

## CONTESTED TECHNOLOGY

### Nuclear Power in the Netherlands

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#### ABSTRACT

Despite high ambitions nuclear technology hardly developed in the Netherlands. Already from the very start, nuclear technology was contested and became subject of power games. Two reactors, one 50 MW the other 450 MW were connected to the grid and several more were planned. Social protest and aversion was mitigated by a nationwide energy debate. In 1986 Chernobyl interrupted and finally stopped the Dutch nuclear ambitions. Twenty years after Chernobyl, the debate about the nuclear option has been re-opened in reference to climate change, security of supply and resource independence.

**Key words:** Energy policy, Netherlands, nuclear power.

#### INTRODUCTION

At the time of the Chernobyl accident I conducted commissioned research on ionizing radiation protection policy in the Netherlands. The nuclear inspectorates. I met with in this project told me that the accident never could have happened in the Western world because of the safety containments of our nuclear reactors (missing in the Chernobyl construction). If the safety containment had been part of the construction, they said Chernobyl never would have happened and the stupidity of the system operators would have become history as a “local incident”.

Twenty years later we know Chernobyl’s enormous impact on energy policies in general and nuclear policies in particular<sup>1</sup>. The accident was the final blow for the Dutch nuclear program in electricity production. Nuclear had been a controversial option right from the beginning, but had managed to enter electricity production. The controversy was not only a matter of the lack of democratic support, but also contested hegemony over the national electricity system, competition between Dutch research institutes, and Dutch industrial politics. The Chernobyl accident suddenly put these parochial debates and

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<sup>1</sup> The Three Mile Island nuclear reactor accident on March 28 1979 did not have such an impact on Dutch nuclear policy. The Harrisburg accident initiated a strengthened focus on nuclear safety issues in the Netherlands and a safety check-up of Dutch nuclear installations but not such a review of nuclear as Chernobyl.

controversies in a completely new perspective of nuclear safety. Chernobyl gave the abstract safety issue a face, which acted as a “wake-up call” in the Netherlands, particularly for the pro-nuclear lobby. Nuclear energy had a low profile in the Netherlands before Chernobyl, which continued afterwards with only one and a half nuclear reactors connected to the grid and with a single (450 MW) reactor in use since 1997.

This chapter describes the Dutch nuclear perspective before and after Chernobyl in reference to electricity production. Other applications (i.e., traction) were briefly considered in the past but never matured. Apart from electricity production, the Dutch position in the nuclear lifecycle concentrates on research, the production of radiological isotopes, and uranium enrichment by means of ultracentrifuge technology.

### THE RISE AND FALL OF THE NEW PROMISE<sup>2</sup>

The focus on nuclear power in the Netherlands followed the atoms for peace program initiated by the United States in the early 1950s. The Dutch wanted to engage in nuclear technology, considered a promising future technology at the time. The Dutch initiated a national R&D infrastructure and collaboration with Norway in the Kjeller reactor, one of the very few operational reactors at that time. In 1955 the Dutch government initiated the construction of a nuclear reactor in the Netherlands. RCN<sup>3</sup> was erected and construction of a High Flux Reactor for R&D was initiated. The promise of nuclear technology was politically translated in the ambition to have nuclear-based power generation by 1962 and a gradual change from fossil to nuclear electricity production in the following years. To effectuate the ambition of the nuclear future, a national nuclear industry uniting the nuclear expertise of the country was initiated. The idea was not only to have nuclear-based electricity generation, but also to develop a Dutch nuclear industrial cluster able to design, produce, and export Dutch nuclear technology. The ministry of economic affairs was one of the architects of this strategy and supported the emergence of such a nuclear industrial cluster as much as possible. The strategy failed for two reasons. The electricity industry was not willing to share its hegemony over the domestic electricity system with any public or private partner and the government overestimated its power in managing and controlling the national electricity industry. The establishment of a domestic nuclear industry failed, but this did not exclude nuclear from the Dutch electricity system.

