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INLA Inter Jura Virtual Congress 2021

Congress Presentations

2021 Nuclear Inter Jura Virtual Congress
International Nuclear Law Association - United States Chapter

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Welcome to the 2021 NUCLEAR INTER JURA CONGRESS!

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WORKING GROUP 3:

THE (NEW) NEW BUILD

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Working Group 3
New Build
Compendium Of Presentations & Bios

October 26, 2021

Nuclear Inter Jura Virtual Congress

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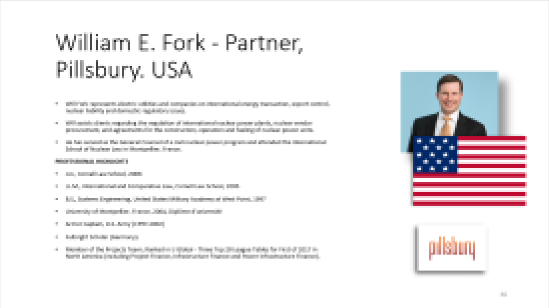
WG 3 – The New New Build



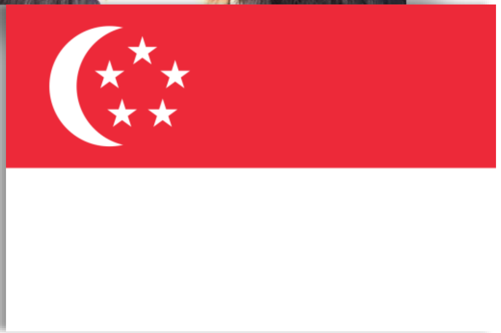
Ahab Abdel-Aziz – Partner and Global Director, Nuclear Power, Gowling WLG - Canada

- Ahab Abdel-Aziz is a partner and global director of Nuclear Power Generation at Gowling WLG.
- Worked in global nuclear sector for more than 30 years.
- Advise leading members of the Canadian and international nuclear energy sector and government agencies in policy and legislative development, nuclear project and program development and finance, licensing and compliance, and dispute resolution. He has also advised clients in the petroleum and petrochemicals sectors, mining and forestry, manufacturing, and project developers on regulatory approvals, environmental assessment, and risk management.
- Served as lead negotiator in multi-billion dollar nuclear project contract negotiations, as well as lead litigation counsel in technically complex civil and regulatory disputes, including multi-billion dollar nuclear project arbitration.
- He is recognized as one of Canada's top energy lawyers by Legal 500 Canada (Leading Lawyer), Canadian Legal Lexpert Directory, Report on Business/Lexpert Special Edition: Canada's Leading Energy Lawyers, Who's Who Legal: Canada, and Who's Who Legal: The International Who's Who of Energy Lawyers.
- Chair of the Board of Directors of the Organization of Canadian Nuclear Industries (OCNI), President of the Canadian Nuclear Law Organization (CNLO), and a member of the Board of the International Nuclear Law Association (INLA). He is also chair of INLA's Working Group 3 (Nuclear New Build) and a member of INLA's Working Group 1 (Regulatory Affairs). He was a founding executive member and director of the National Brownfield Association and a past member of the National Round Table on the Environment and the Economy's (NRTEE) National Brownfield Redevelopment Strategy Task Force.
- He was also the principal author of NRTEE's national policy recommendation, titled *Facilitating a Brownfield Redevelopment Strategy for Canada*, prepared at the request of the Prime Minister of Canada at the time. He is past vice chair of the Environmental Crimes and Enforcement Committee of the American Bar Association (ABA), as well as a member of the ABA's International Environmental Law Committee and Tort Trial & Insurance Practice Section. He has previously served as an executive member of the Ontario Bar Association Environmental Law Section, and as a trustee of the Metropolitan Toronto Lawyers Association.
- He is co-author and co-editor of the *Canadian Brownfields Manual* (LexisNexis Butterworths, 2004-2013).

