**Nuclear Power in the Netherlands**
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## Voorwoord

Op 19 september 2024 verscheen het World Nuclear Industry Status Report met 513 pagina's van 15 auteurs. Er staat ook een hoofdstuk over Nederland in.[1] Het is voor het eerst dat zo'n uitgebreid actueel artikel over vooral de kerncentrale Borssele in het Engels gepubliceerd is. Zo kunnen ook mensen die geen Nederlands kennen, inzicht kunnen krijgen in de stand van zaken. Dit hoofdstuk heb ik hier, met toestemming van de auteurs, overgenomen.
Voor de volledigheid heb ik ook een inleiding in het Nederlands gemaakt.
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## Inleiding

Vanaf 4 juli 1973 leverde de kerncentrale Borssele stroom aan het koppelnet en de officiële start was op 25 oktober 1973.[2] [3] Op 25 oktober 2023 was de kerncentrale 50 jaar in bedrijf zijn.[4] [5] De oorspronkelijk voorziene bedrijfsduur was echter veertig jaar.[6] Begin 2004 kondigde Van Geel, op dat moment staatssecretaris van Milieu, aan dat hij een plan voorbereidde om de bedrijfsvergunning van Borssele te wijzigen. Hij noemde, zoals ook in het regeerakkoord stond, 2013 als einddatum. Maar in februari 2005 stelde Van Geel dat de kerncentrale langer in bedrijf zou kunnen blijven, omdat sluiting veel geld zou kosten en de kerncentrale veilig werd geacht.[7] In 2013 werd de vergunning verlengd tot eind 2033.[8] [9] [10] Maar daar zou het niet bij blijven. Zo pleitte bijvoorbeeld Carlo Wolters, directeur van EPZ (de eigenaar van Borssele) er in 2020 voor om de centrale langer dan tot eind 2033 in bedrijf te houden.[11] [12] EPZ stelde op verzoek van de provincie Zeeland op 9 maart 2020 dat het wenselijk was dat de kerncentrale langer openbleef.[13] Aan de andere kant wilde Zeeland dat de regering de financiële risico's van deze kerncentrale overnam, hetgeen de regering weigerde.[14] Op 14 september 2020 stuurde minister Wiebes een brief van EPZ door aan de Tweede Kamer. Daarin concludeerde EPZ dat het "lastig te voorspellen" is of een verlenging "bedrijfseconomisch aantrekkelijk" is. Daarom wilde EPZ dat de overheid mogelijke tekorten betaalt.[15]
Volgens KPMG zijn de kosten van de levensduurverlenging 199 tot 439 miljoen euro, waarvan 106 tot 233 miljoen euro voor systeem- en veiligheidsaanpassingen.[16]
Op 20 juni 2022 liet minister Jetten van Klimaat en Energie weten: "De kerncentrale van Borssele blijft langer open."[17] Daartoe startte hij op 30 mei 2023 een vergunningprocedure.[18] De huidige regering heeft op 21 augustus 2024 de volgende stap gezet naar de verlenging van de bedrijfsduur van de kerncentrale: de Kernenergiewet moet worden aangepast: "In artikel 15a van de Kernenergiewet staat nu dat de Kerncentrale Borssele na 31 december 2033 geen kernenergie meer mag vrijmaken. Daarnaast staat er dat een vergunningaanvraag bij de Autoriteit Nucleaire Veiligheid en Stralingsbescherming (ANVS) niet in behandeling genomen zal worden." De regering "wil dit artikel aanpassen."[19]

## THE NETHERLANDS FOCUS

The Netherlands operates a single, over 50-year-old 482-MW PWR at Borssele—the oldest in the E.U.—that provided 3.8 TWh of electricity in 2023, just below the previous historic maximum of 4.0 TWh in 2009. This corresponded to 3.4 percent of the country's electricity, compared to the historic maximum of 6.2 percent in 1986, when the country also operated a 60-MW BWR at Dodewaard.