The Dutch electricity industry initiated two nuclear reactors: Dodewaard (50 MW) and Borssele (450 MW). Dodewaard was initiated by the electricity production companies cooperating in the SEP<sup>4</sup> at that time. This small reactor was meant for R & D and experimentation. The decision for construction was made in 1965 and the plant became operational in 1969. In the same year one of the electricity producing

<sup>2</sup> For detailed descriptions of the early episodes in Dutch nuclear history, G. Verbong and J. Lagaaij, *De belofte van kernenergie*, in Schot et al., (red.), *Techniek in Nederland in de twintigste eeuw, deel II Delfstoffen, energie, chemie*, Walburg pers, Zutphen, 2000, pp. 239–257, C.D. Andriess, *De republiek der Kerngeleerden*, Uitgeverij Beta Text, 2000 and, J.J. de Jong, *Kernenergie*, in H.G. Maar, de, *Energiericht*, Samson H.D. Tjeenk Willink, Alphen aan den Rijn, 1987, pp. 275–301.

<sup>3</sup> Reactor Centre Netherlands, known today as ECN Energy Centre the Netherlands.

<sup>4</sup> Samenwerkende elektriciteitsproductiebedrijven (Association of electricity production companies)

companies (EPZ) independently ordered a nuclear power plant. This was a complete surprise and shock for the other production companies as well as the Dutch government. The intention to buy the nuclear plant had not been communicated with the government or SEP. The EPZ purchase restricted the electricity companies' degrees of freedom in decisions on new production capacity, in particular nuclear, but could not be reversed. The Borssele nuclear power plant was connected to the grid in 1974 and remains connected. In January 2006 the Dutch government extended the lifetime of the reactor till December 2033 (see section 4). It is still the only nuclear power plant in the Netherlands. The Borssele nuclear power plant has never had serious technical problems. Technology has been upgraded several times to respond to societal demands on safety.

Despite the lack of governmental control of the nuclear program in Dutch electricity production, nuclear continued to be considered a fuel option. In reaction to the 1974 White paper on energy, evaluating the impact of the first oil crisis for Dutch energy policy, the Dutch government announced the construction of three nuclear power plants of 1,000 MW each. Investment in nuclear was part of the fuel diversification strategy of the government to reduce resource dependency. The investment in the two new nuclear plants and the Dutch participation in the Kalkar project dominated the political and the nuclear agenda during the 1980s. Kalkar, the fast breeder reactor at the Dutch-German border, became the symbol of the anti-nuclear movement in the Netherlands (and Germany). Kalkar was an ambitious and prestigious nuclear project of the electricity industry, but became the symbol of societal resistance against nuclear. In the end "the battle of Kalkar" was won by the anti-nuclear movement and the reactor was not put in operation. The project was cancelled in its final stage on account of tremendous social costs (in Germany in particular)<sup>5</sup>.

By the end of the 1970s the controversy of nuclear electricity production became so strong that the Dutch government tried to mitigate societal pressure with a nationwide energy debate. This unprecedented nationwide event began in June 1981 and lasted 2 years. Despite good intentions, the debate was not a success. The atmosphere for an open dialogue on energy was simply missing at that time. Everything organised in the context of the debate or initiated by the organising board was controversial and debated. The debate was meant for exchange of information, consultation, national hearing, research, and documentation on the future energy supply of the country. In reality, a single question dominated the debate: pro or con nuclear power. The board summarised the controversy in Dutch society in three positions:

- The technological position, considering nuclear energy primarily as a promising option and a technological challenge;
- The ethical position, considering nuclear waste a core problem that needed to be solved because of the responsibility for future generations and;
- The political position, considering nuclear power a core political issue in the debate on the future design of industrial society (BMD, Final Report, p. 21).

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<sup>5</sup> Kalkar is now a leisure park.

In a survey, participants in the national debate and the Dutch population were questioned about the future role of nuclear power in the Dutch energy system. Support for more nuclear was rather low (13% of the population and 17–26% of the participants of the debate). Most of the population preferred to have no more than two reactors in the future (50% of the population and 16–40% of the participants). Finally, it became apparent that a large fraction of the participants and the Dutch population rejected any nuclear in the future and preferred the instant closure of both nuclear reactors. About 37% of the population preferred this position and 33–58% of the participants in the debate (*ibid* p. 193).

On nuclear power, the final report concluded that:

1. extension of the country's nuclear power capacity wouldn't be obvious, given the preference of the majority of the population,
2. both existing power plants, Dodewaard and Borssele, could continue production and,
3. it was highly recommended to continue research on nuclear waste to find acceptable solutions for this urgent problem (*ibid* p. 352).

The organising board added that though they were aware of the different opinions expressed by individual experts and industry, the board's conclusions nevertheless best reflected the general attitude of the population<sup>6</sup>.