GOWLING WLG

Nivedita S – Research Fellow – National University of Singapore Centre for International Law - Singapore

- Nivedita is a research fellow with the Centre for International Law (CIL), National University of Singapore (NUS) working as part of the nuclear law and policy team.
- She was part of a three-and-a-half year multidisciplinary research project funded by Singapore's National Research Foundation (NRF), which successfully completed in 2019. The project focused on research, capacity and network building and forging collaborations in the areas of nuclear safety, security and civil liability for nuclear damage (nuclear liability) in the context of nuclear power development.
- Her research focus has been and continues to be at two levels: at the international level on nuclear safety, security and liability issues including those relating to the governance of transportable nuclear power plants and the use of environmental assessments to enhance transboundary consultation in the nuclear context; and at the regional level on ASEAN instruments and institutions relevant to regional nuclear governance. She also coordinates the podcast series, Nuclear Matters at CIL as well as the team's knowledge management and is the manager for its social media account (@CIL_Nuclear).
- Before joining CIL, she trained at the Office of Legal Affairs of the International Atomic Energy Agency (IAEA) where she assisted with legal analysis and interpretation of international legal instruments and texts in the areas of nuclear safety, security, safeguards and liability, as well as research into international and treaty law issues. She has also worked on nuclear terrorism issues with the UN Office on Drugs and Crimes in the Terrorism Prevention Branch.
- She holds an Advanced Masters of Law in Public International Law from Leiden University, The Netherlands and a Bachelor of Laws with Honours from the University of Birmingham. She also holds a University Diploma (Diplôme d'Université - D.U.) in International Nuclear Law from the University of Montpellier. She is called to the Bar of England and Wales. She is a member of the International Nuclear Law Association.



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CENTRE FOR INTERNATIONAL LAW
National University of Singapore

Written by Denise Cheong & Nivedita S

Presented by Nivedita S

ENHANCING TRANSBOUNDARY CONSULTATION IN THE CONTEXT OF NUCLEAR POWER DEVELOPMENT IN SOUTHEAST ASIA

WG 3, INLA VIRTUAL CONGRESS, 26 – 27 OCTOBER 2021

BACKGROUND, OBJECTIVES & CONTEXT

WORKING GROUP 2 – Nuclear Liability & Insurance

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Nuclear Liability and the Development of New Technologies (SMRs and Fusion)
(Topic 1)

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NUCLEAR LIABILITY AND THE DEVELOPMENT OF NEW TECHNOLOGIES (SMRS AND FUSION)

(TOPIC 1)

Moderator: Fiona Geoffroy, Senior Legal Advisor, EDF SA, and WG2 Secretary

Government initiatives to establish a clear nuclear liability framework for SMRs (land, transportable, floating) and fusion

Speakers:	**Jamie Fairchild**	Senior Advisor, Uranium and Radioactive Waste Division, Natural Resources Canada
	Ian Salter	Partner, Burges Salmon LLP, UK
	Ben McRae	Assistant General Counsel for Civilian Nuclear Programs, Department of Energy, USA

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PAINTING THE LANDSCAPE : HOW DO SMRS AND FUSION FIT INTO THE INTERNATIONAL CONVENTIONS ?

DIFFERENTIATION BETWEEN DIFFERENT TYPES OF SMRS – FIXED, TRANSPORTABLE OR FLOATING

Land based: least controversial: appear to fall under the scope of application of existing conventions

Floating SMRs: difference between SMRs located on ships that are anchored in place and used exclusively for generating power for external consumption (appear to be covered) and reactors used as a source of power for a ship, whether power is used for propulsion or any other purpose associated with the operation of a ship (not covered cf. intention to exclude atomic submarines and ice-breakers)

Transportable: possibility of classification as transport of nuclear material (containing fresh fuel) or following operations (when radioactive)

Fusion: at present does not appear to fall under the scope of the conventions. Long-standing discussions at OECD/NEA Law Committee on possibility of extending scope of Paris Convention to cover fusion installations.