The Dodewaard unit operated from 1968 to 1997. Since April 2003, all the spent fuel has been removed, and the site entered its 40-year safe enclosure period in June 2005, after which the plant is to be dismantled.[20]

While Borssele's operating license is valid for an indefinite period, its initial safety report covered a 40-year operational lifetime, equating to the closure of the plant in 2013, but in late 2006, the owner, its shareholders, and the Dutch Government reached an agreement, formalized as the "Borssele Covenant", to allow the operation of the reactor to continue until 31 December 2033 provided certain conditions are met.[21] Amongst these conditions were enforced actions that Borssele "remain […] amongst the 25% safest water-cooled and water-moderated power reactors in the E.U., the US, and Canada" and that then-shareholding utilities Delta and Essent invest over €100 million (US$ 125.6 million) each into "sustainable energy management policies" and "additional innovative projects."[22] Today, Borssele is owned and operated by the Dutch nuclear utility Elektriciteits Produktiemaatschappij Zuid-Nederland (EPZ), which is co-owned by PZEM (70 percent) and German utility RWE (30 percent) via Energy Resources Holding (ERH).[23] In July 2023, the conservative coalition government of Prime Minister Mark Rutte collapsed over disagreements on migration policy, and a snap election was called for November. Rutte withdrew from Dutch politics after the incoming administration took over and was appointed Secretary General of NATO in June 2024.[24] The election was won by far-right party Partij voor de Vrijheid (PVV) on an anti-immigration agenda, that, spear-headed by its leader Geert Wilders, announced on 16 May 2024 that it had reached an agreement to form a new coalition with Rutte's center-right party Volkspartij voor Vrijheid en Democratie (VVD), centrist party Nieuw Sociaal Contract (NSC), and so-called right-wing "Farmers' Party" BoerBurgerBeweging (BBB).[25] The agreement explicitly excludes Wilders from becoming Prime Minister, resulting in Dirk Schoof, a senior official of the Ministry of Justice and former head of the Dutch intelligence service, being presented as a compromise outside of party politics at the end of May 2024.[26] The new government under Prime Minister Schoof was sworn into office on 2 July 2024. Government plans on how to implement "a clampdown on immigration and exceptions on EU asylum and environmental rules" are to be presented in September.[27]

Regarding energy policy, the new government will increase its focus on offshore gas extraction and nuclear power, possibly exceeding the previous government's ambitions to increase the share of nuclear power in the coming decades.[28] There are ongoing evaluations regarding several newbuild options, including both large reactors as well as Small Modular Reactors (SMRs).

For the only operational reactor at Borssele, the possibility of further lifetime extensions had already been discussed by EPZ in November 2020. The idea was to extend the operational lifetime from 2033 by another 10 or 20 years.[29] As current legislation prohibits the regulator to even consider an application for further prolonged operation at Borssele,[30] in 2020 the Dutch Parliament decided to inquire into the legislative changes required to allow a lifetime Extension.[31] Further operation of Borssele would require the amendment of the Nuclear Energy Act and the Covenant, as well as a license renewal to update underlying safety report forms.[32] In December 2022, operator EPZ applied for a grant to conduct technical feasibility studies on the operation of Borssele beyond 2033.[33] The up to €11.3 million (US$ 12.2 million) state aid to EPZ was approved by the European Commission in October 2023,[34] prompting the acting Dutch Energy and Climate Minister Rob Jetten to approve the feasibility study of Borssele's lifetime extension in December 2023.[35] An initial advance of €2 million [US$ 2.2 million] was paid, while the remainder will be spread annually until 2033, when the current operational license of Borssele is due to end.[36] Additionally, in its draft agreement, the new coalition states that Borssele "will remain open,"[37] and in June 2024, while acknowledging that legislative amendments and further feasibility studies were necessary,

acting Energy Minister Jetten called for the extended operation of Borssele beyond 2033 in a letter to Parliament. Additionally, he openly considered government purchase of a stake of EPZ to support the financing of this proposed lifetime extension.[38]

Until recently, nuclear newbuild was not considered a realistic option to decarbonize the Dutch energy system after Delta—then majority shareholder of EPZ— had put plans on ice "for at least two years" in 2012.[39] While the 2016 Energy Report assessed that "under the current market conditions, there is no demand for a new nuclear power plant, however the cabinet does not rule out new nuclear technologies being deployed in the future, as long as they are safe,"[40] the 2019 Integrated National Energy and Climate Plan 2021-2030 mentions that "a number of studies reveal that for 2050, nuclear power could be a cost-effective option and that a positive business case could be one of the long-term options. Given the lead times, additional nuclear power for 2030 does not seem likely in the Netherlands."[41] The plan targeted a 100-percent renewable electricity generation by 2050 with offshore wind delivering the lion's share.

