

SMR: A New Nuclear Energy Paradigm

How the IAEA is supporting creation of an enabling environment for technology development and deployment

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Chair of the SRM Platform Implementation Team

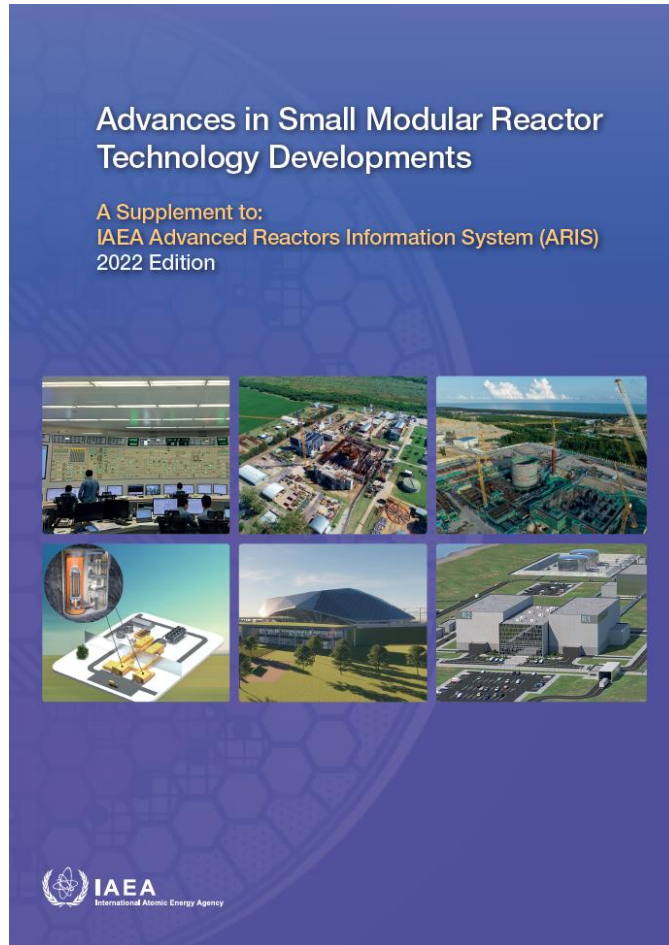
Department of Nuclear Energy

Outline



- Status of SMR Development and Deployment
- IAEA Activities on SMRs
- IAEA Platform on SMRs and their Applications
- Nuclear Harmonization and Standardization Initiative
- First IAEA International Conference on SMRs and their Applications

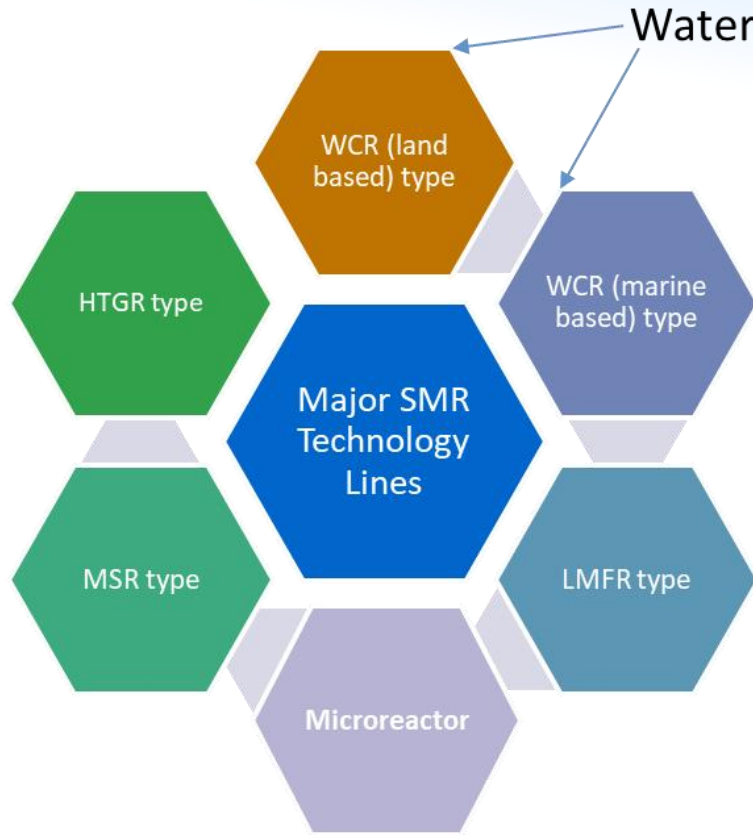
IAEA ARIS SMR Booklet 2022



IAEA SMR Booklet, 2022 Edition	
Number of reactor designs:	83
Member states involved:	18
Reactor types	<ol style="list-style-type: none"> 1.1. Water-cooled Land Based – 25 1.2. Water-cooled Marine Based – 8 2. High temperature Gas-cooled – 17, including 3 HTGR-type test reactors 3. Liquid Metal-cooled Fast Neutron Spectrum – 8 4. Molten Salt – 13 5. Microreactors – 12
Distinguishing features	<ul style="list-style-type: none"> • Annexes on economics, non-electric applications, experiments for design validation, fuel cycle and waste management • Insightful annexes with various charts and tables
Status	Finished, submitted for publication.
Downloadable version	Coming soon.

The 2022 IAEA SMR ARIS Booklet is a biennial publication as a supplement to the IAEA Advanced Reactor Information System (ARIS) Database. It provides a brief yet comprehensive design description of 83 different reactor designs. The 2022 version is an updated version of the 2020 booklet. It includes 11 more designs and a more comprehensive set of annexes.

Major SMR Technology Lines



Microreactor (U.S. DOE Glossary)

Compact reactors that will be small enough to transport by truck and could help solve energy challenges in a number of areas. They are capable of producing 1-20 Megawatts of thermal energy used directly as heat or converted to electric power.

Ref. [What is a Nuclear Microreactor?](#) | Department of Energy

Other Descriptions of Microreactor

- 1) **A subset of small modular reactors** of 1-20 MWe capacity;
- 2) Advanced reactors of power up to 10MWe, **with common features** including modularity, passive safety, flexibility, simpler designs, more factory-based manufacturing possibilities, reduced site construction time and easier and more cost-effective reproduction, etc.

