**

Sector	Indicative allocation in terms of the 49% reduction target (in Mt of carbon dioxide equivalents as of 2030)*
Industry	14.3
Mobility	7.3
Built environment	3.4
Electricity	20.2
Agriculture and land use	3.5**

(\*) Including the effects of the circular economy.

(\*\*) Including 1.5 Mt of reduction from land use that does not count toward achieving the 49% reduction.

Note that these targets are additional to the targets already included in existing climate policies. Thus, for example, the total emission reduction target for industry is around 20 mt compared to 1990: 5.7 mt based on existing policies plus 14.3 mt under the coalition agreement.<sup>33</sup>

Source: NECP (National Energy and Climate Plan 2021-2030)<sup>34</sup>.

Clearly for the government making houses ‘sustainable’ implies disconnecting them from natural gas. The coalition agreement further says that ‘when gas grids need to be replaced, the grid operator will discuss with the local authorities how future energy demand can be met.’

On domestic gas production, the coalition agreement states that ‘measures will be taken to reduce the need for Groningen gas’. (The coalition agreement pre-dated the March 2018 announcement of a complete cessation of Groningen gas production.) The agreement promises a further reduction of production from the Groningen field by three Bcm by 2021 compared to 2017. After 2021, ‘a further reduction may be expected. Scenarios will be developed by the cabinet’.

The government also promises to ‘discuss with large gas users how they can reduce the use of natural gas as feedstock and fuel in industry.’ In addition, the coalition agreement states that ‘no new licences for onshore gas exploration will be issued’ during the cabinet period.

- **Climate Accord (2018)**

As agreed in the coalition agreement, in March 2018 the cabinet launched negotiations over a National Climate and Energy Accord. Selected representatives from industry, labour, environmentalist NGO’s, municipal and provincial authorities were given the task to reach consensus on the measures to be taken in each of the five sectors (industry, mobility, buildings, electricity, agriculture) to achieve the emission reductions for 2030 agreed upon in the coalition agreement (see Table 1).

A final draft of the Climate Accord was published on 21 December 2018<sup>35</sup>, followed by a final cabinet-approved text on 28 June 2019<sup>36</sup>. Under the coalition agreement, the Accord is to be the centrepiece of Dutch climate policy and it will also serve as the basis of the final integrated National Energy and Climate Plan (NECP) that the Netherlands has to submit to the European Commission by the end of 2019.

Below we discuss the major measures in the Climate Accord that are relevant to the gas sector.

<sup>33</sup> See the text of the Climate Accord, p. 91 <https://www.klimaataakkoord.nl/documenten/publicaties/2018/12/21/ontwerp-klimaataakkoord>

<sup>34</sup> [https://ec.europa.eu/energy/sites/ener/files/documents/netherlands\\_draftnecp\\_en.pdf.pdf](https://ec.europa.eu/energy/sites/ener/files/documents/netherlands_draftnecp_en.pdf.pdf)

<sup>35</sup> <https://www.klimaataakkoord.nl/>

<sup>36</sup> <https://www.klimaataakkoord.nl/documenten/publicaties/2019/06/28/klimaataakkoord>

## Buildings

Currently some 95 per cent of buildings in the Netherlands are heated by natural gas. The Accord envisages a major transformation for the entire building stock of about 7.7 million houses<sup>37</sup> and about one million other buildings by 2050, with an intermediate target of 1.5 million houses by 2030. These buildings will be made 'sustainable', according to the Accord, through a wide variety of measures.<sup>38</sup> Achieving the intermediate target should lead to 2.4 mt of emission reductions in the residential sector. For the non-residential sector measures are proposed, mostly consisting of new efficiency standards, which should contribute another one mt of reductions by 2030.

Implementation of this part of the Accord will be the responsibility of local authorities. The Netherlands will be divided into 30 regions which will be asked to develop 'regional energy strategies' (RES's). The idea is that different stakeholders, including municipal and provincial authorities, housing corporations, energy companies, business associations, citizen groups, and water boards, will cooperate and decide democratically on the 'best' ways to increase renewable electricity production and make the building stock 'sustainable'.

Indicatively, new heating systems are expected to be about 50 per cent district heating networks (about five per cent in 2019) and 50 per cent heat pumps, half of which will be all-electric and half hybrid (i.e. a combination of electric and gas-fired). Heat sources for the district heating network may be industrial waste heat, geothermal energy, solar, biomass, power to heat or biogas. The remaining gas used in hybrid heat pumps will be biogas or some other renewable alternative, such as hydrogen. By 2030, 'green gas' (mainly biogas or biomethane) is expected to deliver 70 PJ (two Bcm). Total energy use for heating in the buildings sector was 490 PJ (13.93 Bcm) in 2018, according to EBN (Energie Beheer Nederland)<sup>39</sup>, of which 85 per cent was supplied by natural gas.

Taxes on natural gas consumption are to be gradually increased (€0.04 cts/m<sup>3</sup> in 2020 and €0.01/m<sup>3</sup> per year in the six years thereafter) and taxes on electricity use are to be lowered, to stimulate households to reduce natural gas consumption. This will be done in a 'budget-neutral' manner, i.e. the increase in gas taxes will be fully compensated by a decrease in electricity taxes. New buildings will 'in principle' not be connected to the gas grid anymore, although the Accord does allow exceptions.

## Industry

The energy-intensive industrial sector in the Netherlands (chemical industry, refineries, steel, etc.) is a large user of gas. Industry uses 46 per cent (1115 PJ/31.7 Bcm) of all primary energy in the Netherlands, compared to the buildings sector 28 per cent and the transport sector 20 per cent. Of this 46 per cent, almost a quarter (270.2 PJ/7.68 Bcm) is supplied by natural gas.<sup>40</sup>

The Climate Accord includes ambitious long-term plans for industry: the 2050 goal is 'climate-neutral production in a circular economy'<sup>41</sup>. Activities that do not fit into this plan and are unable to reduce emissions 'will probably have to disappear in the longer term', says the Accord. At the same time, the Accord notes that 'Dutch companies must be able to continue to compete with companies in other countries'.

The draft Accord proposed a 'carrot-and-stick scheme' (i.e. to penalise high emissions and reward emission reduction) to regulate CO<sub>2</sub> emissions of industry, in combination with obligatory CO<sub>2</sub> emission reduction plans, but after an official assessment<sup>42</sup> of the draft Accord by the Netherlands

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<sup>37</sup><https://statline.cbs.nl/Statweb/publication/?DM=SLNL&PA=82900NED&D1=a&D2=0&D3=0,75,187,361,412&D4=a&HDR=T&STB=G1,G2,G3&VW=T>

<sup>38</sup> This term is not defined, but from the text of the Climate Accord it may be inferred that achieving the agreed-upon emission reduction targets is viewed as being 'sustainable'.

<sup>39</sup> <http://www.energieinnederland.nl/download>

<sup>40</sup> <http://www.energieinnederland.nl/download>

<sup>41</sup> This is a literal quote from the Climate Accord. No precise definition is given.

<sup>42</sup> <https://www.pbl.nl/publicaties/effecten-ontwerp-klimaataakkoord>

Environment Assessment Agency (PBL), on 13 March 2019, concluded that this proposal was too complex, the final Accord now includes a CO<sub>2</sub>-tax for industry.

Starting in 2021, a CO<sub>2</sub> tax will be imposed on energy-intensive industry (some 500 companies) of €30 per ton, which will be 'linearly increased' to €125-150/ton by 2030. The tax is 'inclusive' of the CO<sub>2</sub> price that industry has to pay under the EU Emission Trading System (ETS), i.e. the ETS price will be deducted from the tax.

