



wise

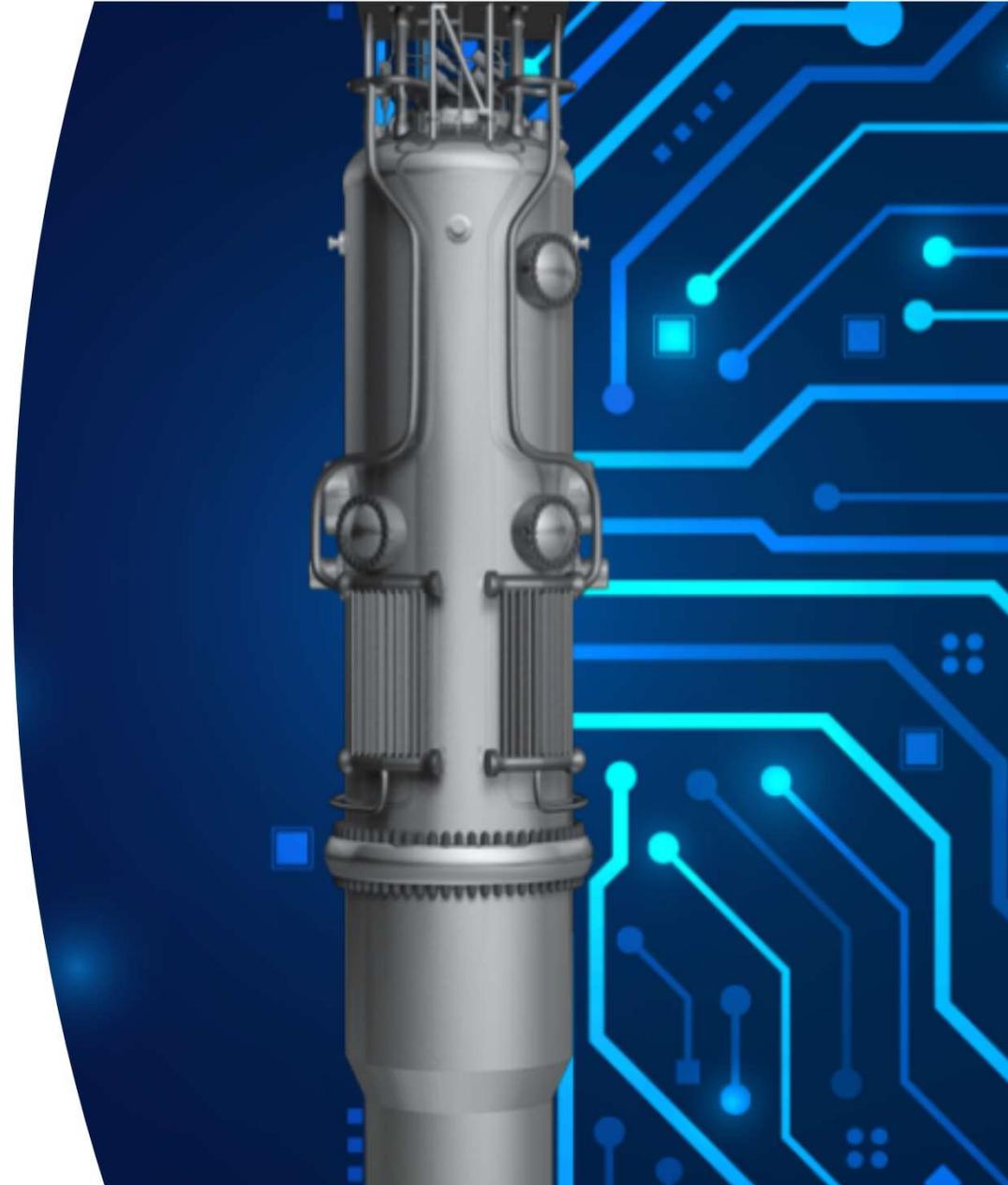
mee met de energierevolutie

Webinar SMR's, Toekomst of Hype?

SMRs toekomst of hype?

WISE

18 februari 2026



Mogelijke energievraag/mix 2050 (bron PEH)

	Nederland Energieiland Regionale Sturing	Nederland Energieiland Nationale Sturing	Nederland Energieiland Europese Sturing	Nederland Energieiland Internationale Sturing	Sterke Knopen Nationale Sturing	Sterke Knopen Europese Sturing	Zeer Sterke Knopen Kernenergie
Totale energievraag	1181 PJ	1319 PJ	1647 PJ	1735 PJ	1319 PJ	1647 PJ	1647 PJ
Elektriciteitsvraag	690 PJ	764 PJ	863 PJ	847 PJ	764 PJ	863 PJ	863 PJ
Waterstofvraag	121 PJ	266 PJ	421 PJ	494 PJ	266 PJ	421 PJ	421 PJ
Wind op zee	43 GW	72 GW	42 GW	38 GW	72 GW	42 GW	42 GW
Wind op land	20 GW	20 GW	10 GW	10 GW	20 GW	10 GW	0 GW
Zon op dak	59 GW	49 GW	23 GW	18 GW	59 GW	58 GW	58 GW
Zon op veld	66 GW	57 GW	34 GW	34 GW	48 GW	0 GW	0 GW
Elektrolyse	42 GW	51 GW	19 GW	16 GW	51 GW	19 GW	18 GW
Systeembatterijen	54 GW	53 GW	33 GW	29 GW	33 GW	33 GW	27 GW
Import	15 GW	15 GW	15 GW	15 GW	15 GW	15 GW	15 GW
Opslag H ₂	36 TWh	37 TWh	10 TWh	47 TWh	37 TWh	10 TWh	13 TWh
Opslag methaan	24 TWh	14 TWh	55 TWh	15 TWh	14 TWh	55 TWh	55 TWh
Kerncentrales	0 GW	0 GW	0 GW	0 GW	0 GW	0 GW	8 GW
Grote centrales	15 GWe	17 GWe	17 GWe	16 GWe	17 GWe	17 GWe	12 GWe
Piekc centrales)	18 GWe	18 GWe	19 GWe	18 GWe	18 GWe	19 GWe	16 GWe

- Elektriciteitsvraag neemt sterk toe
 - 700 – 900 PJ
 - Nu 400 PJ
- Waterstof vervangt aardgas deels
 - 100-500 PJ
- Scenario met 8 GW kernenergie
 - 28 – 36 GW regelbaar vermogen
- Nieuwe analyses: nog hogere elektriciteitsvraag