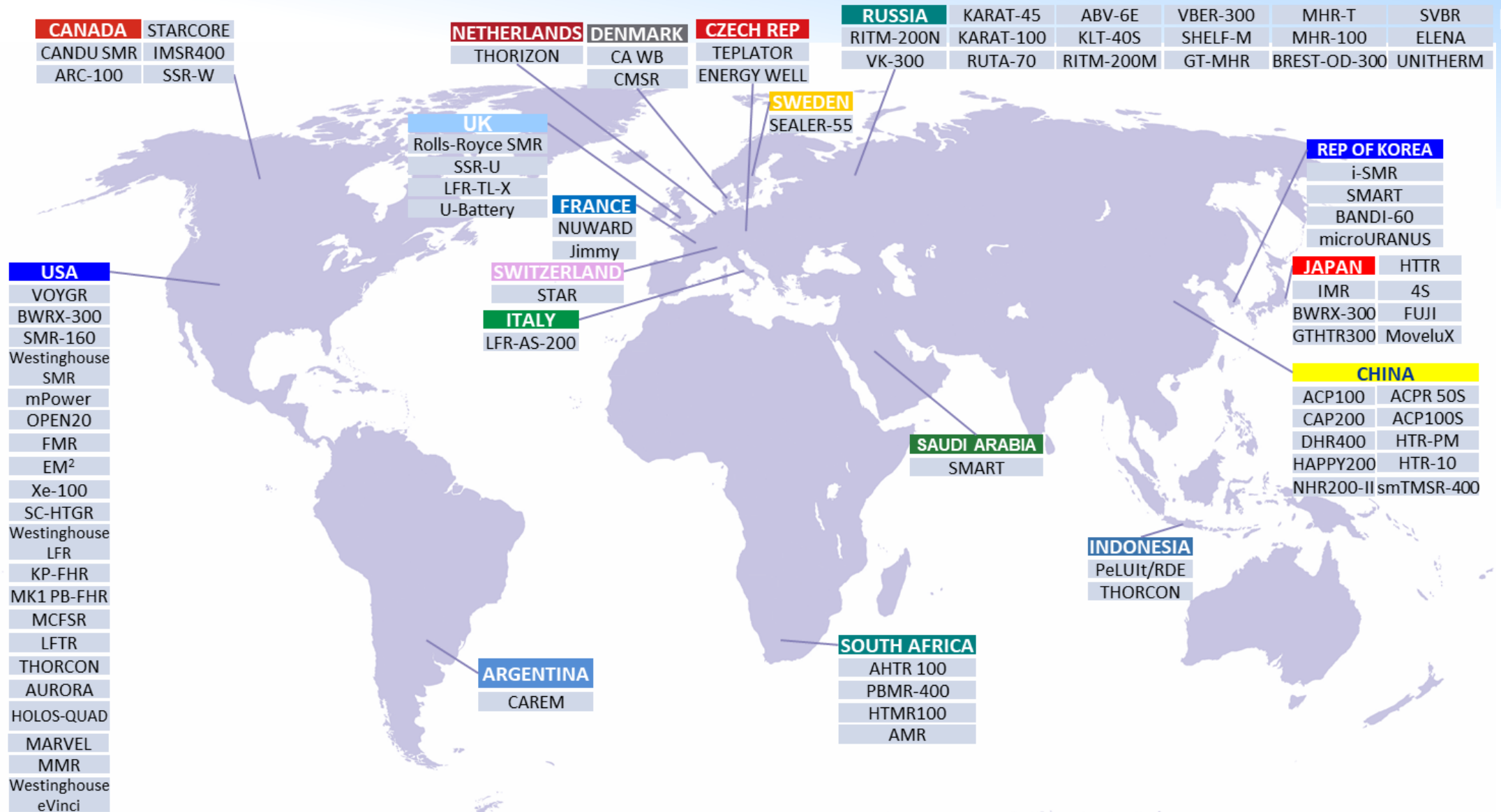


Notes: Commonly seen but lacking consensus.

Global Map of SMR Technology Development



IAEA



Major Technology Developers

European Union, United Kingdom and Russian Federation



Logos include: Rolls Royce, EDF, CEA, TechnicAtome, CVR, NAVAL GROUP, SEABORG, OKBM AFRIKANTOV, NATIONAL RESEARCH CENTER "KURCHATOV INSTITUTE", LEADCOLD, OKB «GIDROPRESS», URENCO, newcleo, UNIVERSITY OF WEST BOHEMIA, copenhagen atomics, THORIZON, moltex energy, STAR ENERGY, CTU, CZECH INSTITUTE OF INFORMATICS, ROBOTICS AND CYBERNETICS.

Asia



Logos include: ENNE, 서울대학교 (Seoul National University), CGN, SINAP, Tsinghua University, ThorCon, 中国科学院 (Chinese Academy of Sciences), JAEA, 国家电投 (SPIC), KHNPP, HITACHI, 한국전력공사 (Korea Electric Power Corporation), NFI Nuclear Fuel Industries, Ltd., KAWASAKI HEAVY INDUSTRIES, LTD., KAERI Korea Atomic Energy Research Institute, ITMSE, UNIST (Ulsan National Institute of Science and Technology), TOSHIBA, MITSUBISHI HEAVY INDUSTRIES, batan.

Africa



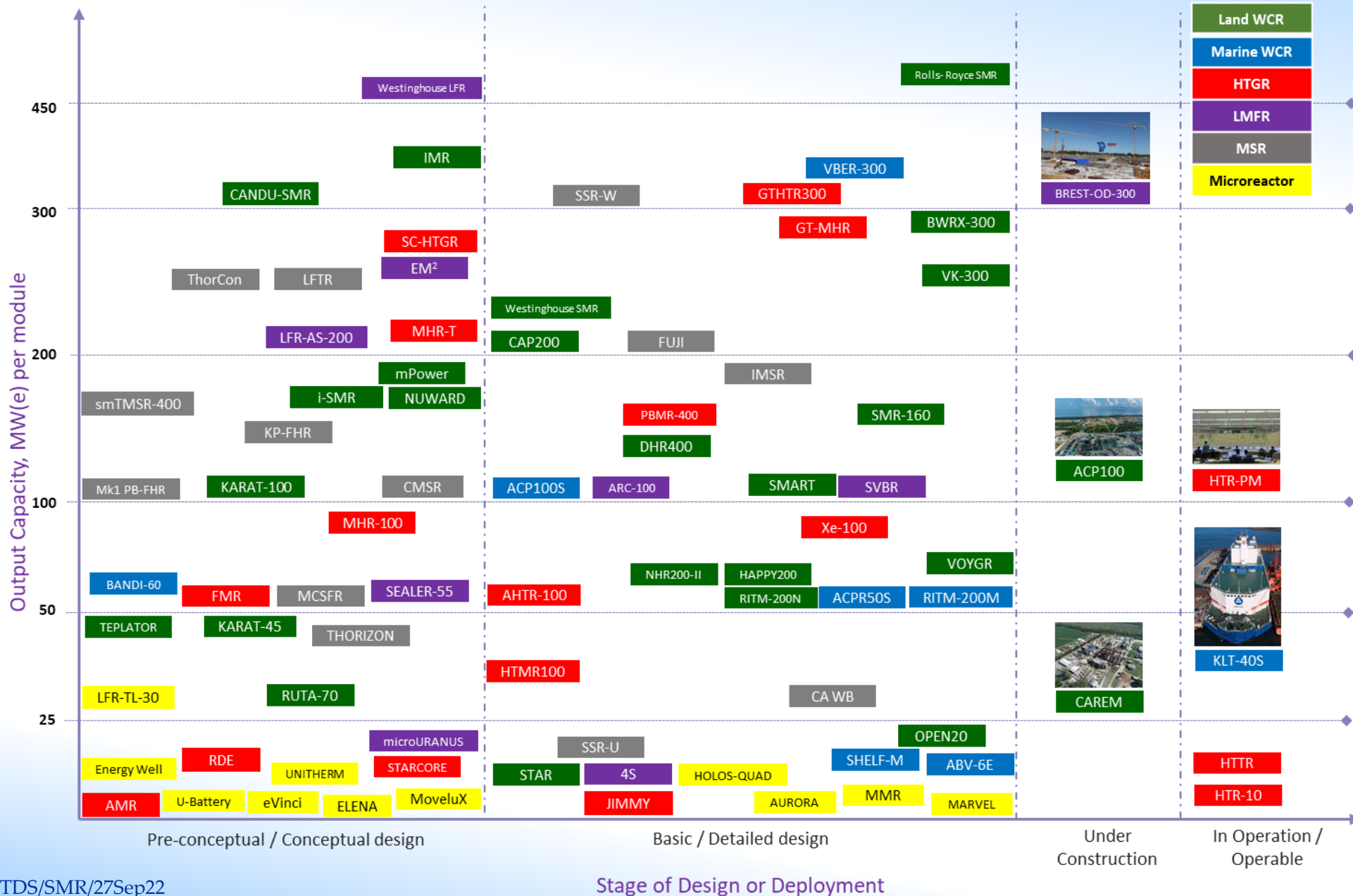
Logos include: P B M R, Eskom, STEENKAMPSTRAL THORIUM (STL NUCLEAR IPTY) LTD.

