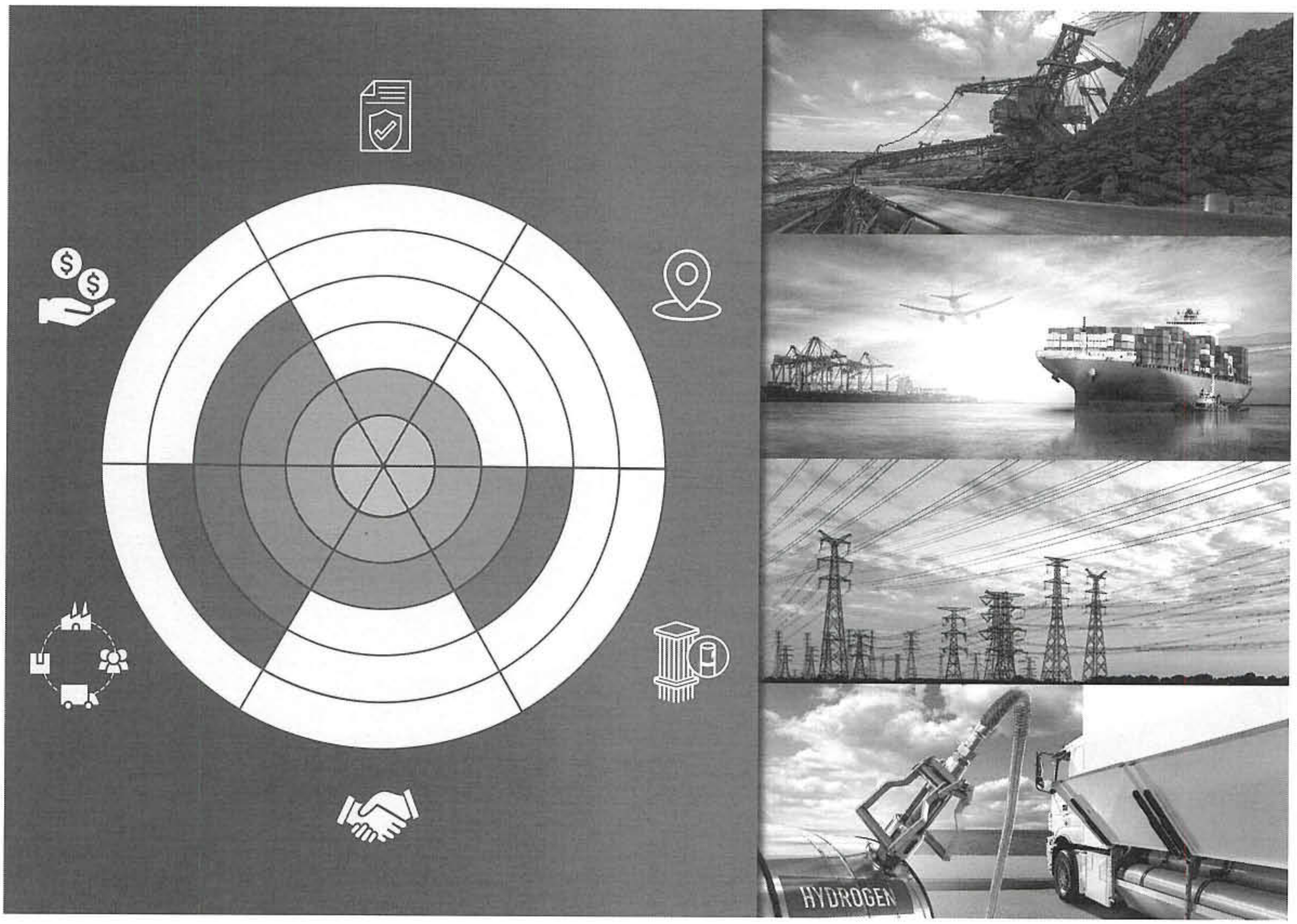
The NEA Small Modular Reactor Dashboard: Second Edition



OECD
BETTER POLICIES FOR BETTER LIVES

NEA
NUCLEAR ENERGY AGENCY

Nuclear Technology Development and Economics

The NEA Small Modular Reactor Dashboard: Second Edition

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.

Revised version, 5 March 2024.

