Giving hydrogen a jump start

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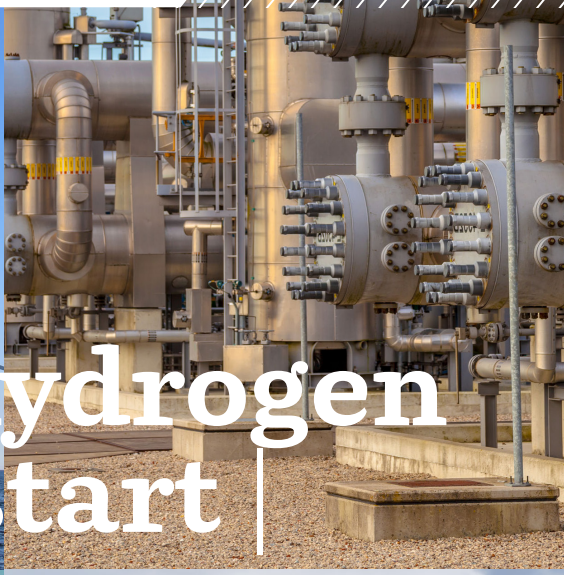

Giving hydrogen a jump start

Lessons learned from Dutch policies in other industries

Daan Hulshof, Machiel Mulder en Peter Perey

Centre for Energy Economics Research (CEER)

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1. Introduction

1.1 Background and objective

Historically, hydrogen has only been used as feedstock in the industry, e.g. in the production of ammonia for making fertilizer, while other potential applications are still scarce. Currently, however, hydrogen is increasingly seen as the energy carrier in future low-carbon energy systems. This is due to the fact that it has the technical potential to replace natural gas as it can be used for heating, while it can also be used as a fuel in transport and as feedstock in the chemical industry. In addition, hydrogen produced through electrolysis can possibly offer flexibility to electricity markets and networks when they have to deal with growing amounts of variable generation from renewable sources.

Because of these perceived benefits, many countries within and outside the EU are now targeting at a rapid deployment of hydrogen in various segments of the economy (see e.g. EC, 2020; EZK, 2020). In order to realise these ambitions a significant number of actions have to be taken in a short period of time. Amongst others, there is a need for a major substitution within demand, a strong increase in the supply of hydrogen produced through electrolysis, as well as the development of a well-functioning infrastructure including international connections and appropriate regulation.

The potential of hydrogen as a key energy carrier in low-carbon energy systems has been analysed extensively from a technical-engineering perspective. Most of this research focusses on the technical feasibility and the production costs on plant level, while increasingly attention is paid to the design of markets for hydrogen. It is not evident, however, that a well-functioning market of hydrogen will develop automatically, even if the

production is technically feasible and the overall societal benefits exceed the overall societal costs. With hydrogen taking a more prominent role in both European as national plans for the energy transition, the questions arise what is needed for a large-scale implementation of hydrogen in these segments and what are the necessary conditions for creating a liquid hydrogen market.

The creation and rapid development of an industry, driven by a common societal objective or problem is not new. In the post-war European countries, including the Netherlands, we have seen numerous examples of industries that have been created or helped to develop with the support of public interventions. This holds in particular for the agricultural and housing sector. In many European countries, including the Netherlands, both sectors suffered from a lack of supply, high prices and low quality in the first decade after the Second World War. In order to overcome these problems, governments took a variety of measures. Another, typical Dutch, example of a massive development of an industry is the transition of the energy system towards the production and use of natural gas after the discovery of the Groningen field in the mid-1960s. Another example of strong government intervention in an industry to realize fundamental changes is the electricity industry where governments intervened in the process of investments in new power plants in order to realize a transition from fossil-fuel generation towards renewable generation.

1.2 Research scope and outline of this paper

In this paper, we explore the developments of the Dutch natural-gas, agricultural, housing and electricity industries over the past decades and how they have been fostered by various types of policy measures. As part of these explorations, we also pay attention to the role of private and public institutions and how the costs and benefits of these developments were

distributed across society. Finally, we reflect on the lessons learned from these industries and how these lessons can be applied to the hydrogen market when the ambition is to foster the development of the hydrogen industry. In formulating these lessons, we depart from the assumption that the hydrogen industry will be developed, which means that we do not go into the efficiency of such a policy (as is discussed, for instance, by Mulder et al., 2019). In contrast to for instance CIEP (2019), we do not assume that a fundamentally different way of organizing the energy system is needed in order to promote hydrogen, but we want to determine the economic criteria to develop hydrogen in an efficient and effective way.

In Chapter 2, we analyse the development of the natural-gas sector after the discovery of the huge Groningen gas field in 1959. In Chapter 3, we analyse how the agricultural sector has been developed after the shortage of food and low agricultural incomes immediately after the Second World War. In Chapter 4, the attention shifts to the building sector and how the scarcity in the housing market has been addressed through various types of policy measures. Chapter 5 is directed at the electricity sector and analyses how the transition from fossil-energy generation towards renewable generation has been pursued. Based on the lessons learned from these four examples of transitions, we formulate conclusions on how the hydrogen sector can be promoted in an efficient and effective way.

2. Natural-gas policy after discovery Groningen field

2.1 Introduction

In 1959, a large natural-gas field was discovered in the province of Groningen, the north of the Netherlands (referred to as the Groningen field from here onwards). The discovery and development of this resource will turn out to have a profound impact on the Dutch (and Western-European) energy landscape, in terms of both energy production and consumption.

In the period immediately after World War II, the Dutch energy landscape was dominated by coal and oil, where the latter was on the rise at the expense of the former. Between 1946 and 1959, the share of coal as primary energy source in the Netherlands decreased from 70% to 53%, whereas the share of oil in that same period increased from 16% to 38% (see Figure 2.1). Natural gas was not present in the *primary* energy mix in 1946 and its role (1%) remained negligible until 1959. Mainly due to the production of cokes oven gas from coal, the gas share in the Dutch *final-consumption* energy mix in 1959 was, at 2%, slightly more important (Ministerie van Economische Zaken, 1962).

Despite the virtual absence of gas in the primary and final-consumption energy mixes around 1960, soon after the discovery of the Groningen gas field in 1959, both the discoverer of this field, the Nederlandse Aardolie Maatschappij (NAM)[1] and the Dutch government recognised its economic potential. This recognition was based on the relatively favourable conditions for extraction, translating to low production costs, in combination with the large size of the field. In 1962, the size of the Groningen field was estimated at 470 billion cubic meters (bcm), the

[1] NAM is a joint venture of the oil companies Shell and Esso.

equivalent of approximately 14 to 15 times total Dutch annual domestic energy consumption in that year. This estimate was revised upwards to 1100 bcm in 1963, 1900 bcm in 1967, and 2500 bcm in 1973. The original size of the field was ultimately estimated at 2800 bcm (see Figure 2.2).[2] The Groningen gas reserve was considered to be a 'giant' natural-gas field for this reason and remains among the ten largest natural-gas fields that have been discovered globally.

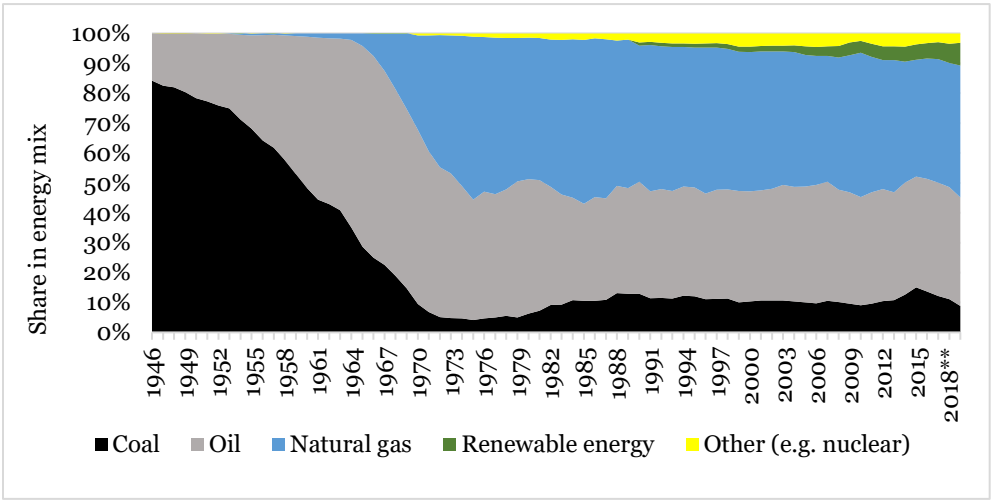
This section explores the reaction of the Dutch government to the discovery of this giant gas reserve. Specifically, the questions addressed in this section are: what targets were formulated with respect to developing the Dutch natural-gas sector?, which policy instruments were used to achieve these targets?, to what extent were these targets realised?, what were the anticipated and unanticipated external effects of the government policies, and, finally, how have these been dealt with?

2.2 Policy objectives

In his 1962 memo on the Groningen-field discovery, the Dutch Minister of Economic affairs De Pous announced the government's intention to maximise the "economic value" to the Dutch society from the discovered reserve (Ministerie van Economische Zaken, 1962). For the government at that time, maximising economic value was equal to maximising revenues from the production of natural gas to the state, and this constituted the primary policy objective of the Dutch government. This was also reflected in the political discussion in the beginning of the 1960s surrounding the concession for the Groningen field. Some political

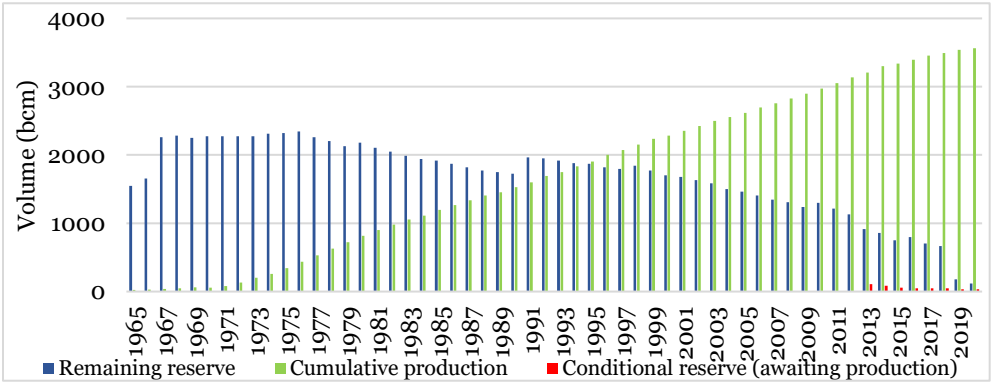
[2] See: https://www.nam.nl/gas-en-oliewinning/het-winnen-van-aardgas/historie-van-aardgas-en-olie.html

Figure 2.1 Primary energy supply by source in the Netherlands, 1946-2019



Source: CBS

Figure 2.2 Natural-gas reserves and cumulative production in the Netherlands, 1965-2020



Source: Ministerie van Economische Zaken en Klimaat

parties, in particular the labour party (PvdA) opposed the plans of minister De Pous as they thought the share of profits for the government was too low compared to the share for the NAM (Correljé et al., 2003).

Writing this in a period where natural gas is often associated with negative externalities, especially climate change from CO_2 emissions and earthquakes (particular in the Netherlands), it may be instructive to mention that such external effects were not perceived in the 1960s and 1970s, at least not in the mainstream scientific literature and policy discussions. In contrast, natural gas was generally perceived to have environmental benefits over coal, because burning natural gas results in considerably less local air pollution.

Given the governmental objective of maximising state revenues from gas production, the primary questions on how to develop the Groningen field and the natural-gas sector included the following: which agreement should be made with the production company NAM?, who should the gas be sold to?, at what price should the gas be offered?, how should the gas be distributed to the end-user?, and at what rate should the Groningen field be depleted? In summary, the government, as the owner of the resource, had to agree on: (i) a production licence with the concession holder in return for a stake in the profits, (ii) a marketing plan constituting who to sell to and at what price, and (iii) a long-term production plan regarding volume (i.e. timing of the production pace).

Regarding the long-term production plan, the general belief in the 1960s was that it was a matter of decades before nuclear energy would become the dominant source of energy (Schot et al., 2000). This contributed greatly to a sense of urgency for developing and marketing the Groningen field. A period of 20 to 30 years was initially often mentioned as target period for depleting the Groningen field (Ministerie van Economische Zaken, 1962). However, the discovered volumes, even at early estimates of 470 bcm and

11000 bcm in 1963, were immense in comparison with the existing Dutch gas consumption of around 2.5 bcm in 1962 (Ministerie van Economische Zaken, 1962). For the profit-maximising government's marketing plan, these circumstances implied that selling considerable amounts of natural gas required realising an energy transition away from existing coal and oil consumption towards natural-gas consumption.

2.3 Policy instruments

The strategy to maximise profits from the Groningen field can be summarized as selling large quantities at the highest possible price, initially in the highest possible pace. The strategy for selling large quantities, i.e. realising the energy transition, primarily entailed: (i) building a high-pressure gas network and extending local distribution networks, connecting virtually all (potential) users, (ii) offering the natural gas to the large industry, neighbouring countries, and households for as many domestic appliances as possible, and (iii) selling the gas at a price which was sufficiently attractive for end-users to switch towards gas consumption. The strategy for obtaining the highest possible price entailed: (i) creating a monopolist producer (NAM) and a wholesale seller (Gasunie) of natural gas, and (ii) offering the gas at a price equal to the price of alternative energy sources (Ministerie van Economische Zaken, 1962). This pricing strategy came to be known as the market-value principle.

2.3.1 Volume strategy and instruments

On the demand side, specifically on the matter of which end-users to target, the government accepted a proposal from NAM to target domestic households, industry, as well as exports to neighbouring countries. Serving many households, in particular, implied the need for a considerably more extensive and, therefore, expensive gas network. At the same time, this

extensive network enabled considerably larger volumes of gas, as compared to serving only industrial users and export markets.

The to-be-constructed high-pressure gas transmission network needed to connect all targeted users to the production location in Groningen. In practice, all existing gas pipelines, and a large number of new local distribution pipelines, were connected to this new high-pressure network, resulting in an extensive, integrated national gas grid. Table 2.1 shows the development of the size of the distribution and transmission networks between 1962 and 1973, displaying its rapid construction and expansion.

Table 2.1 Development in the size of the Dutch gas network, 1962-1973

	Distribution network	**Transmission network**
1962	2,500km	0km
1965	5,000km	1,600km
1968	*All municipalities connected to the national grid*	
1973	6,000km	6,000km

Source: Correljé et al. 2003

The considerable costs associated with the network and gas transport were treated as an integral part of the costs of the concession. As there was no explicit transport or network component in the gas price, the costs for the grid and transportation were socialised over all users (i.e. paid from the general revenue stream associated with the gas sales). Usually, there is a considerable degree of uncertainty regarding the number of future users in the investment decision for a gas (or other type of energy) network. In this case, substantiated with simulation analysis, the government and concession holder expected that the large investments required for a national gas-transmission and distribution infrastructure could be earned

back relatively quickly (Schot et al., 2000). This was due to the expectation that gas could be offered at sufficiently competitive prices, on top of the clean characteristic of this new fuel, to persuade the various type of end-users to consume large quantities, while maintaining a high profit margin, thanks to the low costs of production, which could also be used to recover the fixed costs of the infrastructure.

Offering the gas to end-users at a sufficiently attractive price was ensured through the market-value principle: gas was priced at par with or slightly below the price of (or a weighted price of) the best alternative energy source(s) (Ministerie van Economische Zaken, 1962). The gas price was differentiated in the sense that different end-user types were offered a different price, based on their respective best alternative. This principle ensured that end-users did not pay more for gas than for their best energy substitute, persuading them to switch towards using gas.

With respect to households, besides applying the market-value principle, they were also offered regressive prices for gas. In other words, the price for gas decreased with the consumed volume. This was done to provide households with the incentive to fuel-switch towards natural gas for as many appliances as possible, in particular for space heating (Schot et al., 2000). In addition, the following other instruments were applied to encourage households to switch towards gas: marketing campaigns (e.g. in cinemas, theatres and newspapers), scrap premiums for non-gas appliances, inspections by the authorities for the suitability to burn natural gas in existing household appliances, and financial support to low-income households (e.g. in the form of low-cost loans). While assistance with retrofitting existing burners (e.g. stoves and geysers) was provided, end-users themselves were responsible for purchasing new appliances, also financially. Contributing to households' willingness to switch was the fact that natural gas provided a number of benefits over other energy types.

Importantly, in comparison with coal, natural gas did not require local, highly polluting storage. In addition, gas-burners were more convenient to operate, and gas-fired central-heating systems enabled households to heat all rooms in a house.

With respect to the large industry, the benefits of gas were somewhat similar. Coal required intensive and costly transport and storage. Moreover, gas-burners were easier to control than coal-burners and therefore more efficient in terms of energy use and costs (when gas is priced equivalently in energetic terms). These advantages over coal-burners also largely apply to oil-burners, which was an important reason for the increase in oil consumption at the expense of coal in the 1940s and 50s. Given that most industrial users in the 1960s were choosing oil-burning equipment in new installations, gas was offered on the basis of the prices of fuel and heating oil in this sector.

For the power sector, natural gas provided fewer benefits over coal and oil than for other industrial user types (Correljé et al., 2003). This implied that gas had to be priced relatively more competitive (i.e. at lower prices) in this sector to persuade fuel-switching, and which also has as a result that the government/concession holder initially did not offer gas to electricity producers. As the estimated reserves were revised upwards several times in the 1960s, however, from 1965 onwards, gas was also offered to the power sector at competitive prices.

Export markets, in particular in the neighbouring countries Belgium and Germany but also France and Italy, were also attractive destinations for the Dutch natural gas. Like in the domestic market, the Netherlands only faced competition from other energy types in export markets, particularly in the 1960s and beginning of the 1970s. Not hindered by competing natural-gas producers, this enabled the Dutch government to apply the market-value principle in export markets as well. Long-term take-or-pay

contracts were negotiated in which a minimum volume was contracted, despite of whether this volume would actually be demanded. These contracts reduced the volume risk for the Dutch producer and transporter, and the price risk for the foreign buyer. Furthermore, gas exports had 'earmarked' destinations in order to prevent gas-to-gas competition. For instance, when the gas price at the Dutch border was lower for Italian than for German customers, e.g. to account for higher transport costs or political factors, earmarked destinations prevented Italian buyers to offer the gas on the German market.

2.3.2 Pricing strategy

As a monopolist, the concession holder for the Groningen field did not face any competitors in marketing the gas, enabling this firm to have a very strong influence over prices. While most economists would probably agree that, in terms of market structure, a monopoly market does not maximize the economic value to society, it does generally result in maximum profits for a producer, and, in this case, also the state as shareholder.

