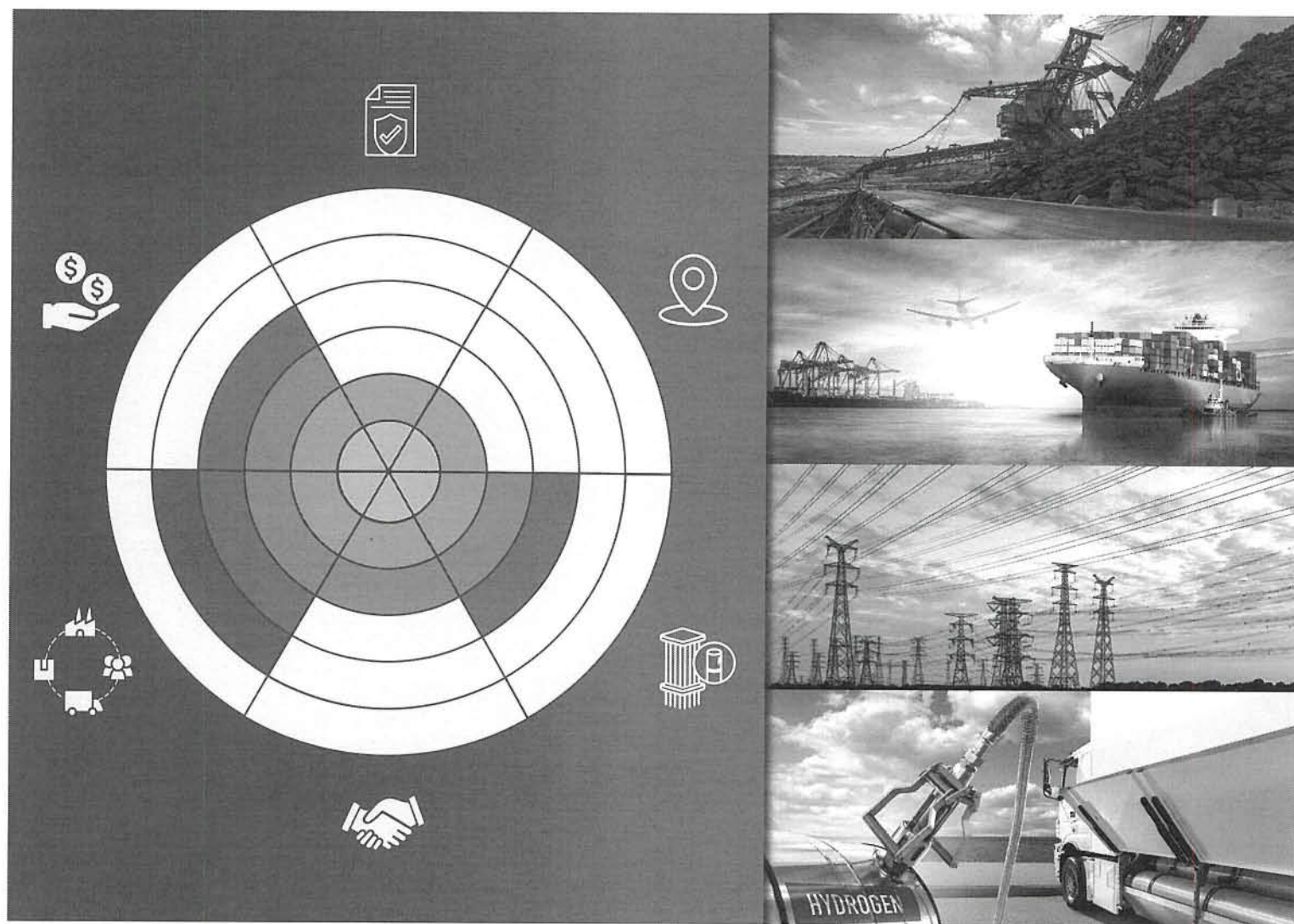


# The NEA Small Modular Reactor Dashboard: Second Edition



Nuclear Technology Development and Economics

# **The NEA Small Modular Reactor Dashboard: Second Edition**

© OECD 2024  
NEA No. 7671

NUCLEAR ENERGY AGENCY  
ORGANISATION FOR ECONOMIC CO-OPERATION AND DEVELOPMENT

## ORGANISATION FOR ECONOMIC CO-OPERATION AND DEVELOPMENT

The OECD is a unique forum where the governments of 38 democracies work together to address the economic, social and environmental challenges of globalisation. The OECD is also at the forefront of efforts to understand and to help governments respond to new developments and concerns, such as corporate governance, the information economy and the challenges of an ageing population. The Organisation provides a setting where governments can compare policy experiences, seek answers to common problems, identify good practice and work to co-ordinate domestic and international policies.

The OECD member countries are: Australia, Austria, Belgium, Canada, Chile, Colombia, Costa Rica, Czechia, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Israel, Italy, Japan, Korea, Latvia, Lithuania, Luxembourg, Mexico, the Netherlands, New Zealand, Norway, Poland, Portugal, the Slovak Republic, Slovenia, Spain, Sweden, Switzerland, Türkiye, the United Kingdom and the United States. The European Commission takes part in the work of the OECD.

OECD Publishing disseminates widely the results of the Organisation's statistics gathering and research on economic, social and environmental issues, as well as the conventions, guidelines and standards agreed by its members.

*This work is published under the responsibility of the Secretary-General of the OECD.  
The opinions expressed and arguments employed herein do not necessarily reflect the official  
views of the member countries of the OECD or its Nuclear Energy Agency.*

## NUCLEAR ENERGY AGENCY

The OECD Nuclear Energy Agency (NEA) was established on 1 February 1958. Current NEA membership consists of 34 countries: Argentina, Australia, Austria, Belgium, Bulgaria, Canada, Czechia, Denmark, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Japan, Korea, Luxembourg, Mexico, the Netherlands, Norway, Poland, Portugal, Romania, Russia (suspended), the Slovak Republic, Slovenia, Spain, Sweden, Switzerland, Türkiye, the United Kingdom and the United States. The European Commission and the International Atomic Energy Agency also take part in the work of the Agency.