Future actions may be taken (e.g. OECD Steering Committee Decision, revision of Explanatory Texts of VC and CSC) to increase clarity in this respect.

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Canada – Jamie Fairchild, Senior Advisor, Uranium and Radioactive Waste Division, Natural Resources Canada

- **Nuclear Liability and Compensation Act**
  - Establishes Canada's third-party liability regime.

- **Nuclear Liability and Compensation Regulations**
  - Specify the limits and liability for low risk installations, including for non-power reactors (CAD $500K - $180M)

- **Small Modular Reactor Action Plan (smractionplan.ca)**
  - Canada's plan for the development, demonstration, and deployment of SMRs for multiple applications at home and abroad.

- **Clean Technology Regulatory Roadmap**
  - Plan to address regulatory issues and identify opportunities for novel regulatory approaches in the clean technology sector.

United Kingdom – Ian Salter, Partner, Burges Salmon LLP

> **Changes to implement the Revised Paris Convention**

> **Nothing specific for SMRs**

> **Nuclear Installations Act 1965:**

- **Section 1** – requirement for a licence to use a site to install or operate a "nuclear reactor" other than a nuclear reactor comprised in a means of transport. Definition covers all fission reactors "whether affixed to land or not"
- **Section 7** – strict and absolute liability for "nuclear damage"
- **Section 16** – "required amounts" (limits of liability) for "low risk", "intermediate" and "standard" sites and low risk transports (categories prescribed in the Nuclear Installations (Prescribed Sites and Transport) Regulations 2018). SMRs likely to be "standard sites"
- **Section 19(1)** – requirement for financial security up to the "required amount" under Section 16
- **Section 19(2E) –** one limit per nuclear site licence (the highest if more than one applies)

> All legislation available at www.legislation.gov.uk

> UK government consultation on a regulatory framework for fusion at: www.gov.uk/government/consultations/towards-fusion-energy-proposals-for-a-regulatory-framework

United States – Ben McRae, Assistant General Counsel for Civilian Nuclear Programs, US Department of Energy

> **Price-Anderson Act - Section 170 of the Atomic Energy Act (AEA) - does not address SMR's explicitly**

> Section 170(b)(1) of the AEA provides that, with respect to **each power reactor with capacity of 100,000 megawatts or more**, the licensee must:

- Have the maximum amount of insurance available from private sources (currently 450 million USD); and
- In the event of a nuclear incident, must contribute up to approximately 121 million USD to an industry indemnification fund.

> Section 170(b)(5) of the AEA provides that **reactors, which have capacity of 100,000 to 300,000 megawatts and which are located at a single site**, shall be treated as a single facility to the extent their combined capacity does not exceed 1.3 million megawatts.

> Sections 170(b)(1) and 170(c) of the AEA provide that, with respect **to other reactors (that is, rectors with capacity less than 100,000 megawatts)**:

- The licensee must have the amount of insurance available from private sources unless NRC permits a lower amount; and
- NRC must provide an indemnification of 500 million USD which shall be reduced by the amount by which required insurance exceeds 60 million USD.

> **Price-Anderson Act must be renewed by the end of 2025**

- Treatment of SMR's may be considered as part of that process.

Practical Arrangements of Claims Handling
(Topic 2)

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PRACTICAL ARRANGEMENTS OF CLAIMS HANDLING
(TOPIC 2)

Moderator: **Ximena Vásquez-Maignan**, Head of the OECD/NEA Office of Legal Counsel, Members of the INLA Board of Management and WG2 Co-Chair

Speakers:	**Caj Weckström**	Managing Director, Nordic Nuclear Insurers (NNI)
	Daniel C. DeMerchant	Vice President, Claims – Legal, American Nuclear Insurers (ANI)
	Gilles Trembley	Chairman, GEIE Claims Handling System (CHS)