While the market-value principle ensured that gas was priced sufficiently attractive to incentivise fuel-switching, it also ensured that the supplier obtained virtually the maximum price it could possibly get. The principle was that end-users did not pay more for gas than for alternative fuels, but also not (much) less. By offering the gas at differentiated prices to the different types of end-users, based on their preferred alternative fuel, the supplier ensured that it received close to the highest price that each end-user was willing to pay for it. These differentiated prices were jointly determined by the government and the other shareholders.

Granting a monopoly to the concession holder implied that the existing gas producers, most of which owned local distributions grids, such as Staatsmijnen and Hoogovens, needed to be prohibited from being able to

offer gas to end users. This was achieved in practice through not allowing other producers than the concession holder access to the newly-built natural-gas network. Producers owning local distribution networks were, in return for financial compensation, practically mandated to transfer their network over to Gasunie. Gasunie was the new transport company, created as part of the Groningen-field concession. This transport company owned and operated the newly built high-pressure gas network. In addition, in return for financial compensation (see Section 2.5.1) Gasunie acquired the existing local distribution grids, primarily from Staatsmijnen, Hoogovens and Staatsgasbedrijf.

2.3.3 Organisation of the gas sector

The initial organisation of the gas sector, referred to as the '*gasgebouw*' is depicted in Figure 2.3. The most relevant agents were:

- NAM, the monopoly producer owned by Shell and Esso (both with an ownership stake of 50%);
- Gasunie, monopoly transporter and wholesale supplier;
- Maatschap Groningen, a holding company for distributing profits from the natural-gas sector between the government and NAM;
- Staatsmijnen (DSM), public coal company serving as shareholder on behalf of the government in Gasunie and Maatschap Groningen.

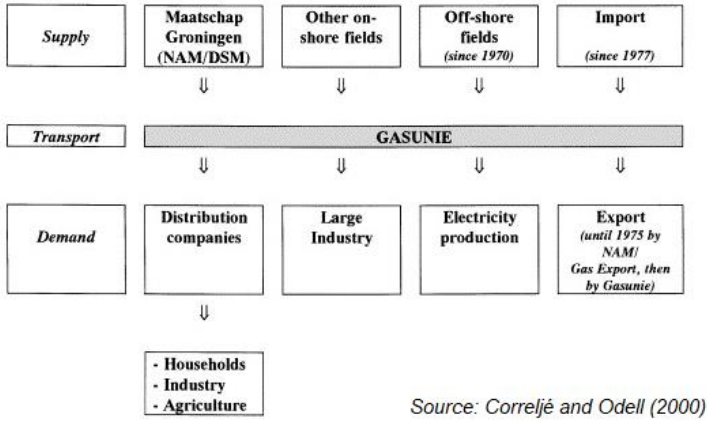
Gasunie and Maatschap Groningen were created as part of the concession for the Groningen field.

From a gas-flow perspective, the monopolist NAM produced the gas and offered this to the monopoly transporter and wholesale supplier Gasunie. In turn, Gasunie was responsible for selling the gas to the various type of end-users.

From a money-flow perspective, Gasunie would collect the wholesale revenues from gas sales. After deducting its own costs, for transport and

administration, and a statutory profit of 18mln Dutch Guilders, the remainder of the revenues were transferred to the Maatschap Groningen. The shareholders of Gasunie were: the Dutch state (50%, of which 10% directly and 40% through state company Staatsmijnen, later known as DSM, and currently as EBN), and NAM (50%).

Figure 2.3 Schematic representation of the organisation of the Dutch gas sector in the 2nd half of the 20th century



Source: Correljé and Odell (2000)

Consequently, after subtracting NAM's production costs, the remaining revenues were distributed as profits to the shareholders in the Maatschap Groningen, conform the following ownership stakes: 40% for the Dutch government (through Staatsmijnen), and 60% for the NAM. In addition, the government was entitled to a direct share in the profits of NAM of 10%. Taking into account other taxes, importantly corporate income tax, the

government initially received around 70% of profits from the natural-gas sector (Ministerie van Economische Zaken, 1962).[3]

2.4 Effectiveness of policy

The policies of the government resulted in a swift energy transition, away from, particularly, coal towards natural gas in the 1960s. The first considerable volumes from the Groningen field were produced in 1965, and production rapidly increased in the following years. Between 1964 and 1974, the share of gas in the primary energy mix increased from 2% to 50% (see Figure 2.1). The increase in this period is virtually exclusively due to the production and consumption of gas from the Groningen field. Until today, natural gas remains the dominant primary energy source in the Netherlands, having represented a relatively steady share of about 40-50% in the primary energy mix in the past 45 years.

The gas-market policy framework succeeded in inducing fuel-switching in all targeted sectors. Figure 2.4 shows domestic natural-gas consumption by type of end-user, and Figure 2.5 shows domestic gas production, consumption, imports and exports. These figures display that all of the targeted sectors (residential, industry, power generation and exports) experienced a rapid increase in the use of natural gas during the second half of the 1960s and beginning of the 1970s.

Associated with the successful ramp-up of production from the Groningen field, which was made possible by the induction of fuel-switching on the energy-consumption side, the Dutch government realised

[3] In the wake of the high oil and gas prices of the 1970s, the distribution of profits between the government and NAM was renegotiated (favourably for the government), see e.g. Correljé 2003. The profit distribution was renegotiated again in 2018, see https://www.rijksoverheid.nl/actueel/nieuws/2018/06/25/minister-wiebes-sluit-akkoord-met-shell-en-exxonmobil-over-gaswinning-groningen#:~:text=In%20het%20akkoord%20staat%20dat,Groningenveld%20toekomt%20aan%20de%20Staat.

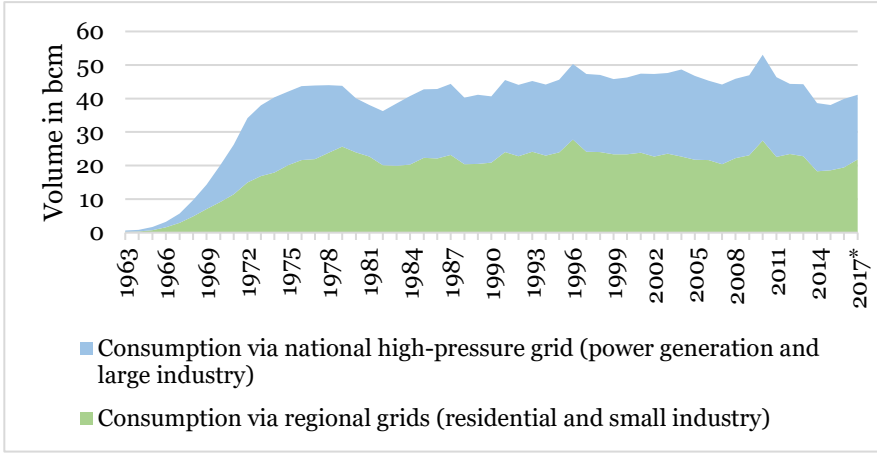
highly considerable revenues from its involvement in the natural-gas sector. Figure 2.6 displays the revenues of the Dutch government from the natural-gas sector, both in absolute terms and relative to total revenues. From 1969 to 1985, government revenues increased from €50 mln to more than €11 bln, which is equal to an increase from about 1% to 10% of its total revenues. Beyond this period, revenues have collapsed in the second half of the 1980s, as a result of the global decline in oil prices, while it increased considerably again in the 2000s and the first half of the 2010s, because of the strong increases in oil prices. In recent years, revenues have collapsed again, mainly as a result of the decision to greatly reduce the production volumes from the Groningen field in response to the increasing number of earthquakes in the Groningen region, but also in response to the lower oil and gas prices.

While the government clearly earned considerable revenues from the development of the Groningen field, it is difficult to assess whether the initial policy objective of *maximising* state revenues has been achieved. Indeed, a counterfactual situation with, for instance, a different marketing plan or a different method for granting the concession (e.g. auctioning) is not observed.[4] Nevertheless, it is generally acknowledged that the Netherlands succeeded in generating very high revenues from the natural-gas sector. For instance, its effective share in profits, initially of about 70%, was considerably higher than the share in profits that most foreign

[4] A comparison with other gas producing countries is also somewhat complicated due to the distinct characteristics and situation of each country. For instance, differences exist in the time production took place (e.g. Norway commenced considerable production of gas more than one and a half decades later with considerable gas production) and the local supply and demand conditions (e.g. the UK, being an island, was considerably more difficult to connect to continental Europe than the Netherlands).

countries received from their respective gas or oil activities (Schot et al., 2000).[5]

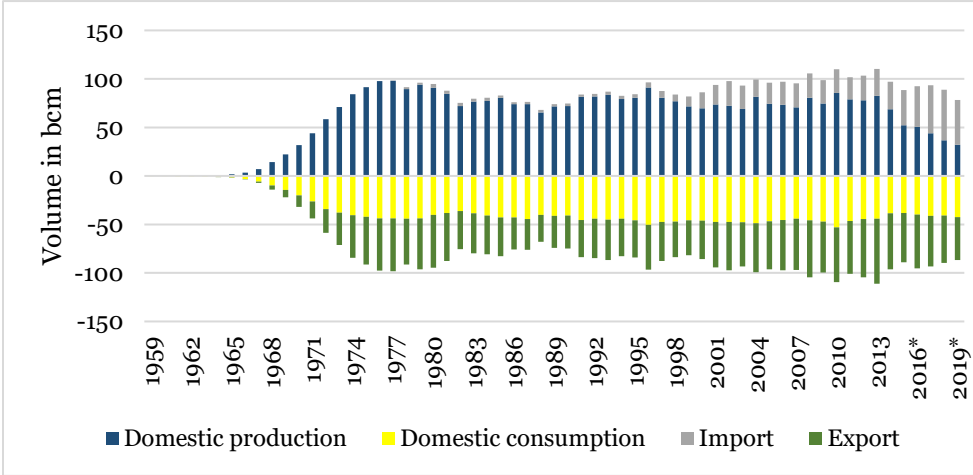
Figure 2.4 Consumption of natural gas by type of end user, 1963-2017



Source: CBS. * preliminary statistic

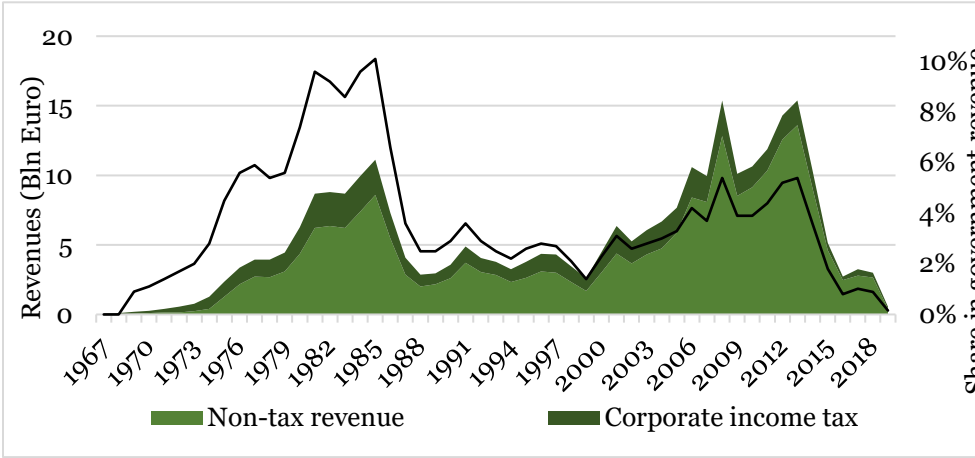
[5] Fearing that, if they would find out about this, Middle Eastern governments would try to re-negotiate their own production contracts with NAM-shareholders Shell and Esso, the latter proposed to organise the concession in a somewhat non-transparent fashion. This fear has sometimes been referred to as the *sheik-effect* (Gastel et al. 2014).

Figure 2.5 Dutch natural-gas production, consumption and international trade, 1959-2019



Source: CBS. * preliminary statistic

Fig. 2.6 Government revenues from the natural-gas sector



Source: CBS

2.5 Response to expected and unanticipated effects of policy

As a consequence of the government policies for the natural-gas sector, a number of expected as well as unanticipated or unintended effects occurred which resulted in additional government intervention. This section focusses on two of those anticipated effects, and the associated government responses: the loss in demand faced by the incumbent (e.g. city and cokes) gas producers, and the decrease in Dutch coal production and related loss in economic activity and jobs. In addition, this section discusses two unintended effects which were not foreseen at the time the natural-gas sector was developed: the growing importance of the Groningen field for security of supply after the oil crises of the 1970s, and the increase in gas-production related earthquakes in the Groningen region after 2012.

2.5.1 Expected effects from the gas-sector policies

Regarding the first anticipated effect, prior to the Groningen discovery, a number of parties were active in the production and transport of gaseous energy (e.g. city, mine and coke gas). The producers and transport companies tended to be the same, regionally operating firms, including Staatsmijnen (a publicly-owned company primarily active in the production of coal in the south of the country), Hoogovens (a private company primarily active in the production of steel in the west of the country) and Staatsgasbedrijf (a publicly-owned company active in the production and distribution of gas). See Figure 2.7 for an overview of their gas-distribution networks.

As a consequence of the decision that gas production and transport was to be handled solely by the newly created monopolist, these firms were essentially put out of business. The incumbent firms were unable to sell gas themselves, such that their production and distribution assets would be worthless in the new situation. As a form of compensation for their losses,

these gas incumbents received financial compensation. In return, the ownership and control over their distribution networks were transferred to Gasunie.

Agreeing on an arrangement for financial compensation turned out to be fairly easy with the publicly-owned companies Staatsmijnen and Staatsgasbedrijf, and fairly difficult with the privately-owned company Hoogovens, who initially objected against any agreement with the government (Schot et al., 2000). A factor that may have contributed to the opposition of Hoogovens was that, in contrast to Staatsgasbedrijf and Staatsmijnen, Hoogovens would no longer play a role in the new organisation of the gas sector.

The second effect that was foreseen as a consequence of the rapid emergence of the natural-gas sector concerned the decline in economic activity in the Dutch coal sector. In the second half of the 1950s and beginning of 1960s, the Dutch coal sector already faced competitive pressure from foreign coal and oil producers who could supply at lower costs. As a result of this competitive pressure, between 1954 and 1964 (when natural-gas production was below 1 bcm), production in the Dutch coal mines decreased by 6% (Ministerie van Economische Zaken, 1965*)*. The intention to strongly promote fuel-switching away from coal towards natural gas, as part of the natural-gas policies, resulted in the expectation that this decline would be strongly exacerbated. This expectation materialised, given that the (already declining) share of coal in the Dutch primary energy mix plummeted from 35% in 1964 to less than 10% in 1970 (see Figure 2.1). Between 1966 and 1974, all Dutch coal mines were closed, resulting in a reduction in the number of direct jobs of 45,000 in the south of the Netherlands, where the mines were located (Ministerie van Economische Zaken, 1969*)*.

Fig. 2.7 Map of Dutch gas distribution infrastructure in 1958

Source: Adapted from Schot et al. (2000)

The coal producers were not compensated financially for their losses by the government. However, the choice for Staatsmijnen, the publicly-owned coal producer, as representative of the government in the negotiations with NAM and government's shares in Maatschap Groningen and Gasunie was generally regarded as a form of compensation for the declining coal sector.

2.5.2 Unanticipated effects from the gas-sector policies

Regarding the first unanticipated effect, at the end of 1973, several Middle-Eastern oil-producing countries initiated an oil embargo against a number of western countries, including the USA, UK, and Netherlands. This

resulted in a global, at least perceived, tightening of the supply of oil. In turn, this contributed to a tripling of oil prices (and associated increase in gas prices) from around 3USD in 1973 to more than 10USD in 1974. It should be noted that another, arguably more important, contributing factor to these high prices was that oil demand had been growing strongly in the period up to 1973 such that many oil producers were already producing close to their production constraints. The sense of scarcity was reflected in the response to the oil embargo, as the government mandated car-free Sundays and prepared rationing of gasoline supplies in this period.[6]

The oil embargo and higher oil prices in the 1970s had a material impact on the political beliefs regarding the degree of scarcity of energy resources such as natural gas, the future value of oil and gas, and the security of energy supply. Somewhat contrasting with initial beliefs of energy abundance and an energy future characterized by nuclear dominance, the belief that emerged in the 1970s was that oil and gas resources were and would remain scarce, and thus valuable, resources in the long term (Ministerie van Economische Zaken 1974). Thanks to the Groningen field and the transition towards gas, the Netherlands was less dependent on energy imports, particularly on oil, which was only produced by a few, apparently unreliable countries. It took the oil crises and high energy prices of the 1970s to fully appreciate the value of having the Groningen field as a strategic reserve in this environment.

The shift in belief had direct consequences for the governmental gas-market policies. Previously, the Groningen field was considered to be

[6] These measures were taken despite that actual oil volumes in Northwest Europe were not materially affected due to other oil-producing countries (who did not participate in the embargo, such as Venezuela) being able to supply to the embargoed countries, and the major oil companies being able to reroute oil volumes from their production locations to both maintain compliance with the embargo and serve demand in the embargoed countries.

primarily a valuable source of revenue that needed to be monetized as fast as possible. In the 1970s, the emerging perception of energy scarcity resulted in the belief that the Groningen field was a scarce resource that was valuable as a strategic source of future energy supply.[7] As a result, the focus of government policy switched from solely focussing on maximising revenues towards also preserving the Groningen field. This implied that the new, overall policy objective consisted of two, somewhat ill-aligned components: producing volumes as to maximise revenues as well as preserving gas reserves for the future.

As part of the new dual policy objective, a number of measures were introduced, specifically focussed on the preservation of gas reserves (i.e. reducing the depletion rate of the Groningen field). On the demand side, gas consumption was curbed by increasing prices,[8] no longer offering gas to new power plants, not renewing existing contracts with power plants, and limiting gas exports (Ministerie van Economische Zaken, 1974). From Figure 2.5, it can be seen that these measures were successful in reducing gas consumption and production. In addition, the share of gas in the primary energy did not decrease in the 1970s and 1980s (see Figure 2.1). This jointly reflects a decrease in total energy use in this period (due to increases in energy efficiency), in turn reflecting the senses of energy scarcity and preservation.