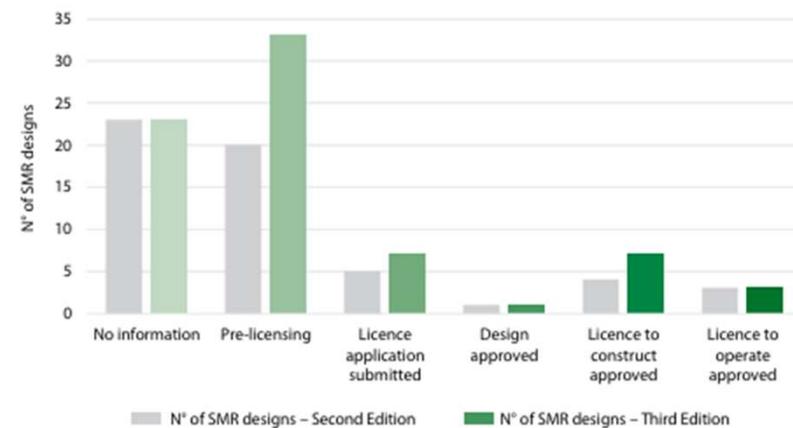
Revival kernenergie

- Vanuit diverse kanten komt kernenergie naar voren als alternatief voor extra zon/wind
- Zon en wind zijn er niet altijd, dus ze kunnen nooit volledig de Evraag dekken
- Thorium-reactor is de toekomst! Of SMR, of is dat hetzelfde?
- Kabinet Schoof/Jettten: 4 grote EPR-centrales
- Veel provincies/gemeenten zien heil in SMR's, klein en dus makkelijk inpasbaar

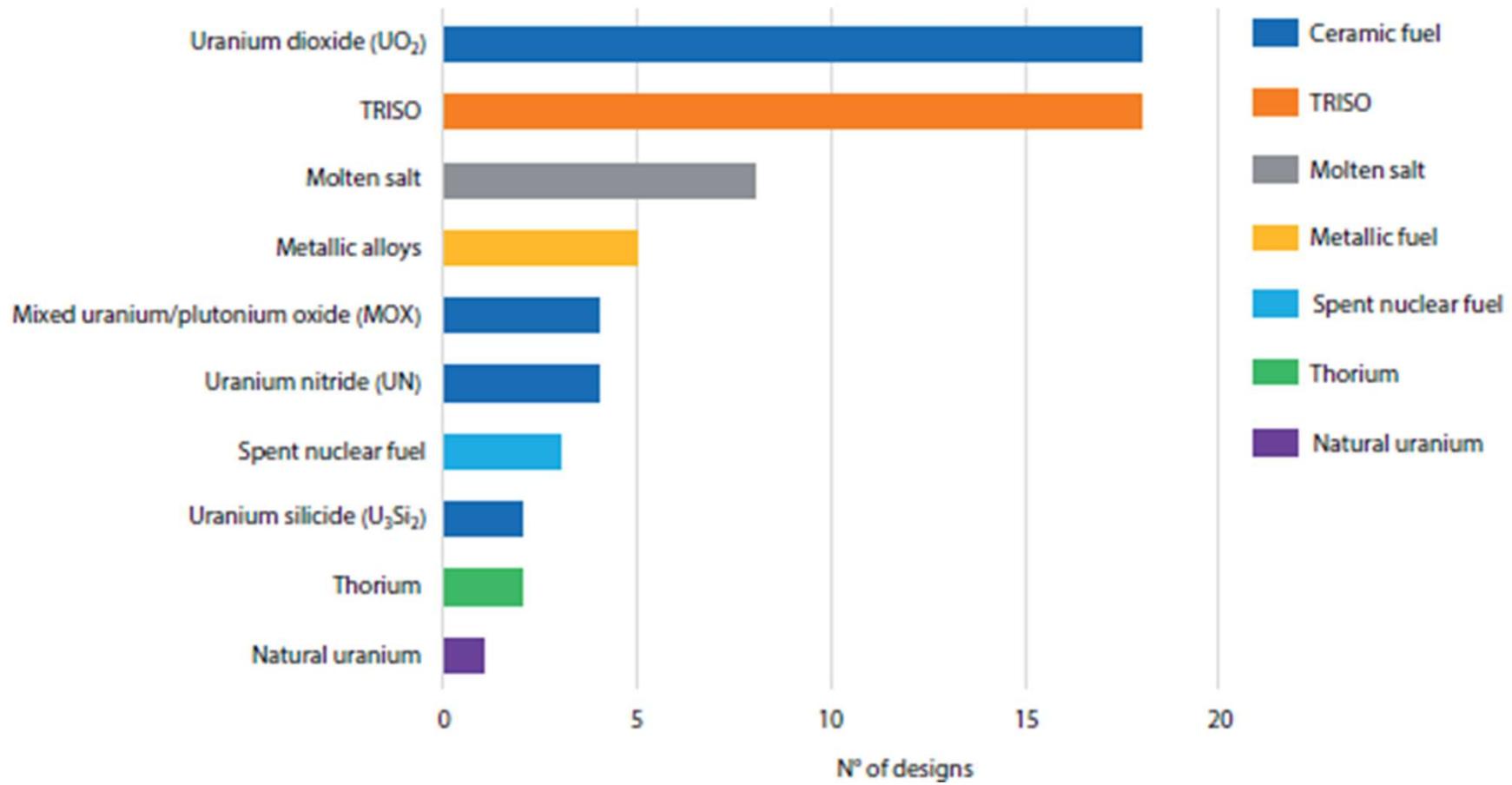
Wat is een SMR?

- SMR = Small Modular Reactor
- Modulair, serieproductie, dan pas lagere kosten
- Vele verschillende technieken
- Wereldwijd 127 initiatieven (NEA) waarvan 74 serieus
- Verschillende temperatuurniveaus
- Verschillende schaalgroottes

Figure 25. Comparison of licensing pipelines between the second (2024) and third (2025) editions of the NEA SMR Dashboard*