North America, Latin America



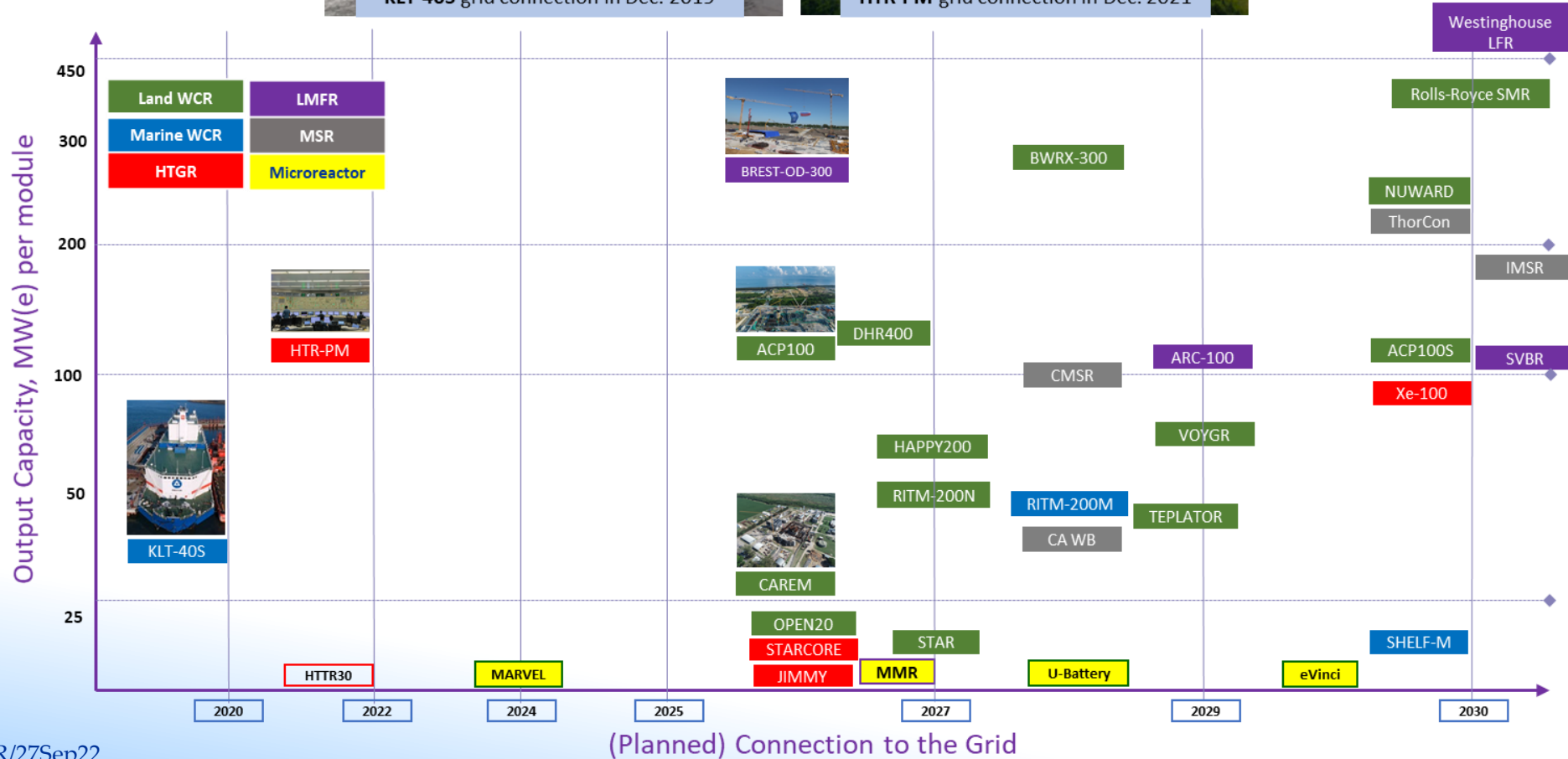
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Stage of Development and Deployment of SMRs



Status and Near-Term Prospect Deployment

The Forerunners: 2 in operation, 3 under construction. More target at deployment by 2030



IAEA Activities on SMRs

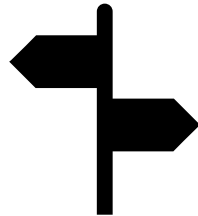
Technology Development and Deployment

- TWG-SMR/GCR
- ARIS Database
- SMR Booklet



Technology Roadmaps

- 'Model' technology roadmaps for specific SMR projects
- Hybrid Energy Systems with SMRs
- Hydrogen production using SMR



Economics

- Economic Appraisal of SMR Projects: Methodologies and Applications



Safeguards-by-Design

- Incorporate facilitation of safeguards inspection early in reactor design stage



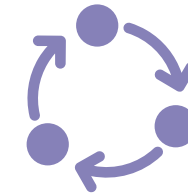
Infrastructure Development

- The IAEA Milestones Approach applicable to SMR
- Integrated Work Plan for Embarking Countries



Safety & Security

- SMR Regulators' Forum
- Applicability of the IAEA Safety Standards & Security Guides



Industrial Harmonization and Standardization

- Generic User Requirements and Criteria
- Industrial Codes & Standards



Reactor Technology Assessment

- Updated Method incorporates SMR



Integrated Approach & Consistency



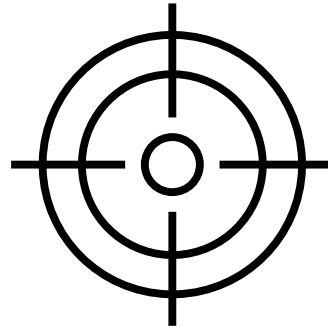
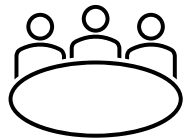
- Already large number of activities on SMR and related applications in 4 Departments (NE, NS, TC, SG)
- Member States request for consistent, coordinated and optimized Agency support for SMR development & deployment
- DG Grossi
“Small Modular Reactors (SMR) as an innovation of particular interest to low and middle-income countries, as they have the potential to become a more affordable and more flexible option for communities and industries with smaller grids. **The IAEA has recently kicked off an initiative to provide national governments, experts and regulators with integrated Agency-wide support on all aspects of SMR development, deployment and oversight**”

Agency-wide Platform on SMRs and their Applications

Objective: Provide national governments, experts and regulators with integrated Agency-wide support on all aspects of SMR development, deployment and oversight

What?