According to the website of the Climate Accord, the Netherlands is the only country in Europe, and perhaps even the world, that will impose a separate CO<sub>2</sub> tax on its industry<sup>43</sup>. However, the cabinet introduced a number of measures to prevent the risk of 'leakage' (industry transferring activities to other countries). Independent assessments of the effects of the CO<sub>2</sub> tax will be made in 2020 and 2025. In addition, revenues from the tax will be used to compensate industry and, if necessary, individual measures will be taken to assist companies which are threatened with job losses as a result of the tax.<sup>44</sup>

To achieve the target of 20 mt of emission reductions by 2030 (see Table 1), the Accord proposes five types of measures that are expected to contribute to the target in the following way:

- |  |      |
|--|------|
| • Carbon capture and storage (CCS)                             | 7 mt |
| • Process efficiency (substituting waste heat for natural gas) | 6 mt |
| • Electrification and 'green' hydrogen                         | 4 mt |
| • Nitrous oxide and F-gases                                    | 2 mt |
| • Recycling and bio-based alternatives                         | 1 mt |

The Accord estimates that industry will have to invest between €nine and €15 billion until 2030 to contribute 'directly or indirectly' to meeting the climate targets. According to the Accord, industry itself must bear 'the largest part' of the expense involved in its own energy transition.

At the same time, the Accord promises financial support to industry of up to €550 million/year by 2030. Part of this budget is allocated to CCS and carbon capture utilization and storage (CCUS), although in the final text of the Accord the amount of subsidy for CCS has been limited in three ways. First, CCS projects will only be supported in cases where there is no cost-effective alternative available. Second, support for CCS projects will not exceed 7.2 mt of CO<sub>2</sub>-reductions. Third, no CCS projects will be supported after 2035. Subsurface CO<sub>2</sub> storage from CCS will be limited to offshore locations.<sup>45</sup>

## Electricity

This is the segment with the largest 2030 emission reduction target by far. This is made possible as a result of the government's decision, made in the 2017 coalition agreement, to phase out coal-fired power generation entirely by 2030.

The Climate Accord aims at 70 per cent of renewable power generation by 2030 (this share was about 18 per cent at the end of 2018<sup>46</sup>). Offshore wind is expected to be responsible for about 60 per cent of 2030 carbon free electricity production; onshore wind and solar each for about 20 per cent.

For the period 2030-2050, a further rapid growth of offshore wind is envisaged with an increasing amount of conversion to carriers other than electricity – in particular hydrogen.

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<sup>43</sup> The Climate Accord website states that 'no other country in the EU has a separate CO<sub>2</sub> tax for industry. Countries with a national CO<sub>2</sub> tax, such as Great Britain and Sweden, have exempted their industries from it.'  
<https://www.klimaatakkoord.nl/industrie/vraag-en-antwoord/co2-heffing>.

<sup>44</sup> The cabinet explained the logic behind the CO<sub>2</sub>-tax in a letter to Parliament on 28 June 2019:  
<https://www.rijksoverheid.nl/ministeries/ministerie-van-economische-zaken-en-klimaat/documenten/kamerstukken/2019/06/28/kamerbrief-voorstel-voor-een-klimaatakkoord>

<sup>45</sup> Subsidies for CCS are controversial in the Netherlands. They were a major reason for Greenpeace, one of the negotiating parties, not to sign the final text of the draft Accord in December 2018.

<sup>46</sup> <https://www.en-tran-ce.org/custom/uploads/2019/02/Renewable-Energy-January-2019.pdf>

A greater share of electricity in final energy demand and a greater share of renewables in electricity implies major modifications and additions to the existing electricity grid. Providing a reliable backup source for electricity, in particular on a seasonal basis, is the other major challenge. By 2030 the Dutch electricity system is expected to require 44 TWh of dispatchable electricity production (of which 17 TWh is envisaged to be emission free). What a combined Dutch electron–molecules system will look like in future is as yet quite unclear as is the extent to which interconnections with other countries and flexible demand can play a role. (See Section 4.)

Nuclear energy is not included in the Climate Accord as a possible additional source of CO<sub>2</sub>-free electricity. According to the Climate Council (Dutch: klimaatberaad), the government-appointed body responsible for coordinating the Climate Accord, nuclear energy was not excluded from the negotiations, but given the time it takes to build a new nuclear power station, it was not regarded as a feasible option to contribute to targets for 2030.<sup>47</sup>

## Hydrogen

The Climate Accord contains a special section on hydrogen, which says that ‘the Netherlands aims to be a hydrogen leader’.

According to the Accord, hydrogen could have five uses:

- As CO<sub>2</sub>-free feedstock for industry.
- As a CO<sub>2</sub>-free energy carrier for high-temperature heat in industry
- As a flexible CO<sub>2</sub>-free energy storage
- As an energy source in heavy transport
- As a heat source in the buildings sector for which there are no other feasible alternatives.

The Accord notes that policy will aim ‘as much as possible’ at expanding ‘green hydrogen’ production, i.e. based on electrolysis with renewable energy sources. Production of ‘blue hydrogen’ (based on natural gas with CCS) will be stimulated only if it contributes to ‘the development of a hydrogen system without hindering the growth of green hydrogen.’

According to the Accord, a ‘substantial hydrogen programme will be started’, consisting of three phases: a preparatory phase (2019-2021), in which a number of studies and pilot projects will be carried out; a developmental phase (2022-2025) that should see electrolysis capacity scaled up to 500 MW (from currently virtually zero), and a third phase (2026-2030) which should see electrolysis capacity expanded further to 3-4 GW. The cabinet will make €30-40 million available for the first phase. There is no indication in the Accord how the second and third phases will be financed or who is responsible for building the electrolysis facilities.

### • Assessment of Climate Accord

On 13 March 2019, the Netherlands Environment Assessment Agency (PBL), an official government body, published an assessment<sup>48</sup> of the final draft of the Climate Accord at the request of the government, aimed at assessing to what extent the measures in the Accord would be likely to achieve the emission reduction targets and what their costs would be.

PBL concluded that the proposed measures could be expected to lead to a reduction of between 31 and 52 mt Co<sub>2</sub>eq by 2030, adding that the target of 49 mt would be unlikely to be met. It also concluded (on p. 67) that, with the measures in the Climate Accord, some 250,000 to 1,070,000 buildings could be made ‘sustainable’ by 2030, i.e. far short of the target of 1.5 million.

With regard to costs, PBL concluded that ‘national costs’ of the measures in the Climate Accord – defined as net costs for ‘society as a whole, regardless of who has to pay for them’ – will be between

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<sup>47</sup> <https://www.klimaataakkoord.nl/actueel/nieuws/2018/06/12/kernenergie>

<sup>48</sup> <https://www.pbl.nl/publicaties/effecten-ontwerp-klimaataakkoord>

€1.6 and €1.9 billion on an annual basis by 2030. That figure, however, is additional to the costs that would have been incurred if there had been no Climate Accord, notes PBL. This is called the 'reference scenario'. However, PBL did not estimate costs of this reference scenario, which is therefore unknown (but the subject of fierce debate between experts)<sup>49</sup>.

In a letter to Parliament<sup>50</sup> accompanying the publication of the Climate Accord on 28 June 2019, the cabinet states that the additional measures proposed in the final text of the Climate Accord, such as the CO<sub>2</sub>-tax on industry, will make it likely that the 2030 targets will be met, although no figures are given to substantiate this claim.

- **Conclusions**

Implementation of the Climate Accord would lead to a complete phaseout of consumption of unabated natural gas in the Netherlands by 2050.

Implications for gas demand in the decades to 2050 are uncertain. For the buildings sector and industry, gas demand will depend strongly on the success of the various measures proposed in the Accord (see Section 4).

The implementation of a significant CCS programme could make it possible for industry to continue to use natural gas, after conversion to hydrogen, but it is highly unclear whether a CCS programme will get off the ground and how big it will be (see Section 3).

The 'sustainability' drive in the buildings sector is likely to encounter a lot of difficulties and will probably take considerably longer than is envisaged now, implying that natural gas will still be used for the heating of buildings for at least the next decade, and probably beyond (see Section 4).