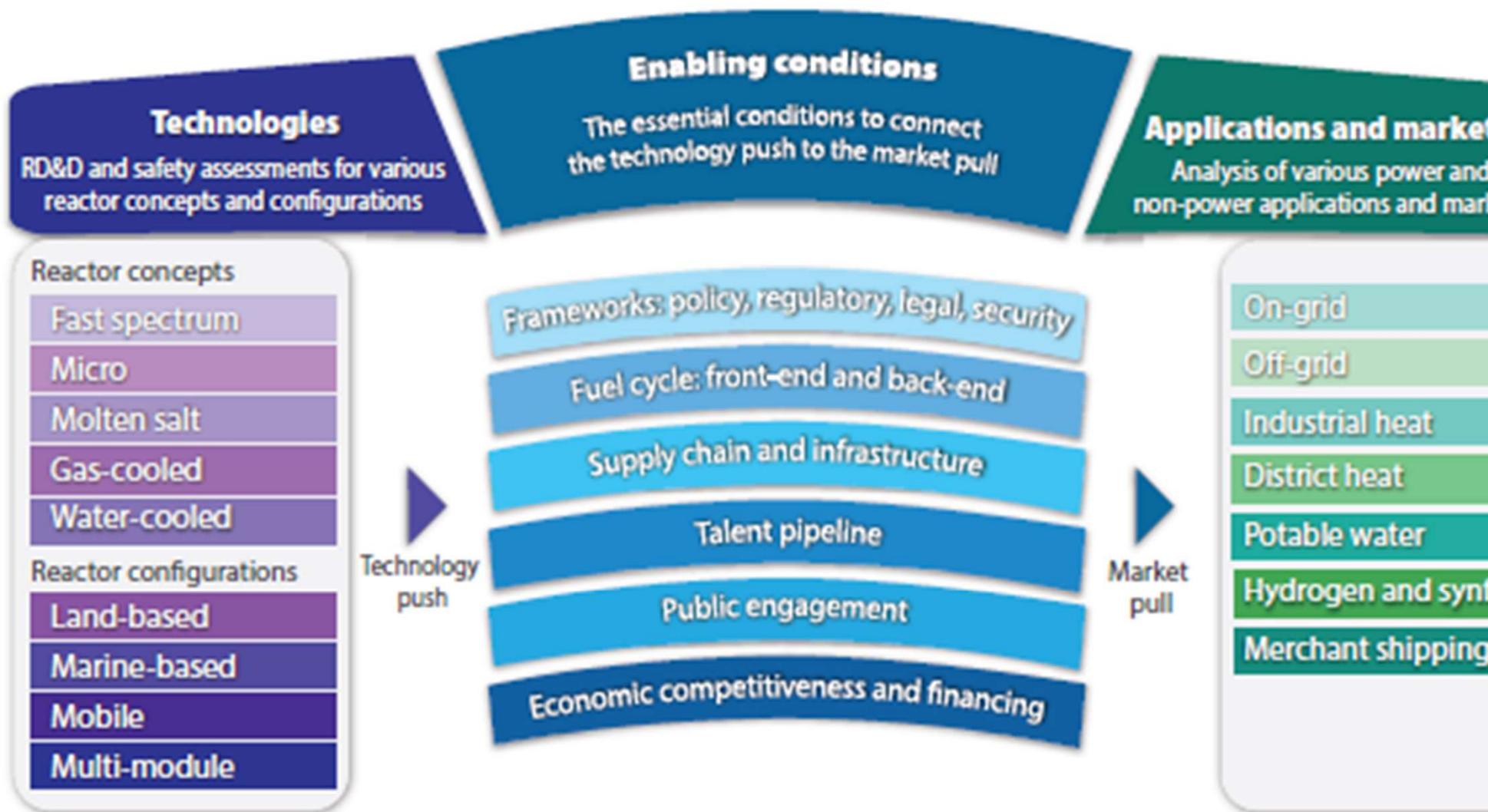


Veel verschillende technieken



Vele verschillende SMR's

- SMR's zijn een nog ontwikkelende technologie; deze zijn commercieel nog niet beschikbaar. Voor SMR's zijn er 127 verschillende ontwerpen, waarvan er slechts vier in aanbouw zijn en drie al opereren in China en Rusland ([OECD, 2025](#)).
- Volgens experts is de verwachting dat het nog 20 jaar duurt voordat een SMR structureel energie kan leveren in Nederland.
- De kosten, voor- en nadelen zijn nog onzeker.
- The NEA Small Modular Reactor (OECD)
 - Nu vooral uranium-reactoren (HALEU 5-20%), licht-water.
 - Problemen met aanleveren HALEU
 - gesmolten zout, thorium, nog veel minder ver ontwikkeld



Source: NEA, 2023a.

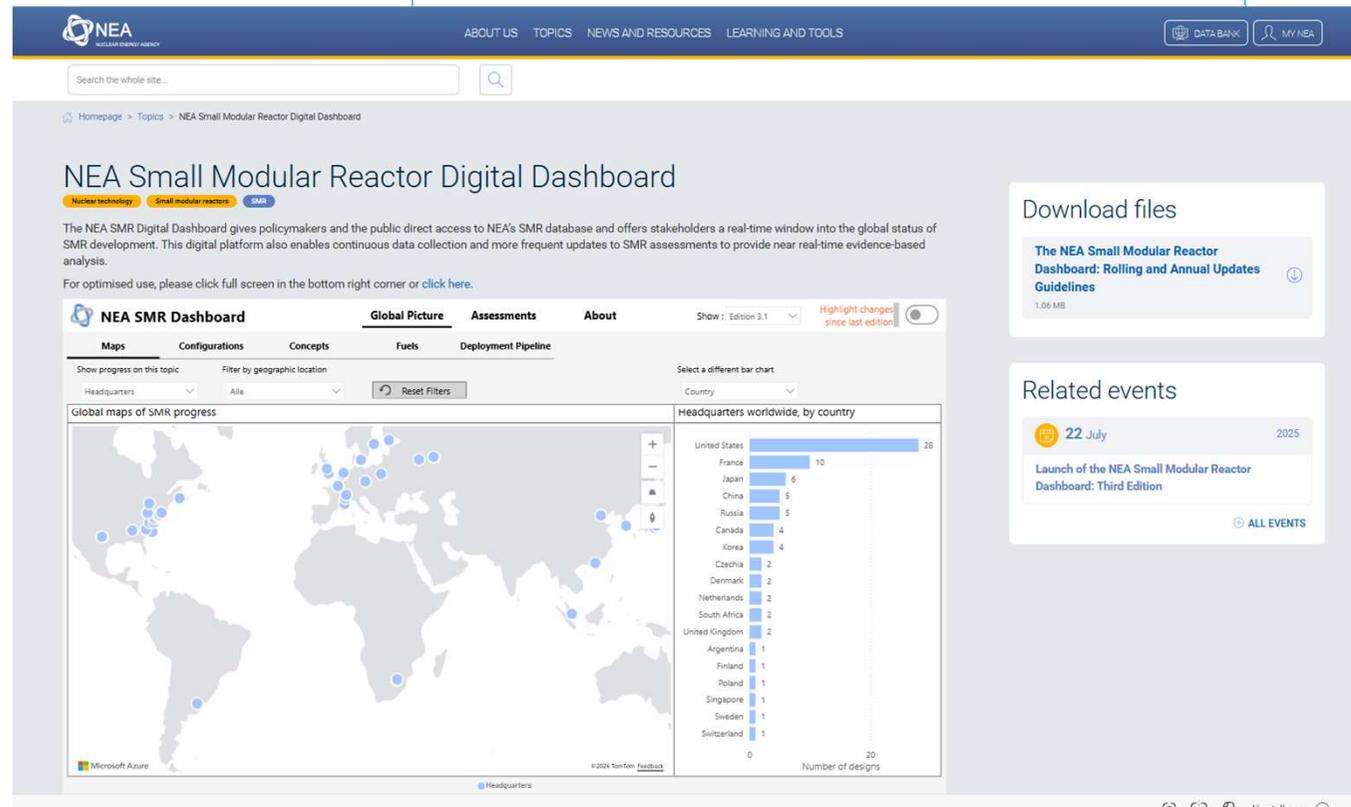
Bestaande (experimentele) SMR's (2025)

- HTR-PM in China (2*250 MWth, FOAK, 2021)
- KLT-40S in Russia (2x150 MWth, 2019)
- High Temperature Test Reactor (HTTR) in Japan (JAEA, 30 MWth)
- ACP100 in China (385 MWth, 2023)
- BREST-OD-300 in Russia (NIKIET, 700 Mwe, U+Pu)
- CAREM-25 in Argentinië (FOAK, 100 MWth)
- NuScale agreements Idaho 460 MWe by 2030
 - Vancelled 2023 \$3.6 billion >> \$9.3 billion

The screenshot shows a webpage from Utility Dive. The main article is titled "The collapse of NuScale's project should spell the end for small modular nuclear reactors" and is categorized as an "OPINION". The article text begins with "Although there were problems specific to the Utah Associated Municipal Power Systems project, the financial challenges and cost trends witnessed in that case will afflict any SMR project." It was published on Jan. 31, 2024, by M.V. Ramana. Below the text is a large image showing the interior of a nuclear reactor core. To the right of the main article, there are sections for "MOST POPULAR" and "LIBRARY RESOURCES". The "MOST POPULAR" section includes articles about New Jersey utilities, natural gas installations, and CAISO's transmission focus. The "LIBRARY RESOURCES" section includes a playbook about AI and advanced tech in the energy landscape and a trendline about creating a strong customer loyalty program.