On the supply side, the government introduced the 'small-fields' policy. This policy aimed at incentivising exploration for and production from other, smaller on and offshore gas fields that were present in the Netherlands. Particularly because of their smaller size, the production costs from these fields were higher than the production costs from the Groningen

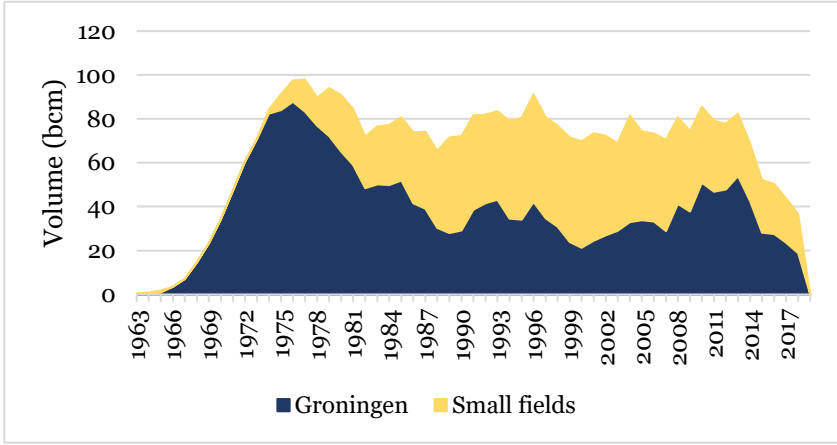
[7] See Mulder and Zwart (2006) for a discussion on the costs and benefits of constraining gas production from the Groningen field.
[8] Due to contractual specificities, gas prices had drifted from parity with oil prices, as aimed for by the market-value principle.

field, which is why these reserves remained largely unexploited under the initial profit-maximisation regime. Another key advantage of the Groningen field over the small fields was its ability to rapidly alter the level of production. This is particularly useful in periods of scarcity, such as during moments of peak demand in winter, or an oil embargo, increasing the value of preserving the Groningen field for future periods. As a result, the Groningen field was used as a so-called swing supplier.

The essence of the small-fields policy was that Gasunie guaranteed that it would buy any volume from producers of small gas fields at the prevailing market prices. This greatly reduced the investment risk for producers from small fields and, therefore, constituted a major incentive for investment in the production of gas from small fields.[9] Figure 2.8 displays historical gas production in the Netherlands by production source and shows that the small-fields policy was successful in triggering production from small fields in the period from 1974 onwards. At the same time, production from the Groningen field decreased considerably between 1976 and 1990. These changes in production, in addition to the decline in global oil and gas prices, contributed to the sharp decline in government revenues from the natural-gas sector in this period, as displayed in Figure 2.6.

[9] Given that the Groningen field had lower production costs, there were few incentives for Gasunie, the monopoly wholesaler, under the old regime to procure or produce gas from small fields.

Figure 2.8 Gas production in the Netherlands by source, 1963-2018



Source: NAM, CBS

Secondly and more recently, a series of earthquakes in the province of Groningen has resulted in a major policy change regarding the production from the Groningen field. Since the 1990s, Groningen has been experiencing earthquakes and the frequency and magnitude of the earthquakes increased during the 2000s and 2010s, as shown in Figure 2.9. The most severe earthquake, with a magnitude of 3.6, occurred near Huizinge in 2012. This earthquake sparked a national debate about the safety of gas production in Groningen.[10]

In response to these concerns, in 2014 the Dutch government decided to limit gas production from the Groningen field, from 54 bcm in 2013 to 42 bcm for the year 2014. This limit was revised/tightened a number of times in the subsequent years. Specifically, production limits for the Groningen

[10] See Mulder and Perey (2018) for an economic discussion on the gas-related earthquake problems in Groningen.

field were set at 30 bcm in 2015, 27 bcm in 2016, 24 bcm in 2017, 22b cm in 2018, 19 bcm in 2019 and 10 bcm in 2020.[11] In 2019, the government has decided to stop production from the field completely in 2022, leaving around 600 bcm in the ground.[12,13]

Amongst the inhabitants in the Groningen region, a deep dissatisfaction has emerged in the past decade regarding the attitude of the government and NAM in dealing with the adverse effects from the gas-production-induced earthquakes.[14] These damages include material damage, particularly property damage and a decrease in housing prices, as well as immaterial, psychological damage.[15] Dissatisfaction among the inhabitants results from, among other things, the fact that obtaining compensation for suffered damages has proven to be a very complicated process and experience, frequently taking many years. In addition, inhabitants perceived that, in spite of their earthquake concerns, the government and NAM responded very late with limiting gas production from the Groningen field.

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[11] See e.g. https://www.nlog.nl/en/groningen-gasfield and https://www.nam.nl/nieuws/2019/productie-groningen-gasveld-gasjaar-2018-2019.html

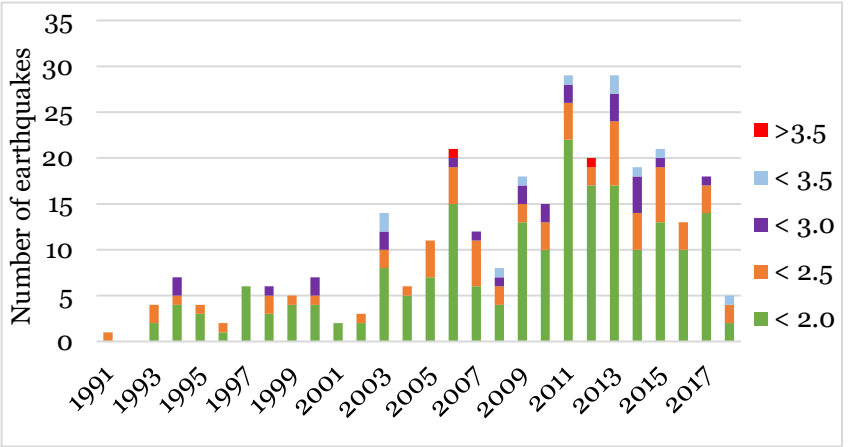
[12] See e.g. https://repository.overheid.nl/frbr/plooi-contentbeheer/rijksoverheid/2020/plooicb-2020-1737/1/pdf/plooicb-2020-1737.pdf

[13] Based on CBS reports https://www.cbs.nl/nl-nl/nieuws/2017/17/aardgasbaten-op-laagste-niveau-in-ruim-40-jaar and https://www.cbs.nl/nl-nl/nieuws/2019/22/aardgasbaten-uit-gaswinning-bijna-417-miljard-euro

[14] For a more detailed discussion, we refer to Mulder and Perey (2018).

[15] See e.g. https://www.rechtspraak.nl/Organisatie-en-contact/Organisatie/Rechtbanken/Rechtbank-Noord-Nederland/Nieuws/Paginas/NAM-aansprakelijk-immateriele-schade-inwoners-Groningenveld.aspx

Figure 2.9 Total number of earthquakes with a magnitude > 1.5 per year, categorised by magnitude, 1991-2018



Source: NAM

2.6 Conclusions and lessons learned

2.6.1 Conclusions on the development of the natural-gas sector

Upon the discovery of the giant Groningen gas field in 1959, the Dutch government formulated as its objective to maximise state revenues from the development of this field. This objective can be decomposed in two components: maximising total profit from gas production (to be shared between the government and its private partners), and maximising the portion of this profits to the Dutch government.

Regarding maximising profit from gas production, considering that gas played a marginal role in the Dutch and Northwest-European energy system at that time, it was perceived that marketing the large volumes of gas from the Groningen field required realising an energy transition away from coal and oil towards gas. Realising this transition was an integral part of the profit-maximisation objective. This energy transition materialised

very swiftly in the 1960s and beginning of the 1970s. Previously being negligible, gas production and consumption increased very rapidly in this period, reaching a share of 50% in the Dutch primary energy mix in 1974. Since that year, gas has remained the largest primary energy source in the Netherlands (maintaining a share of 44% in 2019). Therefore, the government's goal to realise an energy transition towards natural gas can be considered as achieved.

The Dutch government has also generated a very substantial amount of revenues from the natural-gas sector. Despite that it is difficult to assess whether government revenues have actually been *maximised*, this chapter concludes that the government has been successful in realising its revenue-maximisation objective.

The main instruments that contributed to successfully realising the energy transition and maximising government revenue were:

- creating a single producer, distributor and wholesale supplier for natural gas which obtained monopoly power in the supply of gas;
- developing an extensive infrastructure for the transport and distribution of gas;
- promoting demand in as many sectors as possible, including domestic households and industry, for as many applications as possible, and export markets; and
- facilitating the trade in gas by standardizing the unit of trade (i.e. MWh, independent on the precise physical quality of the gas molecules), while systems of green certificates are introduced to facilitate supply of renewable gas.
- incentivising fuel-switching away from coal and oil towards gas through sufficiently favourable gas pricing, based on the market-value principle.

The effectiveness of these instruments was reinforced by the fact that gas from the Groningen field could be produced highly competitively in comparison with other energy types, next to the favorable characteristics of natural gas over coal. In line with the intention to maximize profits from the gas sector, this enabled pricing of Dutch gas conform the market-value principle of pricing gas equivalently to the price of the next-best energy alternative. Furthermore, owing to the fact that this pricing principle ensured that each user paid a price which was close to the price it was maximally willing to pay, the distribution of the considerable costs of the gas network over the users was not a relevant issue, as these were simply paid from the maximized gas-market surpluses.

The Dutch government was confronted with and addressed several expected and unexpected side effects of the initial gas market policies. The expected effects included the losses in demand faced by domestic coal producers and incumbent (e.g. mine and cokes) gas producers. These sectors were compensated in a financial (incumbent gas producers) or non-financial (coal producers) manner. The unanticipated effects include the perceived security-of-supply risk following the oil crises and high energy prices of the 1970s, and the gas-production-related earthquakes in the Groningen region. These effects resulted in changes in the policy objective (e.g. preserving the Groningen reserves for security of supply), and implemented policies (e.g. limiting and ending production from the Groningen field.

2.6.2 Lessons learned

A number of key lessons for the rapid development of an energy market emerge from this chapter. In this section we formulate six lessons.

1. On the supply side, creating a monopoly producer and, particularly, network operator/wholesaler may contribute to the rapid expansion of

an energy sector that requires a network infrastructure. Specifically for a network infrastructure, there are large economies of scale associated with the construction, such that it is much more efficient to create a monopolist in this domain. In addition, having a single network (and producer) in the case of natural gas greatly reduces investment risks and thus contributes to a swift market development. Moreover, in building a network infrastructure, a single network operator faces much less coordination frictions and therefore transaction costs as compared to a situation with multiple operators with their own networks. In the presence of a monopolist, it is of course crucial to implement appropriate regulation.

2. In realizing a market expansion, it is critically important that the good is preferred by users through a sufficiently attractive price, quality or combination of these two.
3. When the production costs of a good are considerably lower than the willingness-to-pay for it (i.e. the perceived benefits), policy instruments may be directed at other targets than realising a transition towards that good, such as maximising government revenues from the targeted sector. As it may not be needed for realising a transition towards the good, whether policy intervention is justified depends importantly on the presence of market failures,[16] as well as on concerns regarding the distribution of benefits and costs.[17] For instance, the natural-gas market suffered from a number of these problems, including the presence of

[16] E.g. the presence of network externalities frequently present in energy markets. Another example is the tragedy-of-the-commons problem which, for instance, occurs when natural-gas production is unregulated and every producer has access to the same natural-gas field, and results in collective over-production due to the misalignment between the interest of private producers and the common interest of the group as a whole.

[17] E.g. natural resources are often considered as collective property, such that it is perceived as fair to let society as a whole profit from the associated profits (i.e. the resource rents).

network externalities, a tragedy of the commons situation, and the presence of very considerable resource rents.

4. Parties that 'lose' as a result of the rapid expansion of a market do not necessarily have to be compensated financially. A form of non-financial compensation includes, for instance, providing the losing side with a role in the new sector.
5. Market circumstances are subject to change and such changes may require a shift in the initial policy objective, or may result in initial policies becoming ill-suited for achieving the initial policy objectives. For instance, when unforeseen external effects materialize (e.g. earthquakes due to natural-gas production), it is important to adapt initial policy instruments and objectives (e.g. maximising state revenues from natural-gas production) to these new circumstances. When not accounted for in a proper manner, the new circumstances (e.g. the earthquakes) may result in the situation that the ultimate, overall impact on society of promoting a sector could be perceived as negative. This could potentially even occur when the benefits outweigh the costs, but the distribution of costs and benefits is perceived as highly unfair. Failing to compensate parties that bear the costs of negative externalities in a fair manner can result in strong opposition and a negative perception of the promoted sector by the public.
6. Public-private cooperation may contribute to the swift development of a sector when these two actors complement each other and their interests are highly aligned. In the case of the natural-gas sector, it appeared that the NAM and its shareholders provided the required expertise to produce natural-gas and to build the required infrastructure in an efficient manner (i.e. at low costs for society), whereas the government provided the required regulatory framework in an efficient manner (e.g. swift implementation of legislation and provision of

permits). However, when the interests of the government and its private partner become less aligned, for instance as a result of the emergence of an unanticipated negative externality, strong public-private cooperation may reduce the responsiveness of the government to these changed circumstances. This may be particularly true for situations where the public interests are not sufficiently guaranteed in the governance structure of the public-private cooperation.

3. Fostering the agricultural industry after WOII

3.1 Introduction

In the first decade after World War II, countries in Europe suffered from many things, including a lack of food. The productivity of the agricultural industry was low, resulting not only in low levels of food production, but also in low-income levels. Initially on a national level, but increasingly on a European level, governments wanted to foster the agricultural industry in order to overcome these problems. This chapter describes the agricultural policy objectives and the policy measures taken to realize these objectives, the effectiveness of these measures as well as how governments dealt with a number of side or adverse effects.

3.2 Policy objectives and instruments

The ambition to stimulate the agricultural production within Europe was one of the main components of the Treaty of Rome (1957) which established the European Economic Community.[18] In this treaty, the policy objectives regarding agriculture and food supply were formulated. These objectives were the following:

- The food supply for the inhabitants should be guaranteed through agricultural production within the Member States of the European community.
- The farming families should be able to realize a reasonable living standard.

[18] This section is based on https://www.europa-nu.nl/id/vg9pir5eze8o/landbouwbeleid_glb

- Agricultural product markets should be stable markets which are able to deal with shocks in supply.

Although the European community has changed in many respects since its Rome treaty, these main objectives regarding agricultural sector and food supply have not fundamentally changed.

These policy objectives were pursued by a number of policy instruments. Initially, these instruments were primarily directed at increasing the productivity of farmers. The productivity increase was promoted through a variety of measures. One of these measures was meant to improve the agricultural structure, by enlarging the size of farmers and increasing the scale of operation. In 1958, the Dutch government started with its agriculture-structure policy laid down in its *Meerjarenplan voor ruilverkaveling* (Long-term plan for redistribution of land) in order to raise the size of farms as well as to raise the labour productivity. As part of this agriculture-structure policy, the government established the *Ontwikkelings- en Saneringsfonds* (Development and Reconstruction fund) in 1963, which was initially meant to help small farmers with financial difficulties. Gradually, this fund was used to foster the structural change by facilitating the process of closure of small firms and increasing the size of other firms.

Another type of measure was meant to foster research and development in agricultural technologies. The Dutch government started already with promoting research and application of new insights and methods in agriculture at the end of the 19th century. This policy resulted in various types of organisations, such as *Proefstations* (experimental farms), *plantenziektenkundige dienst* (Phytopathology Service), and the *Landbouwhogeschool* (now: Wageningen University and Research, WUR).

The Dutch government cooperated closely with the industry. Together they established information and education programmes to support

farmers or to convince small farmers to stop. The industry also participated in the O&S fund. Moreover, the public-private organisation the *Landbouwschap* was created and which organisation received legal powers to implement sector-specific regulation.

As the agricultural product prices were high due to scarcity in international agricultural markets immediately after WO II, governments took measures in order to protect consumers against too high international prices. Later on, when the productivity of agricultural industry increased, international prices reduced, which resulted in too low prices for less productive farmers. In order to support the business of these farmers, governments took price measures in order to protect these farmers from too low prices. This resulted in guaranteed minimum prices for many agricultural products.

This price regulation became a kind of industry policy to protect an industry. The representatives of the agricultural sector were in favour of such a policy instead of income support as price regulation was less transparent as a kind of industry policy and, therefore, they believed it would be less vulnerable to political debate. There existed a general agreement (among all stakeholders, including government) about the need to regulate prices as minimum prices, but more discussion was about the level of the minimum levels.

Generally, the policy became to set the minimum price levels based on the costs of an efficient farm, which implied that the prices were too low for many small and old farms. This Dutch price regulation became later also the basis for the EU agricultural policy when the Dutch Minister of Agriculture (Mr. Mansholt), became EU commissioner in 1958 for about a decade. Besides this regulation of prices, governments also strongly intervened in markets by removing barriers for trade within the European

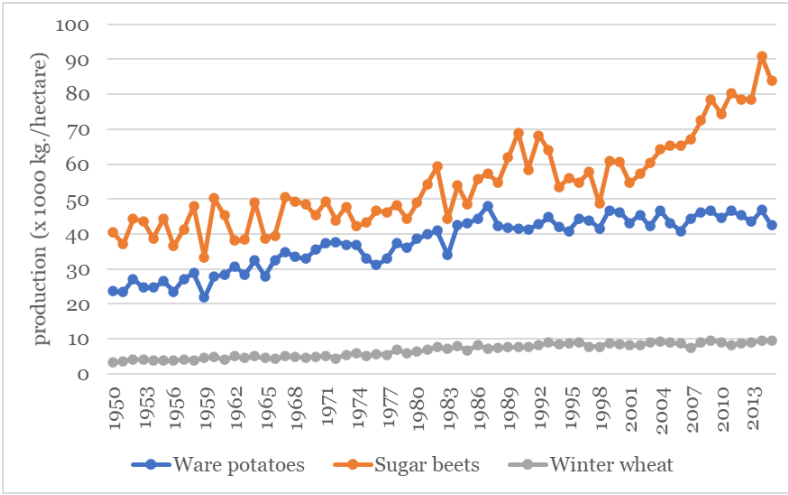
community, but at the same time creating barriers for import from outside the EU (De Groot and Bouwens, 1990).

3.3 Effectiveness of policy

3.3.1 Productivity

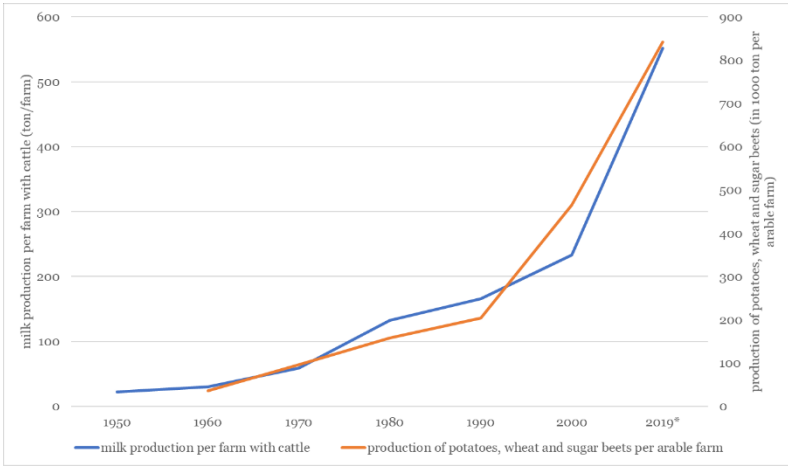
The productivity of the agricultural sector has increased strongly since 1950. The production of potatoes, sugar beets and wheat per hectare of land more than doubled (Figure 3.1). The production per farm increased even more because of this increase production per hectare in combination with the increase in firm sizes (Figure 3.2).