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INTRODUCTION – LESSONS LEARNED FROM THE FUKUSHIMA ACCIDENT

- no direct casualties; mostly mental anguish and damage to the environment, property and businesses
- 3 million applications (2 million threshold was already reached in 2013)
- more than 12 000 persons were involved in the claims handling process
- indemnification procedure was reviewed several times to simplify it
- quickly set up a bi-lingual website to provide information (at one moment in 4 languages)
- call centers and offices were set up throughout surrounding prefectures and where evacuees relocated

Caj Weckström, Managing Director, Nordic Nuclear Insurers (NNI)

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NNI
Nordic Nuclear Insurers

NORDIC NUCLEAR INSURERS CLAIMS HANDLING DATABASE

- Developed in 2010
- Sweden, Finland and Hungary
- Claims handled by 7 member insurance companies: 4 in Sweden and 3 in Finland
- The 3 insurance companies in Finland have about 90% of the households as customers
- Claims handling - from registration to payment
- Full reporting capabilities
- Multiple languages
- One size does not fit all
- Web based, can be accessed from anywhere
- Source code owned by the Pool, Operator, TPA etc. Not a license
- Data ”owned” by the owner, can be stored in the cloud, server etc.

Website for more information: www.atompool.com/en

Background - Developments in Southeast Asia

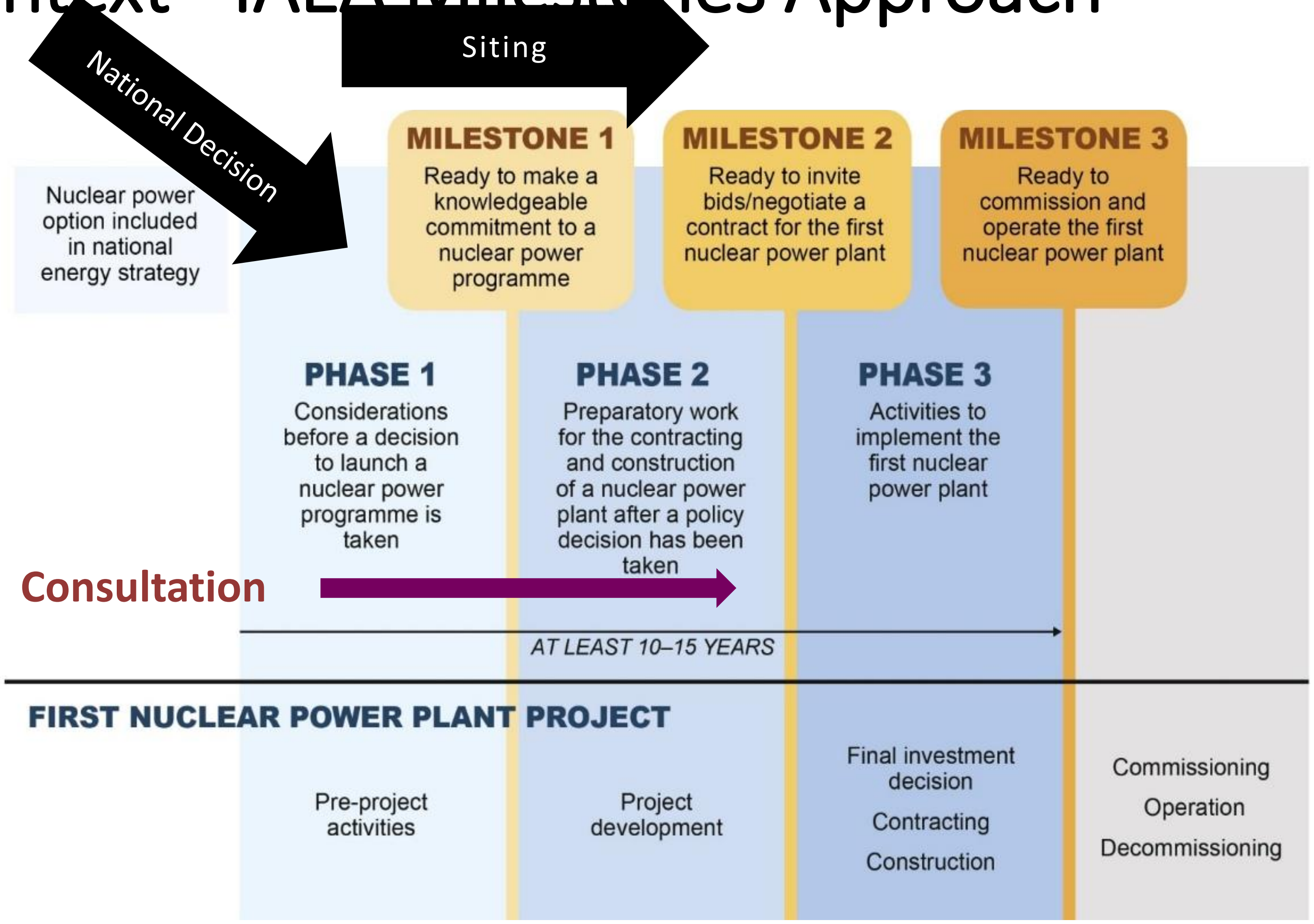
Source: MapChart.net

- Nuclear power could be a reality in Southeast Asia by 2040
- Environmental Impact Assessment (EIA) & Strategic Environmental Assessment (SEA) as mechanisms that facilitate transboundary consultation
- No ASEAN-wide framework on EIA nor SEA

Objectives