IAEA's internal governance to coordinate activities consistently with MSs needs and requests
Single access point for MSs and stakeholders



How?



- Develop medium-term strategy on SMR and its applications
- Create enabling environment and a **portal to enhance internal as well as external communication**

Why?

- Member States request for consistent, coordinated and optimized Agency support
- Effective and efficient support to Member States, International Organizations and stakeholders willing to cooperate with the IAEA



Main Tasks

- Developing and periodically reviewing the **strategy** for Agency support to Member States for the timely development and deployment of SMRs and their applications
- Review and identify ways to **ensure the consistency, coordination, and optimization** of the Agency's programmatic activities on SMRs and their applications
- **Review requests submitted to the IAEA by Member States** and international organizations in the area of SMRs and related applications and identify the best approaches and mechanisms to address them in a consistent and coordinated manner
- **Ensure coordination of efforts** to facilitate international cooperation between the Agency and nuclear and non-nuclear organizations



- SMR Portal:

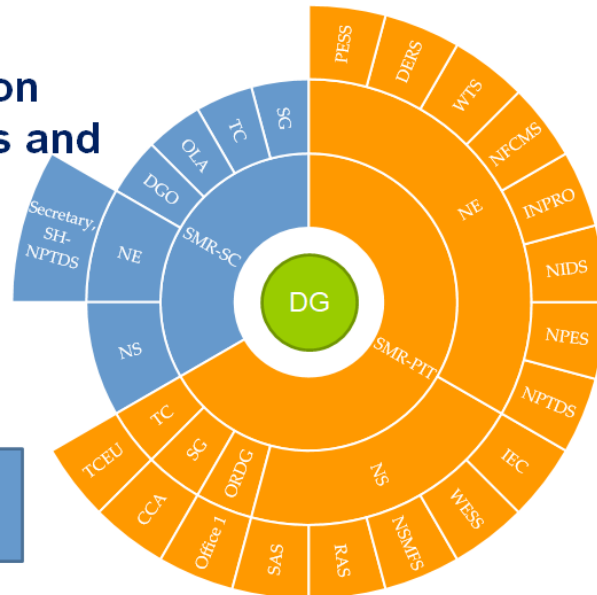
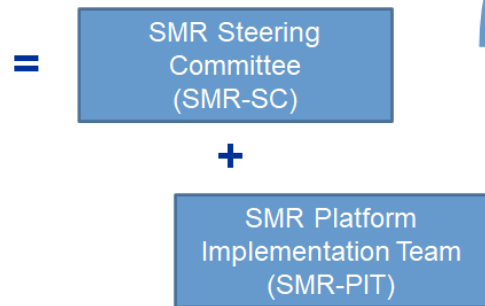
SCORPION

SMR Coordination and Resource Portal for Information Exchange, Outreach and Networking (SCORPION)

- Provides Member States with a **comprehensive and systematic overview of all the Agency's services and activities** on SMRs and their applications.
- Serves as an internal collaboration tool as well as a means of sharing information and data with external stakeholders.

Mechanism of Work

Agency-wide Platform on Small Modular Reactors and their Applications



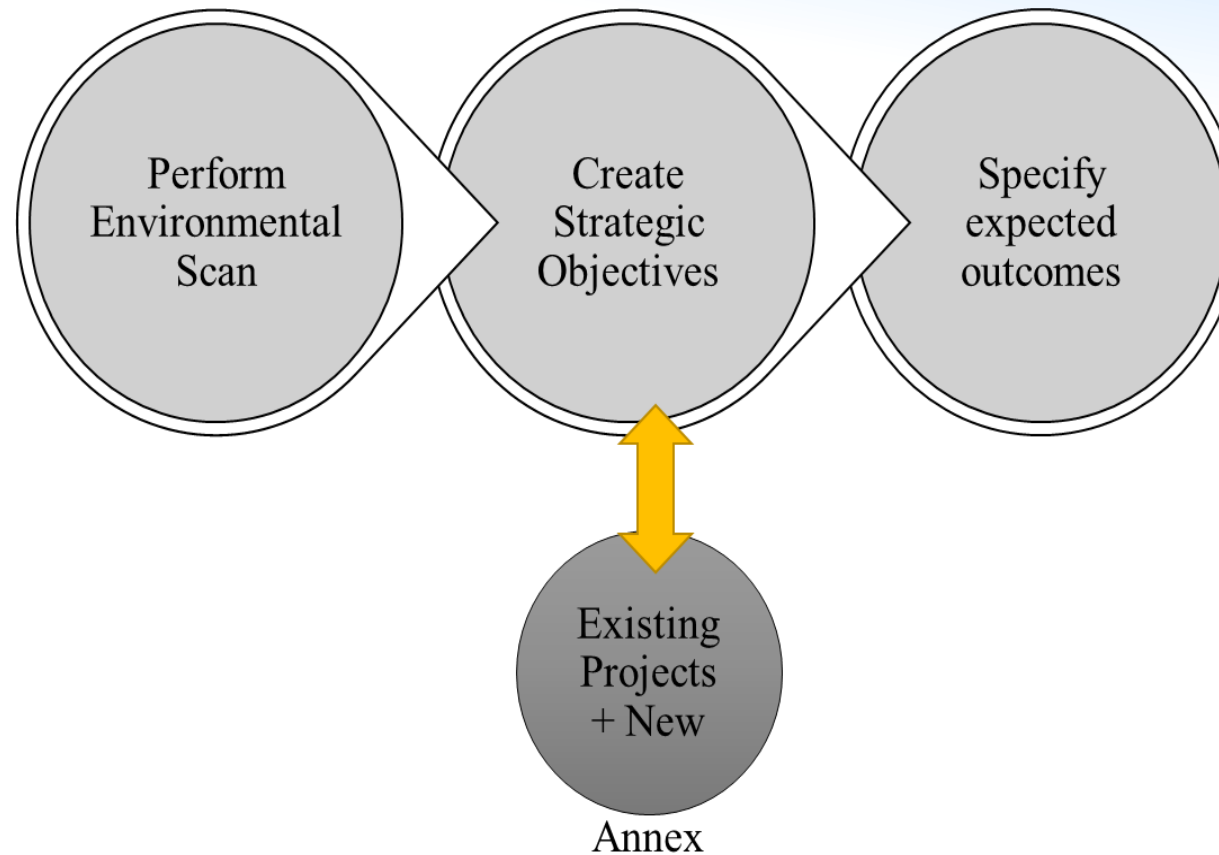
SMR- Steering Committee

- 7 Regular Members + 1 Observer (DGO) + 1 Scientific Secretary (PIT Chair)
- Chaired by DDG-NE
- Members appointed by DDsG (at director level)
- Meet every quarter or when necessary