With regard to the electricity sector, the closure of the coal-fired power stations (two by 2025 and three by 2030 at the latest)<sup>51</sup> is likely to lead to a continued, perhaps even expanded, need for gas-fired power as a supplement and back-up for renewable power. Nevertheless, as the share of renewable energy grows and investments are made in grid stability measures and decentralised electricity generation, the role of gas-fired power will start to decline and be reduced to zero by 2050.

### 3. The response of the Dutch gas industry

- **New strategy: Gas by Design**

When the combination of the Groningen earthquakes (particularly after the major Huizinge earthquake on 16 August 2012) and climate concerns (which received a strong impetus after the Paris Agreement on 12 December 2015) suddenly made natural gas unpopular in the Netherlands, the industry realised that it had entered a different world. Business as usual was no longer an option.

For the Dutch gas industry this was a new situation. As we discussed in Section 2, until now, the role of natural gas had never been seriously questioned in public energy and climate debates.

The industry realised it had to come up with a response. Representatives from the major players in the sector, united in industry associations KVGN (the Royal Association of Gas Companies in the Netherlands, including Shell, Gasunie and Gastera) and NOGEPa (the association for oil and gas exploration and production companies, including NAM), initiated a series of discussions to come up with a new strategy to regain their 'licence to operate'.

The new strategy was developed during 2016 by KVGN and NOGEPa, together with EBN the state-owned company that by law participates in all upstream oil and gas projects in the Netherlands, and

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<sup>49</sup> <https://www.naturalgasworld.com/gas-transitions-the-flaws-in-dutch-climate-policy-68769>

<sup>50</sup> <https://www.rijksoverheid.nl/documenten/kamerstukken/2019/06/28/kamerbrief-voorstel-voor-een-klimaataakkoord>

<sup>51</sup> <https://nos.nl/artikel/2232450-twee-oudste-kolencentrales-dicht-in-2025.html>

was officially launched by KVGN on 26 January 2017 in the form of the so-called GILDE Agenda<sup>52</sup>. It was accompanied by a policy brief called ‘Gas op maat’<sup>53</sup> (in English: Gas by Design<sup>54</sup>), a title which summed up the basic idea behind the strategy.

According to the policy brief, the industry acknowledged that natural gas would no longer be the ‘default solution’, but

‘will only be used when more sustainable alternatives are not readily available and when it provides the best value for society and the end-user. We call this: ‘Gas by Design’. With this tailored approach for natural gas, together with on-going innovation in the sector, the use of renewable gases and smart interaction with other sources of energy, the entire energy supply can become climate-neutral, while also remaining reliable and affordable for all.’

Concretely, this meant that by 2050,

‘the role of gas in the energy system is expected to become a combination of sustainable gases such as green gas<sup>55</sup> and hydrogen, and in specific cases converted into methane. Natural gas will only be used when emissions can be captured.’

Although the new strategy seemed to accept a much-reduced use of natural gas – and a much reduced role for the gas industry – it could also be interpreted as an ingenious way for the industry to attempt to maintain its role in a low-carbon future.

First of all, the strategy did make a case for the use of natural gas as a ‘bridge fuel’ in those cases where it would lead to lower emissions, for example in the transport sector, especially in heavy-vehicle transport and shipping, and in the heating of ‘existing buildings’ with ‘hybrid heat pumps’.

It also suggested to ‘make use of depleted small fields in the North Sea as well as the infrastructure there’, for example, for transport and storage of CO<sub>2</sub>, and to ‘ensure optimum use of existing gas reserves up to 2050.’ Importantly, it further recommended to ‘make full use of the existing gas infrastructure. Once infrastructure has been removed, it can no longer contribute to the energy transition (for example for the transport of biogas, CO<sub>2</sub> and hydrogen).’

In developing its strategy, the industry associations no doubt took into account that Dutch gas production was bound to enter a period of natural decline in any case. At the time they announced their new strategy (2017), the industry assumed that production from the Groningen field would continue for a few more decades and that likewise the ‘small fields’ would continue to produce for another 20 to 30 years before they were depleted. Thus, the strategy anticipated a gradually diminishing role for the industry that was pretty much unavoidable anyway and, at the same time, sought to define new activities, e.g. in infrastructure and ‘alternative’ gases (biogas, biomethane, hydrogen), that would give it a new lease of life.

Whether the strategy will be successful remains to be seen. There is still strong pressure from policymakers and the public in the Netherlands to phase out the role of natural gas as quickly as possible rather than gradually (as evidenced by the government’s decision to close Groningen) and continued exploration and production of natural gas remains mired in controversy. In September 2017, in an attempt to increase public acceptance for new onshore gas exploration projects, industry association NOGEPA felt it necessary to adopt, for the first time, an industry-wide Code of Conduct<sup>56</sup>.

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<sup>52</sup> <https://kvgn.nl/nieuws/gilde-agenda/>

<sup>53</sup> <https://kvgn.nl/wp-content/uploads/2016/10/gas-op-maat-pp.pdf>

<sup>54</sup> <https://kvgn.nl/wp-content/uploads/2016/10/kvgn-gas-by-design.pdf>

<sup>55</sup> Green gas is not defined anywhere in the document. It presumably means biogas in this context.

<sup>56</sup> <https://www.nogepa.nl/gedragscode/?lang=en>. For example, the code of conduct mandates that for every new gas field a consultation programme will be set up which will involve representatives from the industry, local government and private citizens.

NOGEPa also proposed using part of the state revenues from gas production to develop local low-carbon energy projects.<sup>57</sup>

- **'New gas' activities**

If the Dutch gas industry's strategy is successful, what will its future look like?

According to the GILDE Agenda and other publications, the following activities could emerge as alternatives to the traditional natural gas business:

- Production, transport and sales of 'green gas' and 'renewable gas' (biogas, biomethane, 'green' hydrogen)<sup>58</sup>
- Production and sales of 'blue hydrogen' (i.e. based on natural gas, combined with capture, transport and storage (or re-use) of CO<sub>2</sub>)
- Offshore energy integration (in the North Sea), i.e. using gas production platforms and infrastructure to support renewable energy generation, mainly offshore wind
- Supporting production and transport of 'deep geothermal' energy<sup>59</sup>
- Contributing to sustainable heating of buildings, e.g. with hybrid heat pumps
- Supporting the construction of large-scale district heating networks
- Production and sales of LNG for use in heavy transport

Needless to say, the economic potential of these activities, which are all still at an early development stage, and the contribution the gas industry can make to them, is still subject to large uncertainty.

One way the gas industry has been exploring these possible new opportunities thus far is through participation in government-supported innovation programmes. The main government-sponsored innovation support programme in the Netherlands goes by the name of Topsectorenbeleid<sup>60</sup> – 'policy for top sectors', which began in 2011. Under this policy the government brings together business, universities, research centres and government agencies to promote expertise, innovation, and exports in nine different ('top') sectors, one of which is Energy.

Under the Top Sector Energy (TSE) scheme, groups known as 'top consortia for knowledge and innovation' (known in Dutch as TKIs) are set up and their task is to pool expertise, promote new initiatives and earmark funds for R&D projects. The Top Sector Energy scheme includes five TKIs, including TKI Gas, which in 2018 changed its name to TKI New Gas.

Under TKI New Gas seven innovation programmes have been set up in recent years in which researchers and public and private parties are being brought together to initiate projects: Green Gas, Hydrogen, CC(U)S, North Sea, Geo-energy, Upstream Gas and Small-scale LNG. Most of the efforts within these programmes have concentrated on producing studies and 'roadmaps'. We will briefly discuss the results to date of the programmes for Green Gas, Hydrogen, CCUS, North Sea Energy and Geo-Energy.