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

Table of contents

List of figures

List of tables

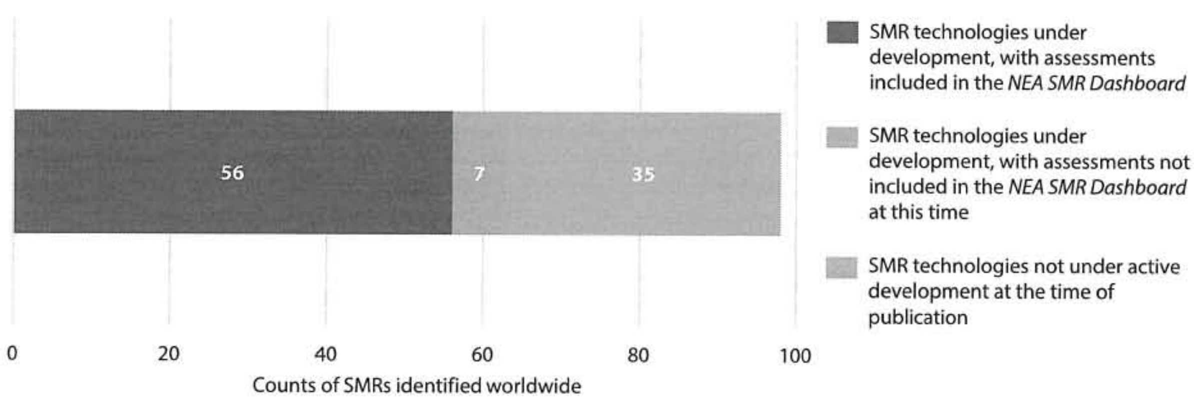
Executive summary

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) 36th Regulatory Information Conference on 13 March 2023. Volume II was published in July 2023 during the 14th Clean Energy Ministerial in Goa, India, on 19 July 2023.

Figure 1. **Count of SMRs identified worldwide**



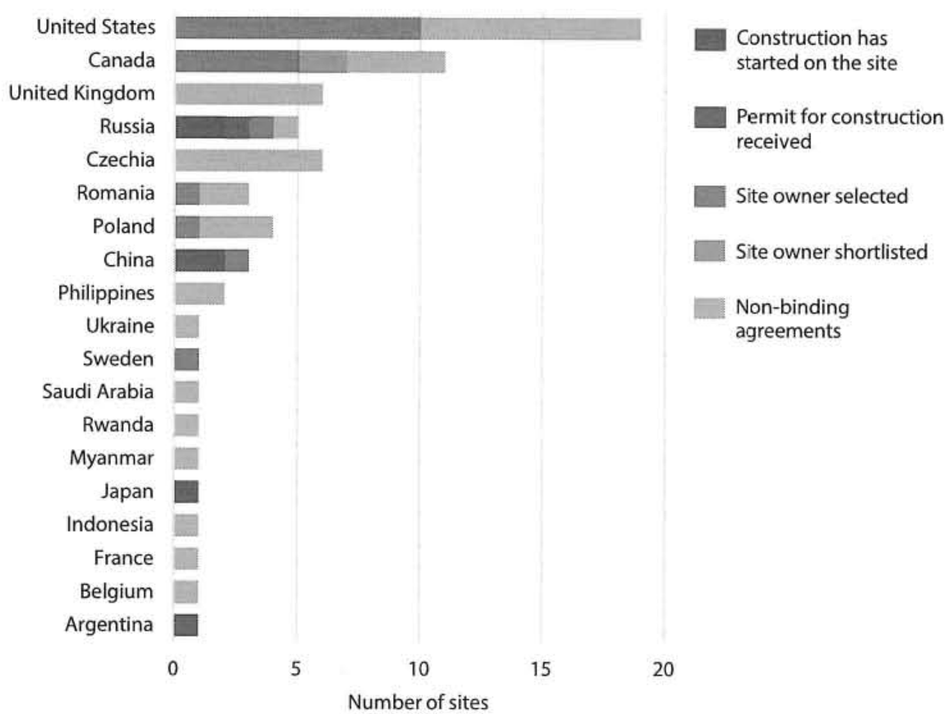
For this second edition of the *NEA SMR Dashboard*, the NEA's comprehensive global review identified 98 SMR technologies around the world. Fifty-six SMRs are included in this complete edition of the *NEA SMR Dashboard*; these are the SMRs for which the requisite publicly available information was assessable 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.