The government ignored the preference of the majority of the population and continued focusing on extending the country's nuclear capacity in power generation. In 1985 it was decided that Dodewaard and Borssele would not be closed, basically because of the enormous social costs<sup>7</sup>. Moreover, the government reconfirmed its earlier intention to increase the nuclear share in power generation by some 2,000–4,000 mW<sup>8</sup>. Parliament approved the governmental intentions to extend the country's nuclear capacity and the electricity industry was put in charge of the effectuation of the Dutch nuclear ambitions. Then Chernobyl radically changed the Dutch nuclear horizon. The continuation of the nuclear route was interrupted and later completely stopped by the accident.

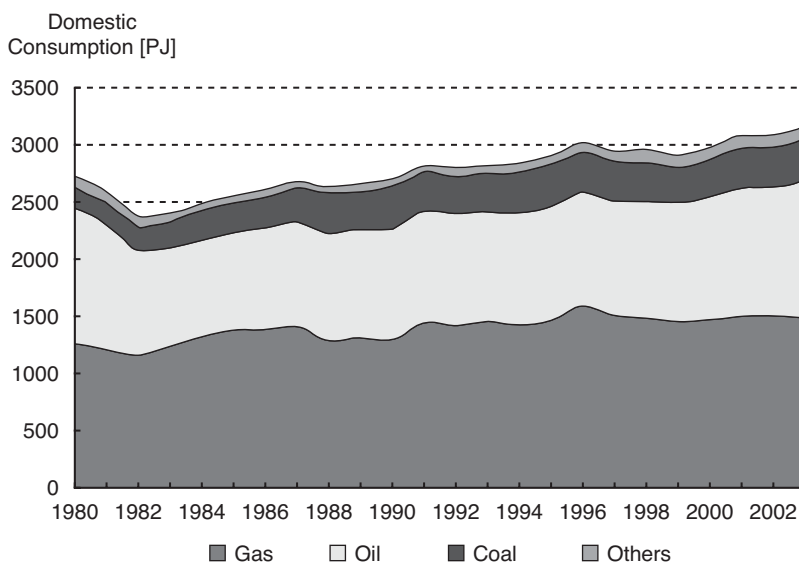
The liberal conservative government coalition in charge at the time of Chernobyl initiated a wide and intensive review of the nuclear option (De Jong, 1987, p. 278–279). All aspects of nuclear power were intensively analysed and assessed, safety aspects in particular. The assessment took several years but could not change the prospects for a nuclear route in Dutch electricity generation. According to the minister for economic affairs at the time, the country would have to decide about new nuclear options within a timeframe of ten to fifteen years given the increasing global energy demand, corresponding shortage, and the climate change problem. Environmental groups were very critical about the governmental assessment of the nuclear plans. They published a reaction under the title "The Dutch nuclear file can be closed as well as the nuclear power plants"<sup>9</sup>. They pleaded

<sup>6</sup> *Maatschappelijke Discussie Energiebeleid, Het Eindrapport*, p. 352.

<sup>7</sup> The social costs were calculated by the *Commissie voor Bestaande Kerncentrales, Commission Beek*. The total costs of closure were estimated at five billion Dutch guilders at the beginning of the 1980s (De Jong, 1987, p. 278).

<sup>8</sup> *Nota Elektriciteitsvoorziening in de jaren 1990*, Dutch Parliament, No. 18830.

<sup>9</sup> [www.Energie.nl](http://www.Energie.nl), Dossier kernenergie, Energierapport 1993.



Source: ECN, *Energie in cijfers*.

Figure 1: Primary energy consumption.