### **Green Gas programme**

Under the Green Gas programme, some 125 stakeholders – including two ministries, the port of Rotterdam, research institutes TNO and ECN, Wageningen University, and companies like DSM, Akzo Nobel, Cosun, Friesland Campina and Gasunie – collaborate in an association called Green Gas Netherlands<sup>61</sup>.

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<sup>57</sup> Personal communication.

<sup>58</sup> No exact definitions are given for the various terms used in the GILDE document. 'Green' or 'renewable' gas refers to gas derived from biological sources (biogas, biomethane), 'green hydrogen' is hydrogen derived from electrolysis based on renewable power.

<sup>59</sup> The gas industry believes its geological know-how can be deployed in the development of geothermal energy.

<sup>60</sup> <https://www.topsectoren.nl/>

<sup>61</sup> <https://groengas.nl/>

In 2014, Green Gas Netherlands published a first roadmap (Routekaart Hernieuwbaar Gas<sup>62</sup>) which concluded that the potential for domestic biogas production from fermentation was 1.2 Bcm in 2020 and 3.7 Bcm in 2030, compared to production of just 100 million cubic metres (MMcm) in 2017.

On 23 April 2018, Green Gas Netherlands published a new roadmap, Green Liaisons<sup>63</sup>, which confirmed that by 2030 3.61 Bcm of 'renewable gas' could be produced (defined as all gas based on renewable sources such as biomass, solar and wind power), which could be increased to 11.92 Bcm in 2050. According to this new roadmap, more than half (6 Bcm) of the 2050 potential could be delivered by supercritical water gasification, described as a 'revolutionary' new technology. In December 2016, Gasunie New Energy – a subsidiary of Gasunie founded in 2014 to invest in sustainable energy – and SCW Energy started building the first pilot plant for supercritical gasification in the Netherlands, in Alkmaar, which started production in December 2018.<sup>64</sup>

According to the Green Liaisons roadmap, the consumption of 12 Bcm of 'green gas' by 2050 could lead to CO<sub>2</sub>-emission reductions of 16.5-17.5 mt, around nine per cent of current Dutch greenhouse gas emissions. If CCS is added, the CO<sub>2</sub>-reduction potential could be increased to 21.5-27.5 mt, according to the report.

The costs of emission reductions through 'renewable gas' are estimated at €120-270/ton CO<sub>2</sub>, but they can be reduced to €90-140/ton CO<sub>2</sub> by 2030, according to the report.

## Hydrogen programme

Under the hydrogen programme, stakeholders collaborate in the H<sub>2</sub> platform,<sup>65</sup> in which the Ministries of Infrastructure and Economic Affairs & Climate are involved, as well as companies like Shell, Gasunie, Tata Steel, Air Liquide, and others. The H<sub>2</sub> platform promotes both 'green' hydrogen (based on electrolysis) and 'blue' hydrogen (based on natural gas with CCS).

In May 2018, TKI New Gas published 'Outlines of a hydrogen roadmap'<sup>66</sup>, written by Jörg Gigler and Marcel Weeda, which concluded that 'investment is necessary now in pilot schemes and demonstration projects, so that experience can be built up - especially in industry and transport, the most promising markets for sustainable hydrogen.'<sup>67</sup>

Since 2018, a number of 'green hydrogen' initiatives have been announced. In October 2018, Engie and Gasunie announced that they would build a 100 MW electrolyser in the province of Groningen.<sup>68</sup> In the same month Tata Steel, Nouryon and the Port of Rotterdam announced<sup>69</sup> that they are investigating the feasibility of building a 100 MW electrolyser at the Tata Steel factory in IJmuiden, to be fed by offshore wind.

Nouryon and Gasunie are also planning to build a 20 MW water electrolysis facility in Delfzijl in the province of Groningen<sup>70</sup>. A FID on this project will be taken in 2019. Further, in February 2019, Nouryon and Gasunie announced that they have agreed to supply 'green hydrogen' to BioMCN, which will combine the hydrogen from this intended facility with CO<sub>2</sub> from other processes to produce

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<sup>62</sup> <https://groengas.nl/rapport/routekaart-hernieuwbaar-gas/>

<sup>63</sup> <https://groengas.nl/nieuws/rapport-green-liaisons-toont-belang-hernieuwbare-gassen-in-energie-en-grondstoffenhuishouding/>

<sup>64</sup> <https://www.gasunienewenergy.nl/projecten/scw>

<sup>65</sup> <https://opwegmetwaterstof.nl/>

<sup>66</sup> <https://www.topsectorenergie.nl/en/nieuws/sustainable-hydrogen-available-large-scale-2030>

<sup>67</sup> According to the roadmap, 'hydrogen is emerging as one of the pillars of the energy transition, in addition to all kinds of other sustainable and climate-neutral options.' However, the authors also note that 'there remain, for the time being, many challenges. The technology to produce and apply hydrogen (electrolysis, fuel cells, burners) is already available, but the cost price will have to drop considerably in order to compete with current, often fossil-based alternatives.'

<sup>68</sup> <https://www.gasunie.nl/nieuws/gasunie-en-engie-gaan-samenwerken-om-groene-waterstof-op-grote-schaal-mogelijk-te-maken>

<sup>69</sup> <https://www.portofamsterdam.com/en/press-release/nouryon-tata-steel-and-port-amsterdam-partner-develop-largest-green-hydrogen-cluster>

<sup>70</sup> <https://www.gasunie.nl/en/news/biomcn-to-produce-renewable-methanol-with-green-hydrogen>

renewable methanol<sup>71</sup>. On 26 June 2019, Gasunie opened a one MW electrolysis facility in Veendam in the province of Groningen, which the company described in a press release as 'the first step in creating the hydrogen supply chain of the future.'<sup>72</sup>

In November 2018, a more ambitious initiative was announced<sup>73</sup> by a consortium of 27 companies, research institutes, environmental organisations and local authorities – including transmission system operators Tennet (electricity) and Gasunie, distribution system operator Stedin, the city of Groningen, the ports of Rotterdam and Amsterdam, chemical company Nouryon, Tata Steel and Greenpeace – to build three to four GW of green hydrogen production capacity in the Netherlands by 2030. The Hydrogen Coalition, as it is called, said it wants to build five large electrolyzers throughout the country to realise this ambition, although no concrete projects have been announced.

### CCUS programme

CCUS and CCS activities in the Netherlands take place under the so-called CATO initiative, a national R&D programme for CO<sub>2</sub> capture, transport and storage in which a consortium of nearly 40 partners cooperate. The programme is funded by government institutions and industry and is now in its third phase.<sup>74</sup>

Several dozen CCS and CCUS projects have been identified and are in various stages of planning, but no final investment decision has been taken on any of them. The projects with the most potential are: the Magnum Power Plant<sup>75</sup>, H-Vision/Porthos<sup>76</sup> and Athos<sup>77</sup>.

Under the Magnum project, Mitsubishi Hitachi Power Systems, Equinor, Nuon/Vattenfall and Gasunie are converting one of the three 440 MW gas generators of the Magnum power station in the province of Groningen into a hydrogen-based generator. Equinor will supply hydrogen for the power station made from natural gas, and will store the CO<sub>2</sub> in an empty gas field off the Norwegian coast. The project is scheduled to become operational in 2023.

H-Vision is a plan for large-scale decarbonisation of natural gas used in the refining and chemicals sectors in and around the port of Rotterdam. Under this project, CO<sub>2</sub> is to be separated and used in the horticultural sector or stored in empty gas fields in the North Sea. The CO<sub>2</sub>-capture and storage part of the project is called Porthos. A FID on this plan is expected to be taken in 2020.

Athos is a similar plan in the Amsterdam region, in which CO<sub>2</sub> would be captured at the Tata Steel works in IJmuiden and possibly at the AEB waste incinerator in Amsterdam, and stored in empty gas fields or used in greenhouses in the region. This project is still in the planning stages.