In recent years however, the Dutch Government has been drawing closer attention to the possibility of continuing nuclear production beyond 2033. A few weeks after the publication of an Enco report on 1 September 2020, the then Minister of Economic Affairs and Climate Policy, Eric Wiebes—whose party, VVD, "want[ed] up to 10 new nuclear plants to be built" at the time—informed Parliament of the findings and the launch of procedures to allow a market consultation on nuclear newbuild.[42] The study concluded that nuclear "could play an important role in the future energy mix of the Netherlands" and argued that both large units and SMRs would be "cheaper" than renewable technologies.[43]

Another study commissioned by Minister Wiebes from Berenschot and Kalavasta concluded, on the contrary, that "nuclear energy is more expensive, except when nuclear power always takes precedence over the electricity grid and the government assumes a large part of the financial risks" as summarized by *Nuclear Engineering International (NEI)*.[44]

In addition to its lifetime extension propositions made in 2020, EPZ also suggested newbuild as an option. According to the proposal, the government would have to invest in the construction of new nuclear reactors, the favored option being two Generation-III+ reactors of around 1.5 GW capacity each, increasing the currently installed capacity sixfold. This capacity would correspond to the European Pressurized Water Reactors (EPR) or the South Korean Advanced Pressurized Water Reactors (APR), "safe and reliable" technologies according to EPZ.[45] For this project, EPZ envisioned costs of €8–10 billion (US$ 9.1–11.4 billion) and a construction duration of eight years per reactor, "if the project is properly implemented."[46]

In a 2021 market consultation, commissioned by the House of Representatives prior to the last Rutte administration taking office, consulting firm KPMG stated that "private financing without extensive government guarantees would be difficult or impossible to achieve [as] a large nuclear power plant is too big an investment for many private investors, and has too long a horizon."[47] The report further states that "proven" technologies of Generation III+ designs, such as the EPR or APR would limit first-of-a-kind (FOAK) cost risks in comparison to implementing a completely new reactor design. Russian and Chinese technologies were placed "out of scope" at the request of the Ministry of Economic Affairs, thus pointing to EDF, Westinghouse, and KEPCO as "obvious options". Nonetheless, without consensus on the "best" design, and given that "a choice can only be made once a sufficient number of projects have actually been completed", it was expected that a choice would only be possible by 2023.

In late 2021, the Dutch Government followed EPZ's original proposal in their coalition agreement. An undefined lifetime extension for Borssele and the construction of two new

reactors were included in the official governmental plans. A total of €5 billion (US$ 15.9 billion) was planned to be spent by the state until 2030 to facilitate the construction of the new plants.[48]

Dutch newbuild plans took a new turn in December 2022, when it was announced that two reactors would be built near the Borssele plant with the government as co-investor. The plan is to begin construction in 2028 and complete both units by 2035 thanks to an "accelerated approach".[49] A second consultation issued by KPMG in February 2023, tasked with identifying financing options for newbuild confirmed that state involvement is considered indispensable and concluded that, in the Dutch context, existing financing schemes would have limited applicability. The KPMG study also stated that "market parties" expected a role for the government to limit licensing and political risks, and advance agreements on setting up a decommissioning fund. Construction duration was estimated at 11 to 15 years, calling the Dutch Government's envisioned "accelerated approach" into doubt.[50]

Meanwhile, Dutch company NRG Pallas, active in nuclear medicine and operator of the High Flux research Reactor (HFR) at Petten, and Belgian nuclear engineering company Tractebel, a subsidiary of the utility Engie, signed a Memorandum of Understanding in March 2023 to "cooperate to support the new-build of nuclear power plants in the Netherlands."

On 12 April 2023, then Minister for Climate and Energy Rob Jetten renewed his pledge to stick with the coalition agreement of 2021 despite disagreement from the "Expert Team Energy System 2050", which he had appointed to outline recommendations for the country's Energy System Plan 2050.[51] In its report, submitted on the same day as the Minister's remarks, the team sees "no or a limited role" for nuclear power in the Dutch energy system and emphasized current electricity demand and neighboring European countries started importing electricity from the Netherlands.

They further questioned the possibility of having a new reactor online before 2040 and the potential choice of Borssele as a possible location for new capacity—as this could lead to system overload from the large amount of wind farms located nearby—all while noting that they had drawn their conclusion on nuclear power from other studies.[52] Minister Jetten indicated that the "final decision" on new nuclear capacity would be made towards the end of 2024.[53]

However, at the end of April 2023, the former administration stated its intent to reach a carbon-neutral electricity system by 2035 with nuclear mentioned as a potential contributor of up to 10 percent of the mix if two new reactors were built. Emphasis on SMR technologies in the statement contradicts the assumption of just two plants providing such a large portion of electricity.[54] Given the long lead time of nuclear newbuild in planning and construction experienced in other countries, it seems unlikely that the plans can be implemented in the targeted timeframe.