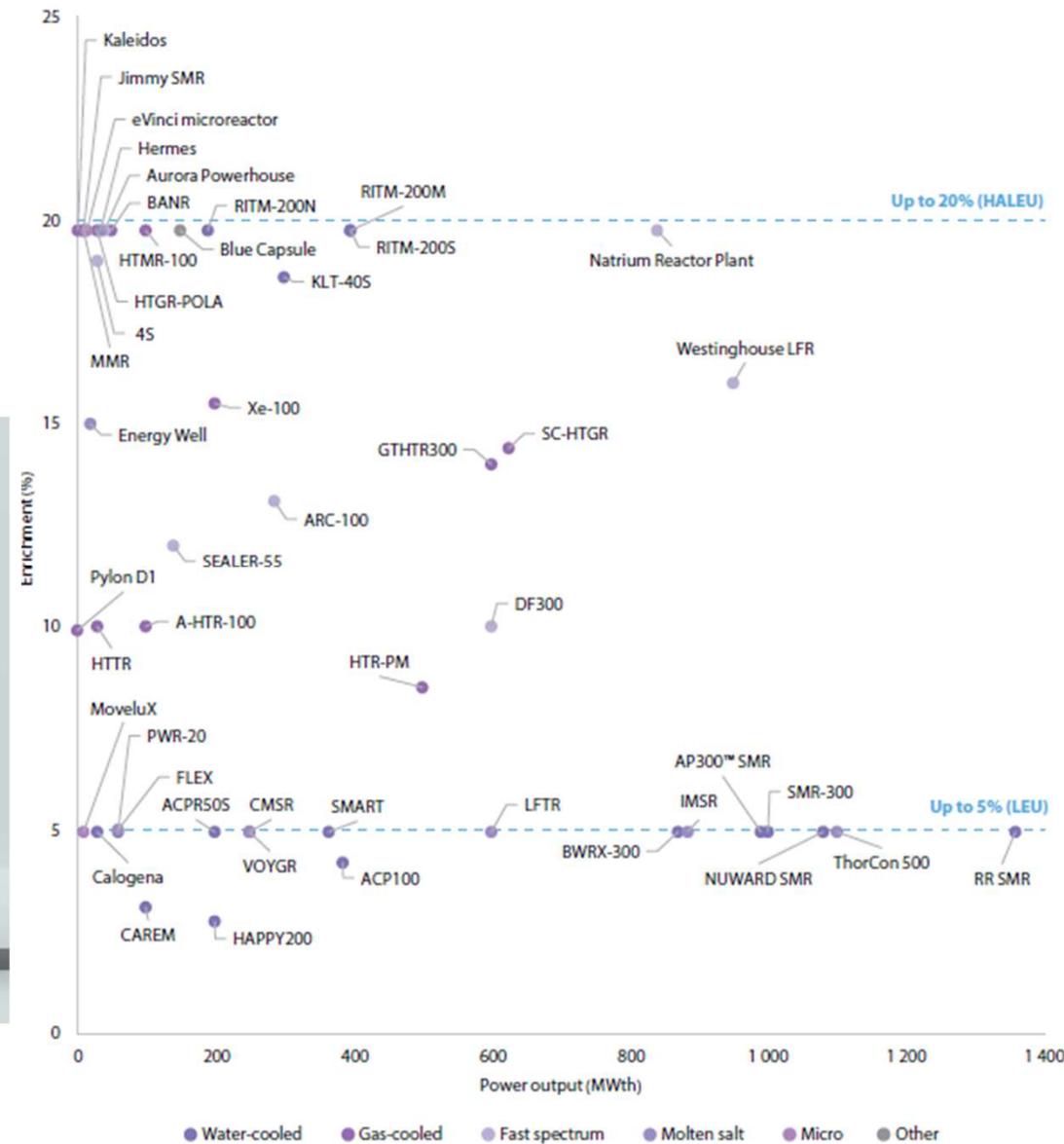
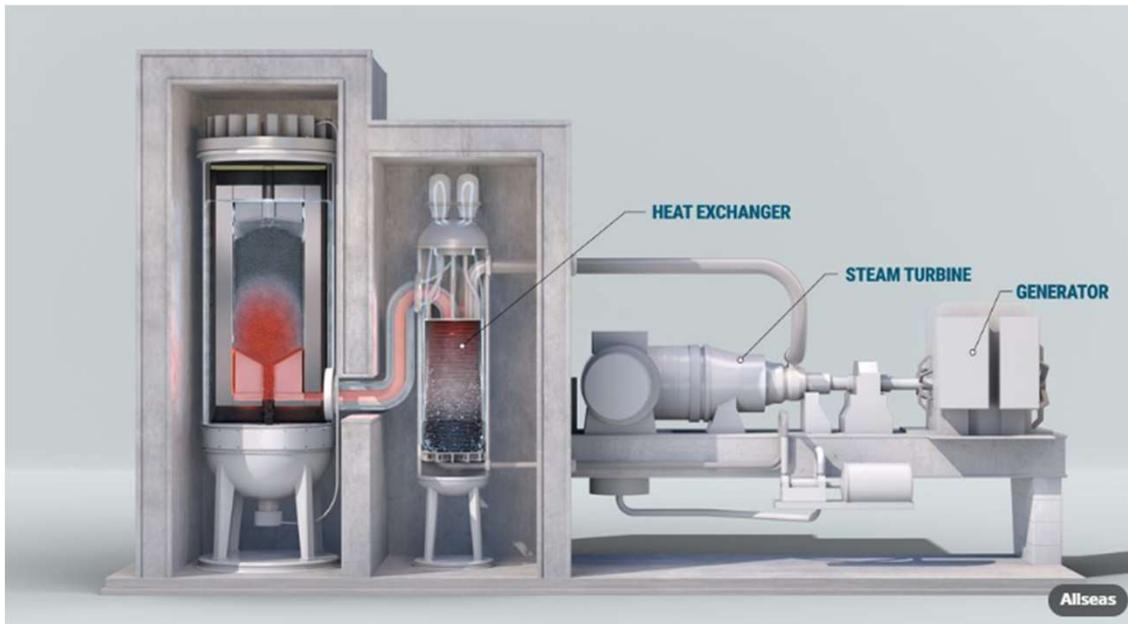
Dashboard NEA Nuclear Energy Agency (OECD)

- https://www.oecd-nea.org/jcms/pl_107879/nea-small-modular-reactor-digital-dashboard