SMR Platform Implementation Team

- Section Head from each relevant section/division and ORDG
- Chaired by NPTDS – SH
- Members Nominated by DDsG
- Works through plenary + *ad-hoc thematic task forces (TFs)*
- Members of TFs are subject matter experts
- Meet every month

Medium Term Strategy



Identification of strategic objectives

The Agency's Strategic Objectives



Strategic Objectives

1. Support Member States to become knowledgeable customers and make an informed decision on whether to embark on or expand nuclear power based on SMRs
2. Support industrial preparedness for Small Modular Reactors and their applications, including related fuel cycles
3. Promote, support, and develop research and innovation
4. Supporting establishment of institutional, legal, and regulatory frameworks for the safe and secure deployment, operation, closure, and decommissioning of SMRs, including the management of spent fuel and waste
5. Prepare effective and efficient Agency safeguards
6. Support international cooperation on SMRs
7. Provide effective knowledge/technology transfer through technical cooperation

SMR Portal SCORPION



SharePoint



CARTAS, Andrew Robert



The Platform on Small Modular Reactors and their Applications

Services Resources News Events Working Groups Contact Us Help Edit

Share site

Welcome to the Portal of the IAEA Platform on Small Modular Reactors and their Applications

Announcement! [SMR Platform Annual Report](#) and [IAEA Mediumterm Strategy on SMRs](#) are just published

The IAEA Platform on Small Modular Reactors (SMRs) and their Applications (SMR Platform) coordinates the Agency's activities in this field and provides a 'one-stop shop' for Member States and other stakeholders. The SMR Platform offers expertise from the entire Agency, encompassing all aspects relevant to the development, early deployment, and oversight of SMRs and their applications.

Within the SMR Platform, the IAEA has developed the [SMR Coordination and Resource Portal for Information Exchange, Outreach and Networking \(SCORPION\)](#), to provide an overview of all Agency resources, service and activities on SMRs and their applications, facilitating exchange of information and experience among Member States.

Member States can request assistance on general issues related to SMRs and their applications through official channels, addressing their request to the Chair of the Steering Committee of the Platform, IAEA Deputy Director General and Head of the Department of Nuclear Energy. Once received, the request will be managed by the SMR Platform's Steering Committee and Implementation team, where Agency-wide follow up response and activities will be planned and implemented. The SMR Platform enables the IAEA to handle Member States' requests in an effective and efficient manner, providing comprehensive support.



Latest SMR News



SEE ALL

<https://smr.iaea.org>

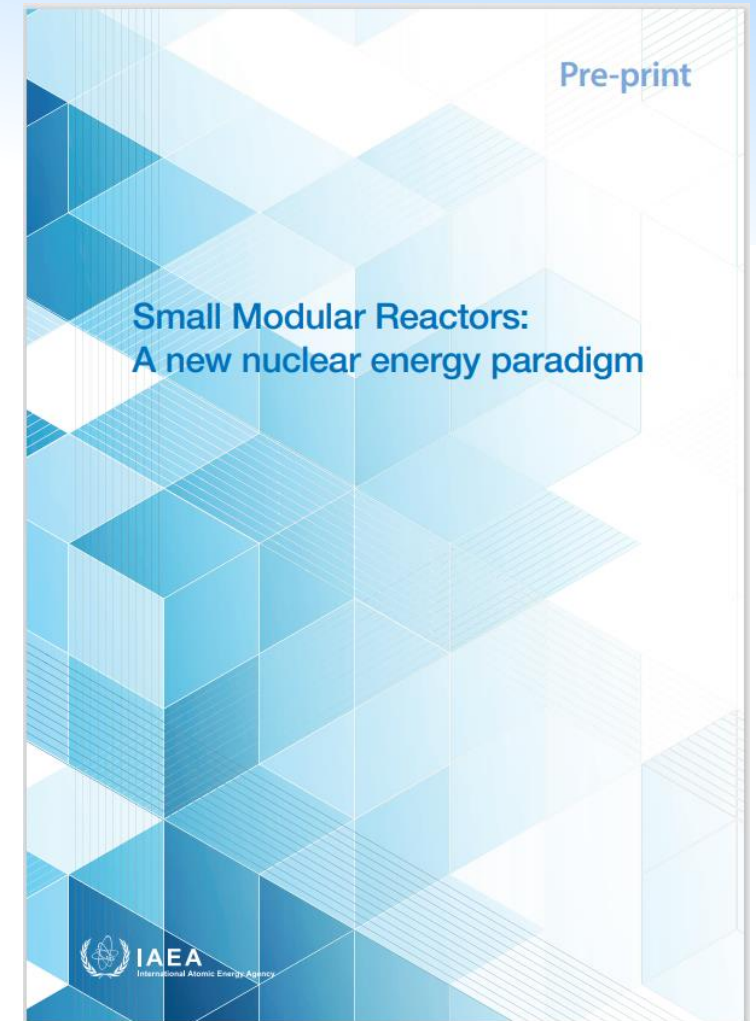
High Level SMR Booklet

SMRs: A new nuclear energy paradigm

- Chapter 1: SMRs and What They Can Offer – Understanding Technological and Global Perspectives
- Chapter 2: Success – what will it look like?
- Chapter 3: What's Next for SMRs?
- Chapter 4: IAEA Agency-Wide Support and Services

Target audience:

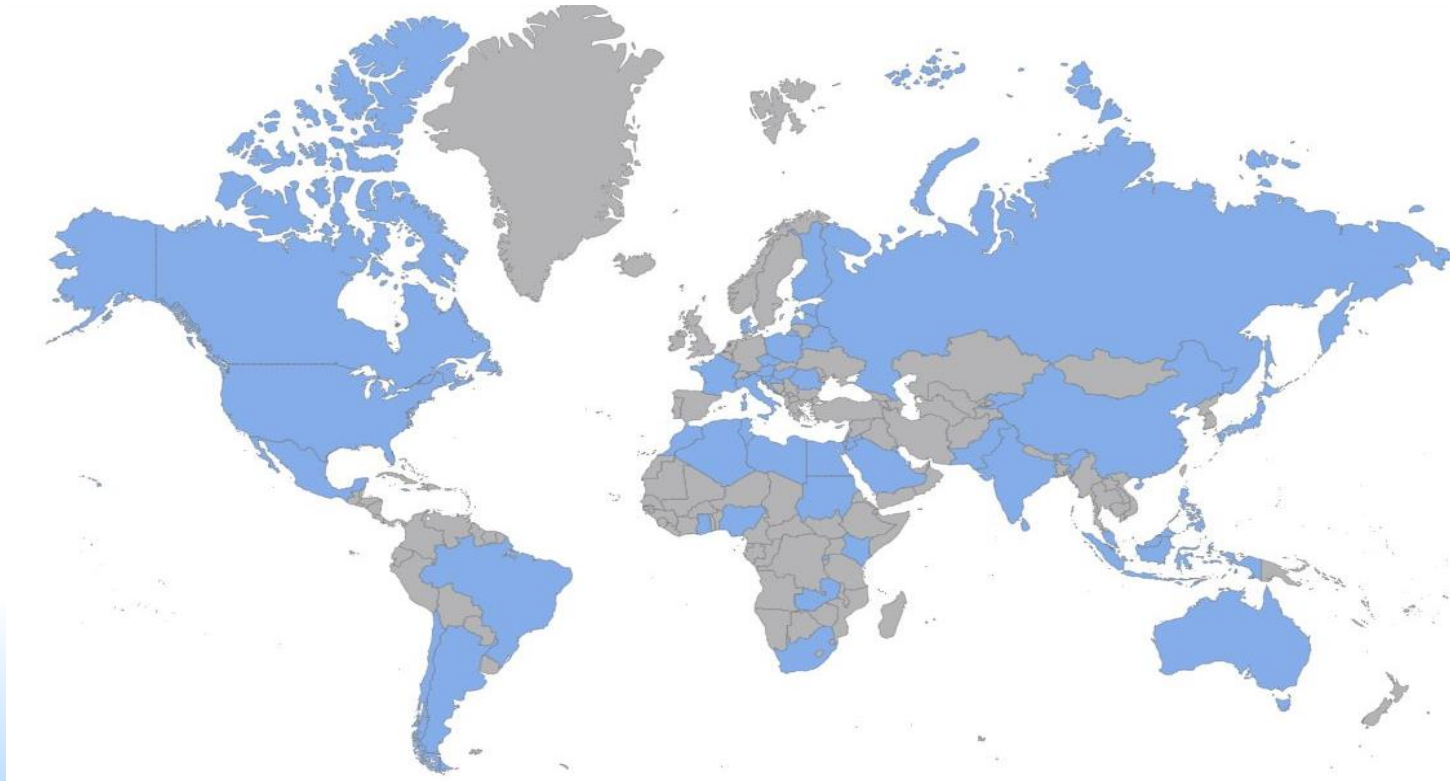
- ✓ Primarily policymakers and government officials interested in SMRs, not targeted towards subject matter experts
- ✓ MSs interested in SMRs may be technology providers, potential customers, both new and expanding countries, or just interested to understand better challenges and opportunities offered by SMRs and their applications in view of possible inclusion in their energy mix



It is now on the SMR Portal

New TC Interregional Project

**Supporting Member States' Capacity Building on
Small Modular Reactors and Microreactors and their Technology and
Applications – A Contribution of Nuclear Power to
the Mitigation of Climate Change
Period: 2022 – 2025**



TC-INT Activities completed to date



- Interregional Training Course on Understanding the Physics and Technology of Small Modular Reactors (iPWR design) using IAEA's educational Simulator 05 – 08 July 2022, Vienna
- Workshop on Economic Competitiveness, Marketability, and Bankability of Micro and Small Modular Reactor Technologies, August 15-18, 2022, Vienna

SMR Platform Brochure



IAEA Platform on Small Modular Reactors and their Applications

The Agency-wide Platform on SMRs and their Applications was established in April 2021 to provide a "one-stop shop" for Member States.



Why?

Member States are asking for the Agency's consistent and coordinated support related to all aspects of Small Modular Reactors (SMR) development, deployment, and oversight. So far, over 40 Member States have expressed interest in the technology.

The Standing Advisory Group for Nuclear Energy and the Commission of Safety Standards have also stated that concerted and coordinated action by the entire Agency is necessary to provide effective and efficient support to Member States and stakeholders interested in the early deployment of SMRs and their related electric and non-electric applications.

To respond to such requests, the Agency engaged in a comprehensive and holistic effort to establish an Agency-wide Platform on SMRs and their Applications. The Platform aims at supporting Member States in the early deployment of SMRs, including in accelerating their technology development, readiness level, and demonstration, showcasing their competitiveness against other clean energy technologies. At the same time, the Platform ensures that high standards of safety, security, and safeguards are considered at all stages.

What is the Agency-wide Platform on SMRs and their Applications?

The Agency-wide Platform on SMRs and their Applications was established in April 2021 by the IAEA Director General with the purpose of coordinating the Agency's activities on SMR and their applications and providing a "one-stop shop" for Member States and stakeholders. Comprising of a high-level Steering Committee and a Platform Implementation Team, the Platform involves all relevant IAEA's Departments and Offices Reporting to the Director General. It includes expertise from the entire Agency, encompassing all aspects relevant to the development, early deployment, and oversight of SMRs and their applications.

The Platform enables the IAEA to handle Member States' requests in an effective and efficient manner, providing comprehensive expertise, while ensuring necessary managerial and expert support.

Platform Organization



Governance of the Agency-wide Platform on SMRs and their Applications

The **SMR Steering Committee** is the senior governing body chaired by Deputy Director General and Head of the Department of Nuclear Energy and comprises of Directors from relevant Departments and Offices Reporting to the Director General.

The **SMR Platform Implementation Team** comprises of Heads of Sections from relevant IAEA Departments and Offices Reporting to the Director General. It is chaired by the Head of the Nuclear Power Technology Development Section.

Main Tasks of the Agency-wide Platform on SMRs and their Applications

The Agency-wide Platform on SMRs and their Applications is responsible for developing and periodically reviewing the strategy for Agency support to Member States for the timely development and deployment of SMRs and their applications, while effectively including safety, security, and safeguards considerations.

It also reviews and identifies ways to ensure the consistency, coordination, and optimization of the Agency's programmatic activities on SMRs and their applications and provide advice to the IAEA Director General and to the Heads of the relevant IAEA Departments, as needed.

The role of the Platform is also to review all requests submitted to the IAEA by Member States and international organizations in the area of SMRs and related applications and to identify the best approaches and mechanisms to address them in a consistent and coordinated manner.

The Platform also ensures coordination of efforts to facilitate international cooperation between the Agency and nuclear and non-nuclear organizations, including related stakeholders working on SMRs and SMR applications.