Figure 3.1 Production of potatoes, sugar beets and wheat per hectare, 1950-2015



Source: CBS

Figure 3.2 Production of milk, potatoes, wheat and sugar beet per farm, 1950-2019



Source: CBS

3.3.2 Structural change

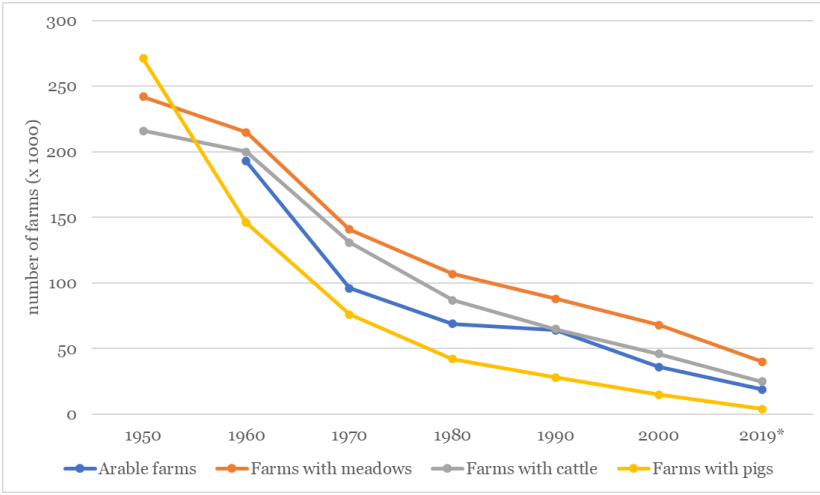
As the productivity of agricultural firms could only be raised so strongly by increasing the firm size, the many small farms had to grow or to sell the land to other firms enabling them to increase in size. Initially, the focus was on helping small firms to grow. Therefore, the Dutch government initiated the *Borgstellingsfonds*, which was a fund able to give a financial guarantee to lenders of debt capital in order to enable them to provide loans to agricultural firms. In addition, a number of Dutch firms were offered the option to move to the new agriculture areas in the newly created land (*de polders*), which also resulted in more firms having a larger size with a higher productivity.

Later on, the focus of the Dutch agricultural policy became to restructure the sector, by helping small farmers to stop and to help other

farmers to grow. This distinction was expressed as *blijvers* (remainers) and *wijkers* (leavers). Government and agricultural organisations established "information and education programmes" to help both groups of farmers. In addition, the government established the *Ontwikkelings- and Saneringsfonds* (O&S fund), in which also the agricultural organisations participated, to financially facilitate this process. This was a great success.

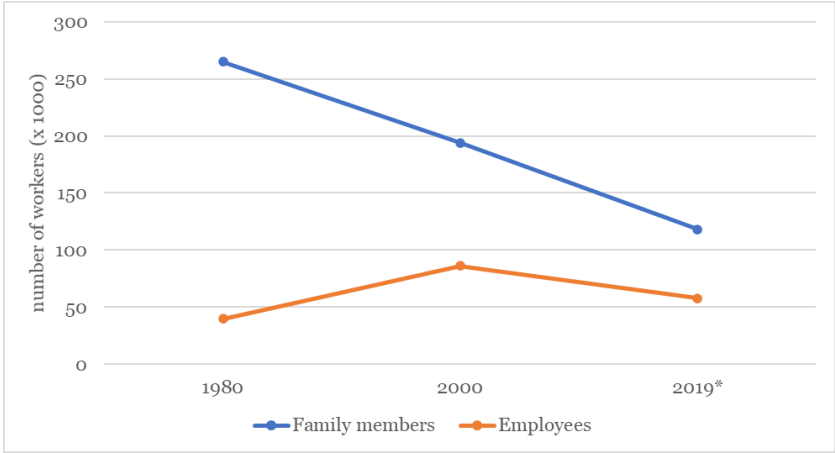
The structure of the agricultural sector changed dramatically since 1950. The number of firms with meadows declined from about 250,000 in 1950 to less than 50,000 now (see Figure 3.3). Together with the decrease in the number of farms, the total employment in the agricultural sector declined as well (Figure 3.4). Agricultural firms grew in firm size, not only measured in terms of hectare and number of animals per firm, but also in the number of people working on a farm (Figure 3.5).

Figure 3.3 Number of agricultural firms per sector, 1950-2019



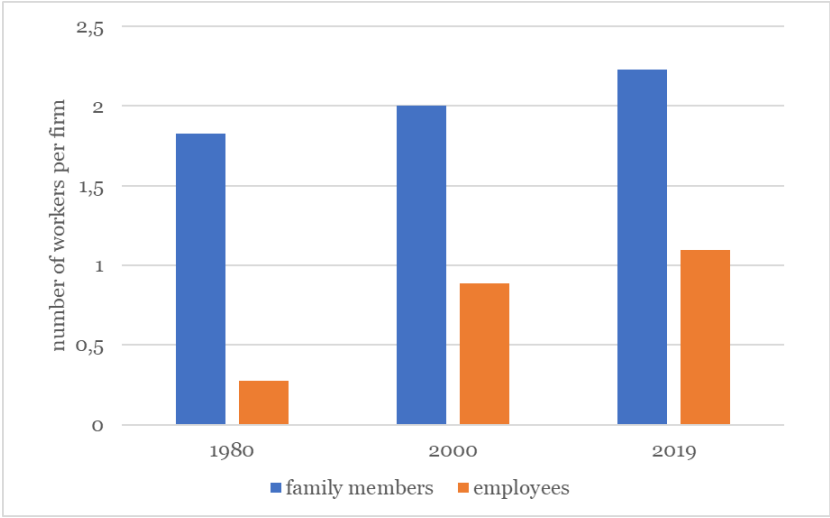
Source: CBS

Figure 3.4 Employment in the agricultural sector, 1980-2019



Source: CBS

Figure 3.5 Employment in the agricultural sector, 1980-2019

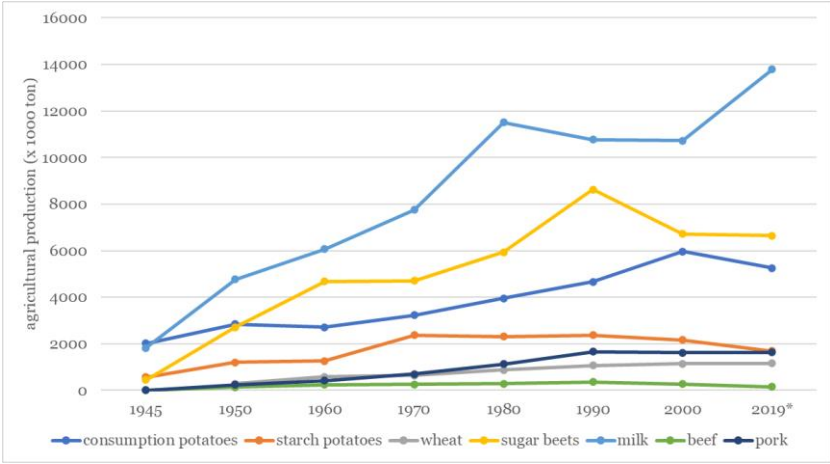


Source: CBS

3.3.3 Total production

The strong increase in productivity contributed to the growth in total agricultural production. The production of in particular milk, sugar beets and consumption potatoes increased strongly (Figure 3.6).

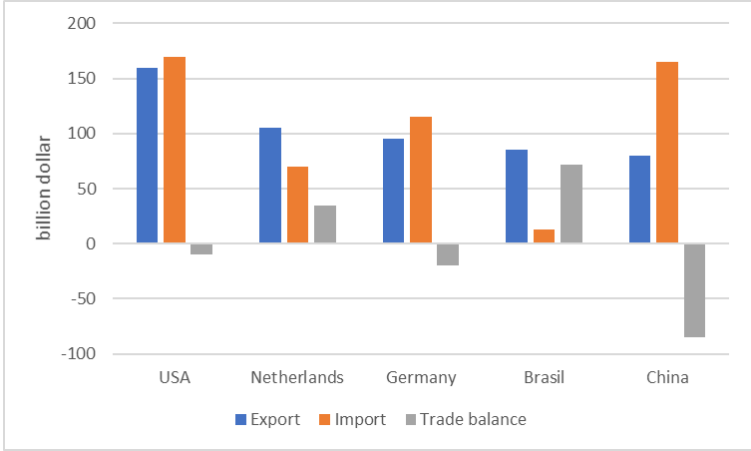
Figure 3.6 Agricultural production in Netherlands, 1945-2019



Source: CBS

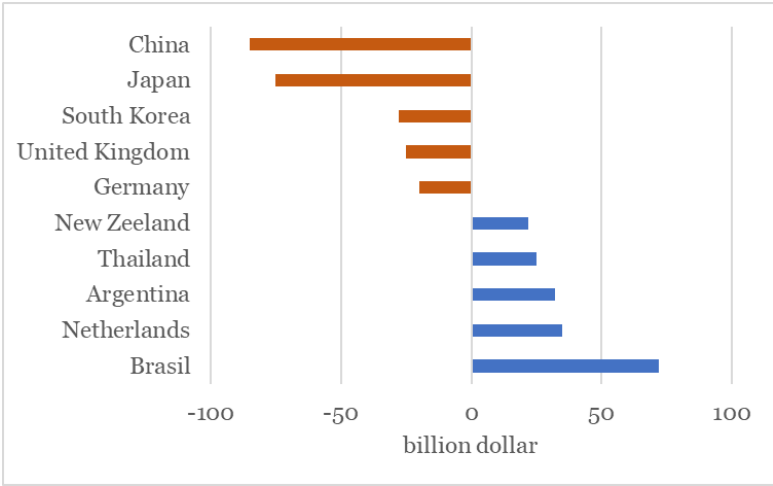
This strong increase in domestic agricultural production has mainly been realized by becoming one of the top global exporters (see Figure 3.7). Even in absolute terms, the Netherlands is globally the number second in terms of the value of agricultural export. The Netherlands also imports significant amounts of agricultural products, which indicates that the agricultural sector is also dependent on the supply of inputs from other countries. Nevertheless, the agricultural trade balance is one of the largest globally. Only Brazil realizes a higher surplus in international trade (see Figure 3.8).

Figure 3.7 Top 5 countries with highest value of agricultural Export, with export, import and trade balance, 2018



source: WUR/Agrimatie.nl

Figure 3.8 Countries with the highest positive trade balance and countries with most negative trade balance, 2018

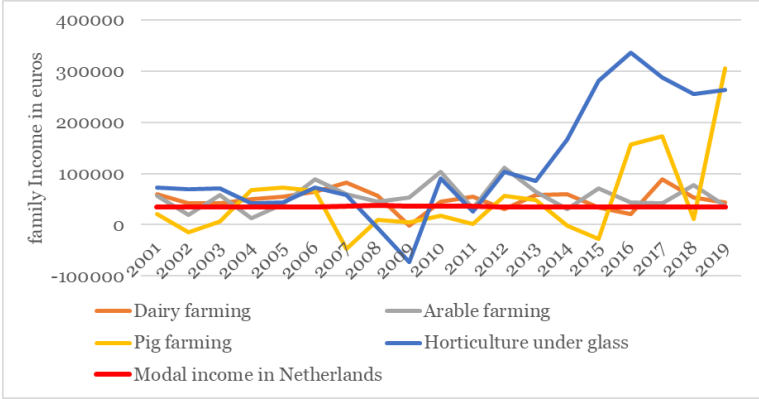


source: WUR/Agrimatie.nl

3.3.4 Income and prices

As agricultural firms operate on international, competitive markets, the incomes of farmers fluctuate quite strongly. Nevertheless, the average income per farm family has been significantly higher than the modal income in the Netherlands (Figure 3.9).

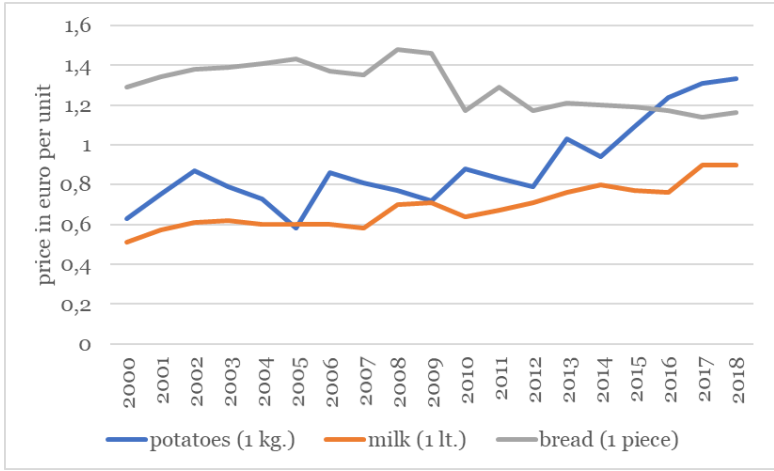
Figure 3.9 Family income in agricultural sectors in comparison to modal income in the Netherlands, 2001-2019



Sources: Agricultural income: Wageningen Economic Research; modal income: CPB

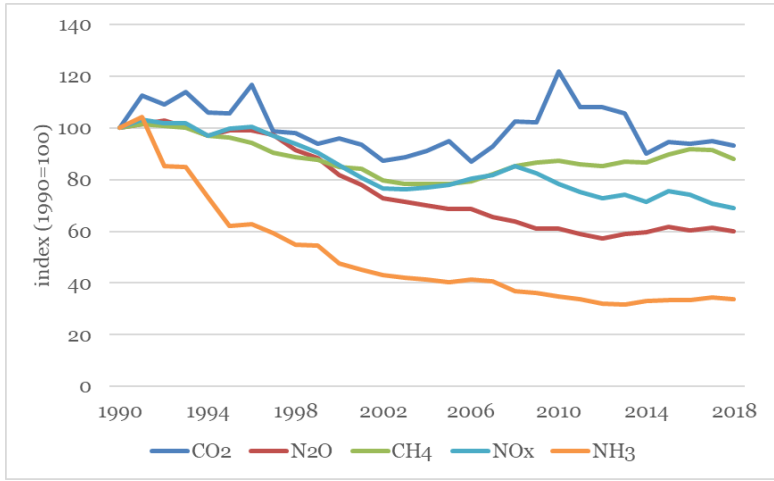
The food prices for Dutch consumers have increased in nominal terms, but corrected for inflation, they have not risen much.

Figure 3.10 Prices of some agricultural products in the Netherlands, 2001-2019



Source: CBS

Figure 3.11 Environmental emissions by the Dutch agricultural sector, 1990-2019



Source: www.clo.nl

3.3.5 Environmental effects

The environmental emissions by the agricultural sector have been reduced since 1990 (see Figure 3.11). This holds in particular for the emissions of ammonia (NH_3). This reduction has been realised through the reduction of the number of animals as well as a number of technical measures. Nevertheless, the intensity of the emissions of NH_3 is still high and belongs to the highest levels in Europe (www.clo.nl). Moreover, the agricultural sector is the major contributor to the emissions of NH_3, CH_4 and N_2O in the Netherlands (with their shares being 86%, 75% and 74% in 2018, respectively).

3.4 Effects of agricultural policy

3.4.1 Debate within agricultural sector

Not all farmers agreed with the policy to restructure the industry and fostering large scale farmers and, meanwhile, protecting the income of farmers by setting minimum output prices. A number of groups of farmers opposed this policy, including the group of so-called *Vrije boeren* (Free Farmers). These farmers were against the process of structural change through a reconstruction process, as they did not agree with the strong governmental intervention in the agricultural sector. These farmers were mostly small farmers, who had also difficulties to find alternative activities outside the industry (because of age and/or education). Partly because of the financial support from the Development & Reconstruction fund, this opposition gradually disappeared.

Another group of farmers was not against the intervention, but they disagreed with the low level of regulated prices. They organized massive protest actions in order to claim higher minimum prices. This group

consisted of relatively young farmers who wanted to have more certainty about future income.

A third group of farmers, generally also younger, but with quite modern farms, did not agree with the market-based policy, despite the minimum prices. This group wanted just more government intervention, less market forces, more rules, for instance regarding maximum production (quota) and maximum firm sizes.

3.4.2 Benefits of EU agricultural policy

The Dutch agricultural sector strongly benefited from EU internal market because of the open borders within EU for agricultural products, without the pressure of competition from outside the EU because of the high import tariffs to EU. In addition, the EU guaranteed minimum prices through the price regulation, while the surpluses were taken from the market resulting in so-called butter mountains. These subsidies for agricultural products were given on EU level, while no national subsidies were given anymore.

The Dutch farmers could strongly benefit from the removal of trade barriers within the EU because of their relatively high productivity compared to many European competitors. This high productivity was realized through an intensive process of specialisation – in the past most farms were active in various branches, but more and more they became specialized in one type of activity, which resulted in the so-called bio-industry.[19]

[19] See (source: https://www.dbnl.org/tekst/lint011tech03_01/lint011tech03_01_0001.php)

3.4.3 Adaptations of policy

The agricultural policy has been subject to debate throughout the full period of analysis. One of the topics of fierce discussion was the use of guaranteed minimum prices for farmers. Several economists (including the Groningen Economics Professor Hartog) opposed the minimum prices as this would result in over-production. In their view, the government should not address the symptom of the problem (i.e. the low prices), but tackle the cause (which is too much production and too many farms). These economists suggested to introduce quota (which actually occurred on EU level later on). The bottom line of this critique was that the minimum prices were too much based on costs of efficient production, while no attention was directed to the idea of an equilibrium in the market, and as a result, the total supply exceeded the total demand.

Indeed, the critique appeared to be right: the oversupply together with the price regulation required huge (EU) government spending. Later on: the negative effects of overproduction for the environment became more pregnant. This also led to intervention to reduce production, but this resulted in more opposition from the agricultural industry.

Because of these problems, the agricultural policy of the EU has changed a number of times.[20] In 1992, the so-called MacSharry reforms were implemented. In these reforms, minimum prices were replaced by subsidies per product. In addition, large farms were forced not to use a part their land when they want to receive the subsidies (*braakliggen*), in order to reduce the overproduction.