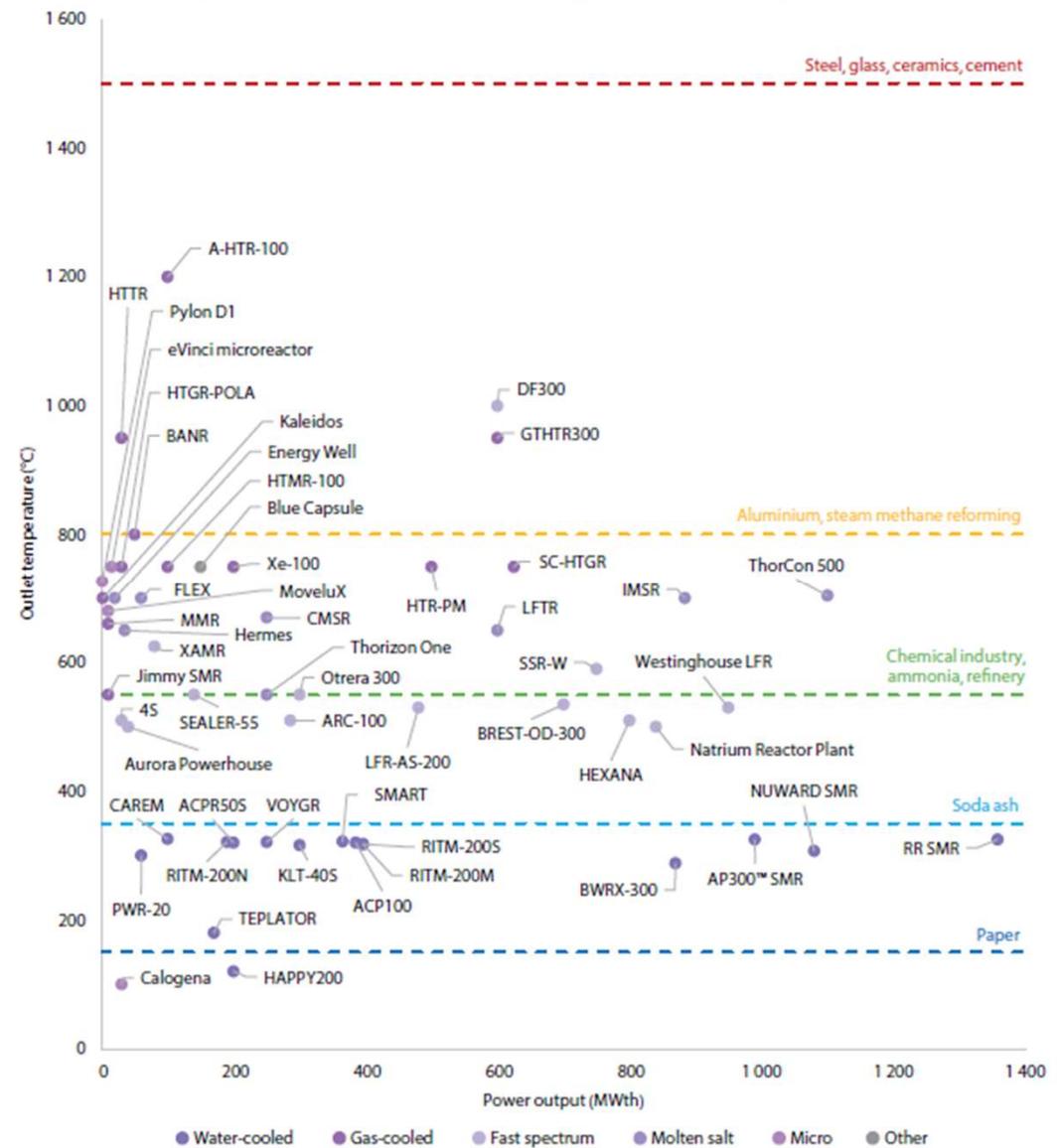
Verschillende Uranium

- Meeste SMR's op basis van verrijkt uranium



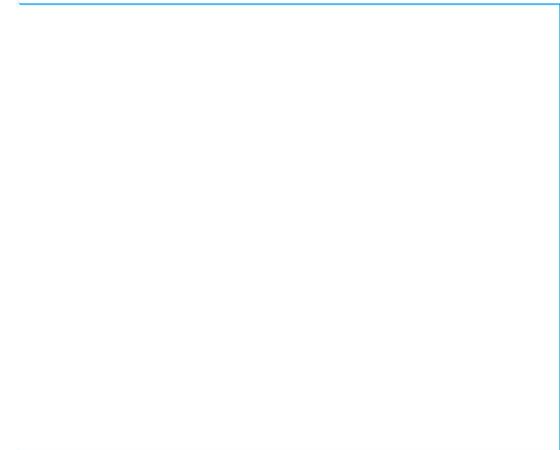
Verschillende Temperaturen

- Meeste gericht op industriële energiebron



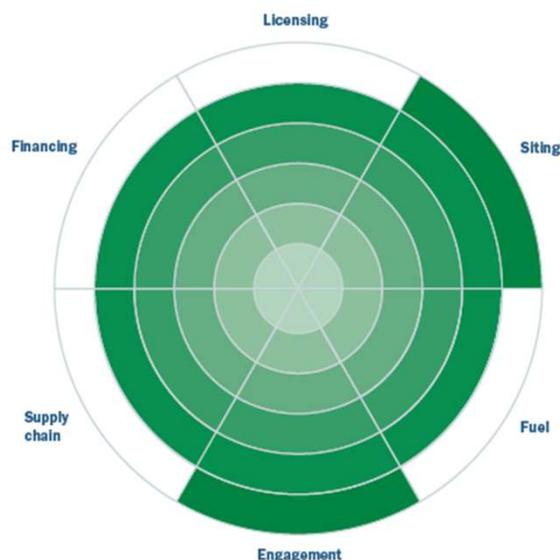
Overzicht NEA

- **Licensing:** The criteria for assessing progress in licensing closely follow international licensing norms, including pre-licensing interactions with regulators, design approval, construction and the issuance of operating licences. SMRs with licensing activities in multiple jurisdictions at any level are accorded a bonus.
- **Siting:** The criteria for assessing progress in siting reflects decisions by site owners and considers licensing readiness of sites for SMR construction. A bonus is given to SMR technologies making progress at multiple sites at any level.
- **Financing:** The criteria for the financing assessments reflect both public announcements from reactor designers and financing reports from publicly available sources.
- **Supply chain:** The criteria for assessing progress in supply chain readiness consider increasing levels of commitment reflected in memoranda of understanding, binding contracts and formal partnerships, joint ventures or consortia with suppliers or engineering, procurement and construction companies.
- **Engagement:** The criteria for engagement reflect the number of engagements with people and communities associated with the SMR project, evidenced by memoranda of understanding, endorsements, town hall meetings or benefit-sharing agreements.
- **Fuel:** The criteria for assessing progress on fuel are based on progress towards the commercial supply of qualified fuel. Where there is a licensed and operating fuel fabrication facility, it is considered alongside others already being used in operating plants. The next stages of maturity include having contracts for fuel supply and a licence to operate the reactor with the specific fuel.



CNEA (Argentina's National Atomic Energy Commission) – CAREM

Assessment of CAREM's progress to deployment



Reactor description: Integral pressurised water reactor.