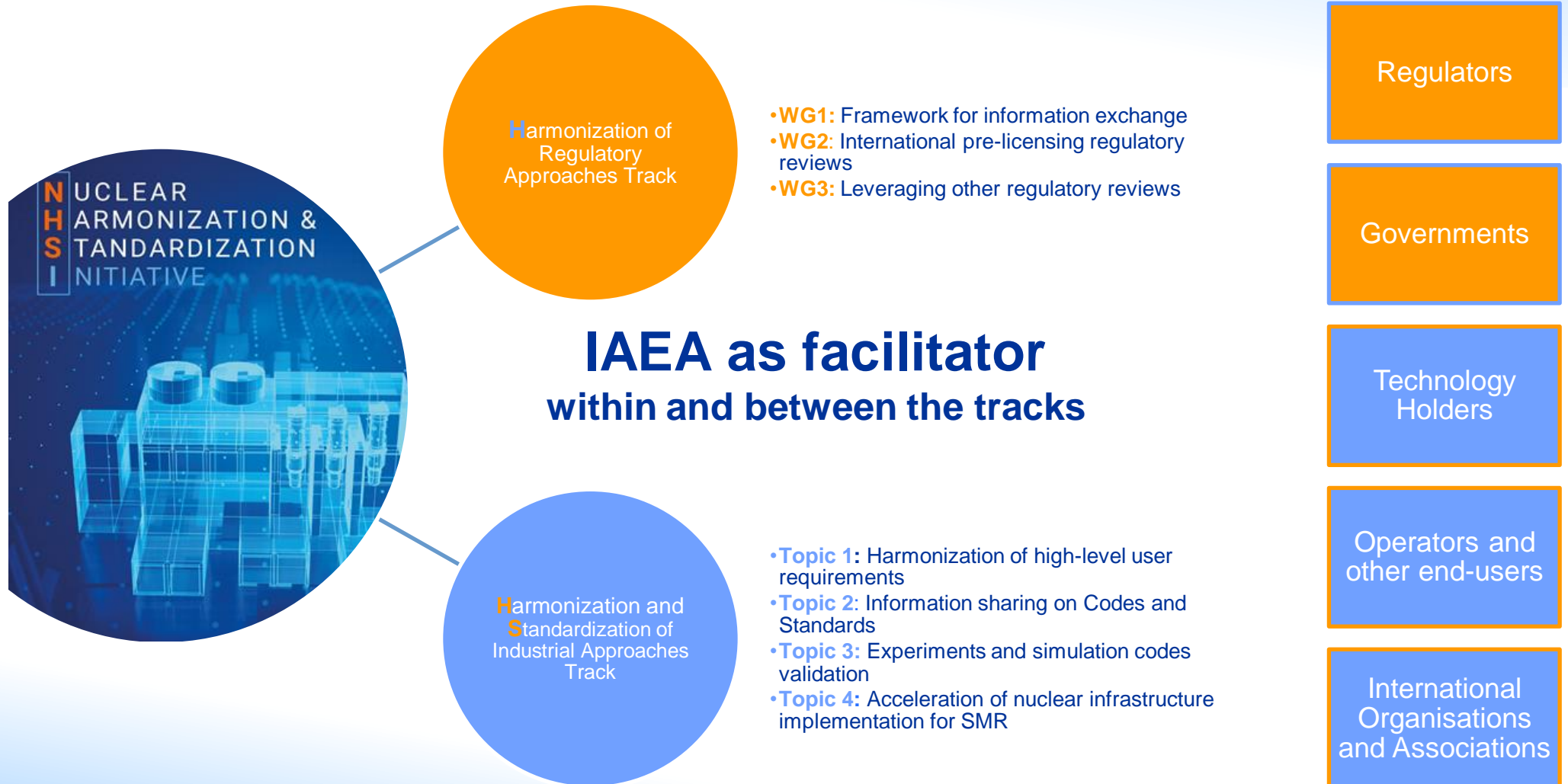
In addition, the **SMR Coordination and Resource Portal for Information Exchange, Outreach and Networking (SCORPION)**, will provide Member States with a comprehensive and systematic overview of all the Agency's services and activities on SMRs and their applications. The Portal will also serve as an internal collaboration tool as well as a means of sharing information and data with external stakeholders.

While the above-mentioned tasks have been identified as a priority for the Platform, additional activities will be implemented based on requests from Member States and international organizations.



Nuclear Harmonization and Standardization Initiative (NHSI) Background

Effective Global Deployment of
Safe and Secure Advanced
Nuclear Reactors

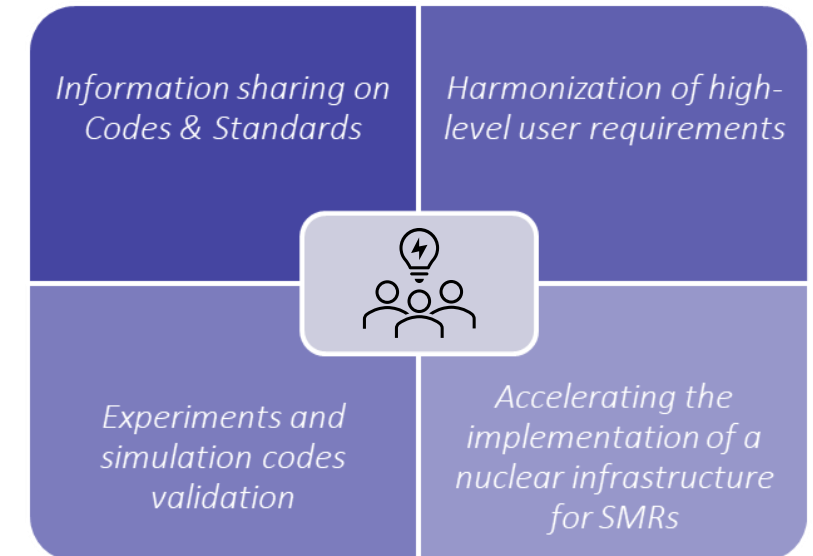
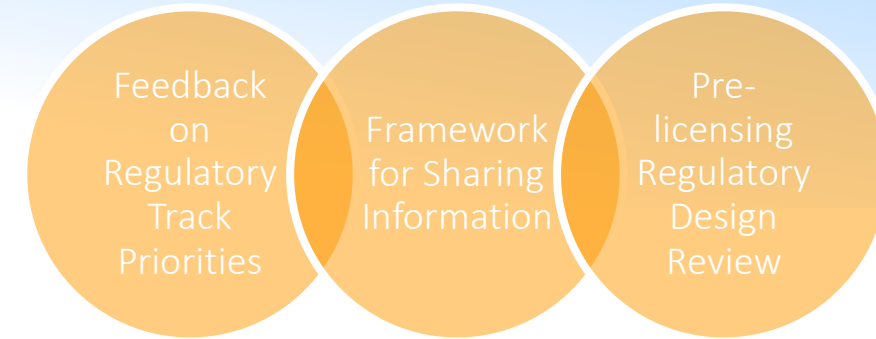


Nuclear Harmonization and Standardization Initiative (NHSI) – Kick off June 2022



For the effective global deployment of standardized fleets of safe and secure advanced nuclear reactors

- In total 125 participants Senior nuclear regulators and industry leaders from 33 countries gathered for the launch meeting on 23-24 June
- Two separate but complementary tracks – one for regulators and the other for technology holders and operators – to develop a joint workplan through 2024.
- Interfaces for sharing information and progress



Working Groups of the NHSI Regulatory Track

Framework for information exchange

To identify regulators' information sharing needs, obstacles and potential solutions