### North Sea Energy programme

The North Sea Energy Initiative<sup>78</sup> is a combined effort of 'TKI New Gas' with 'TKI Offshore Wind'. Some 30 companies and research institutions collaborate in the programme, which was started in 2017. The programme seeks to combine the resources of the existing offshore oil and gas sector with the emerging offshore renewable energy sector.

Researchers have thus far identified the following potential 'energy uses' of the North Sea, many of which would involve gas industry resources:

- Offshore wind production

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<sup>71</sup> <https://www.gasunie.nl/en/news/biomcn-to-produce-renewable-methanol-with-green-hydrogen>

<sup>72</sup> <https://www.gasunie.nl/en/news/king-willem-alexander-opens-sustainable-hystock-hydrogen-plant>

<sup>73</sup> <https://www.greenpeace.org/nl/klimaatverandering/11314/waterstof-coalitie-eeen-duurzame-waterstofeconomie-in-2030/>

<sup>74</sup> <https://www.co2-cato.org/>

<sup>75</sup> <https://www.equinor.com/en/news/evaluating-conversion-natural-gas-hydrogen.html>

<sup>76</sup> <https://rotterdamccus.nl/en/>

<sup>77</sup> <https://energeia.nl/energeia-artikel/40066905/co2-opslag-noordzee-technisch-haalbaar-maar-overheidssteun-nodig>

<sup>78</sup> <https://www.north-sea-energy.eu/>

- Production of green hydrogen from offshore wind power (power-to-gas) both with offshore and onshore electrolysis
- Transport network to take hydrogen to key industrial hydrogen demand centres
- Conversion of offshore installations to other supporting functions
- Electrification of existing offshore installations by means of wind power ('wind meets gas')
- CO<sub>2</sub> storage in empty gas fields
- CO<sub>2</sub> transport network
- Creation of an offshore wind grid, including possibly an artificial island to serve as connection and distribution point for offshore wind turbines<sup>79</sup>
- Development of other alternative energy projects, for example wave and tidal power
- Construction, logistics and maintenance functions

An overview of the findings can be found in the North Sea Energy Atlas<sup>80</sup> on the website of the programme.

### Geo-energy programme

The Geo-energy programme<sup>81</sup> under TKI New Gas focuses on the development of geothermal energy and underground energy storage 'making use of the knowledge and expertise of the oil and gas sector'. It is aimed at deep (1250-4000 m) and ultradeep geothermal (>4000 m) projects.

Research<sup>82</sup> from TNO and EBN for TKI New Gas in May 2018 estimates that between 100 and 300 PJ of geothermal capacity could be developed in the Netherlands by 2030. In 2018, just three PJ of geothermal capacity had been developed. (To compare: total gas use in the Netherlands was 1294 PJ in 2018.) The researchers note that, for large parts of the Netherlands, the geothermal potential is not known at the moment.

#### • Conclusions

It may be concluded that the Dutch gas industry is responding in a proactive manner to the new realities facing it. The sector has jointly produced a new strategy that is envisioning a transition that, if successful, would see the natural gas industry take upon itself a new role as energy provider and 'enabler' in a zero-emission energy system.

However, this transition is still at a very early stage. The outcome of this process will depend partly on the policy choices that will be made by the Dutch government (which we will discuss in the next section) and partly on decisions taken by the industry itself. With the exception of Gasunie, no gas company has definitely committed to invest substantially in 'new gas' activities. This can be explained partly by the political uncertainty that still exists and the desire of the companies to first secure subsidies for new projects, and partly by the need for the gas companies to cooperate with players from other sectors to realise projects, which complicates decision-making.

According to an evaluation published on 21 September 2018 by TKI New Gas, called Outlook 2019<sup>83</sup>, the industry spent 2017 and 2018 mostly on developing various alternative-energy roadmaps, including for renewable gas, hydrogen, CCUS and geo-energy. 2019, said TKI New Gas, will be a 'transition year for the industry, as the Climate Accord would still have to be approved by Parliament. The real 'gas transition' will not start until 2020.

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<sup>79</sup>[https://www.tennet.eu/fileadmin/user\\_upload/Our\\_Grid/Offshore\\_Netherlands/Brochure/Brochure\\_Connecting\\_wind\\_energy.pdf](https://www.tennet.eu/fileadmin/user_upload/Our_Grid/Offshore_Netherlands/Brochure/Brochure_Connecting_wind_energy.pdf)

<sup>80</sup> <https://www.north-sea-energy.eu/atlas.html>

<sup>81</sup> <https://www.topsectorenergie.nl/tki-nieuw-gas/innovatieprogramma/geo-energie>

<sup>82</sup> <https://www.tno.nl/nl/over-tno/nieuws/2018/6/geothermie-veilig-en-kosteneffectief-versnellen/>

<sup>83</sup> <https://www.topsectorenergie.nl/sites/default/files/uploads/TKI%20Gas/publicaties/Vooruitblik%202019%20-%20TKI%20Nieuw%20Gas%20-%20versie%2021%20sept%202018.pdf>

## 4. What's next for gas in the Netherlands?

- **Recent controversies**

In this final section we will look at how climate policy may be expected to evolve in the Netherlands and what this will mean for gas.

With the Climate Accord, the Dutch government had hoped to acquire a detailed blueprint, with broad public support, on how its climate targets could be reached and how the Netherlands would be able to gradually go 'off gas' in the coming decades.

However, it has already become clear that reality will not be as simple as that. In the first place, the Accord itself states several times that it does not provide a blueprint or roadmap but should be seen rather as providing the basic building blocks of a process of which many parts are still unclear.

Two issues in particular are still unsettled; how the buildings sector can be made 'sustainable' as efficiently as possible, and what the respective roles will be of 'molecules' and 'electrons' in the energy system of the future. We will return to both topics below. The expansion of renewable energy in electricity generation is subject to much less uncertainty: this will be based on a massive expansion of offshore wind energy and, to a lesser extent, on onshore wind and solar power. The continued cost reductions in wind and solar power have made it possible to be fairly confident about this development.

Secondly, the political context around climate policy has changed considerably since the draft Climate Accord was presented in December 2018. In the same month, it became clear that electricity prices would rise sharply from 1 January 2019 onwards. The rise in electricity prices led to intense political debate about the perceived high costs of climate measures and the burden-sharing of those costs. In February 2019, the Central Bureau of Statistics confirmed<sup>84</sup> that average energy prices could be expected to go up €334 per household in 2019, an increase of around 20 per cent, half of which was attributed to a tax increase associated with climate measures, in particular renewable energy subsidies.

On 13 March 2019, the Netherlands Bureau for Economic Policy Analysis (CPB), an official government agency, published an evaluation<sup>85</sup> of the Climate Accord which found that lower income groups (especially lower middle income groups) bear a relatively higher burden of the cost of climate policies than higher income groups. Welfare recipients and pensioners, said CPB, are hit hardest of all. On average, households will see their income reduced by 1.3 per cent annually in the period 2018-2030 as a result of all climate measures together, CPB calculated, ranging from 0.8 per cent for the highest income groups to 1.8 per cent for the lowest income groups.

In response to the findings of the CPB report and political pressure, especially from the new right-wing political party FvD (Forum for Democracy), which campaigned successfully on an anti-climate change platform before the Provincial Elections on 20 March 2019<sup>86</sup>, the government promised<sup>87</sup> a 'fairer distribution of the burden of climate costs'. In the final text of the Accord, a number of measures are proposed that will lead to lower costs for households, especially lower and median income households, and higher costs for business and industry. In particular, the surcharge on sustainable energy (called ODE in Dutch), will be lowered for households and increased for business.