The mission of the NEA is:

- to assist its member countries in maintaining and further developing, through international co-operation, the scientific, technological and legal bases required for a safe, environmentally sound and economical use of nuclear energy for peaceful purposes;
- to provide authoritative assessments and to forge common understandings on key issues as input to government decisions on nuclear energy policy and to broader OECD analyses in areas such as energy and the sustainable development of low-carbon economies.

Specific areas of competence of the NEA include the safety and regulation of nuclear activities, radioactive waste management and decommissioning, radiological protection, nuclear science, economic and technical analyses of the nuclear fuel cycle, nuclear law and liability, and public information. The NEA Data Bank provides nuclear data and computer program services for participating countries.

This document, as well as any data and map included herein, are without prejudice to the status of or sovereignty over any territory, to the delimitation of international frontiers and boundaries and to the name of any territory, city or area.

Corrigenda to OECD publications may be found online at: [www.oecd.org/about/publishing/corrigenda.htm](http://www.oecd.org/about/publishing/corrigenda.htm).

*Revised version, 5 March 2024.*

© OECD 2024

You can copy, download or print OECD content for your own use, and you can include excerpts from OECD publications, databases and multimedia products in your own documents, presentations, blogs, websites and teaching materials, provided that suitable acknowledgement of the OECD as source and copyright owner is given. All requests for public or commercial use and translation rights should be submitted to [neapub@oecd-nea.org](mailto:neapub@oecd-nea.org). Requests for permission to photocopy portions of this material for public or commercial use shall be addressed directly to the Copyright Clearance Center (CCC) at [info@copyright.com](mailto:info@copyright.com) or the Centre français d'exploitation du droit de copie (CFC) contact@[cfcopies.com](mailto:cfcopies.com).