Thermal power (MWth)	100
Outlet temperature (°C)	326
Spectrum (thermal/fast)	Thermal
Fuel type	UO ₂ pellets
Fuel (LEU/HALEU/HEU)	LEU

Licensing



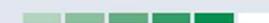
The CAREM prototype reactor license for construction was approved in 2010. In 2013, the CAREM prototype reactor was authorised to start construction, which began in 2014.

Siting



The CAREM reactor is under construction on the nationally owned site of Atucha, where Atucha I and II are already located. The Autoridad Regulatoria Nuclear, Argentina's nuclear regulator, granted the authorisation for site use and construction to the Comisión Nacional De Energía Atómica (CNEA) in September 2013. The first concrete was poured in February 2014.

Financing



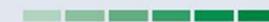
The Argentinian government has written into national law that the government will fully finance the construction of the CAREM first-of-a-kind reactor.

Supply chain



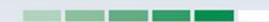
CAREM's construction started in 2014 and was ongoing as of 2023. CNEA remains the responsible authority ensuring overall co-ordination along the supply chain. Under current planning, up to 70% of the components are to be manufactured in Argentina. Nucleoelectrica Argentina SA is providing the construction and technical assistance under contracts signed in 2021 and 2023. In 2023, CNEA also signed a new contract with an Argentinian engineering, procurement and construction company, Industrias Metalúrgicas Pescarmona Sociedad Anónima, for the manufacture of auxiliary components.

Engagement



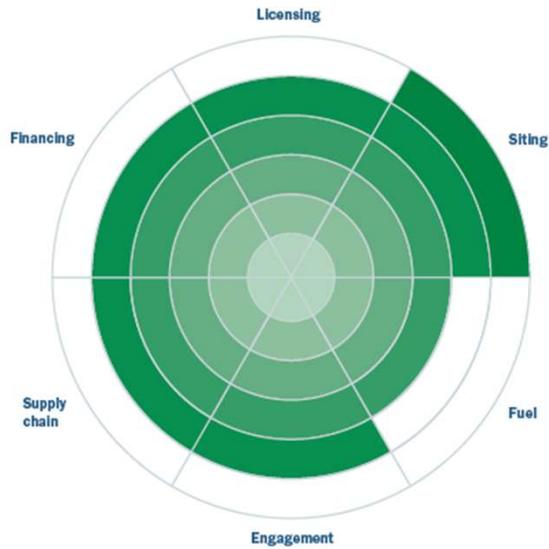
Argentina has co-operation agreements with Bolivia for activities in the field of peaceful uses of nuclear energy, including but not limited to engagement about CAREM. Argentina also has a Memorandum of Understanding with Indonesia for co-operation on nuclear energy, including CAREM. From 2022 to 2023, CNEA hosted more than ten national and subnational government officials, including the President of Argentina and the governor of Rio Negro Province, to discuss the CAREM project. CNEA is engaged with the National University of General San Martín on a market study for the commercialisation of CAREM. In 2022, the Deliberative Council of Zárate, the city where CAREM is being constructed, met in the facilities of the Atucha Nuclear Complex and unanimously agreed to support of the CAREM project.

Fuel



Combustibles Nucleares Argentinos S.A. was contracted to manufacture fuel for CAREM in 2013. This contract for fuel supply is ongoing.

CNNC (China National Nuclear Corporation) – ACP100



△ Indicates change since 2023.

Reactor description: Integrated pressurised light water reactor, also known as the Linglong One.

Thermal power (MWth)	385
Outlet temperature (°C)	320
Spectrum (thermal/fast)	Thermal
Fuel type	UO ₂ pellets
Fuel (LEU/HALEU/HEU)	LEU



Assessment of ACP100's progress to deployment

Licensing

China's National Nuclear Safety Administration (NNSA) approved the ACP100 preliminary safety analysis report in 2020. In June 2021, the NNSA approved the Quality Assurance Outline (Construction Phase) of the ACP100 demonstration reactor project, followed by the issuance of the construction license in July 2021. In 2021, the Ministry of Ecology and Environment of the People's Republic of China approved the Environmental Impact Report (Construction Phase) of the demonstration project.

Siting

In 2017, the Hainan provincial government agreed to site one ACP100 unit on the existing Changjiang Nuclear Power Plant site. Construction started in 2021. The unit is planned to be commercially operational in 2026.

Financing

The People's Republic of China's National Development and Reform Commission approved the construction of a ACP100 demonstration reactor in June 2021. This ACP100 demonstration reactor is wholly owned by CNNC's China National Nuclear Power, a state-owned enterprise under direct management by the Chinese central government.

Supply chain

The supply chain for the ACP100 demonstration reactor involves various Chinese companies, including China National Nuclear Power (a subsidiary of CNNC) as the owner and operator, the Nuclear Power Institute of China (NPIC) as the reactor designer, China Nuclear Power Engineering Group as the plant construction company, China First Heavy Industry as the supplier of the reactor vessel, as well as Harbin Electric Corporation and Dongfang Electric Corporation as suppliers for other parts of the reactor. The ACP100 demonstration reactor core and steel containment dome were installed in August and November 2023, respectively.

Engagement

In 2014, CNNC presented the progress of the ACP100 demonstration project at the 12th National Committee of the Chinese People's Political Consultative Conference. In 2017, CNNC met with members of the Changjiang County Party Committee and the Governor to discuss the ACP100 demonstration project. The national and local governments support the ACP100 demonstration project, including through policy statements, media interviews, and site visits to promote the project. In 2017, CNNC said it had met with foreign countries including Brazil, Canada, Egypt, Indonesia, Iran, Mongolia, Pakistan, Saudi Arabia and the United Kingdom to discuss the ACP100 demonstration project and explore opportunities for potential co-operation.

Fuel

The ACP100 design is based on existing Generation II/III light water reactor technology and therefore relies on well-established fuel supply chains.

Rolls-Royce SMR – RR SMR



- ★ Active in multiple jurisdictions or countries.
- Δ Changes since Second Edition (2024).

Reactor description: Close-coupled, three-loop pressurised water reactor using low enriched uranium fuel.

Thermal power (MWth)	1 358
Core outlet temperature (°C)	325
Spectrum (thermal/fast)	Thermal
Fuel form	Uranium-oxide ceramic
Base fissile material	U-235, enrichment level: < 5%



Assessment of RR SMR's progress to deployment

Licensing

In July 2024, Rolls-Royce SMR (RR SMR) advanced to Step 3 of the UK Office for Nuclear Regulation (ONR) Generic Design Assessment (GDA) process, two years after submitting its design certification application for review. Regulators from Czechia, Finland, Poland, Sweden, and the Netherlands have observed GDA meetings to familiarise themselves with the RR SMR design and the GDA assessment process. This engagement may facilitate future deployment in their respective countries. Additionally, in 2024, the International Atomic Energy Agency conducted a Technical Safety Review of the Rolls-Royce SMR design.