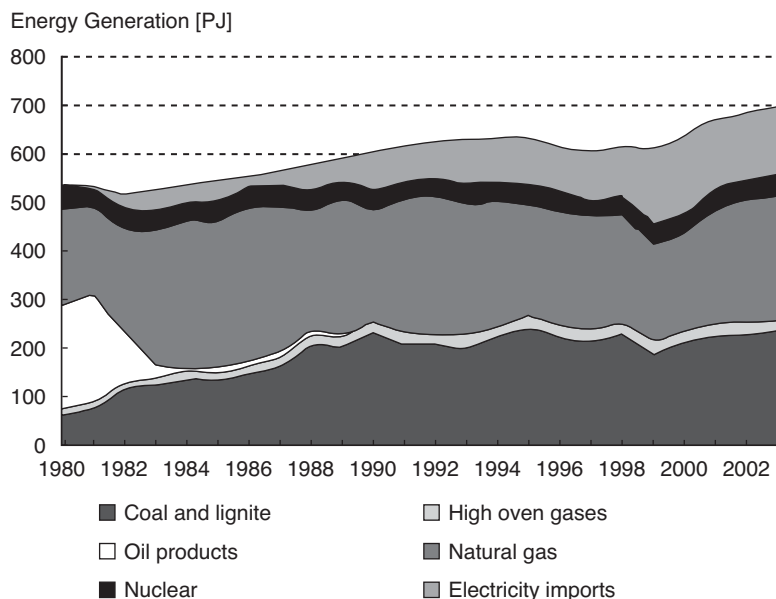
for energy efficiency improvements, energy saving, and renewable forms of energy. Dutch electricity producers united in the SEP hoped for a new future for nuclear but by 1993 the government had decided to cancel the country's nuclear ambitions. In 1997 the Dodewaard nuclear power plant closed, leaving the country with only Borssele in the very south of the country<sup>10</sup>.

### THE DECADE OF NUCLEAR SILENCE

The previous section shows that Dutch nuclear ambitions began as part of the atoms for peace program and was motivated by the promise of new technology. In 1974, after the first oil crisis, fuel diversification became the guiding motive of the Dutch nuclear efforts. The oil crisis in combination with power games and tensions between coalitions, research groups, and interested organisations kept the results of the Dutch efforts rather restricted. The oil crisis provided a new perspective on the Dutch natural gas reserves and Dutch gas depletion policy. Before the oil crisis, the Dutch wanted to get rid of the gas as soon as possible, because of the expected dominance of nuclear by the year 2000. Thanks to the oil crisis, the Dutch forestalled this blind optimism and started cherishing their natural resources more intensively by changing the depletion strategy in natural gas (Arentsen and Künneke, 2003). As Figure 1 shows, the Dutch energy balance was and still is dominated by fossils, natural gas in particular.

Nuclear power usage (3% share in Dutch electricity production) is minor compared to the three dominant energy resources of the Netherlands: oil, natural gas, and coal. See Figure 2.

<sup>10</sup> The Borssele nuclear reactor is a Siemens Pressurised Water Reactor starting electricity production on October 25 1973. Andriesse, 2000, p. 223.



Source: ECN, *Energie in cijfers*.

Figure 2: Fuel mix Dutch electricity production.

The figure shows the dominance of natural gas in electricity production. The country has substantial gas reserves in the North also used for electricity production. One consequence of the uncertainties (and later blockade) of the nuclear route has been an increase in the share of natural gas in electricity production. The figure also shows the uniformity over time in the percentage of nuclear power in Dutch electricity production.

After the governmental decision to cancel new nuclear capacity, the topic disappeared from the electricity agenda. New topics appeared such as sustainable development, climate change, energy efficiency and saving, renewables, and liberalisation. In the mid-1990s a new social liberal coalition took over and initiated the change of Dutch electricity supply towards liberalisation. The outlook of Dutch electricity supply completely changed between 1995 and 2000. The centralised system with the technical and financial dispatch in electricity production disappeared. The once centralised electricity system diversified and fragmented. Some Dutch electricity production companies were sold to private foreign firms. In this climate of change and upheaval, all parties were focused on everything but investing in new production capacity, let alone new nuclear capacity. Politics and industry were completely immersed in the regulatory changes and the commercialisation of business. Electricity production and trade had become a commercial business and all companies were eagerly engaged in the new game.

In addition to liberalisation and regulatory change, climate change was also on the country's electricity agenda at that time and intensified the ambition to increase the share of renewables in domestic electricity production. The ambition originated from the first oil crisis. Climate change reinforced the necessity of increasing the share of renewable energy sources. The country worked on the realisation of this ambition in the context of the EU renewables directive with mixed results (Dinica, 2003; Hofman, 2005).

Nuclear-based electricity production came to the fore again in 2004 in the context of disclosure requirements of the EU electricity directive. Due to the disclosure obligations it became clear that the country imported substantial quantities of electricity produced by nuclear power plants from surrounding countries. Despite the clearly indicated nuclear origin of great portions of imported electricity, nobody seemed to care. Environmental groups occasionally raised a voice pointing to the inconsistency in the country's position of rejecting nuclear power generation capacity but importing nuclear electricity from France, Belgium, or Germany. Most of the time, these voices were accompanied by a plea for more renewables and a stronger RES-E support policy. The relative silence about the imported nuclear electricity is a clear difference from the 1970s, when large parts of the population contested the "*Kalkar-heffing*", the surcharge in the electricity tariff to finance Dutch participation in the fast-breeder project. But it seems that after years of silence, "The Times They Are A-Changin'"<sup>11</sup>, for Dutch nuclear.