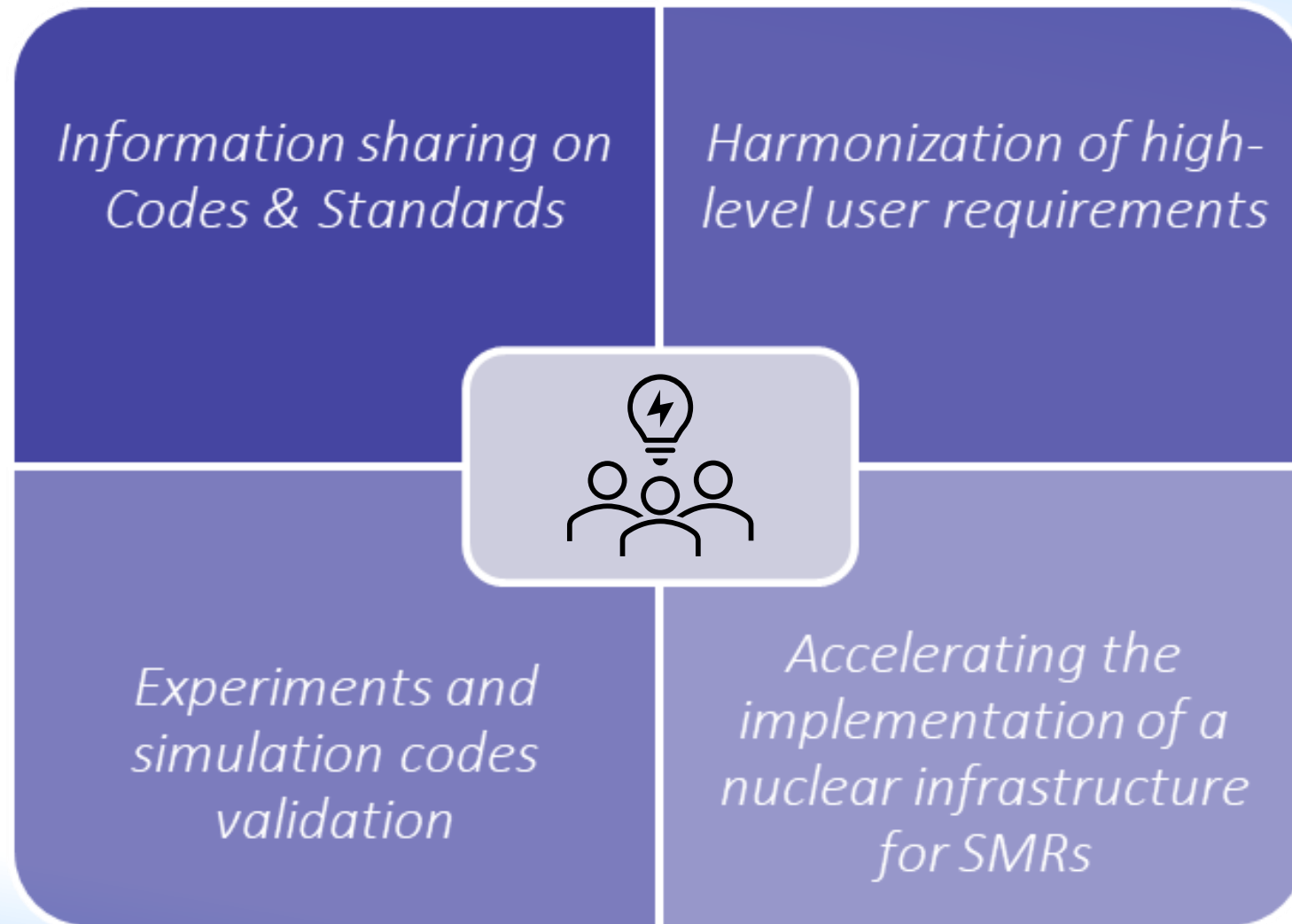
International pre-licensing regulatory reviews

To develop a process and criteria for an international pre-licensing design review

Leveraging other regulatory reviews

To develop approaches and best practices for leveraging other regulators' reviews

Topical Groups of the NHSI Industry Track



Progress and Achievements

- ✓ **Launch Meeting** held in June 2022
- ✓ Working Groups **membership** established
- ✓ Overall **scope and timeline** for the work developed
- ✓ The IAEA internal **team** and management **structure** in place
- ✓ Regulatory Track WGs kick-off meetings held in October
- ✓ Industry Track meetings ongoing as part of already planned activities



NHSI Launch meeting in June 23-24, 2022, Vienna



Members of the NHSI Regulatory Track



Next Steps

2022

- Work plans and outline of publications for each Working Group (WG)
- Key inputs, experience available, cooperation with ongoing projects
- Start development of publications
- Define interface between tracks

2023

- Series of virtual and face to face WG events to continue with the development of publications
- Progress meeting event in June 2023 to report on all WGs progress
- Targeted interface meetings between Industry and Regulatory Track

2024

- Completion of draft publications
- Interface meetings between Industry and Regulatory Track



NUCLEAR HARMONIZATION & STANDARDIZATION INITIATIVE



Regulatory Track Publications:

- Publication to establish information sharing needs by regulators, potential obstacles to information sharing, and potential solutions
- Publication to establish the criteria and process for an international pre-licensing design review
- Publication to establish an approach on how one regulator's reviews can be used by another regulator

The success of this Initiative will require **clear commitment** and **support** from Governments, regulatory bodies and industry

Save the date- May 2024

International Conference on Small Modular Reactors and their Applications

- The conference is expected to address and actively discuss major topics in relation to development, deployment, safety, economics and market readiness of SMR and their applications
- May 2024



IAEA

International Atomic Energy Agency



8 December 1953



1 to 23 October 1957



11 December 1957



1959



10 December 2005



1958 to 1979



23 August 1979

Thank you for your attention!

**For inquiries, please contact:
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*Atoms for peace and
Development...*

Path Forward

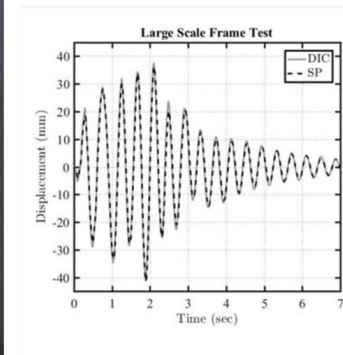
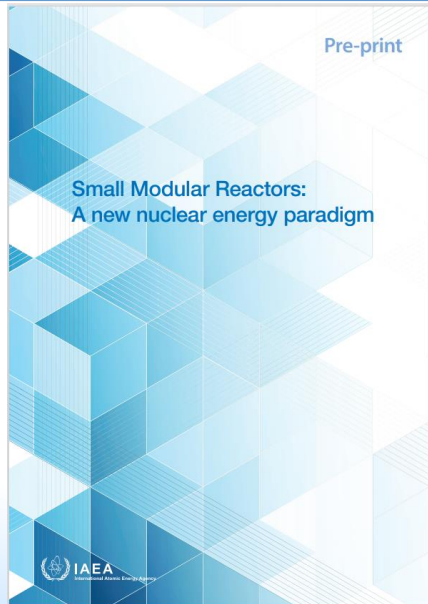
- Develop a Work Plan for the implementation of the SMR strategy, including expanding focused work in the following categories:
 - Harmonization of high-level requirements and criteria
 - Regulatory harmonization to facilitate licensing
 - Capacity building for readiness level assessment
 - Non-electric applications
 - Business case development/economics
 - Supply chain of components and applicability of codes & standards
- **IAEA's International Conference on Small Modular Reactors and their Applications in May 2024**

Task Forces for implementation of specific requests

High level SMR booklet

Jordan Expert Mission on the use of SMR for desalination

SMR and External Events – site-independent design



Task Forces for implementation of specific requests (cont)

Prospective scenarios to accelerate deployment of SMRs in newcomer countries: a publication accompanying the review of the Milestone Approach to take into account the case of SMR

Floating/Transportable nuclear power plants in particular for offshore facilities