Siting

In October 2024, Czech operator CEZ Group chose Rolls-Royce SMR for up to 3 GWe at its Temelin site, with early work planned to start in 2025. That same month, Great British Nuclear (GBN) shortlisted Rolls-Royce SMR among four SMR technologies for the next phase of the United Kingdom's deployment competition, with GBN selecting the sites. Also in 2024, Sweden's Vattenfall shortlisted Rolls-Royce SMR as one of two potential SMR suppliers for its Ringhals site. Poland's Ministry of Climate and Environment approved Industria's plans to deploy Rolls-Royce SMRs for its Central Hydrogen Cluster. UK-based Chiltern Vital Group (CVG) partnered with Rolls-Royce SMR for potential deployment at the Gloucestershire Science and Technology Park, which CVG acquired in 2024.

Financing

Rolls-Royce SMR has attracted more than GBP 490 million (USD₂₀₂₃ 713 million) in combined public and private sector funding to support its development and deployment. The UK government has supported the RR SMR, including with GBP 210 million (USD₂₀₂₃ 305 million) in funding through the UK Research and Innovation funding. In the private sector, partners in the Rolls-Royce SMR business have made equity investments. Specifically, Rolls-Royce Group, BNF Resources, Constellation, and the Qatar Investment Authority have raised nearly GBP 280 million (USD₂₀₂₃ 407 million) in combined funding for the RR SMR. In October 2024, CEZ Group acquired a 20% equity position in Rolls-Royce SMR.

Supply chain

In 2024, Rolls-Royce SMR signed contracts with GSE Solutions for a power station simulator and the University of Sheffield to establish Module Development Facility concepts at the University Advanced Manufacturing Research Centre. The facility hosted the first supplier conference for the RR SMR in June 2024. Rolls-Royce SMR has secured multiple agreements for design and engineering services with: AtkinsRéalis, BAM Nuttall, Laing O'Rourke, Jacobs, Nuclear AMRC, Assystem, The Welding Institute, and the UK National Nuclear Laboratory. It also has Memoranda of Understandings (MoUs) with: Sheffield Forgemasters, and Škoda JS. In 2024, Rolls-Royce SMR was selected to form a Project-Working Group under the European Industrial Alliance on SMRs.

Engagement

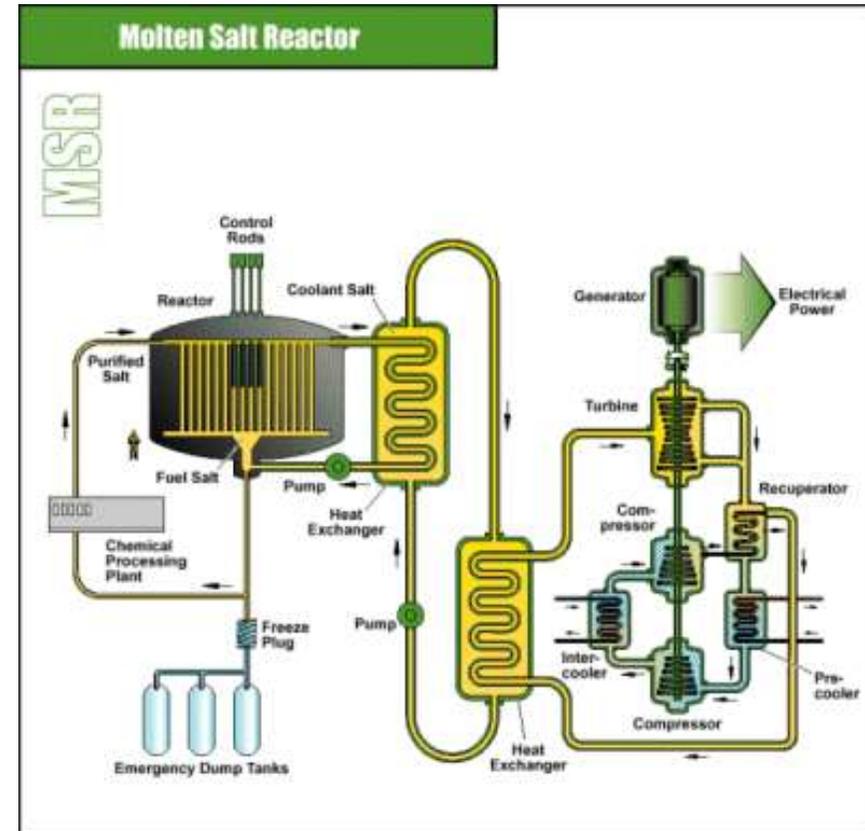
Since 2021, Rolls-Royce SMR has received endorsements from UK government officials, including former Business and Energy Secretary Kwasi Kwarteng, and has been working with local stakeholders in six communities to identify potential sites for an SMR module factory. Additionally, Solway Community Power Company, an SMR development facilitator, chose Rolls-Royce SMR for deployment in West Cumbria, United Kingdom. Rolls-Royce SMR has also signed MoUs with: ULC-Energy in the Netherlands, the Jordan Atomic Energy Commission in Jordan, Constellation in the United States, and Energoatom in Ukraine.

Fuel

The RR SMR utilises fuel that is the current industry standard for water-cooled reactor technologies that are similar in design. Given this, there are no barriers expected in the fuel supply chain for this SMR. In 2023, Rolls-Royce SMR signed an agreement with Westinghouse Electric Company to develop and advance work on the design of the RR SMR nuclear fuel.

Maar hoe zit het dan met de Thorium-reactor?

- Brandstof ruim aanwezig
- Veiliger dan EPR - uranium
- Veel kortere halveringstijd radio-actief materiaal (300 jaar ipv 100.000 jaar)
- Nog in experimenteel stadium
- Commercieel beschikbaar op z'n vroegst 2040
- Kosten zijn nog onbekend
- Momenteel zijn er geen kern-reactoren die thorium gebruiken; het hoort bij de nieuwe generatie IV-reactoren.



Thorizon – Thorizon One



- ★ Active in multiple jurisdictions or countries.
- △ Changes since Second Edition (2024).

Reactor description: Cartridge core molten salt reactor using spent fuel and thorium with option for thermal or fast spectrum.

Thermal power (MWth)	250
Core outlet temperature (°C)	550
Spectrum (thermal/fast)	Both thermal and fast
Fuel form	Molten chlorides
Base fissile material	Plutonium, not requiring uranium enrichment



Assessment of Thorizon One's progress to deployment

Licensing ★

Thorizon is undergoing a joint preparatory review with the French Nuclear Safety and Radiation Protection Authority (ASNR) and the Dutch Authority for Nuclear Safety and Radiation Protection (ANVSI). This review focuses on evaluating the reactor's design and safety features to streamline future licensing processes in both countries. This joint preparatory review is progressing under a Memorandum of Understanding signed in September 2023 between ASNR and ANVSI.

Siting

Thorizon has announced it is working with EPZ, the Dutch nuclear power plant operator, to evaluate the feasibility of deploying a demonstration reactor at the Borssele nuclear power plant site in Zeeland, Netherlands. EPZ is collaborating with industry to prepare for SMR development at industrial sites in the Netherlands and is engaged with Thorizon as well as a shortlist of other SMRs for this purpose.