In the 2000 reforms, product subsidies were gradually replaced by subsidies per hectare, while also more attention was paid to environmental

[20] Source: https://www.europa-nu.nl/id/vg9pir5eze8o/landbouwbeleid_glb

effects. Moreover, the income support (i.e. subsidy per hectare) became dependent on performance in the field of animal welfare, landscape and environment.

In the 2008 reforms, no direct income support was paid anymore to farmers. Since then, subsidies are only used for landscape development/protection, water management and climate adaptation, climate mitigation (i.e. renewable energy).

3.5 Conclusions and lessons learned

3.5.1 Conclusions on the agricultural sector policy

The main agricultural policy objectives regarding the agricultural sector were to secure the food supply, to stabilize prices and to enable farmers to realize a reasonable living standard. This agricultural policy was extremely successful as it resulted in a strong increase of production, higher incomes for farmers and lower prices for consumers.

These results were realized by a number of intensive interventions, which included guaranteed minimum prices for farmers, financial support to farmers, research and information programmes, market-protection measures on EU borders, as well as the removal of trade restrictions between countries within the EU. The subsidies were financed from the general public budget. Another characteristic element of this policy was that the government closely cooperated with the agricultural industry, not only in the field of research and information programmes, but also in relation to the determination of prices. A consequence of this intensive cooperation between government and industry is that the latter was able to influence the policies in their favourite direction.

The policies to promote the agricultural sector, however, also had a number of adverse effects. It resulted in overproduction and severe EU

budget problems. In addition, the oversupply of products (like milk, cheese, sugar) were dumped on the world market, which made it impossible for small farmers in developing countries to compete. The strong increase in production had also negative effects on animal welfare and animal diseases, while also negative environmental effects resulted, in particular in terms of emissions of nitrogen and phosphate and impacts on landscape. Because of these adverse effects, the EU agricultural policy has been adapted several times, which reduced the direct price and income support for farmers, and increased the support for environmental and landscape benefits.

3.5.2 Lessons learned

From the experience with the development of the Dutch agricultural industry, a number of lessons can be learned.

1. Systems based on financial support may be very difficult to change as the recipients become dependent on the support and may oppose any change to reduce support. When financial support schemes are introduced it may be helpful also to announce from the start how the scheme will develop in the future.
2. Groups within society that tend to face negative effects of a transition policy can be compensated through special programmes helping them to make a transition themselves. When the so-called losers of a transition are supported to make a transition themselves, the social resistance against the transition may be lower.
3. The implementation of minimum price guarantees can be very effective instrument to foster production, but this kind of policy may also have dramatic adverse effects. Minimum price guarantees may result in a very costly oversupply if no attention is paid to the necessary equilibrium between supply and demand. In order to prevent this

adverse effect, attention should be paid to the amount of supply that receives a regulated minimum price.

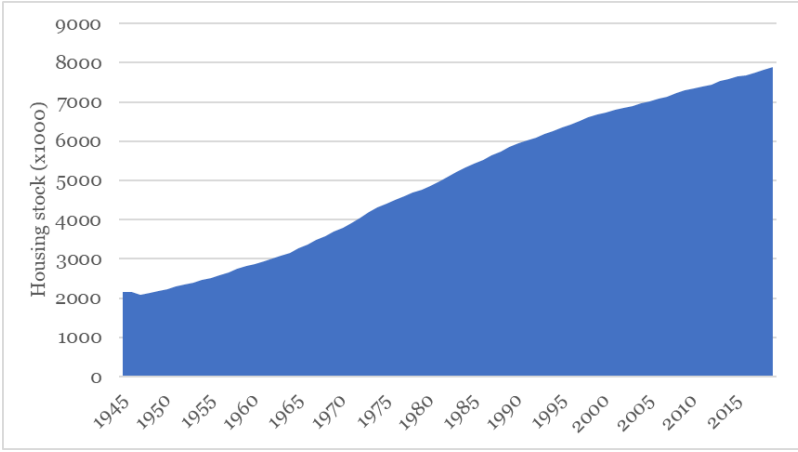
4. A strong focus on developing an industry may go at the expense of other public interests, such as with regard to environment and landscape. In order to be able to address these adverse effects, it is crucial that governments are able to adapt their policy measures in order to remain focussed on the ultimate policy objectives. Instead of fostering a particular industry, governments should keep an eye on the broader objective which takes the other relevant public interests into account. Consequently, because of the possibility of conflicts between these public interests and interests of particular groups, it is crucial to keep a clear view on the ultimate objective of the policy intervention.
5. Close cooperation between government and industry may help to define appropriate policies, but has also as a risk that the government becomes captured, resulting in less optimal policy measures from a society point of view.

4. Solving housing shortages since WW II

4.1 Introduction

After the second world war (WW II), the Dutch housing market was characterised by severe shortages due to demolition in battles and air raids, paired with the lack of building of new houses. This urgent housing shortage was the incentive for a shift in Dutch government policy for the housing sector (Boelhouwer et al., 2006). While historically, the belief was that social housing organised by the central government was an addendum to housebuilding by private developers, now, faced with the urgent need for new houses in the Netherlands, the central government concluded that interventions in the housing sector where needed to overcome the housing shortage. As a result of this policy, the Dutch housing stock grew significantly (see Figure 4.1).

Figure 4.1 Dutch housing stock, 1945-2019



Source: CBS

In this section, the Dutch housing policy will be analysed. More specifically, the different policy objectives for the Dutch housing sector, and the policy instruments to reach those objectives will be elaborated on. In addition, the effectiveness of these instruments, as well as additional effects will be analysed. To conclude, the Dutch housing policy will be summarized and the lessons from this sector will be presented.

4.2 Policy objectives

Right after WWII, the Dutch housing sector was experiencing a severe shortage in the housing shock, leading to many households not having a house to live in. This severe shortage was caused by a lack of construction of new houses that had come to a complete stop, since there were no workers available, paired with a high degree of demolition due to air raids, ground battles and the construction of the *Atlantik* wall. This drop in the housing stock during the war, paired with a birth wave immediately afterwards, made that the demand for houses by far exceeded the supply. As a consequence, many households had to share their homes with other households while the house prices of the available houses were high.

The motive for the Dutch central government to intervene in the housing sector was driven by both the basic human right of shelter, and the functioning of the housing market (Boelhouwer & Priemus, 1990). The human right of shelter is translated into the policy objective to have a house for every household in the Netherlands. This objective could not be realised by the housing market alone. This is due to the fact that the housing market is by itself inelastic in the short run, meaning that the supply of houses is, in the short run, not responsive to the demand for houses (PBL, 2018). Consequently, there is a lag between the demand and supply, resulting in a rather persistent shortage of housing. Although a small persistent shortage of housing does not need to be a large problem for society, a rather large

shortage is a societal problem. These two drivers combined, made the Dutch central government to intervene to solve the housing shortage.

To make housing available for every household, only increasing the housing stock would not be sufficient. A large part of the population had little to spend on housing as a consequence of the Dutch government's efforts to boost the Dutch industry and the related policy to freeze the wages of Dutch workers. Hence, to achieve the policy objective of making housing available for every household, there was a need for the houses to be affordable. Consequently, in the first decades after the war, with low wages for a large share of the population, the policy objective of solving the housing shortage resulted in the wish to increase the availability of social housing (Salet, 1999).

The economic prosperity of the 1960s and 1970s, however, diminished the need for increasing the availability of social housing as the housing shortage was reduced strongly (see Figure 4.4). With the policy objective of solving the housing shortage largely realised, the Dutch central government aimed for another objective: increasing the share of owner-occupied homes. This objective was motivated by the wish to decrease governments spending on housing (Koffijberg et al., 2012). For the objective to reduce the share of housing in the government budget to be realised, the importance of the social sector had to be decreased, with a growing share of owner-occupied homes (Boelhouwer & Priemus, 1990). To illustrate this, the minister of Housing and Spatial Planning, Hans Gruijters said in 1975: "We should aim to have rather soon in the Netherlands the same situation as in Belgium, with two-thirds home-owner occupied homes and one-third rental homes".

4.3 Policy instruments

To reach the three objectives for the housing sector in the Netherlands, the Dutch central government developed and implemented a wide range of policy instruments. The majority of the policy instruments can be categorised in three different categories. First, many of the instruments that were developed were implemented via housing associations. Over the years, the housing associations can be seen as the executive agents of the housing policy set by the Dutch central government. Second, the central government was actively involved in the spatial planning of housing projects. This spatial planning was described in the so-called *Memoranda Spatial Planning* presented by the Ministry of Spatial Planning, which stopped to exist in 2010. Finally, there have been policy instruments designed specifically for increasing the share of owner-occupied homes.

4.3.1 Housing associations

Several instruments that the Dutch government used in housing policy were targeted at increasing the housing construction and exploitaition by housing associations. These associations already received a formal position in the Dutch housing policy in the Housing Law of 1901 (Priemus, 1995). According to that Law, the associations became eligible for government support after being admitted by the Minister of Housing. Before WWII, housing associations were subsidized by a deposit of the central government, which had to be repaid in 50 years (extended to 75 years during the Depression period before the war). These deposits were replaced by municipal loans or guarantees after WWII.

In addition to this financing of by the central government, housing associations were stimulated with subsidies and priority in housing projects. From 1950 onwards, the housing shortage, due to a lack of cheap (affordable) houses, became a more prominent problem for the central

government, which led to housing associations being stimulated more by the government (Boelhouwer, 2002). In 1965, there was a priority position created for housing associations compared to municipal housing companies, strengthening the position of housing associations. Two important subsidy schemes for housing associations were: the Financial Support for Private Rented Homes Decree (1968) and the Financial Support for Rental Homes Decree (1975). In exchange for more intensive subsidizations, the Dutch central government became more involved in regulation, planning and the allocation of subsidies leading to the effect of the housing associations losing their private character (Salet, 1999).

However, the subsidy schemes resulted in large-scale creative accounting with construction subsidies for housing-law houses, resulting in unefficient government spending on public housing. This has led to a Parliamentary survey on construction subsidies in 1986. After 1986, housing corporations and associations became more independent while also more competition in the financing of housing corporations was introduced. This became apparent in 1989 in the note "Public housing in the 1990s". Subsidies were drained and two-third of all housing associations had to turn to the capital market for financing their projects.

In addition to the closure of subsidies, the “Grossing Act”[21] of 1994 made housing associations more independent. This caused stagnation in the housing stock for social rent and sale or demolition. There was more focus on quality than quantity, given that this realised higher returns on investments. Although further liberalization of housing associations was rejected in 2006, a landlord levy was introduced in 2013. The levy was applied when more than 10 houses were rented out in the social rental sector, effectively affecting housing associations. The political reason for

[21] In Dutch *Bruteringswet*.

this levy was that the associations were not seen as crucial partners in the housing market anymore and their capital could be taxed away to fund the government budget.

4.3.2 Policy documents on spatial planning

The spatial planning of the Netherlands is one of the crucial instruments of the Dutch central government to influence housing projects. The Dutch central government addressed the spatial planning regarding housing projects for the first time in the 'Memorandum spatial planning'[22] of 1960. This would be the first of 6 policy documents in which the central government gives steering in the use of the available land for housing. Local authorities, such as provinces and municipalities, were obliged to bring their regional plans and zoning plans in line with these core decisions. An overview of the policy documents on spatial planning, their year of implementation and their focus is provided by Table 4.1.

The focus of the Dutch housing policy over the years is reflected in the policy documents on spatial planning. In the first Memorandum, the focus was on rapid deployment of social housing in the 'Randstad', which is the megalopolis in the central west of the Netherlands. In the second and third Memorandum, of 1966 and 1973 respectively, the focus was on establishing multiple growth centres, to control the growth of the Randstad. In the fourth Memorandum of 1988, there was more attention to develop the quality of the new growth centres, with well-developed infrastructure and, with the addendum of 1991, a reduced environmental impact. The fifth document, implemented in 2002, focused on increasing the role of private agents and local governments in planning. In the sixth and last Memorandum, of 2004, the Dutch government broke with centrally

[22] In Dutch *Nota ruimtelijke ordening*.

regulated spatial planning and the attention shifted to a decentralised approach. Also, the focus was more on giving incentives to private parties to developed desired projects instead of implementing restrictions and direct control by the central government.

Table 4.1 Memoranda spatial planning, year of implementation and their focus

Nr.	Title	Year of implementation	Focus of Memorandum
1	Memorandum spatial planning	1960	Structured development of the 'Randstad'
2	Second Memorandum spatial planning	1966	Appointing designated growth centres close to 'Randstad'
3	Third Memorandum spatial planning	1973-1983	New-build homes in 11 growth centres outside the large cities
4	Fourth Memorandum spatial planning	1988	Matching the quality of spatial layout with (high) future international standards
4+	Fourth Memorandum spatial planning extra	1991	Addendum with special attention to environmental impact
5	Fifth Memorandum spatial planning	2002	Decentralisation and increasing role of private agents
6	Memorandum Space	2004	Decentralised planning and less restrictions

4.3.3 Owner-occupied homes

Until 1952, the Ministry of Reconstruction and Housing was controlled by the Social Democrats, who were not convinced that homeownership would be beneficial for the lower working class. Kees ten Hagen, PvdA-parliaments member, said in 1950: "Common ownership of homes through

the housing association is a higher form of ownership." This policy changed during the regime of the Catholic People's Party (KVP) in the 1950s, with the introduction of several premium schemes for both builders and buyers of owner-occupied homes. For example, the mortgage guarantee was introduced in 1956, by which the central government guaranteed the repayment of the mortgage if the homeowner could no longer pay it due to unforeseen circumstances. As a result, mortgage lenders dropped the requirement for co-financing by the client.

The 1970s gave a mixed political preference, with the Social Democrats still aiming at stimulating social rental houses, where their coalition partner, the Democratic party D66, had a different view. The D66 minister of Housing and Spatial Planning, Hans Gruijters, wrote in 1974 in the policy paper on Rental and Subsidy Policy: “Owning his home offers opportunities to experience responsibility and independence” (Gruijters, 1974). Under this administration, a premium scheme for starters in the housing market was implemented, to foster owner-occupied housing.

In the 1980s onwards, the urgent housing shortage was solved, and the influence of the housing associations was reduced by letting more people own their own homes. This would also lead to a higher feeling of responsibility for their homes and neighbourhood. The privatization of housing corporations and associations made these organisations focus more on projects with higher returns for their investments, leading to the housing associations selling parts of their properties to private investors and private individuals. Generally, these were buildings and houses that previously served as social rental homes (Boelhouwer & Priemus, 1990).

Another policy instrument of the Dutch government to stimulate private home ownership, is the home mortgage interest deduction[23], which allows

[23] In Dutch *hypotheekrenteaftrek*.

taxpayers who own their own homes to reduce their taxable income by the amount of interest paid on their mortgage. This instrument, already established in 1893, became increasingly important when both the mortgage and mortgage interest rate were high. This financial instrument would ideally lower the barrier for non-homeowners to buy a house instead of renting. However, the outcome of this policy instrument is strongly influenced by the number of new houses build. Without a matching increase in housing stock, the only effect was that potential house buyers could spend more on the limited number of houses. Also, the costs of having a house, in the form of the assumed rental value, transfer tax and property tax rose. Due to the design of the financial instrument of mortgage interest reduction, the homeowners with the highest mortgage benefit the most. This is in contrast with the ideal outcome, where the benefit is for the resident that is at the margin of buying a house, instead of renting.

4.4 Effectiveness of policy

As stated in the previous sections, the Dutch housing policy, with corresponding instruments, was targeted at achieving two objectives: solving the housing shortage and increasing the share of owner-occupied homes. This section will first focus on the effectiveness of policy instruments on solving the housing shortage, whereafter the focus will be on effectiveness of the instruments implemented for increasing the share of owner-occupied homes.

Box 4.1: Housing shortage – How to calculate?

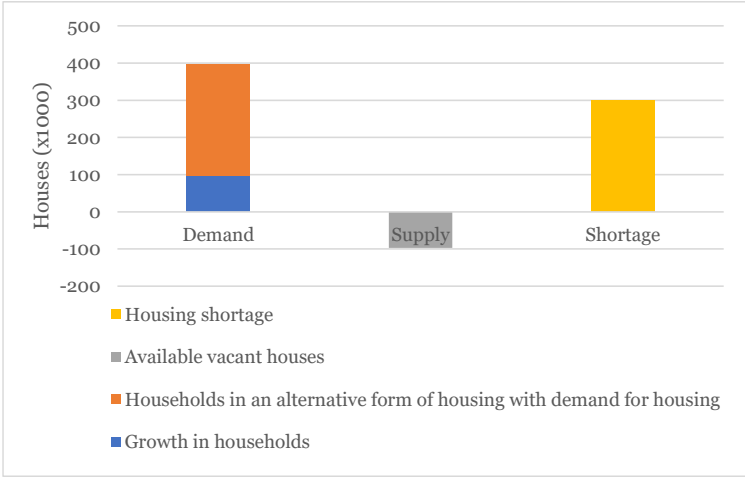
To measure the shortage of houses, one has to calculate the total demand for housing as well as the total supply. Where the supply is simply the housing stock, the demand is somewhat more difficult to calculate. The calculation of the Dutch housing shortage was done on behalf of the Ministry of Housing, by consultancy ABF Research, that used the "Primos-method" to calculate the housing demand. This was done annually on the basis of survey data and the expected population development (Den Otter, 2007). After the dissolution of the Ministry of Housing in 2010, this was done on behalf of the Ministry of the Interior and Kingdom Relations. On behalf of that ministry, ABF drew up a new calculation method for the housing shortage in 2018 (ABF Research, 2018).

In this new calculation method, demand is calculated more on the basis of registration files, and less on the basis of survey results. The demand for housing that is important for the shortage consists of both the growth in households and households in an alternative form of housing with demand for housing.

On the other hand, the supply side is made up of available vacant houses. A vacant house is labelled as available if the following four criteria are met: a) there is no significant usage of power and gas, b) the house is registered as a regular house, c) the house is not registered as a shop function, and d) the house is not a second home.

For the calculation of the housing shortage, the number of occupied houses and their residents are not relevant, as this does not contribute to the shortage. In Figure 4.2, the calculation of the Dutch housing shortage for 2019 is depicted.