- **Will Dutch houses go off gas (and if so, when)?**

The Climate Accord aims at switching all buildings (7.7 million houses and one million other buildings) from natural gas to district heating and electric heat pumps by 2050, with possibly minor

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<sup>84</sup> <https://www.cbs.nl/nl-nl/nieuws/2019/07/energierekening-334-euro-hoger>

<sup>85</sup> <https://www.cpb.nl/doorrekening-ontwerp-klimaataakkoord-en-kabinetsvarianten>

<sup>86</sup> FvD became the biggest party in those elections garnering around 16% of the votes.

<sup>87</sup> <https://www.trouw.nl/groen/kabinet-kiest-toch-voor-co2-heffing-industrie~a5bac204/>

supplementary roles for 'renewable gas' and hydrogen. As an intermediate target, 1.5 million houses are to be made 'sustainable' in this way by 2030.

The goal of 'getting rid of gas' became a widely talked about topic in the Netherlands in 2018, with many businesses, public housing corporations and local authorities joining in the drive. In a typical example, Lidl, the German food discounter, triumphantly announced in December 2018 that after a four-year-overhaul all its 410 stores in the Netherlands had been divorced from gas and are now heated by electric heat pumps powered with renewable electricity (based on renewable energy certificates)<sup>88</sup>.

Eneco, one of the largest utilities in the Netherlands, waged a national campaign, entitled 'Van gas los' (Getting rid of gas), enthusiastically proclaiming<sup>89</sup> that 'getting rid of gas is the greatest challenge since (post-World War Two) reconstruction'.

Yet at the same time, several reports appeared warning about the high costs of disconnecting existing houses from the gas grid. For instance, the Dutch Economic Institute for the Building Sector (EIB) declared in a report<sup>90</sup> from May 2018 that making the total housing supply in the Netherlands 'energy neutral', over a period of 25 years, would save 250 PJ per year and would cost €235 billion, €36,000 per house on average. The report did add that realising a slightly less ambitious 'label A' efficiency, reducing energy use by 165 PJ (instead of 250 PJ), would cost just €12,500 per house.

The EIB report was followed by other studies warning of high costs. On 29 May 2018, the national association of public housing corporations, AEDES, presented a study<sup>91</sup> saying they would need 'over €100 billion' to 'make 2.1 million rental units sustainable'. On 19 January 2019, the national Association of Homeowners (Vereniging van Eigenaren, VVE) warned<sup>92</sup> that making privately owned homes 'climate neutral' was turning out to be 'too complex' and 'too difficult to finance'.

The costs and complexity of disconnecting existing houses from the gas grid has already led to uncertainty about the feasibility of achieving the targets set out in the Climate Accord. As discussed above, the Netherlands Environment Assessment Agency (PBL) concluded in its official evaluation<sup>93</sup> of the Climate Accord published on 13 March 2019, that the measures proposed in the Accord would result in some 250,000 to 1,070,000 buildings being made 'gas-free', i.e. considerably below the target of 1.5 million. PBL also noted that the measures in the Climate Accord, if implemented, would be likely to achieve between 0.8 and 3.7 mt of emission reductions by 2030 and would be unlikely to achieve the official target for the buildings sector of 3.4 mt reduction.

None of this necessarily means that the drive to 'make buildings sustainable' will not continue. New initiatives and studies are continuing. To mention just one example, technical consultancy DNV GL published a study<sup>94</sup> on 3 December 2018 which took an in-depth look at two residential neighbourhoods to determine how they could best be heated without natural gas. The study, part of a larger research effort looking into the possibilities of low-temperature heating in the buildings sector (called TKI Winst in Dutch), concluded that, for existing standard houses in the Netherlands, built around the 1960s, a district heating network fed by waste heat or low-temperature geothermal heat is the best replacement for conventional gas-fired boilers (in terms of CO<sub>2</sub> emissions and cost). The researchers found that an all-electric solution, based on electric heat pumps, is roughly 50 per cent more expensive. A district heating network system even turned out to be around 10 per cent cheaper than a conventional gas-fired system.

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<sup>88</sup>[https://www.ad.nl/privacy-gate/accept?redirectUri=%2fkoken-en-eten%2flidl-alle-filiaal-en-nederland-zijn-van-het-gas-af%257Ea7163fa7%2f&pwv=2&pws=functional%7Canalytics%7Ccontent\\_recommendation%7Ctargeted\\_advertising%7Csocial\\_media&days=3650&referrer=](https://www.ad.nl/privacy-gate/accept?redirectUri=%2fkoken-en-eten%2flidl-alle-filiaal-en-nederland-zijn-van-het-gas-af%257Ea7163fa7%2f&pwv=2&pws=functional%7Canalytics%7Ccontent_recommendation%7Ctargeted_advertising%7Csocial_media&days=3650&referrer=)

<sup>89</sup> <https://fd.nl/advertorial/enecogroep/1280983/van-gas-los-is-de-grootste-uitdaging-sinds-de-wederopbouw>

<sup>90</sup> <https://www.eib.nl/publicaties/beleidsanalyses/klimaatbeleid-en-de-gebouwde-omgeving/>

<sup>91</sup> <https://www.aedes.nl/artikelen/bouwen-en-energie/energie-en-duurzaamheid/routekaart/aedes-hoe-verduurzamen.html> In the Netherlands there are 125,000 small homeowners associations which together own 1.2 million buildings.

<sup>92</sup> <https://nos.nl/artikel/2268081-vve-s-luiden-noodklok-verduurzamen-te-moeilijk.html>

<sup>93</sup> <https://www.pbl.nl/publicaties/effecten-ontwerp-klimaatafkoord>, p. 67.

<sup>94</sup> <https://www.dnvgl.nl/news/goedkoper-van-het-gas-af-met-lage-temperatuur-warmtenetten-134943>

Another key finding of the study was that a municipal or regional heating plan is more efficient than a neighbourhood-by-neighbourhood approach. This is because some alternatives for gas, such as district heating networks, only become efficient when applied to 3,000 housing units or more, according to DNV GL.

This last point is relevant because the Climate Accord foresees a strong ‘decentralisation’ of decision-making in energy policy measures, particularly with regard to buildings.

Firstly, under the Accord, all Dutch municipalities will be required to come up with a ‘climate and energy plan’ by 2021, which will have to be approved by the city council and will have to show, among other things, how the municipality in question intends to reduce gas consumption in its buildings.

Secondly, as stated above, under the Climate Accord the Netherlands will be divided into 30 ‘energy regions’, which will be given the task of developing ‘regional energy strategies’ (RESs) and coordinate climate policy at a regional level<sup>95</sup>.

Thus, the future of gas in the buildings sector will increasingly lie in the hands of local authorities in the Netherlands. It is difficult to say what consequences this decentralisation will have.

- **Electrons versus molecules**

The Climate Accord<sup>96</sup> contains some references indicating that full-scale electrification of the energy system would not be the most efficient solution and that instead some combination of ‘electrons’ and ‘molecules’ is desirable. For example, it notes that ‘it must be investigated how sustainable electrons and sustainable molecules can be used’ (p. 170), and states that ‘the transformation of electricity into (sustainable) molecules (and vice versa) offers new possibilities to link an (over)supply of one energy carrier with a (temporary) shortage of another energy carrier’. (p. 187)

Further, as noted above (Section 2), the Accord contains a chapter on hydrogen, which underlines the importance of investing in large-scale production of ‘green hydrogen’ by expanding electrolysis capacity to 3-4 GW by 2030.

But the Accord gives no clear indication on how large the role for ‘molecules’ will be.

In April 2018, Berenschot, a well-known Dutch consultancy, presented a study<sup>97</sup> investigating the implication of an ‘Electrons’ scenario up to 2050, based on a massive expansion of solar and wind power as well as ‘green’ hydrogen, and a ‘Molecules’ scenario, based on large-scale production of ‘blue’ hydrogen and much more limited electrification. The Electrons scenario assumes fully electric solutions for industry and all-electric heat pumps in the buildings sector, the Molecules scenario assumes some electrification in industry and the use of hybrid heat pumps in buildings.