### A CHANGE OF CLIMATE?

The ultimate result of the Dutch nuclear efforts is a single nuclear power plant. Chernobyl undeniably stopped the country's ambitions for further increase of nuclear capacity. The decision not to increase the number of nuclear power plants in the Netherlands was taken in 1993 after intensive research and consultation from 1986 onwards (see section 2). Only after this decision was taken did it become quiet at the Dutch nuclear front. Apart from the nuclear power plant, the country was left with nuclear research at some Dutch universities and the enrichment of uranium by Urenco in Almelo. Meanwhile, the electricity system entered a period of regulatory reform and climate change became the primary motivation for the country's energy innovation. In this context the country basically focused on energy efficiency improvement and renewables. Energy transition for a carbon neutral energy supply became the overall guiding concept. The idea of transition expressed the need of a complete system change in a timeframe of 25–50 years (see Rotmans et al., 2000). Such an overall innovation should result in a clean, sustainable, and affordable energy supply, with substantial shares of renewables. Thus far the results, in particular in renewables, are not impressive and this gives proponents of nuclear power additional arguments to plead for the nuclear option. This is what happened in the country at the beginning of 2006. Twenty years after Chernobyl, nuclear re-entered the public and political debate again and this raises the question whether the 1993 decision stopped or interrupted the further rise of nuclear in Dutch power production. There are signals of a resurgence of pro-nuclear opinions.

For instance, the Energy Report 2005 added clean fossil and nuclear to the energy transition agenda (Energy Report, 2005, p. 12). Since 2000, Energy Reports published every 2 years serve as the official governmental publication on the state of the art in energy policy. In the 2005 Energy Report, both clean fossil and nuclear were introduced as additional strategies to mitigate the climate change problem. The idea of clean fossils is the renewed entry of large-scale coal firing and gasification in electricity production in combination with CO<sub>2</sub> storage. In the Energy Report it is said that Dutch electricity

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<sup>11</sup> Title of a popular song by Bob Dylan.



producers want to invest in large-scale coal fired plants again and the current government supports industrial intentions on this point. Government also announced further support of CO<sub>2</sub> storage research as part of the innovation of the energy system.

In addition to coal, the 2005 Energy Report also considers nuclear an option to meet the climate change targets. The Report does not announce any investments in nuclear but stresses the necessity of the option for future energy provision. Therefore, nuclear R&D should continue to receive public funding, and domestic research groups are encouraged to intensify international collaboration. The Energy Report presents both coal and nuclear as sustainable energy options, which is completely new for the energy transition debate and clearly a change of policy. Since 2005, nuclear has been again offered as another answer to the climate change challenge for the first time in the twenty years after Chernobyl.

A second, even clearer signal of a change in favour of nuclear is the country's position in energy supply security. This issue not only refers to electricity but also to natural gas. Thanks to natural gas, the country never really needed to worry about its supply position, but here too the perspective is changing. The Dutch gas reserves are expected to be exhausted somewhere around 2025 and how this should be compensated is still open. Gas imports are considered an alternative, but the Russian Ukraine twist about gas deliverance in early 2006 showed the country's vulnerability in this respect. Prospects are not that promising, since the alternatives for the Russian gas are restricted. Moreover, the general expectation is that in the coming decades global competition in gas demand will intensify and complicate the position of importing countries. In 2005 the authoritative Dutch advisory board on energy (AER), recommended a reconsideration of the Dutch gas market liberalisation intentions in relation to changing global gas trade conditions. The board argued for a coordinated public-private model to face global competition in gas demand and strengthen the country's gas trading position in the European gas market (AER, 2005).