Figure 4.2 Calculation of Dutch housing shortage in 2019

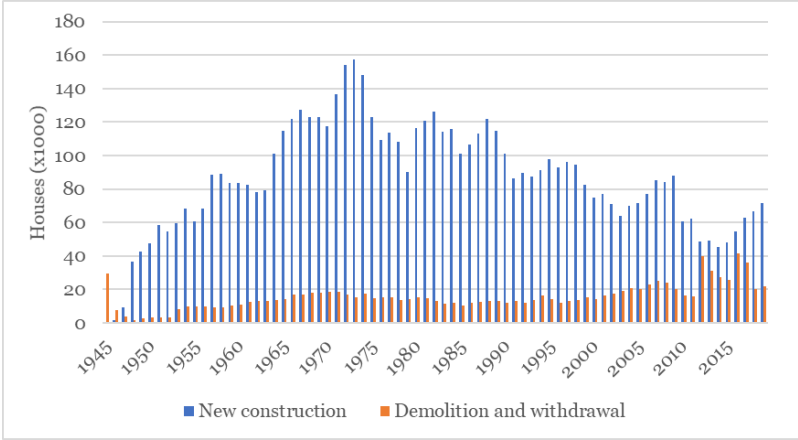


Source: Primos 2020 (https://primos.datawonen.nl/)

4.4.1 Solving housing shortage

To analyse the effect of Dutch housing policy on the housing shortage, it is important to know how the housing shortage is calculated. The calculation of the housing shortage is explained in Box 4.1. The first instruments to solve the housing shortage, in the form of stimulation and subsidization of housing associations, were implemented in the 1950's. In addition to the stimulation of housing associations, the first national Memorandum the spatial planning, was presented in 1960. The effect of these first instruments is depicted in the yearly number of constructed houses in Figure 4.3. The number of newly constructed houses increased from 47,300 in 1950 to a peak of 157,460 in 1973. Evidently, the instruments had a stimulating effect on the number of houses that were constructed.

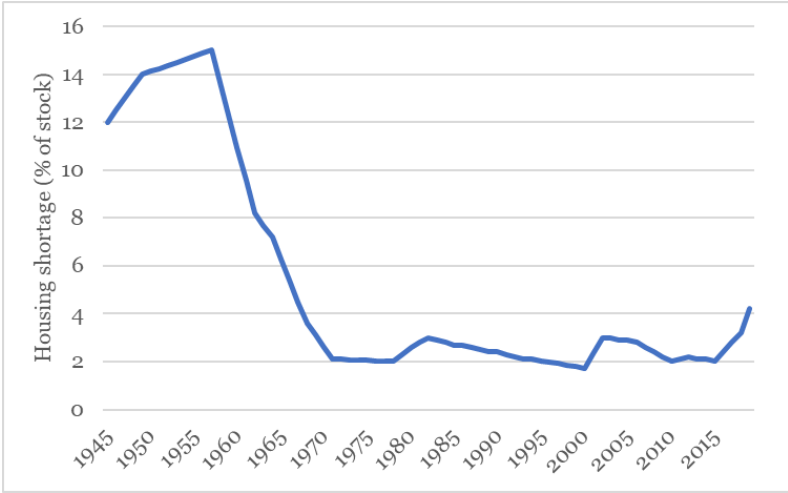
Figure 4.3 Newly constructed and demolished houses in the Netherlands per year, 1945-2019



Source: CBS

As a consequence of this growth in newly constructed houses, the Dutch housing shortage declined strongly. In Figure 4.4, the housing shortage in the Netherlands is depicted as a percentage of housing stock. The shortage peaked at 15% in 1957, after which it rapidly dropped to a level around 2% in 1971. From Figures 4.3 and 4.4, it can be concluded that the first set of policy instruments, consisting of the stimulation of housing associations and the first notes on spatial planning, were successful in realising a large decline in the Dutch housing shortage.

Figure 4.4 Housing shortage in the Netherlands as percentage of housing stock, 1945-2019



Source: DNB, Ministerie van BZK

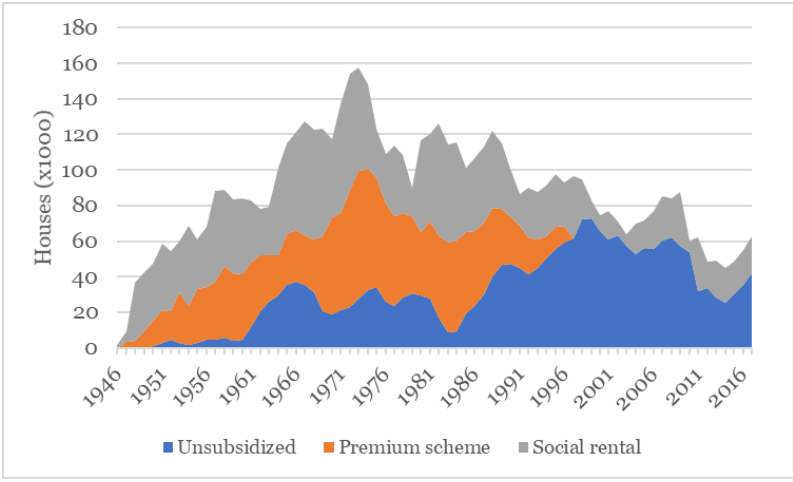
After this successful period of fighting the housing shortage, the level of subsidized constructed houses declined (see Figure 4.6). The housing shortage was to a large extent solved and, consequently, more attention was directed at limiting the number of subsidies for the housing sector. This led to a stabilization of the housing shortage in the 1970s. In the late 1970s, the level of newly constructed houses had dropped to around 90,000 per year. This, in combination with a growing demand for housing[24], led to a short increase again in the housing shortage.

At the beginning of the 1980s, there was a period of extensive subsidization of houses (Boelhouwer & Priemus, 1990). As a result, the number of newly constructed houses increased, while the shortage started

[24] The generation born after the second world war, a period with high birth rates, became active at the housing market in the 1970s.

to decline. With higher economic prosperity, the level of unsubsidized housing construction increased (Figure 4.5). This was enough to compensate for the decline in subsidized housing projects, following the privatization of housing associations since the Parliamentary survey on construction subsidies in 1986. The housing shortage kept declining to a historically low level of 1.7% in 2000 (Figure 4.4). In recent years, the Netherlands experienced an increase in the housing shortage to the current level of 4.2%, which is the highest rate since 1967. We will further analyse the recent increase of the housing shortage in section 4.5.

Figure 4.5 New constructed houses in the Netherlands, subsidized and unsubsidized, 1946-2017



Sources: Ministerie van BZK (2018), CBS

4.4.2 Owner-occupied homes

With the housing shortage largely solved, the objective of increasing the share of owner-occupied homes became prominent for the Dutch central government. Although the prominence became apparent after solving the

housing shortage, some of the policy instruments were already developed in the 1950s or, in the case of the mortgage interest deduction, even in the nineteenth century. Most of these instruments were mainly targeted at increasing the financial ability of Dutch inhabitants to buy a house. Although these instruments have been introduced earlier, Figure 4.5 shows that the building of unsubsidized[25] houses, which are primarily for the buying sector, became most prominent from the 1980s onwards. This followed from both the increased economic prosperity and the priority switch from the central government from cheap social rental homes to more expensive owner-occupied homes.

This priority switch was also apparent in the spatial planning policy of that time. In the third Memorandum spatial planning, introduced in stages between 1973 and 1983, there was more attention for new-build homes in new growth centres outside the large cities (see Table 4.1). This bundled deconcentrating was induced by the emergence of the car in the middleclass, making it possible to travel from these new houses in the growth centres to work. These new-build homes were primarily built for the so-called free sector of owner-occupied homes (Boelhouwer & Priemus, 1990).

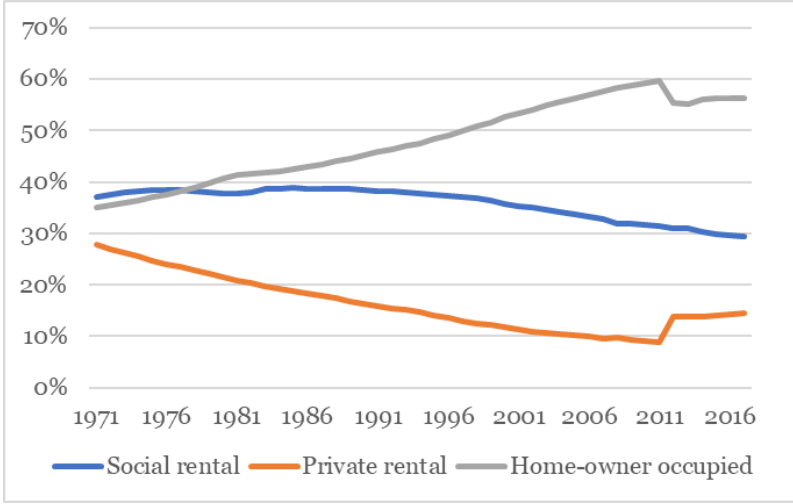
Since the introduction of the third Memorandum spatial planning, as well as the ending of the stimulation of housing associations, the share of owner-occupied homes grew gradually. In Figure 4.6, the share of social rental, private rental and owner-occupied homes in the Dutch housing stock is depicted. In the years prior to 1971, the share of owner-occupied homes increased from 28% in 1945 to 35% in 1971[26], induced by financial

[25] The term unsubsidized here refers to no direct subsidies for the construction of houses. Effectively, houses in the unregulated sector are also subsidized, due to the mortgage interest reduction.
[26] https://www.historischnieuwsblad.nl/geschiedenis-van-de-hypotheekrenteaftrek/

instruments introduced in the 1950s and the increase of economic prosperity in the 1960s. It is shown in Figure 4.6, that the share of owner-occupied homes increased to 56% in 2017. In 2012, there was a change in the classification of private rental and owner-occupied homes, explaining the jump in both the graphs of owner-occupied and private rental houses.

The increase of owner-occupied homes was primarily at the expense of the share of private rental, and in a later stage, the share of social rental. The decrease of private rental can be explained by the fact that it was more expensive than social rental, which indicates that the financial measures benefited the group of residents that was at the margin of purchasing a house in the 1970s and 1980s. The decline in social rental since the mid 90's was an effect of the privatization of housing associations and spatial planning policies to induce urban renewal. Many housing associations began to sell properties build to private parties in the 1960s, because of the high costs of renewal to the new standards for social housing and the limited benefits driven by the rental limit for social housing, which was the desired effect for the central government (Boelhouwer & Priemus, 1990).

Figure 4.6 Share of social rental, private rental, and owner-occupied homes in the Dutch housing stock, 1971-2017



Source: CBS; PBL

The objective of minister Gruijters in 1975, to reach a share of two-thirds of owner-occupied homes in the Netherlands, has not been reached. However, with an increase from 37% in 1975 to 56% in 2017, and the majority of that increase coming from private rental, we can conclude that the policy instrument targeted at enabling residents to buy a house have had the desired effect. In the next section, we will describe how the set of financial instruments in place also had a counterproductive effect, driven by a sharp price increase of houses.

4.5 Response to expected and unexpected policy effects

As a consequence of the government policies for the housing sector, a number of expected as well as unexpected effects occurred. Sometimes, this had adverse effects on the effectiveness of the instruments or raised the

need for additional government intervention. This section discusses two expected effects caused by Dutch housing policies: a) the effect on municipal housing companies and housing associations and b) the effect of decentralisation of housing policy on the housing shortage (Priemus, 1995; Van Straalen et al., 2016). In addition, this section discusses the unexpected effect of sharp rising housing prices in the recent years and the subsequent effect on starters on the housing market.

4.5.1 Effect on municipal housing companies and housing associations

Prior to the urgent housing shortage, a large share of housing projects was executed by municipal housing companies, regulated by municipalities. After the stimulation of housing associations in the 1960s, driven by a priority position, object subsidies and building premiums, the role of municipal housing companies rapidly vanished. This was a deliberately chosen strategy by the Dutch central government, whose belief was that central organized spatial planning was in the best interest of the society. Municipal housing companies were somewhat forced to merge with housing associations, squandering the private and local character.

After the Parliamentary survey on construction subsidies in 1986, housing corporations and associations became more independent while also more competition in the financing of housing corporations was introduced with further privatization induced by the Grossing Act of 1994. This radical change led to problems in financing for housing associations (Priemus, 1995). In response to this effect, the 'Waarborgfonds Sociale Woningbouw' was introduced to help housing associations to be financed at the lowest possible cost. The objective was that the assosciations were supported in the execution of building projects and managing of social

rental homes[27]. As can be seen in Figure 4.6, however, the share of social rental homes decreased from almost 40% to under 30% after the change in regulation of housing associations.

4.5.2 Effect of decentralisation on housing shortage

Since the implementation of the third Memorandum spatial planning between 1973 and 1983, planning and housing policy was decentralized. This trend was extended in the following Memoranda and, ultimately, in the sixth policy document on spatial planning of 2004, the Dutch government broke with the tradition of centrally organized spatial planning. This led to municipalities and provinces getting more room for pursuing their own interests, rather than the interests of the entire country. Given that municipalities earn on the sales of land and property tax, which are influenced by the value of houses, it is logical that each municipality aims for higher valued houses (Salet, 1999). In addition, more expensive houses are more likely to attract higher incomes, which also stimulates the local economy.

Besides pursuing more expensive owner-occupied houses, municipalities are also more inclined to urban renewal at the expensive of the cheap rental homes build in the 1960s and 1970s (van Straalen et al., 2016). Indeed, it follows from Figure 4.3 that the demolition and withdrawal of houses increased in the recent years.

As a consequence of these two policy changes, the share of social rental homes decreased, while the prices of houses increased substantially. This have led to long waiting lists for social rental homes in the largest cities. The availability of these houses is low, while the demand is increasingly driven

[27] Mission statement of the Waarborgfonds Sociale Woningbouw: https://www.wsw.nl/over-wsw/over-ons/wat-doen-we

by the inability of residents to purchase a house (Kromhout & Wittkämper, 2019).

In response to these effects, municipalities of the more densely populated cities are now making arrangements with housing associations to combine the more lucrative private rental with social rental in new housing projects. An example is that housing associations interested in building are required to include a percentage of social housing in their project proposal, to ensure a growing supply of social rental houses. However, as Figure 4.4 suggests, this is not sufficient to resolve the growth in the shortage of houses.

4.5.3 Effect of Dutch housing policy on housing prices

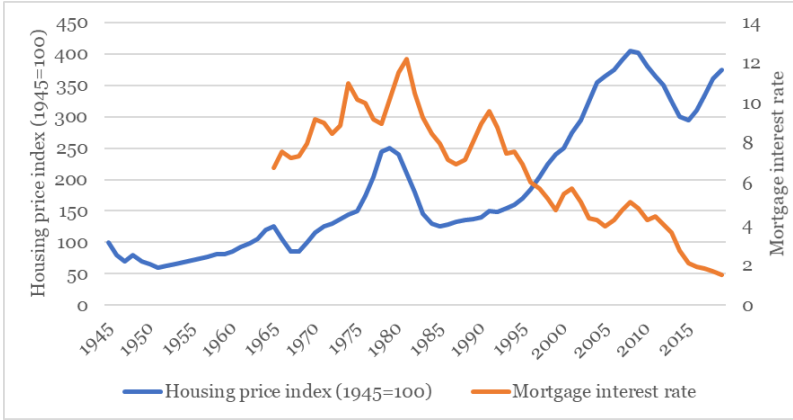
An unexpected effect of the, primarily financial, instruments to stimulate owner-occupied housing refers to the housing prices. The Dutch housing prices, corrected for inflation, tripled in the past 35 years (see Figure 4.7). Although houses increased in quality to some degree, this quality increase cannot explain the exponential increase in prices, since the same houses have increased in price as well (Knoll et al., 2017). Typically, one would expect that the price increase is driven by growing demand and not matching supply. However, the housing shortage, which reflects the difference of demand and supply has not increased significantly in the last 35 years, (see Figure 4.4). According to the Dutch Central Bank, empirical evidence suggests that a decrease of the housing shortage by 1 percentage point leads to a decrease of housing prices of 1 to 2%[28].

The price increase of houses seems to be largely influenced by the financing abilities of households. Empirical evidence suggests that the development of housing prices was strongly related to the development of

[28] https://www.dnb.nl/nieuws/nieuwsoverzicht-en-archief/dnbulletin-2020/dnb389563.jsp

the maximum mortgage households were able to attain, and the real interest rate they had to pay (Harris, 1989; Bank for International Settlements, 2001; Bosma et al., 2018). This maximum mortgage has strongly risen due to higher incomes as well as low mortgage interest rates. In the last 35 years, the average mortgage interest rate has declined from 7% to under 2% (see Figure 4.7). In addition, the fiscal benefits introduced over the past decades attributed to the increase of housing prices.

Figure 4.7 Housing price index, 1945-2019, and average mortgage interest rate, 1965-2019

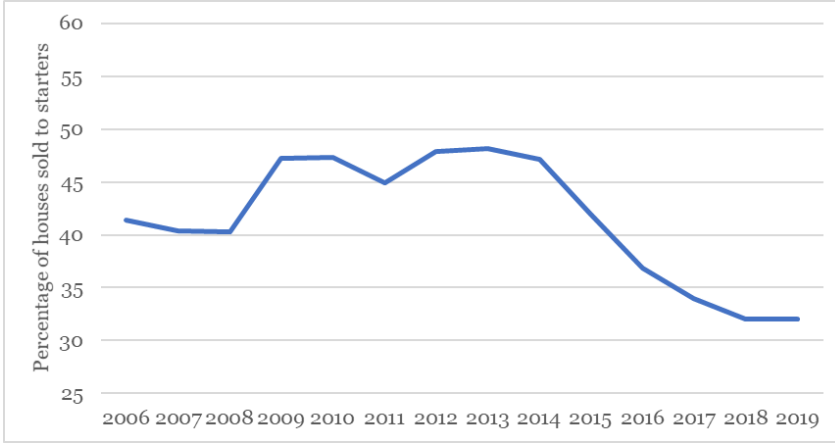


Sources: DNB, hypotheekshop.nl

The strong correlation of financial aspects to the housing prices, leads to the conclusion that an individual's financial position has become increasingly important when purchasing a house. This is a disadvantage for starters in the housing market, who generally have a lower income and wealth than potential buyers that already own a house (Schilder, 2020). The share of starters in the purchase of houses has decreased by 15% over the past years (see Figure 4.8). To stimulate the position of starters, also helping to solve the problem of waiting lists for social rental homes, the

government has introduced several instruments. An example is the phasing out of the mortgage interest deduction, which will give some relative advantage to starters, due to the low interest on new mortgages, this. In addition, the Dutch central government announced to abolish the transfer tax for starters in 2021. Currently, buyers of a house, including starters, have to pay a premium of 2% of the purchase price as a tax. With the abolishment for starters, this will create some additional advantage for this group of buyers.