The Molecules scenario turned out to be significantly cheaper than the Electrons scenario (€31 billion per year versus €45 billion per year), as illustrated in Figure 1.

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<sup>95</sup> <https://www.regionale-energiestrategie.nl/default.aspx>

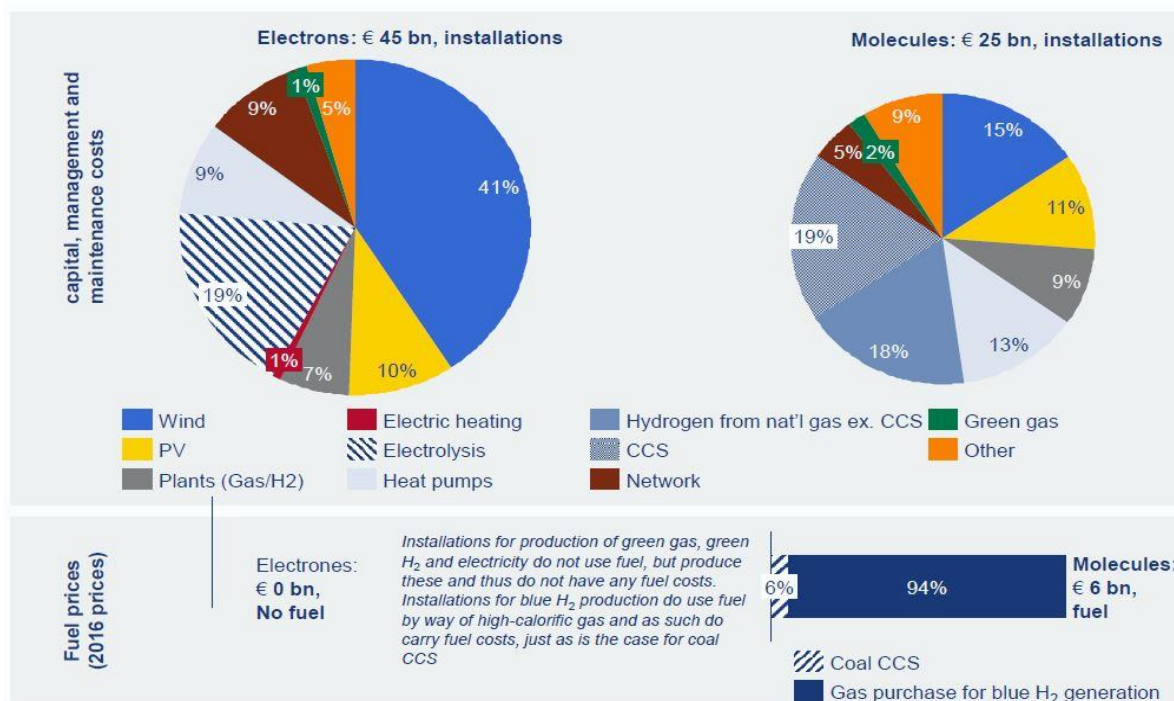
<sup>96</sup> <https://www.klimaatakkoord.nl/documenten/publicaties/2019/06/28/klimaatakkoord>

<sup>97</sup> <https://www.berenschot.nl/actueel/2018/april/elektronen-moleculen-transitie/>

**Figure 1: Difference in total annual costs (all sectors) between the electrons and molecules scenarios**

**Difference in total annual costs (all sectors) between scenarios is significant:**

Electrons €45\* billion, installations only    Molecules € 31\* billion, installations and fuel



**Berenschot**

\* Total energy system costs now: €22 billion (11 billion installations, 11 billion fuel)

14 ●

Source: Berenschot<sup>98</sup>

The two scenarios imply a highly different future for natural gas as seen in Figure 2. As illustrated in this Figure, in the Electrons scenario no natural gas would be used anymore. By contrast, in the Molecules scenario, there still is a large role for natural gas (with CCS). As a matter of fact, 34 Bcm is almost as much as the Netherlands used in 2018.

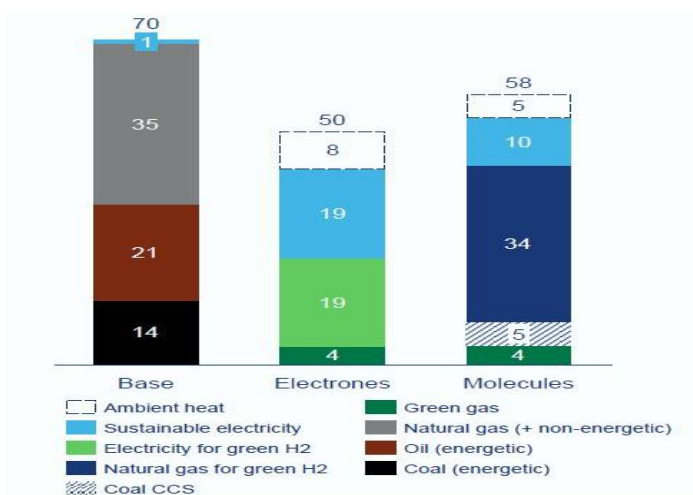
To see if the Netherlands could also achieve a pathway with lower natural gas use that would still be economically efficient, Berenschot did a third analysis, called 'the Heat scenario'<sup>99</sup>, which was published in September 2018. In this scenario the demand for heat is met, as much as possible, with district heating networks which use sustainable heat sources: geothermal, solar thermal and waste heat from industry and data centres. A small amount of heat is supplied with electric heat pumps and 'green' gas.

The result: estimated costs came out at €38 billion per year, that is in between the Molecules (€31 billion) and Electrons (€45 billion) scenarios. In the Heat Scenario, much of this cost is due to the need to build a large-scale district heating network to replace the existing gas network. The Netherlands has very little district heating. In this Scenario, there still is a small role for natural gas: 5.6 Bcm per year to 2050.

<sup>98</sup> <https://www.berenschot.nl/actueel/2018/april/elektronen-moleculen-transitie/>

<sup>99</sup> <https://www.berenschot.nl/actueel/2018/september/nieuw-warmtescenario/>

**Figure 2: Distribution of primary energy demand in 2050 versus 2016 (billion cubic natural gas equivalents)**



Source: Berenschot<sup>100</sup>

Most energy experts in the Netherlands probably agree that an optimal zero-emission energy system should include a significant role for ‘molecules’, although not necessarily natural gas molecules.

Jörg Gigler and Marcel Weeda, independent experts and authors of ‘Outlines of a hydrogen roadmap’<sup>101</sup> (see Section 3), believe ‘green’ hydrogen will not be profitable until around 2050 and see an important role for ‘blue’ hydrogen, but only as a bridge solution.

But they both also note that ‘hydrogen is only one solution among many’. Weeda is in fact sceptical of the idea of a ‘hydrogen economy’. He believes some hydrogen will be used in industry and mobility, but probably not in the buildings sector.<sup>102</sup> According to Gigler, ‘hydrogen is pushed too much’ and we should focus above all on reducing energy (including gas) consumption.<sup>103</sup>

In a paper<sup>104</sup> published in March 2019, researchers Machiel Mulder, Peter Perey and José L. Morage of the Centre of Energy Economics Research (CEER) at the University of Groningen, conclude that the development of ‘green’ hydrogen faces many obstacles in the Netherlands. They find that ‘blue’ hydrogen may be an efficient alternative to decarbonising a considerable part of the Dutch economy. They conclude that under a scenario favourable to ‘blue’ hydrogen, the market potential could be 1000 PJ in 2050, almost as much as the volume of the Dutch gas market today (1300 PJ). The potential for ‘green’ hydrogen is lower, they argue – around 500 PJ – because in a scenario favourable for ‘green’ hydrogen, electrification is an attractive alternative.