*Cover photos: Mining (SvedOliver, Shutterstock); Transportation (Aun Photographer, Shutterstock); Highvoltage Power Lines (ABCDstock, Shutterstock); Hydrogen Filling Station (Scharfsinn, Shutterstock).*



# Table of contents

<b>Executive summary .....</b>	<b>11</b>
SMRs are part of nuclear energy's contribution to net zero energy systems by 2050 and beyond ....	12
SMRs are driving innovation in the nuclear sector .....	12
The <i>NEA SMR Dashboard</i> as a tool to track progress .....	12
Key insights into SMR deployment progress.....	13
Progress by region .....	14
Waste management.....	16
Future updates to the <i>NEA SMR Dashboard</i> .....	16
<b>Energy policy priorities: The role of nuclear energy and SMRs .....</b>	<b>17</b>
Existing nuclear power plants displace 1.6 gigatonnes of carbon emissions annually and contribute to energy security.....	17
Pathways to net zero require global installed nuclear capacity to triple by 2050 .....	17
Addressing the challenges faced by nuclear energy .....	19
The role of SMRs in pathways to net zero.....	20
<b>Potential benefits and attributes of SMRs .....</b>	<b>21</b>
Safety.....	21
Flexibility .....	21
Costs, competitiveness and economic benefits.....	22
Nuclear fuel and waste management .....	23
<b>Conditions for successful deployment of SMRs.....</b>	<b>27</b>
<b>Tracking progress of SMRs: From concept to first commercial deployment .....</b>	<b>29</b>
Licensing .....	29
Siting.....	30
Financing .....	31
Supply chain.....	31
Engagement .....	32
Fuel .....	33
<b>Key findings worldwide .....</b>	<b>35</b>
Global momentum for SMRs.....	35
Different SMRs for different applications .....	39
Overview of progress towards demonstration and commercialisation .....	46

<b>The NEA SMR Dashboard</b> .....	<b>65</b>
ARC Clean Technology – ARC-100.....	68
Blue Capsule Technology – Blue Capsule.....	70
Blykalla – SEALER-55 .....	72
BWX Technologies (BWXT) – BWXT Advanced Nuclear Reactor (BANR) .....	74
BWX Technologies (BWXT) – Project Pele.....	76
CGN (China General Nuclear Power Group) – ACPR50S.....	78
CNEA (Argentina’s National Atomic Energy Commission) – CAREM .....	80
CNNC (China National Nuclear Corporation) – ACP100 .....	82
CVŘ (Research Centre Řež) – Energy Well.....	84
Dual Fluid Energy – DF300.....	86
Eskom – A-HTR-100 .....	88
Flibe Energy – LFTR.....	90
Framatome – Steam Cycle High Temperature Gas-cooled Reactor (SC-HTGR).....	92
GE Hitachi Nuclear Energy – BWRX-300.....	94
Gorgé – Calogena .....	96
Hexana – HEXANA.....	98
Holtec International – SMR-300.....	100
INET (Tsinghua University Institute of Nuclear and New Energy Technology) – HTR-PM.....	102
JAEA (Japan Atomic Energy Agency) – GTHT300.....	104
JAEA (Japan Atomic Energy Agency) – HTTR.....	106
Jimmy – Jimmy SMR .....	108
KAERI (Korea Atomic Energy Research Institute) – SMART .....	110
Kairos Power – Hermes .....	112
Last Energy – PWR-20 .....	114
Moltex Energy – Stable Salt Reactor-Wasteburner (SSR-W).....	116
MoltexFLEX – FLEX .....	118
NAAREA – XAMR.....	120
NCBJ (National Centre for Nuclear Research) – HTGR-POLA .....	122
newcleo – LFR-AS-200.....	124
NIKIET (N.A. Dollezhal Research and Design Institute of Power Engineering) – BREST-OD-300 .....	126
NuScale Power – VOYGR.....	128
NUWARD – NUWARD SMR .....	130
Oklo – Aurora Powerhouse .....	132
Otrera Nuclear Energy – Otrera 300.....	134
Radiant Industries – Kaleidos .....	136
Rolls-Royce SMR – RR SMR.....	138
ROSATOM – KLT-40S .....	140
ROSATOM – RITM-200M .....	142