Figure 4.8 Percentage of houses sold to starters in the Netherlands, 2006-2019



Source: Ministerie van BZK (2020)

4.6 Conclusions and lessons learned

4.6.1 Conclusions on Dutch housing policy since WWII

Since WWII, the Dutch housing policy was targeted at achieving two policy objectives: solving the housing shortages and increasing the share of owner-

occupied homes. The policy instruments used by the Dutch central government to achieve these targets can be categorised in three different categories: 1) direct stimulation and steering of housing associations, 2) active involvement in the spatial planning in the Netherlands, and 3) financial instruments to support owner-occupied housing.

The first objective of solving the housing shortage is largely realised, with a drop of the shortage of 15% to around 2% of the housing stock. This realisation is realised by a high growth in housing construction in the period 1950-1975. Drivers behind this effective policy were the subsidisation of cheap and fast-build social rental homes by housing associations, as well as the direct involvement of the Dutch central government in spatial planning.

Similarly, the policy instruments designed to achieve the second objective of increasing the share of owner-occupied homes can also be seen as realized. The share of owner-occupied homes has increased from 37% to 56%, driven by spatial planning designed for newly constructed houses for the unregulated sector[29], financial instruments to promote homeownership, and the privatization of housing associations.

However, as a consequence of these government policies for the housing sector, a number of expected as well as unexpected effects occurred. Expected effects were the diminishing role of the municipal-housing companies, the increasing role of the housing associations as well as the increasing housing shortages due to decentralisation. On the other hand, an unexpected effect was the sharp increase in housing prices and the following disadvantages for first-time buyers. For both the expected as unexpected effects, the government had to intervene and adapt policy to mitigate these effects.

[29] In Dutch *vrije sector*.

4.6.2 Lessons learned

From the experience with the development of the Dutch housing sector, a number of lessons can be learned.

1. Centrally-regulated policies can be successful in realising a rapid deployment. This is driven on the one hand by economies of scale and lower transaction costs, and on the other hand, by better aligned incentives and increased harmonisation.
2. However, centrally regulated policies can have as negative consequences a high burden on the national budget combined with low quality and effectiveness. This is due to information asymmetry between the central regulating body and the decentrally located executors of the policy. This makes that the latter could have too little incentives to aim for high quality and effectiveness. This issue is mainly relevant in those sectors with many decentralized decision-making units, where it is more difficult to get the incentives aligned with central objectives.
3. When decentralized policy measures are used to overcome this information asymmetry problem, additional policies have to be in place to aim for national policy objectives. Decentralisation can lead to friction with national objectives, induced by competition among local authorities having conflicting interests. This friction should be countered with additional policies to incentivise local agents to contribute to the national objectives.
4. When this additional national policy consists of financial measures, the effect may, however, be limited when other constraints exist, resulting mainly in distributional effects. Imposing financial measures, while there are unresolved underlying constraints, will merely result in a redistribution of welfare without contributing to the key objective.

Hence, for such policy measures to be effective, the underlying constraints must also be addressed adequately.

5. Changing the generation portfolio in electricity sector

5.1 Introduction

The electricity sector offers another type of example in which the government pursued a policy to fundamentally change a sector. While in the examples of the policies regarding the gas, the agricultural and housing sector, the objectives were to foster the size of the domestic supply and consumption, in the electricity sector the policy objective was and still is related to a change the structure of the supply. Since the mid-1990s, the Dutch government has implemented policy measures to increase the share of renewable electricity generation, as a means to reduce the emissions of greenhouse gases.

In this chapter, we first briefly describe the various policy objectives regarding the structure of electricity generation and the policy measures implemented to realize these objectives (Section 5.2). Then, we discuss the effectiveness and the factors which have affected this (Section 5.3). Afterwards, we discuss the distributional effects of these measures (Section 5.4), before presenting the conclusions and lessons learned.

5.2 Policy objectives and instruments

In the mid-1990s, the Dutch government started to implement measures to promote the renewable energy production. The objective at that time was to have a share of renewable energy production in total consumption of 10% (see Table 5.1).

Table 5.1 Policy objectives regarding renewable energy, 1996-2019

Policy document (year)	Policy objective regarding renewable energy
Derde Energienota (1996)	Share of renewable energy should be 10% in 2020
Werkprogramma Schoon en Zuinig (2007)	Share of renewable energy should be 20% in 2020
European directive on renewable energy (2009)	Share of renewable energy should be 14% in 2020
Energieakkoord voor duurzame groei (2013)	Share of renewable energy should be 14% in 2020 and 16% in 2023
Klimaatakkoord (2019)	Volume of renewable electricity generation should be 84-120 TWh in 2030 (corresponding with a 49-55% decrease of CO_2 emissions)

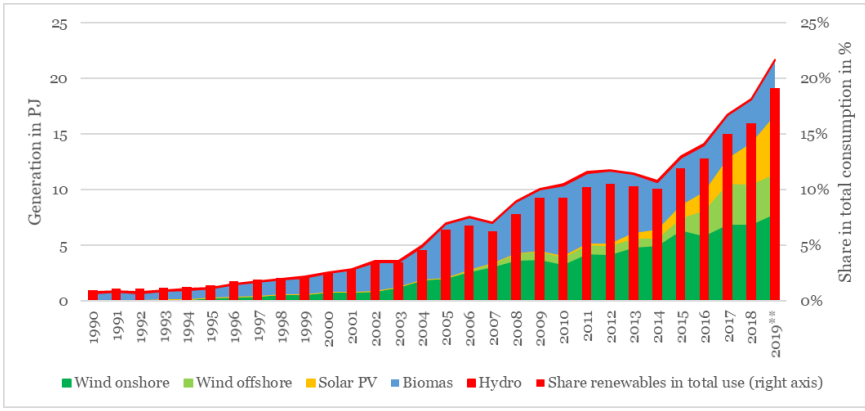
Source: Boot (2020); Klimaatakkoord hoofdstuk elektriciteit

In order to reach these objectives, the government took a number of policy measures. One of the key measures consists of subsidies for renewable energy production. The support started with the so-called MEP support scheme, which was replaced by the SDE scheme around 2007 which developed into the SDE+ scheme later on. Other policy measures which were taken to promote the share of renewables include regulatory constraints on the generation by coal-fired power plants. In the *Energieakkoord* it was agreed to close a number of coal-fired power plants, while later on, all coal-fired power plants were made subject to constraints.

5.3 Effectiveness of policy

Until recently, the policies to promote the share of renewables was not very successful. In 1996, when the policy started, the share of renewable generation was only a few percentages and this share increased to about 10% in 2013, when the *Energieakkoord* was concluded (see Figure 5.1).

Figure 5.1 Generation per type of renewable electricity plant, and share of total renewable generation in total consumption in Dutch electricity market, 1990-2018

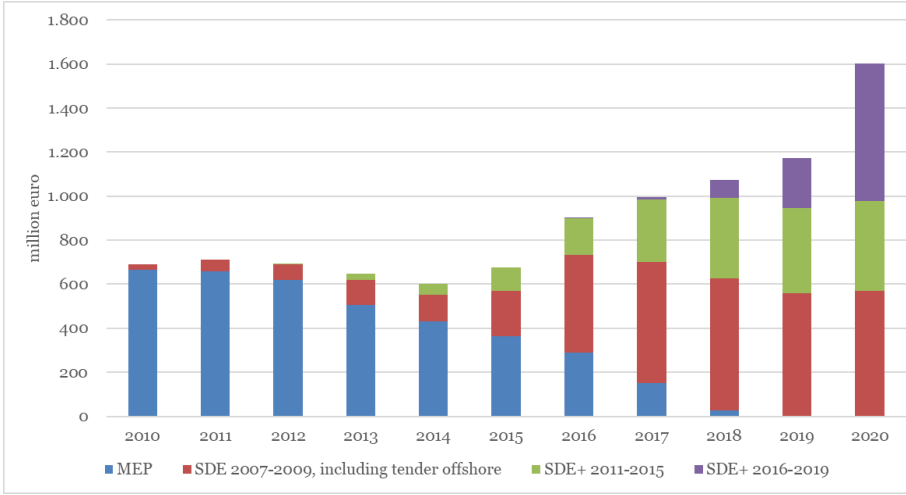


Source: CBS, Statline

The increase in the share of renewable electricity generation in that period was mainly financially supported through the MEP support scheme (see Figure 5.2). In these years, the Dutch government spend annually about 700 million euro for renewable energy. The support through the MEP scheme continued until recently, although the scheme itself was stopped in 2007. This is due to the commitments made to investors based on the MEP scheme. Gradually, the support became more based on the SDE and the SDE+ schemes. Since 2015, the annual budget for support is increasing. In

2019, the total amount spent to support renewable energy for onshore projects has risen to almost 1.6 billion euro.

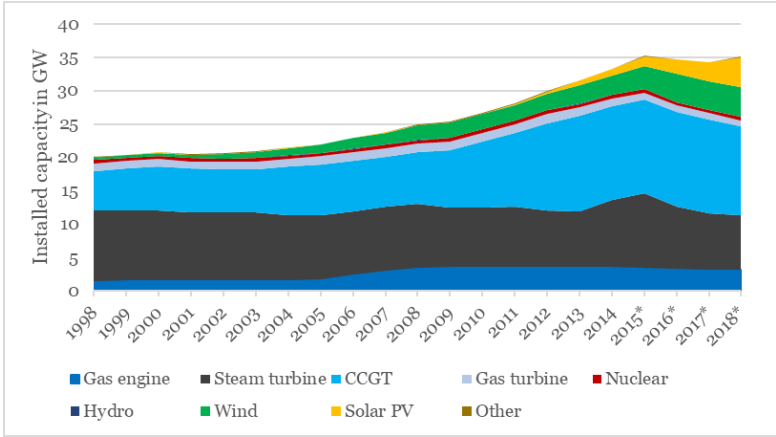
Figure 5.2 Governmental expenditures for renewable energy support for onshore projects, based on various support schemes, 2010-2020



Source: RVO

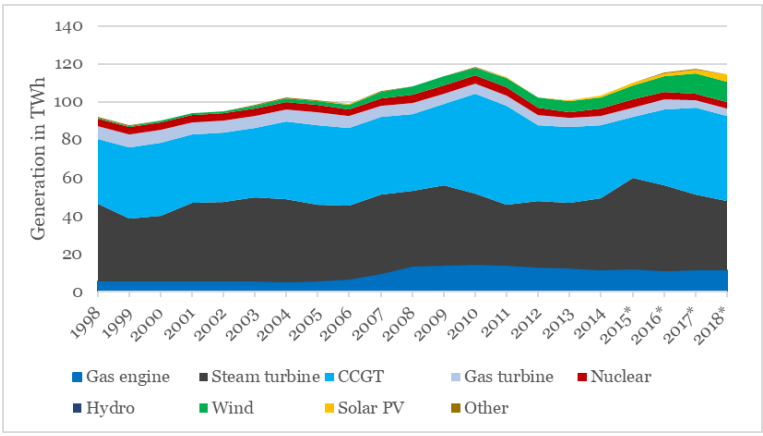
In line with the growth in the support for renewable energy, the share of renewable electricity capacity in the total amount of installed capacity has increases as well (see Figure 5.3). The share of production by renewable sources in total domestic generation, however, has increased much less (see Figure 5.4). This is due to the low capacity factors of in particular wind turbines and solar PV (see Figure 5.5).

Figure 5.3 Installed generation capacity in Dutch market, per technology, 1998-2018



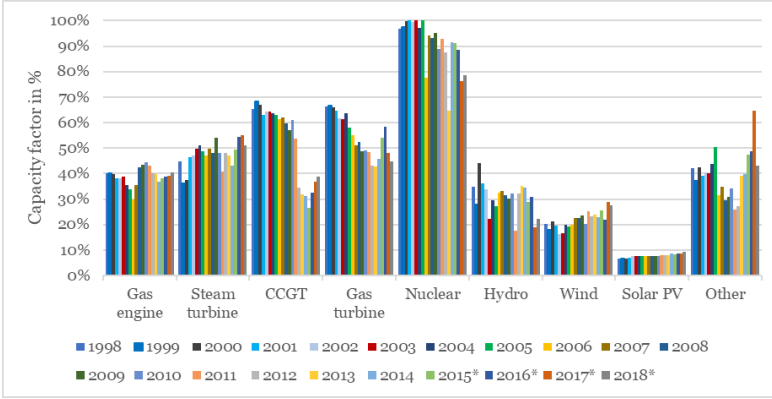
Source: CBS, Statline

Figure 5.4 Electricity generation in Dutch market, per technology, 1998-2018



Source: CBS, Statline

Figure 5.5 Capacity factor per type of plant in Dutch electricity market, 1998-2018

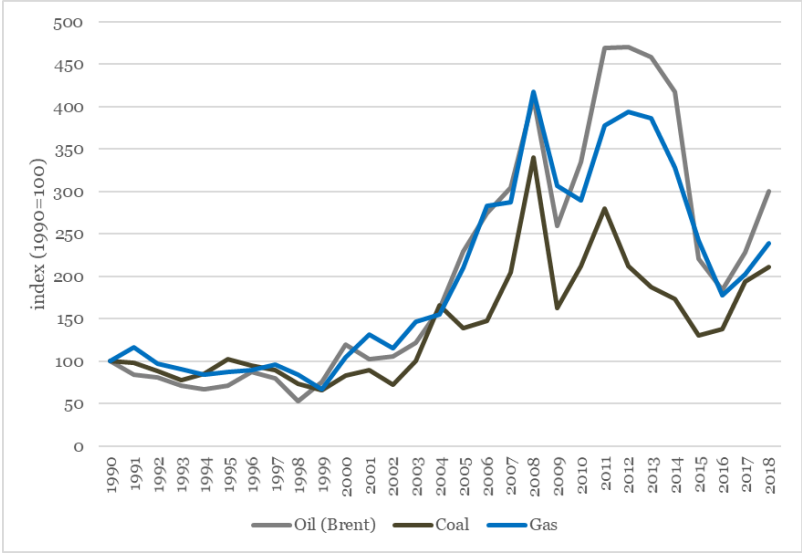


Source: CBS, Statline

As a result of the relatively low share of renewable electricity generation in domestic generation, the generation volume of fossil-fired power plants did not change fundamentally over the past decades (see Figure 5.4). The relative shares of gas and coal-fired generation changed during this period, but their joint share remained around 90% for many years. The relative importance of gas or coal-fired plants is strongly influenced by the relative prices of the fuels. From Figure 5.6, it appears that the price of gas has risen more strongly than the price of coal since 2008. This relatively modest development of the coal prices was related to the share gas revolution in the USA which made gas in that country more abundant and, hence, cheaper. As a result, it became more attractive to producers of coal to export this energy carrier to Europe which reduced coal prices in this region. Because of this decline in the relative price of coal, coal-fired power plants obtained a stronger position in the European electricity markets. This can also be seen in Figure 5.4, where the volume of generation by coal-fired power plants grew relatively strongly, as well as in Figure 5.7, where we see a

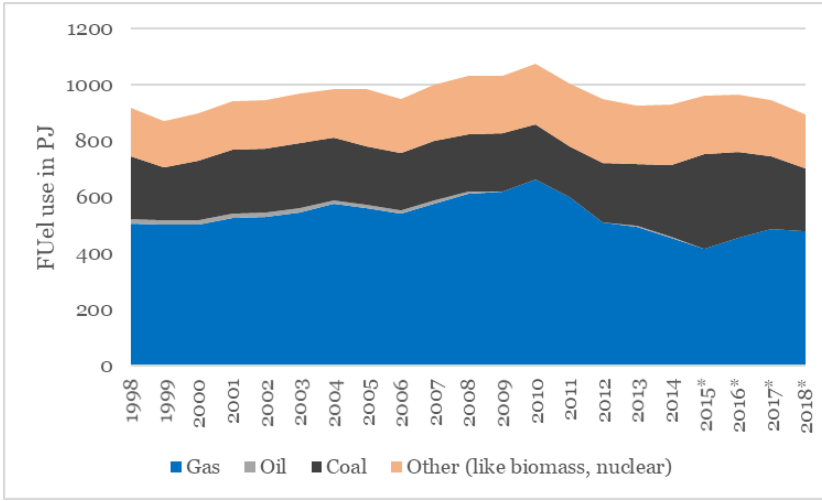
growth in the volume of coal being used by the electricity sector. Because of this change towards a higher share of coal-fired power generation, the carbon emissions by the electricity sector grew until recently despite the gradual increase in the share of renewables (see Figure 5.8).

Figure 5.6 Prices of fossil energy, 1990-2018



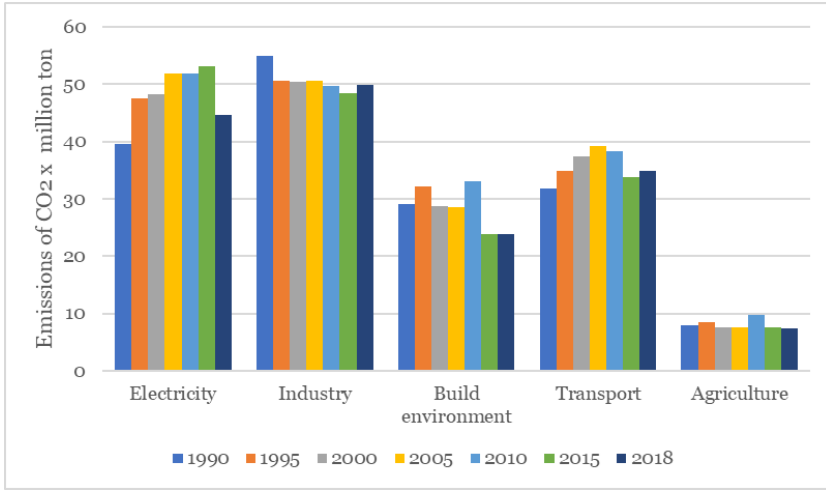
Source: BP Statistical Review 2019

Figure 5.7 Use of fuels in Dutch electricity system, 1998-2018



Source: CBS, Statline

Figure 5.8 CO_2 emissions in Netherlands, by sector, 1990-2019

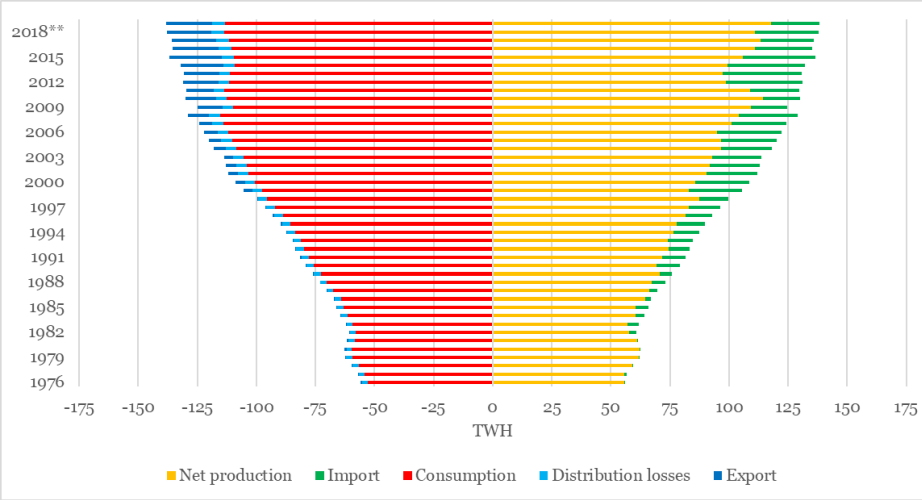


Source: PBL

The recent decline in the share of coal-fired generation as well as in the carbon emissions of the Dutch electricity sector is due to the regulatory measures regarding coal-fired power plants. As discussed above, in the *Energieakkoord* it was agreed to close a number of coal-fired power plants and later on, the policy became to close all coal-fired power plants, including the newest ones. It appears that this measure in particular was effective to quickly change the structure of the electricity system.