In 2006 renewable energy sources are finally taken seriously in the country, but are not expected to provide a mature alternative for Dutch natural gas after 2025 when the reserves are depleted. The Dutch results in renewable energy are not that impressive. Despite three decades of public attention and public support, the actual share of renewables in electricity production is still very modest, and behind schedule. Like nuclear, renewables were put on the public agenda after the first oil crisis in the beginning of the 1970s, but only after 2000 did the share of renewables in electricity production begin to increase substantially in the Netherlands. The country's physical, social, and political conditions for renewables are bad however. Physical resources are restricted, social resistance to onshore renewable facilities is broad, and the consensual political culture in the Netherlands compromised many promising ideas to the sideline. Since the Energy Report of 2005, the country is focusing on offshore wind technology and biomass, in particular co-firing. In 2005 public support for renewables has been adjusted in such a way that the country will attain to its EU commitment of 5% renewable based domestic electricity production by 2010. This is the horizon in renewables of the current government.

The electricity industry is not too entrepreneurial in renewables either. They do initiate and participate in green projects, and some clearly position themselves with



green brands. But when it comes to investments in new large-scale production capacity, in 2006 companies choose fossil-based technology or hybrid technology able to use biomass and other green fuels next to fossils. Industry keeps all options open, including renewables and nuclear, but no company has announced any serious nuclear-based investments plans thus far.

In 2006 the government re-opened the country's nuclear scene by extending the lifetime of the country's nuclear power plant by twenty years from 2013 to 2033. The decision was inspired by the costs of a forced early closing of the plant, but climate change and security of supply were also used to legitimate the decision politically. Government and the owners of the plant, EPZ and Essent, signed an agreement exchanging the prolonged operation for investments in renewable energy production. The total agreed budget for the investment is a billion euros, half from the government, and the other half paid by the plant owners. This budget equals the social costs of early closing of the plant. Part of the agreement is world-class safety requirements assessed every 5 years. Trading nuclear for renewables and renewables for nuclear is undeniably a surprising way of reopening the nuclear dossier of the country.

This dossier continues to be complicated as was evident in a consultation round on nuclear in the Netherlands in 2004 (Ratenau Institute, 2004). The consultation gave a state of the art in the technical and non-technical aspects of nuclear energy. The report pointed out the changing conditions for management and control of nuclear under liberalisation as well as the emergence of a new generation of intrinsically safe nuclear plants in the world, the serious new threat of terrorism, climate change, and security of supply as new pro-nuclear arguments. In addition to these changes in the nuclear landscape, the report stated the unchanged societal aversion to nuclear. Public opinion has hardly changed and is about the same as in the 1970s according to the report. Whether this will continue remains to be seen. Nuclear is making its way back onto the Dutch political agenda. In early 2006, about a month after the governmental decision to extend the lifetime of the Borssele plant, the undersecretary<sup>12</sup> for the environment suggested nuclear as one of the options of the Netherlands to mitigate the climate change challenge. He said that to commit to the Kyoto target, the country could not afford to exclude nuclear. After the interview, EPZ, one of the current owners of the Borssele nuclear power plant<sup>13</sup>, called for a new nuclear power plant at the current location in Borssele. It is unclear how the progress of nuclear in the Netherlands will continue but it will definitely continue because the country's attitude has changed twenty years after Chernobyl.

## CONCLUSIONS

Our previous analysis showed how nuclear started its "career" in the Netherlands as a new promise: as an appealing technology freeing the country from energy shortages. In 2006 nuclear is again suggested as a new promise: this time as remedy for security

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<sup>12</sup> Since 2002 environment is part of the portfolio of the undersecretary in stead of the minister at the department for the environment and physical planning.

<sup>13</sup> The other owner is Essent, the country's largest energy company.

of supply for climate change, and for energy independence. In the years since the early 1950s, nuclear barely developed as a serious option in Dutch electricity production. With only a single reactor, the technology is still marginal in the country. Chernobyl gave the nuclear option the final blow. After the accident in 1986, popular support for nuclear faded almost completely away and blocked any nuclear ambition.

Before Chernobyl, both the government and the electricity industry were extremely decisive in their nuclear ambition despite widespread aversion from the population. Even the conclusions of the national energy debate could not stop their intention to build two new nuclear reactors in the country. Without Chernobyl (and all other circumstances equal) at least two more nuclear reactors would have been operating in the Netherlands. Chernobyl stopped these intentions, but now some 20 years after the accident, the nuclear alternative is making resurgence. Whether this will be a second start in nuclear-based power production in the Netherlands remains to be seen. Popular aversion is still strong and companies do not have any nuclear ambitions. Even though the country talks about nuclear again it is far from clear where these talks will lead to in the coming decades.

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