ROSATOM – RITM-200N .....	144
ROSATOM – RITM-200S .....	146
Seaborg Technologies – Compact Molten Salt Reactor (CMSR) .....	148
SPIC (State Power Investment Corporation) – HAPPY200 .....	150
Stratek Global – HTMR-100 .....	152
TerraPower – Sodium Reactor Plant .....	154
Terrestrial Energy – Integral Molten Salt Reactor (IMSR) .....	156
ThorCon International – ThorCon 500 .....	158
Thorizon – Thorizon One .....	160
Toshiba Energy Systems & Solutions Corporation – MovelluX .....	162
Toshiba Energy Systems & Solutions Corporation – 4S .....	164
Ultra Safe Nuclear Corporation (USNC) – Micro-Modular Reactor (MMR) .....	166
Ultra Safe Nuclear Corporation (USNC) – Pylon D1 .....	168
UWB and CIIRC CTU (University of West Bohemia and Czech Technical University in Prague) – TEPLATOR .....	170
Westinghouse Electric Company – AP300™ SMR .....	172
Westinghouse Electric Company – eVinci microreactor .....	174
Westinghouse Electric Company – Westinghouse LFR .....	176
X-energy – Xe-100 .....	178
<b>Annex 1. The NEA SMR Dashboard assessment criteria definitions .....</b>	<b>181</b>
<b>References .....</b>	<b>183</b>

### List of figures

1. Count of SMRs identified worldwide .....	11
2. SMR pipeline: Progress from concept towards first commercial deployment .....	13
3. Siting progress by country .....	14
4. Types of site owners for SMRs selected for deployment, under construction or already operating .....	15
5. SMR uranium enrichment requirements .....	15
6. Full potential of nuclear contributions to net zero .....	18
7. Windows of opportunity for SMRs to support net zero objectives .....	20
8. Key economic drivers to compensate for diseconomies of scale .....	23
9. Enabling conditions connecting SMR technology push to market pull .....	27
10. Tracking progress in licensing .....	30
11. Tracking progress in siting .....	30
12. Tracking progress in financing .....	31
13. Tracking progress in supply chain readiness .....	32



14. Tracking progress in engagement .....	32
15. Tracking progress in fuel availability.....	33
16. Locations of SMR designer headquarters by region .....	35
17. Global map of SMR sites.....	36
18. Global map of SMR designer headquarters .....	38
19. Reactor concepts.....	39
20. Reactor configurations .....	40
21. SMRs: Range of sizes and temperatures for heat applications.....	41
22. SMRs: Range of sizes and uranium enrichment requirements.....	42
23. Examples of sites of near-term emerging markets for SMRs .....	44
24. Count of SMRs identified worldwide .....	46
25. SMR pipeline: Progress from concept towards first commercial deployment.....	46
26. Licensing progress worldwide.....	47
27. Count of SMRs in pre-licensing or licensing activities with nuclear safety regulators, by country.....	48
28. Licensing progress by SMR concept.....	49
29. Licensing progress by SMR configuration .....	49
30. Siting progress worldwide.....	50
31. Siting progress by country.....	51
32. Types of site owners for SMRs selected for deployment, under construction, or already operating .....	52
33. Financing progress worldwide .....	53
34. Supply chain progress worldwide.....	54
35. Supply chain progress by SMR concept.....	55
36. Supply chain progress by SMR configuration.....	56
37. Engagement progress worldwide .....	57
38. Fuel progress worldwide.....	59
39. Fuel progress by SMR concept.....	60
40. Fuel progress by SMR configuration .....	60
41. SMR fuel types.....	61
42. SMR uranium enrichment requirements .....	62