The ability to change this system through financial measures is restricted because of the fact that the electricity sector has to operate in an international market, in which relative prices of fuels and international differences in power prices determine how much electricity is produced by what type of technique. The Dutch system has increasingly become related to the neighbouring markets, as can be inferred from the increasing volumes of import and export of electricity (see Figure 5.9). Since the early 1980s, the import of electricity has gradually increased, fostered by the improved integration of European electricity markets and the relatively low electricity prices in neighbouring countries. As a result, the Dutch domestic consumption of electricity could continue to grow, while the domestic production could grow at a slower pace. Without this increase in the import of electricity, the carbon emissions due to electricity generation would have increased even stronger. The international market integration also creates options for Dutch electricity producers to export electricity when domestic generation costs are below international market prices. When this happens, such as in more recent years, this does increase the domestic carbon emissions, although it does of course not affect the share of renewable electricity in domestic consumption.

Figure 5.9 Balance of Dutch electricity system, 1976-2018

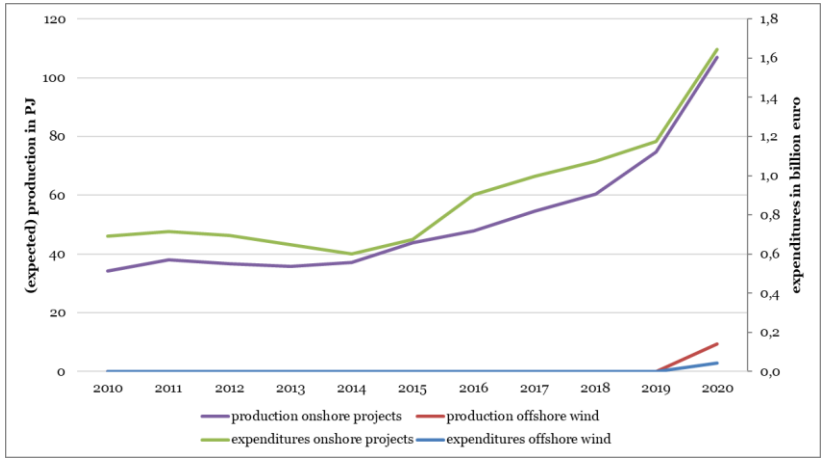


Source: CBS, Statline

5.4 Distributional effects

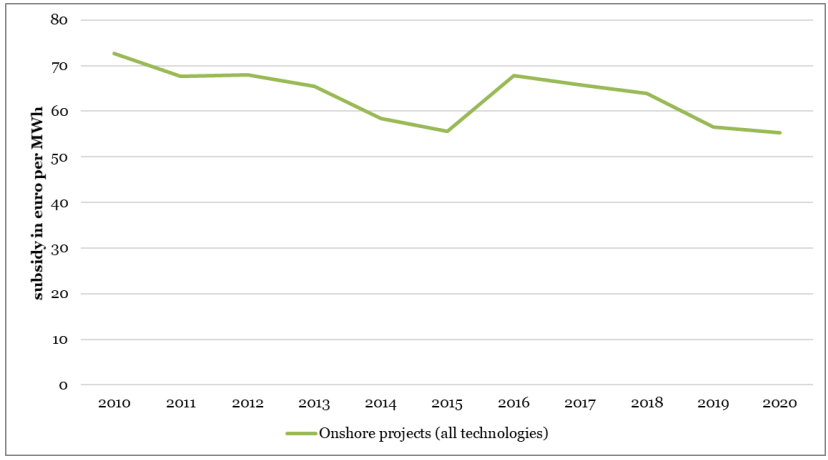
The promotion of the share of renewable energy through providing financial support has a number of distributional effects. The total amount of support given to both onshore and offshore projects is about 1.6 billion euro in 2020 (see Figure 5.10). In return for this support, the renewable energy projects produced about 116 PJ energy. Per unit of energy, the producers or renewable energy received on average 70 euro/MWh in 2010, which amount declined to about 55 euro/MWh in 2020 (see Figure 5.11). This decline in support per unit of renewable energy was due to a number of factors: reduction in costs of production as well as smarter design of support schemes which fostered competition among producers and reduced windfall profits due to less over subsidisation (see Korteland et al., 2007).

Figure 5.10 Subsidy expenditures for and production by renewable electricity projects, both onshore and offshore, 2010-2020



Source: RVO

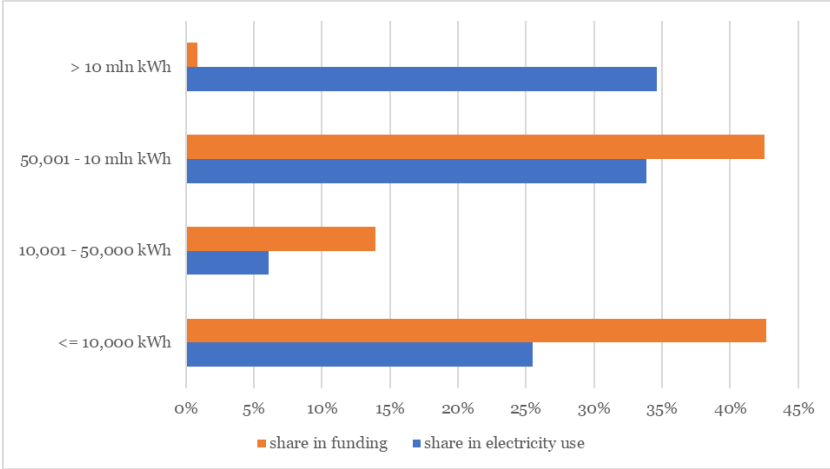
Figure 5.11 Cost effectiveness of renewable support measured through support in euro/MWh, onshore energy production 2010-2020



Source: RVO

The support is increasingly funded through a special levy on energy consumption, the so-called ODE. The tariffs in this levy are differentiated across different types of users. It appears that the group of residential and other small users contribute to about 45% of the total funding, while their share in total electricity consumption is about 25% (see Figure 5.12). The group of the heavy industrial electricity users, on the other hand, have a share of about 35% in total electricity consumption while their share in the funding of the ODE subsidies is only a few percentages.

Figure 5.12 Contribution to the funding of subsidies for renewable electricity, per type of user and in relation to share in total electricity use, 2019



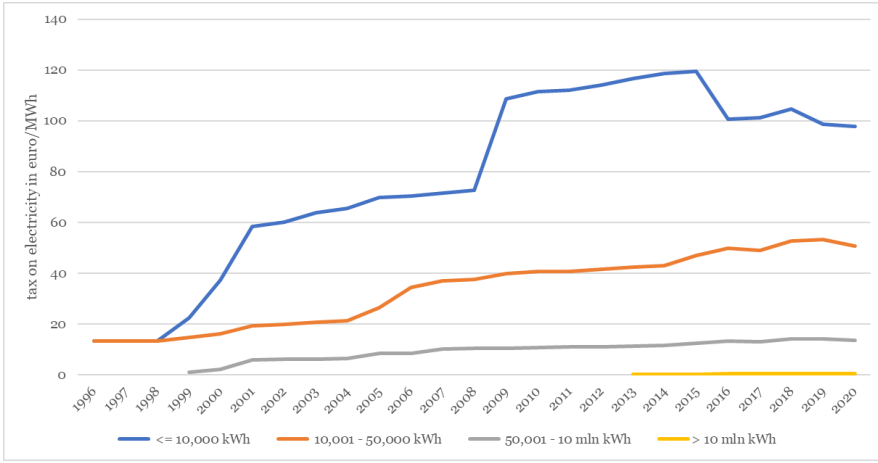
Source: Belastingdienst; Statline; own calculations

Another instrument to stimulate renewable electricity production is the facility that enables residential consumers to subtract their annual solar PV production of electricity from their annual consumption.[30] Because the

[30] In Dutch, this arrangement is called *salderingsregeling*.

electricity consumption is taxed through the energy tax, the arrangement implies that the production of residential solar PV generation receives a much higher price than only the electricity price. Figure 5.13 shows that residential consumers have to pay about 100 euro/MWh, while the electricity price in the wholesale market is less than half of this tax level. For larger users, the tax levels are much lower. As a result, a number of distributional effects occur. First of all, consumers who make use of this arrangement do not or hardly contribute to the funding of government policies through the energy taxes than consumers who do not have installed solar PV installations. Second, the latter group of consumers have also a much higher contribution to the government funding through energy taxes, in relative terms, than the heavy users of electricity.

Figure 5.13 Tax on electricity consumption per type of user, 1996-2020



Source: Belastingdienst; Statline

5.5 Conclusions and lessons learned

5.5.1 Conclusions regarding the electricity sector policy

Although policies to promote the energy transition within the electricity sector have existed for more than two decades, these policies have only become somewhat successful in the last number of years. Initially, the main policy instruments to promote the share of renewable electricity consisted of support schemes, but the use of these instruments were costly. The high costs of the support were due to the high costs of renewable electricity compared to fossil energy, while also the design of the support schemes was suboptimal, giving room for a significant amount of windfall profits realized by the recipients of the support.

In the electricity industry, it appears that the relative prices of fossil energy to a large extent determine by what type of technologies electricity is generated. Despite generous support for renewables, the coal-fired power plants operated on full capacity due to the relatively low international coal prices. As a result of the reduction in costs of the production of renewable electricity, the required support strongly decreased. This decrease in required budget for the support scheme was also due to improvements in the design of the support scheme, giving more incentives for cost reduction and leaving less options for windfall profits. The decrease in the required support facilitated the growing use of the support instrument (i.e. more projects) to facilitate the energy transition in the electricity system.

Besides the increased use of support for renewable electricity, the increase in the share of renewable electricity in total consumption was also facilitated by the implementation of regulatory constraints of the use of coal for generating electricity.

The burden to finance the support is still unequally distributed among users of electricity. It appears that residential and other small users contribute to about 45% of the total funding for support, while their share

in the electricity consumption is about 25%. The largest electricity users, on the other hand, hardly contribute to the funding of the support for renewable electricity, while their share in the national electricity consumption is about 35%.

5.5.2 Lessons learned

From the experience with the development of the transition within the electricity sector, a number of lessons can be learned.

1. Financial measures to realize a change in the industry may be ineffective due to other economic variables which are relevant for the firms in that industry. Hence, it is key to take the impact of other economic variables into account when using a financial measure to realize a governmental objective. This may have as an outcome that, instead of a financial measure, stricter regulatory measures have to be used in order to ensure that the policy objective will be realised.
2. Support schemes should give some degree of certainty to investors. When they perceive too much uncertainty about the available budget and tariffs in the (near) future, they may be more hesitant to develop new projects, like we have seen in the promotion of renewable generation in the electricity sector. As part of the information on the future support levels and conditions, support schemes should also include information on how the support will be (gradually) reduced in the future in order to enable future relaxation of the support.
3. The effectiveness of national policies may strongly depend on policies in neighbouring countries. National policies to promote a particular industry may become more costly if neighbouring countries foster the same industry which raises the costs and/or reduces the revenues.
4. When a policy is only focussed on fostering a particular technology, such as renewable electricity or hydrogen, this may harm the ultimate public

interest, which is in these examples the reduction of carbon emissions. Hence, stimulating a particular technology in an effective way, does not necessarily imply that the ultimate goal is realised. Therefore, it remains crucial to keep this goal, i.e. reducing carbon emissions, in mind when implementing policies for a particular technology.

6. Lessons learned for hydrogen policy

1. As governments increasingly want to foster the production and usage of hydrogen, it may be helpful and instructive to look at earlier experiences with government policies aimed at promoting a sector. In this policy paper, we have analysed experiences with the realisation of fundamental changes in four sectors: natural gas, agriculture, housing and electricity. From these experiences we can infer a number of lessons which are useful for the development of the hydrogen sector. In formulating these lessons, we depart from the assumption that the hydrogen industry has to be developed, which means that we do not go into the efficiency of such a policy.
2. For the realisation of a common infrastructure, such as for the onshore transport of hydrogen, it may be efficient to make one organisation responsible for the investments and the operation. This efficiency results from inherent economies of scale and a reduction in transaction costs. Because of the resulting effectuation of the natural monopoly of such an organisation, it is necessary to make it subject to regulatory supervision, while it may also be helpful to let it be publicly owned.
3. For those activities where a natural monopoly does not exist, it may be more efficient to let these activities be done by market entities because they have stronger incentives to operate efficiently. In case of hydrogen, this holds, for example, for the production activities.
4. Under specific conditions, it may be efficient to have public-private collaboration (joint ventures). These conditions refer to, for instance, the need to benefit from efficiencies realized by private companies while there is also the need to protect public interests. Such a collaboration will in particular be effective when all interests are aligned. However, in order to prevent that such a joint organisation becomes less oriented at

public interests once they are not aligned anymore with the private interests, it is crucial to have an adequate governance protecting public interests. The example of the agricultural sector has shown that an ongoing economic protection of an industry may result in overproduction with a number of adverse societal and environmental effects. It is therefore important to be able to adapt a policy after a number of years, in order to prevent that an effective policy turns into a policy with net negative effects for society.

5. A switch towards a new energy carrier may mean that the suppliers of conventional energy carriers, such as natural gas producers and traders, have to deal with a decline in activities. In order to raise the societal support for the transition, these suppliers can be compensated. This compensation does not need to be given in financial terms, as other non-financial measures can also be effective. Examples of such measures are offering these firms a role in the new energy sector or helping them to make a transition to another type of activity.
6. When support schemes are used to overcome inefficiencies in supply, they should give some degree of certainty to investors. When they perceive too much uncertainty about the available budget and tariffs in the (near) future, they may be more hesitant to develop new projects, like we have seen in the promotion of renewable generation in the electricity sector. From this support schemes, we have also learned that a smarter design, with sliding feed-in-premiums, is able to reduce the risk of windfall profits. As part of the information on the future support levels and conditions, support schemes should also include information (i.e. a kind of road map) on how the support will be (gradually) reduced in the future in order to enable future relaxation of the support.
7. In order to stimulate potential users to make use of hydrogen and to switch away from conventional energy carriers, the end-user price of

hydrogen needs to be attractive compared to the end-user price of the conventional energy carriers. This can be done through measures which directly affect prices or through measures which indirectly affect the costs of end-users, such as taxes of the conventional energy carrier or subsidies on the use of hydrogen. In order to prevent adverse effects of subsidies, such as free riders and rebound effects, it is more efficient to promote the competitive position of hydrogen by raising taxes on the use of conventional fossil energy types.

8. In order to promote the market places, the unit of trade should be standardized, like what has happened in the gas market, which means that the trade in hydrogen should be done independent of how the molecules are produced. Systems of certificates can be used to foster the trade in green hydrogen.
9. Intervening directly in the functioning of markets can be very effective, as we have seen in the agricultural and housing sectors, but this can also create significant adverse effects. For example, guaranteeing minimum prices for producers, protecting them from competition or giving them subsidies, may become very costly for society. In addition, such a policy may also be difficult to change because of the social resistance against any policy change that negatively affects the position of some groups within society. In order to facilitate a process of adapting the policy in the future, it may be effective to formulate a road map how the support will develop in the future.
10. Based on the above lessons learned, we formulate the following recommendations for a policy aimed at promoting a hydrogen sector in an efficient way:
    a) The infrastructure for transport and distribution should be centrally developed with one operator, subject to regulation and public ownership.

b) The production and marketing of hydrogen can be commercial activities conducted by private parties. The trade in hydrogen can be supported through standardisation of the unit of a product in combination with a certificate scheme to give market participants information on the underlying production process. Moreover, in order to promote these markets activities, financial support is needed, because of the high current costs of electrolysis hydrogen production compared to the market price of alternatives.

c) The effectiveness of financial support schemes depends on the ability of the industry to expand activities. In case of constraints somewhere within the system, such as regarding the supply of renewable energy, financial support will mainly result in distributional effects, like we have seen in the housing sector. In the presence of such constraints, it seems to be more efficient to take measures that relieve these constraints, i.e. fostering the supply of renewable electricity, instead of promoting the production of hydrogen.

d) As the business case of hydrogen strongly depends on fuel and electricity prices in international markets, using financial instruments to make hydrogen (or any other specific technology) competitive can be very costly and rather ineffective, as we have seen in the electricity market. Making use of other instruments, which include regulatory obligations, may therefore be more effective, although it may remain inefficient.

e) It is, however, important that the policy to promote domestic hydrogen production includes a roadmap which describes in which pace the financial support and regulatory obligations will be reduced in the future. In addition, it is important to monitor negative societal (environmental) effects of the promotion of this

activity and to relate the development of the hydrogen sector to the more fundamental policy objective, which is the reduction of carbon emissions. A hydrogen production sector that results, for instance, in many large-scale renewable-electricity projects, strongly affecting landscape onshore and offshore, while the hydrogen is mainly used for export, may not be the best climate policy for the Netherlands.

f) In relation to the previous point, it is important to take into account that the primary objective should be to make the domestic energy use increasingly less carbon intensive, and that the development of an industry that is able to realize a strong competitive position on international markets is a secondary goal, at the very best. A hydrogen policy that would be too much focused on the latter, as has happened in the agricultural sector, is likely to become suboptimal from a societal perspective, because of the high costs and environmental burden.

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As governments increasingly want to foster the production and usage of hydrogen, it may be helpful and instructive to look at earlier experiences with government policies aimed at promoting a particular sector. In this policy paper, the authors analyse experiences with the realisation of fundamental changes in four sectors: natural gas, agriculture, housing and electricity. From these experiences they infer a number of lessons which are useful for the development of the hydrogen sector. In formulating these lessons, the authors depart from the assumption that the hydrogen industry has to be developed, which means that they do not go into the efficiency of pursuing such a policy target.

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