- At the international level, is there a normative basis for transboundary consultation related to:
  (a) a State's national decision to embark on a nuclear power programme; &
  (b) the siting of a nuclear power plant?
- Is there an independent normative basis at the ASEAN level?
- What can ASEAN do to strengthen the collective normative basis?

Context - IAEA Milestones Approach



Source: https://www.iaea.org/topics/infrastructure-development/milestones-approach

Thank You

Nivedita S: nivedita.s@nus.edu.sg

Denise Cheong: denisecheong@nus.edu.sg

Nuclear Matters at CIL, podcast series https://bit.ly/NuclearMattersatCIL

CIL_Nuclear

Dr. Priyanka M Jawale - Post Doctoral Research Fellow at Department of Law, Savitribai Phule Pune University - India

- Dr. Priyanka Jawale did her LL.M. and Ph.D. in the area of Nuclear energy laws from Department of Law, Savitribai Phule Pune University Pune, Maharashtra, India. She is an alumnus of International School on Nuclear Laws (ISNL). At present she is Post-Doctoral Fellow working on ‘Outer Space Liability and Use of Nuclear Substances: International and National Law and Policy’.
- June 2019, she presented a paper at the international conference on spent fuel management at IAEA. She has also worked as a rapporteur in the United Nations/Turkey/APSCO Conference on Space Law and Policy at Istanbul, Turkey in Sept. 2019. Her presentation at IAEA nominated her at the International Youth Nuclear Congress at Sydney, Australia (March 2020) for the category ‘Innovation for Nuclear’.
- Recently she was panelist for Session 3: Legal and Regulatory Aspects of Space Applications for Food Systems, at the UN/Austria Symposium ‘Space Applications for Food Systems’ organized by United Nations Office of Outer Space Affairs (UNOOSA) (Online Event) on 7-9 September 2021.