Financing

In 2020, Thorizon received EUR 350 000 (USD₂₀₂₃ 449 000) from the Dutch Government in loans. In 2021, Positron Ventures led a EUR 750 000 (USD₂₀₂₃ 938 000) pre-seed round for Thorizon. In 2022, Thorizon raised EUR 12.5 million (USD₂₀₂₃ 14.4 million) from private investors, including Positron Ventures and Huisman, and public investors, including Invest-NL, the Participation Fund Sustainable Economy North Holland (PDENH), and Impuls Zeeland. In 2024, the Thorizon-led consortium PROXIMA was awarded EUR 10 million (USD₂₀₂₃ 10.8 million) from the France 2030 programme. Also in 2024, Thorizon formed a consortium with Demcon and VDL Group to establish an advanced testing facility for molten salt reactor technologies. The consortium submitted a matching grant application to the Dutch Province of Noord-Brabant in October 2024.

Supply chain

Thorizon, a spin-off of the Netherlands' national nuclear research institute NRG, is working with Tractebel for engineering services. Thorizon is part of two consortia: with Oakridge, Ecole Centrale Lille, Lille University, Orano, and France's Alternative Energies and Atomic Energy Commission (CEA) in France for research and development; and with Demcon and VDL Group in the Netherlands for manufacturability and safety analysis. Thorizon has also contracted Electricité de France (EDF) for neutronic core calculations and nuclear fuel cycle scenario analyses, and the Dutch Institute for Fundamental Energy Research (DIFFER) for corrosion studies. Thorizon was selected for a Project-Working Group under the European Industrial Alliance on SMRs.

Engagement

Thorizon has initiated engagement and outreach activities, including interviews with the Dutch news radio channel BNR, a video interview with the Energy Impact Center, and podcasts with Studio Energy. In 2023, Sander de Groot, Thorizon's co-founder and CTO, presented his project and vision to the Royal Netherlands Institute of Engineers.

Fuel

Thorizon plans to use a chloride molten fuel salt mixture of uranium, plutonium from spent nuclear fuel, and thorium. The fuel is contained in cartridges, separated from the molten salt coolant. Under the PROXIMA project, Thorizon is working with Orano to develop liquid molten-salt fuel and is part of a working group with Orano and two other fast spectrum molten-salt fuelled SMRs to develop a joint strategy for liquid molten-salt fuel supply, logistic and processing in France. Thorizon is a member of MIMOSA (Multi-recycling strategies of LWR SNF focusing on MOIten SAIt technology), an Orano-led consortium of 14 parties including EDF, Delft University and NRG, with a budget of EUR 5.75 million (USD₂₀₂₃ 6.6 million) from the Euratom HORIZON fund to work on recycling spent nuclear fuel.

Waarom willen provincies/gemeenten SMR's?

- Benutting warmte naast elektriciteitsproductie
- Geen extra windmolens, toch CO₂-vrije E-productie
- Kleinschalig
- Inherent veilig

Conclusies

- Veel SMR's groter dan Dodewaard (50 MWe)
- 74 serieuze ontwikkelingen van prototype (2025)
- Veelal verrijkt uranium als brandstof (HALEU)
- Nog niet te koop
- Serieproductie nog ver weg

- Thorium-reactor op z'n vroegst 2040, wordt nog nauwelijks ontwikkeld

Kernenergie

Waarom wel

- Minder regelbare centrales nodig
 - 25% ipv 30%
- Minder windenergie
- Kleine kans op ongelukken
- Kleinschalig mogelijk SMRs

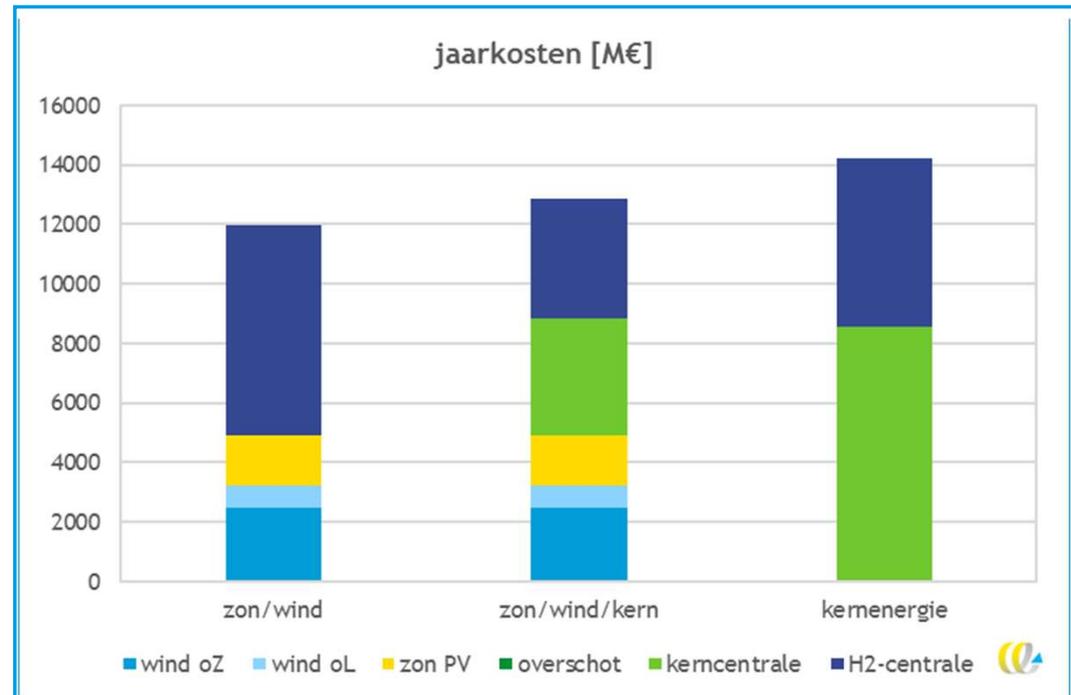
Waarom niet

- Meer mogelijkheden wind op zee
 - Daar verdient NL geld aan
- Geen eigen kernindustrie
 - Bouw door buitenlandse partij
 - Splijtstof is bijna volledig import EU
- Geen radio-actief afval
- Lagere kosten
- Kernenergie vergt garanties overheid
- Grote effecten bij ongeluk

Kosten van volledig CO₂-vrije elektriciteitsvoorziening

- Zon/wind/H₂
 - 70% Evraag door zon/wind,
 - 30% door H₂-centrales
 - 25 GW aan H₂-centrales, 49 TWh
 - Circa 9 €/kWh gemiddeld
- Kernenergie/H₂
 - 75% Evraag door kernenergie,
 - 25% door H₂
 - 15 GW H₂-centrales, 44 TWh
 - Circa 11 €/kWh gemiddeld

Onzekerheidsmarges!



Conclusies

- Ook kernenergie kan niet alleen de hele Elektriciteitsvraag dekken
- Andere momenten dan met zon/wind
- Zon/wind/H2
 - 70% Evraag door zon/wind, 30% door H2-centrales
- Kernenergie/H2
 - 75% Evraag door kernenergie, 25% door H2-centrales
- Kernenergie komt er alleen met actieve steun (subsidie, garantie) overheid
- Thorium-reactor is nog ver weg, op z'n vroegst 2040

Bedankt voor uw aandacht



Frans Rooijers

https://www.oecd-nea.org/jcms/pl_107879/nea-small-modular-reactor-digital-dashboard

wise

mee met de
energierevolutie

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