#### List of tables

1. Projected contributions of nuclear energy to cumulative emissions reductions (2020-2050) ....	19
2. Flexibility attributes and potential benefits of SMRs.....	22
3. Examples of near-term demand for SMRs in emerging markets .....	45
4. Licensing progress, detailed .....	47
5. Siting progress, detailed .....	50
6. Financing progress, detailed.....	53
7. Supply chain progress, detailed .....	55
8. Engagement progress, detailed.....	57
9. Fuel progress, detailed .....	59
10. Full list of SMRs assessed in the second edition of the <i>NEA SMR Dashboard</i> .....	65

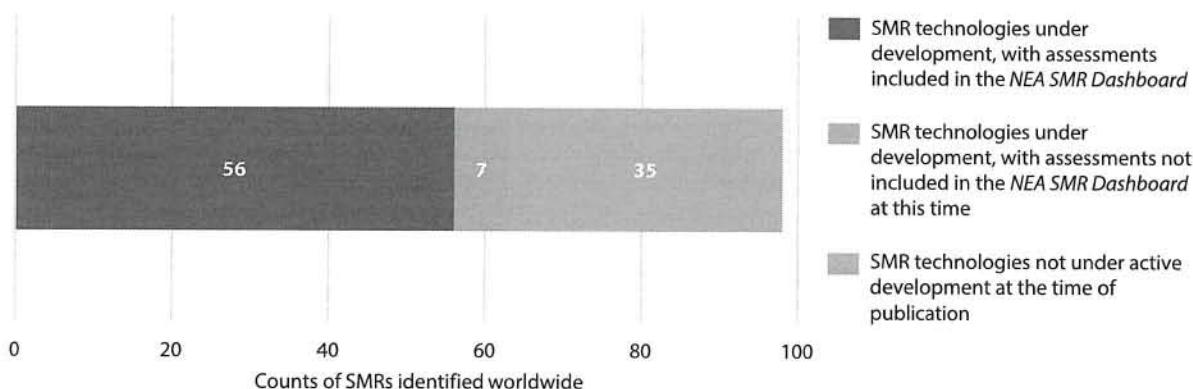
## Executive summary

Small modular reactors (SMRs) are technologies capable of harnessing the energy from nuclear fission reactions to produce heat and electricity with power outputs typically smaller than 300 MWe, with some as small as 1-10 MWe. SMRs are designed for modular manufacturing, factory production, portability and scalability. They also come in a variety of configurations and temperature ranges to create heat that can be used directly, or to generate electricity to decarbonise hard-to-abate sectors. The combination of these innovations presents additional potential benefits in terms of safety, operational and deployment flexibility, economics, as well as potentially spent fuel and waste management.

The second edition of the *NEA SMR Dashboard* provides a comprehensive assessment of the progress made by SMR designers and companies worldwide. Looking beyond technical feasibility, the *NEA SMR Dashboard* assesses progress towards first-of-a-kind commercial deployment across six dimensions: licensing, siting, financing, supply chain, engagement and fuel. The *NEA SMR Dashboard* reveals substantial progress towards SMR deployment and commercialisation in NEA and non-NEA member countries, with a subset of designs in more advanced stages of commercialisation and deployment.

The first edition of the *NEA SMR Dashboard* tracked the progress of 42 SMRs worldwide and was published in two volumes. Volume I of the *NEA SMR Dashboard* was launched during the US Nuclear Regulatory Commission's (NRC) 36<sup>th</sup> Regulatory Information Conference on 13 March 2023. Volume II was published in July 2023 during the 14<sup>th</sup> Clean Energy Ministerial in Goa, India, on 19 July 2023.