Sky is not the limit: Nuclear Power Sources in Outer Space

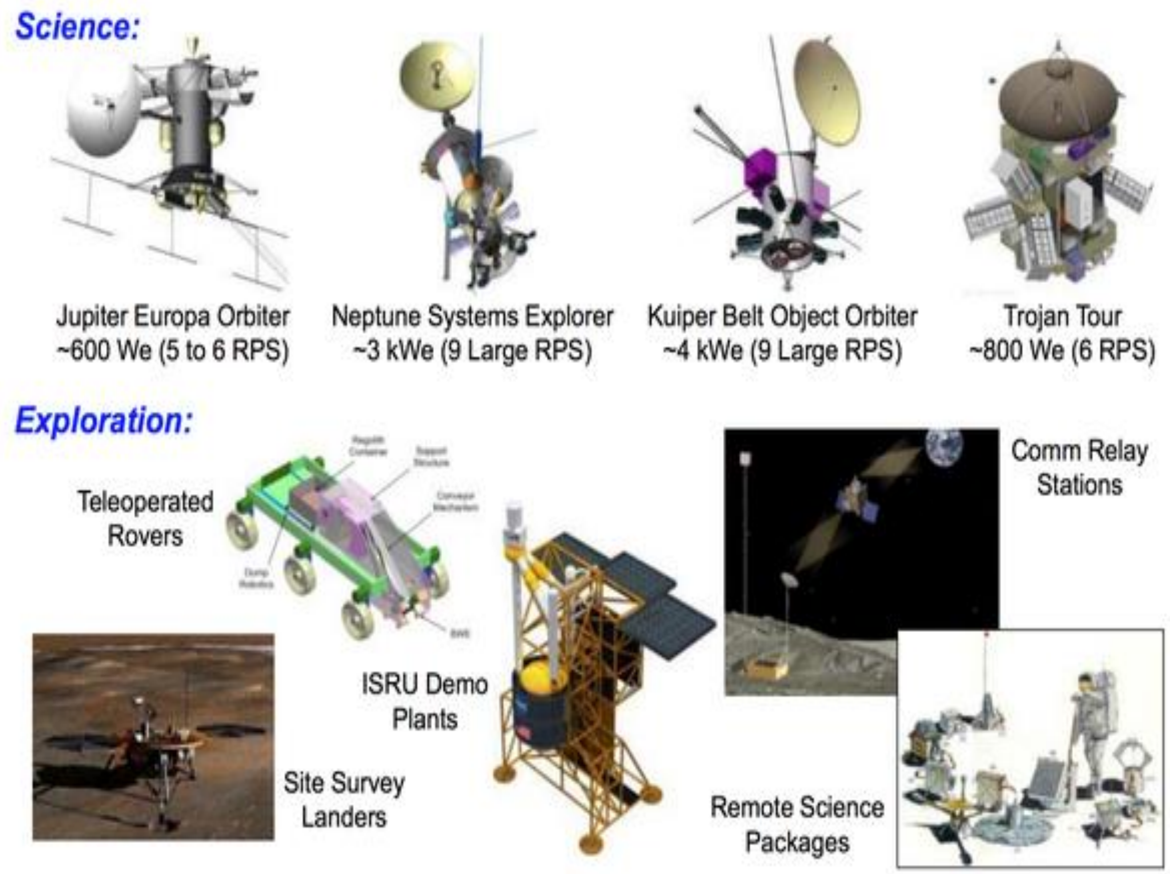
Dr. Priyanka M Jawale
Post Doctoral Research Fellow at Department of Law, Savitribai Phule Pune University – India
jawale.m.Priyanka@gmail.com

https://pixabay.com/photos/rocket-launch-night-space-shuttle-67722/ Image credit.