Dutch new nuclear policy gained further momentum when, also in April 2023, approx. €320 million were allocated to nuclear-associated funds in the draft document for the 2024 climate budget.[55] These expenditures exceed the planned budget of the 2021 coalition agreement by €199 million (US$ 215.2 million). Included are €10 million for studies spanning from 2023 to 2025 on lifetime extension at Borssele and an additional €62 million for the local municipality and the province of Zeeland for efforts regarding newbuild projects and continued operation at Borssele. Further €117 million are allocated to newbuild feasibility studies and €65 million are to be spent on the development of knowledge and training of nuclear industry staff for the future operation of Dutch nuclear power plants.[56]

In December 2023, the Dutch Government announced that Korea Hydro & Nuclear Power (KHNP) had been contracted to carry out a technical feasibility study on the construction of two reactors at Borssele - expected to span at least six months starting in January 2024 - with similar contracts with Westinghouse and EDF to follow "soon". On that

occasion, the Dutch and South Korean Governments signed an MoU to "cooperate on nuclear energy".[57]

In February 2024, Westinghouse followed with the announcement that it was also to conduct such a study for two AP-1000s, without divulging an estimated timeline.[58] However, according to *The Wall Street Journal* "Westinghouse said it learned from its U.S. experience during the 2010s and no longer takes on reactor construction."[59] That suggests that Westinghouse would provide the technology but not act as the main builder-contractor, who then remains to be identified.

As of June 2024, no contract with EDF had been made public. The government envisions a final site selection in 2025 as a second location, in addition to Borssele, might still come under consideration.[60]

In March 2024, the "Tweede Kamer", the lower house of the Dutch Parliament, adopted a resolution to extend newbuild plans from two to four new reactors.[61] The incoming government, in addition to the lifetime extension of the operational Borssele plant, indeed envisions the construction of four new nuclear power plants.[62] According to the coalition agreement, funding is to be increased from the current €4.5 billion to €14 billion (US$ 4.9 to 15 billion), most of which is to be spent in the 2030s, by which time another policy shift might have happened.[63]

In the outgoing government's multi-annual climate fund budget, published in October 2023, an additional €65 million were earmarked for 2025 for the development of SMRs in the Netherlands.[64] In August 2022, Amsterdam-based ULC-Energy and British Rolls-Royce signed an exclusive agreement to cooperate on Dutch SMR development. ULC-Energy hopes to apply for a license for its reactor in 2025, envisioning construction to begin in 2027.[65]

In November 2023, Rolls-Royce signed an MoU with Dutch construction company BAM "to explore the opportunities for collaboration to support deployment of Rolls-Royce SMRs in the Netherlands."[66] The previously mentioned July 2021 KPMG report had considered SMRs as an "interesting option" to market parties but suggested waiting until "any FOAK issues have been resolved" to identify successful projects, deeming the start of such a process impossible before 2027–2033.[67] Moreover, in March 2024 acting Energy Minister Jetten in a letter to the "Tweede Kamer" acknowledged that there was, as of today, no SMR concept ready for deployment, while describing steps taken to prepare the potential deployment of SMRs in the future.[68]

Today's electricity mix in the Netherlands is dominated by natural gas, which supplied 37.7 percent of total electricity, 122.15 TWh (gross), in 2023. Wind energy (23.7 percent) and solar (17.3 percent) are next, followed by coal (6.9 percent) and bioenergy (6.8 percent). The contribution of "other fossil fuels" at 4.2 percent exceeds the nuclear share at 3.3 percent of total electricity generation.[69]

Renewables had strong growth rates in 2023 with wind turbines generating 35 percent and solar panels 24 percent more power than in the previous year. The Dutch National Energy and Climate Plan from June 2023 expects the share of renewable energies in gross electricity consumption to increase from 33.4 percent in 2021 to 86.2 percent in 2030 and 95.5 percent in 2040 (raising questions about the envisioned nuclear plans). This development is to be driven by the expansion of wind and solar power. The plan envisions capacity expansions of 28.3 GW for wind power by 2040, of which 21.2 GW are planned as offshore capacity.[70] 2023 marked the milestone of exceeding 10 GW of installed wind power, of which nearly 2 GW had been installed in the year including 1.4 GW offshore.[71] Solar is expected to grow from 23.9 GW at the end of 2023 to 42.6 GW by 2040.[72] The target seems realistic as in 2023 alone, solar capacities increased by 4.3 GW. In the E.U., the Netherlands lead the charts on

installed solar capacity per capita at 1.3 kW, followed by Germany (0.9 kW) and Belgium (0.7 kW).[73]

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