Nevertheless, there are still strong question marks about whether public opinion in the Netherlands would support a large-scale CCS effort, which would be a precondition for the successful expansion of domestically produced ‘blue’ hydrogen. There are strong sentiments in society and among political decision-makers in favour of maximum electrification.

<sup>100</sup> <https://www.berenschot.nl/actueel/2018/april/elektronen-moleculen-transitie/>

<sup>101</sup> <https://www.topsectorenergie.nl/en/nieuws/sustainable-hydrogen-available-large-scale-2030>

<sup>102</sup> personal communication

<sup>103</sup> personal communication

<sup>104</sup> [https://www.rug.nl/research/portal/publications/outlook-for-a-dutch-hydrogen-market\(adf4659b-daa2-496b-9908-0778849d7d34\).html](https://www.rug.nl/research/portal/publications/outlook-for-a-dutch-hydrogen-market(adf4659b-daa2-496b-9908-0778849d7d34).html)

## Conclusions – where do we stand, what lessons can we draw?

From our research into the Dutch ‘gas transition’ and personal conversations with a number of industry experts (see sources below), we have drawn a number of conclusions, which we believe may also be relevant for other countries faced with similar choices on how to evolve towards a zero-emission energy system.

- The ‘gas transition’ will be much more difficult than the coal to gas transition which took place in the Netherlands in the 1960s. The latter was a transition to a single source of energy which, moreover, presented a clear gain to the economy. The country did it because it wanted to do it. The current transition is much more diverse and complex and is done out of necessity. It may also lead to economic loss instead of gain.
- The Climate Accord shows that it is much too early to be able to present blueprints for the energy future. There are still too many uncertainties, in particular around the buildings sector and industry. Conversion of heating in buildings is costly and complex and involves millions of individual owners. Other major uncertainties exist around the costs of ‘green’ hydrogen, the feasibility of the emergence of an international hydrogen market and public acceptance around CCS. The easiest part is the expansion of renewable energy in power generation, especially offshore wind and solar power, which are both well on track.
- The official evaluation of the measures proposed in the draft Climate Accord reveals that they fall short of achieving the government’s targets. The Dutch track record in meeting targets to reduce emissions has been quite bad in the past.<sup>105</sup> The question is whether it will be different this time.
- Although ‘building consensus’ in energy policy is no doubt useful, and decentralisation and ‘regionalisation’ of decision-making may also be valuable for certain purposes, there still is a strong need for the government to make clear-cut decisions on energy and climate policy. To achieve far-reaching greenhouse gas emission reductions, a ‘Climate Accord’ prepared by civil society groups cannot be a substitute for a regulatory and policy framework decided on by the government.
- To achieve the ambitious climate targets set by the government, it is necessary to start undertaking projects ‘at scale’. There are many initiatives being considered, for example around ‘green’ and ‘blue’ hydrogen, but most of them are still in the demonstration phase. Only when projects are undertaken at scale will it become possible to get a better picture of their true costs and limitations.
- Political conflict around the energy transition focuses mostly on the costs, in particular the burden-sharing of costs and the upfront financing of programmes and projects. Political differences could lead to a strongly polarised political climate, which could give rise to erratic policies that will increase the already large uncertainties that exist around energy transition.
- One of the most important lessons is that political and public opinion can radically and suddenly change the prospects of an important economic sector like the gas industry. Although the Dutch gas industry has developed a creative strategy for the future, and the desire to phase out natural gas inevitably faces technical and economic limitations, for many people the motivation to move to a zero-emission energy system is still very strong. As a result, the future of the Dutch gas industry is seriously threatened. The move away from natural gas may also open up many new opportunities and lead to innovations that will see the prospects for the gas industry diminish

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<sup>105</sup> The Netherlands Environment Assessment Agency (PBL) reported in January 2019 that the Netherlands will not achieve its EU-agreed emission reduction targets for 2020. <https://themasites.pbl.nl/balansvandeleeftomgeving/jaargang-2010/bevindingen/nationaal-klimaatdoel-voor-2020-buiten-bereik>

There is one important caveat to this last conclusion. Dutch climate and energy policy, as developed through the Climate Accord, has a strong national focus and is very little concerned with international developments. However, the eventual outcome of the Dutch gas transition may be affected by future technological progress, cost reductions and other international and global developments and policies on which the Netherlands has only a very limited influence. For example, if Germany and other EU countries opt to keep natural gas in the system, it will be difficult for the Netherlands not to go along, if only for competitive reasons. The goal of net-zero emissions in industry will likewise be difficult to realise in a purely national context.

## Sources

Information and news on the Climate Accord (or Climate Agreement) can be found at:

<https://www.klimaataakkoord.nl/> (in Dutch).

The accord itself, as presented on 21 December 2018, can be found at:

<https://www.klimaataakkoord.nl/documenten/publicaties/2018/12/21/ontwerp-klimaataakkoord> (in Dutch).

Evaluation of the Climate Accord (“Effecten Ontwerp Klimaataakkoord”) by Netherlands Environment Assessment Agency (PBL), 13 March 2019, can be found at:

<https://www.pbl.nl/publicaties/effecten-ontwerp-klimaataakkoord> .

Evaluation of Climate Accord by Central Planning Bureau (“Doorrekening ontwerp Klimaataakkoord”), 13 March 2019, <https://www.cpb.nl/doorrekening-ontwerp-klimaataakkoord-en-kabinetsvarianten>

One main official source of energy statistics are the Nationale Energieverkenningen, formerly published by the independent research institute ECN (Energy Centre of the Netherlands), nowadays by the government agency Planbureau voor de Leefomgeving (PBL Netherlands Environmental Assessment Agency). The latest Nationale Energieverkenning was published in 2017. In April 2018, PBL announced<sup>106</sup> that it would not publish an edition in 2018 because of the uncertainties around the Climate Accord and lack of research capacity. The next edition is expected in 2019, but had not been published at the time of writing.

Another official source is from CBS (Central Bureau of Statistics). The latest figures are summarised in this table: “Energiebalans; aanbod, omzetting en verbruik”, 18 December 2018.

<https://opendata.cbs.nl/statline/#/CBS/nl/dataset/83140NED/table?ts=1548059379164> .

CBS also publishes “Trends in Nederland 2018” (Dutch energy mix 2000-2017), <https://longreads.cbs.nl/trends18/economie/cijfers/energie/> and annual updates on energy use, including gas production and state revenues from natural gas: <https://www.cbs.nl/nl-nl/nieuws/2019/16/energieverbruik-gedaald-in-2018> (17 April 2019).

A useful overview of Dutch energy statistics is published annually by Energie Beheer Nederland (EBN), a state-owned company, in the form of an infographic:

<http://www.energieinnederland.nl/download> .

The Draft Integrated National Energy and Climate Plan, submitted to the European Commission in December 2018, which is to be finalized by the end of 2019, can be found at:

[https://ec.europa.eu/energy/sites/ener/files/documents/netherlands\\_draftnecp\\_en.pdf.pdf](https://ec.europa.eu/energy/sites/ener/files/documents/netherlands_draftnecp_en.pdf.pdf).

It is one of the few English-language sources of Dutch energy and climate policy.

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<sup>106</sup> <https://www.pbl.nl/nieuws/nieuwsberichten/2018/vanwege-werk-aan-klimaataakkoord-geen-nationale-energieverkenning-in-2018>

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- Jilles Raadschelders, Director, Energy Transition, DNV GL
- Arendo Schreurs, Director, Communications and Public Affairs, Nogepa
- Bert Stuij, Manager, national programmes/energy, Netherlands Enterprise Agency (RVO)
- Nynke Verhaeg, Project Coordinator, TKI “Winst” (heat infrastructure programme)
- Ulco Vermeulen, Director, Business Development, Gasunie, and Chairman, TKI New Gas
- Marcel Weeda, Senior Researcher, Hydrogen Transition, ECN/TNO

They are in no way responsible for the contents of this paper. The views expressed in this paper are those of the authors’ alone.