Figure 1. Count of SMRs identified worldwide



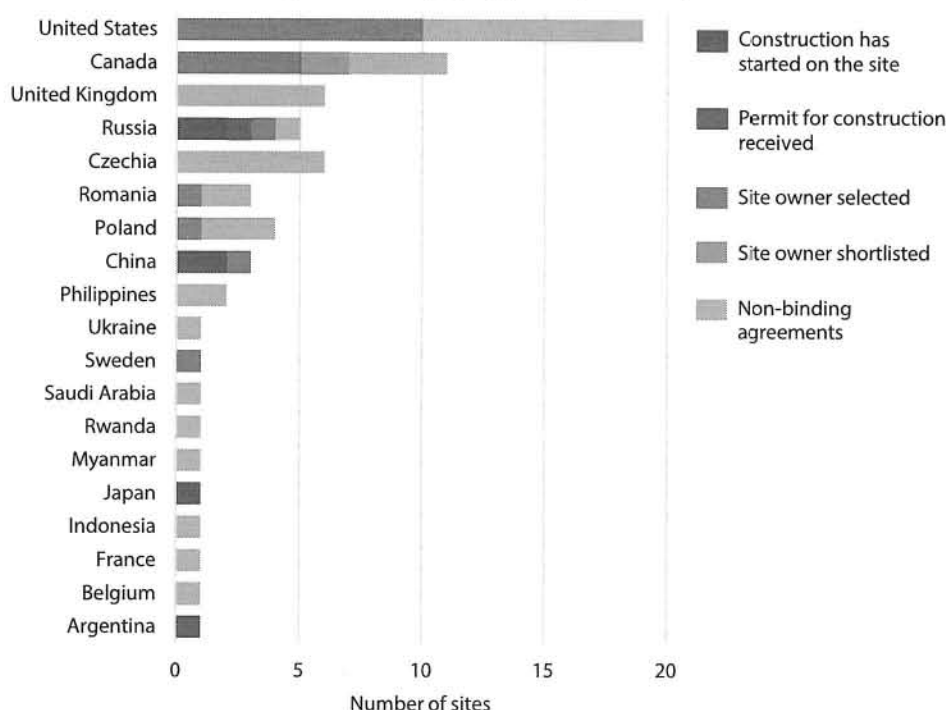
For this second edition of the *NEA SMR Dashboard*, the NEA's comprehensive global review identified 98 SMR technologies around the world. Fifty-six SMRs are included in this complete edition of the *NEA SMR Dashboard*; these are the SMRs for which the requisite publicly available information was assessable and for which the relevant designers were willing to participate. The other 42 include approximately 7 that are under development but requested not to be included in the *SMR Dashboard* at this time but may be included in the future; the remainder include SMR technologies that are not under active development, may be without human or financial resources, or have been cancelled or paused indefinitely. The assessments in this edition of the *SMR Dashboard* are based on progress up to a cutoff date of 10 November 2023.



### Progress by region

Initial findings show that Russia and China are leading on first-of-a-kind deployment, but rapid and real progress is underway in North America and Europe. To date, there are already SMRs deployed and operating in Russia and China as well as one test reactor in Japan. SMRs are under construction in Russia, China and Argentina. Three additional SMR designs have received regulatory approval: VOYGR by NuScale in the United States, SMART by KAERI in Korea and Hermes by Kairos Power in the United States. North America and Europe are home to the headquarters of many SMR designers. The United States is home to the largest number of SMR design organisations, with nearly 35% of the field. The *NEA SMR Dashboard* also reveals significant progress on siting, with SMRs operating and/or under construction in Russia, China, Japan and Argentina, and a large number of earlier stage siting discussions and negotiations advancing in North America and Europe.

Figure 3. **Siting progress by country**



### Different markets, financing strategies and business models are emerging

Different markets, financing strategies and business models are emerging (Figure 4). A number of SMR projects are located on government-owned land, particularly at national laboratories. This underscores governmental support for the initial demonstration projects. Utilities have also selected several designs for on-grid applications, notably existing nuclear or coal sites, which present opportunities to leverage existing infrastructures while securing reliable low-carbon generation and local economic benefits. Additionally, an increasing number of site owners are from industrial sectors, such as mining and chemicals, which confirms the growing recognition of the potential of SMRs in hard-to-abate industrial sectors.

To a large extent, SMR developers rely on public-private partnerships to bring their projects to fruition. Private finance plays a sizeable role, with public efforts devoted primarily to supporting research and development activities and to de-risking first-of-a-kind demonstration plans. Within private financing, venture capital also plays a role, particularly for SMR designs at lower technology readiness levels.