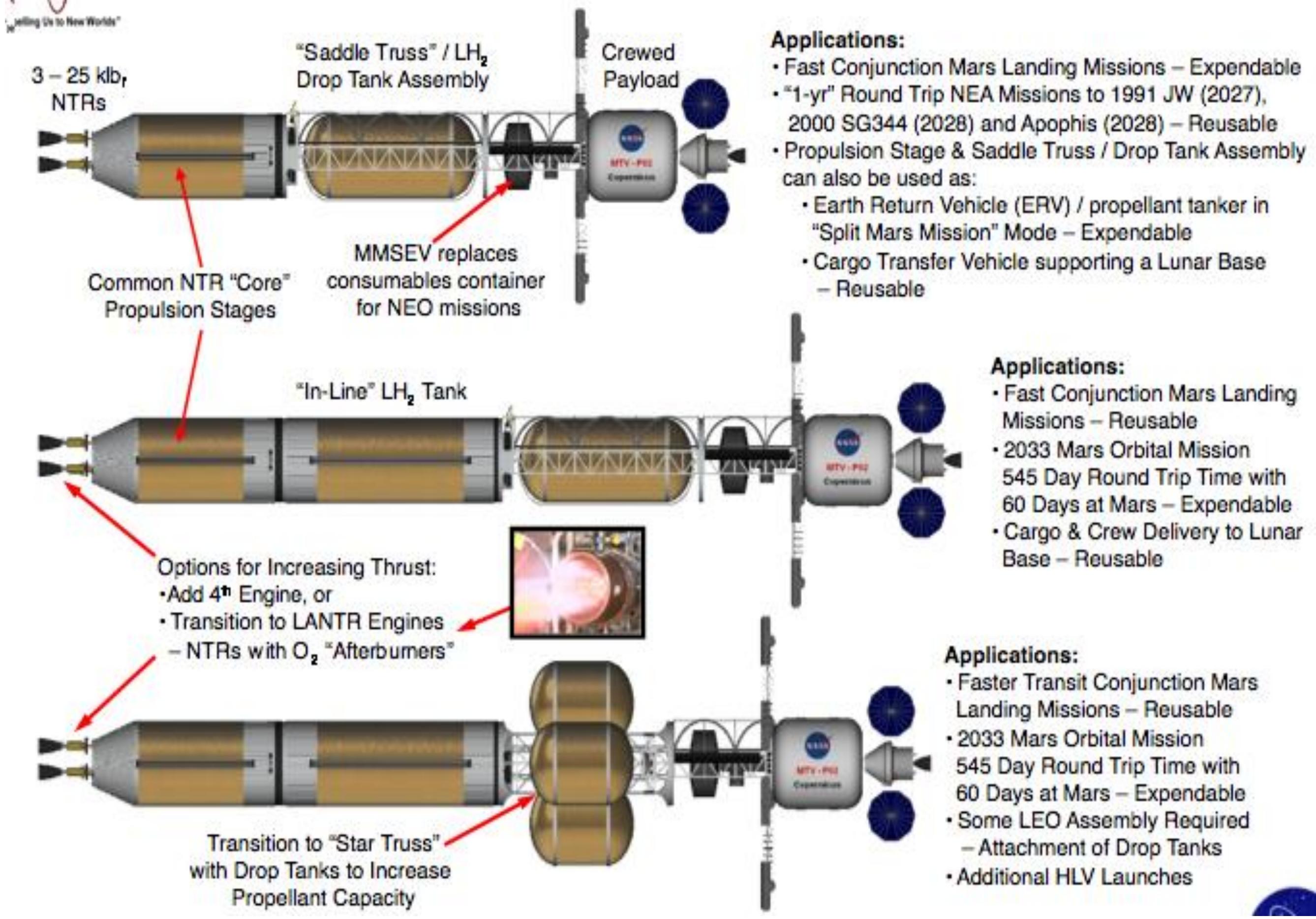
Nuclear in Space :

- Possibilities of using Nuclear for space applications
- Issues and Challenges
- Legal Framework under IAEA and UNOOSA
- Case study:
  Cosmos 954 nuclear satellite Accident (Nuclear liability in outer space)
- Conclusion

NASA proposals for nuclear-powered exploration rovers and craft. Credit: NASA https://phys.org/news/2015-02-exploring-universe-nuclear-power.html **(seen on 22/10/21)**



Using modular components, a NTP spacecraft could be fitted for numerous missions profiles. Credit: NASA. https://phys.org/news/2015-02-exploring-universe-nuclear-power.html (seen on 22/10/21)



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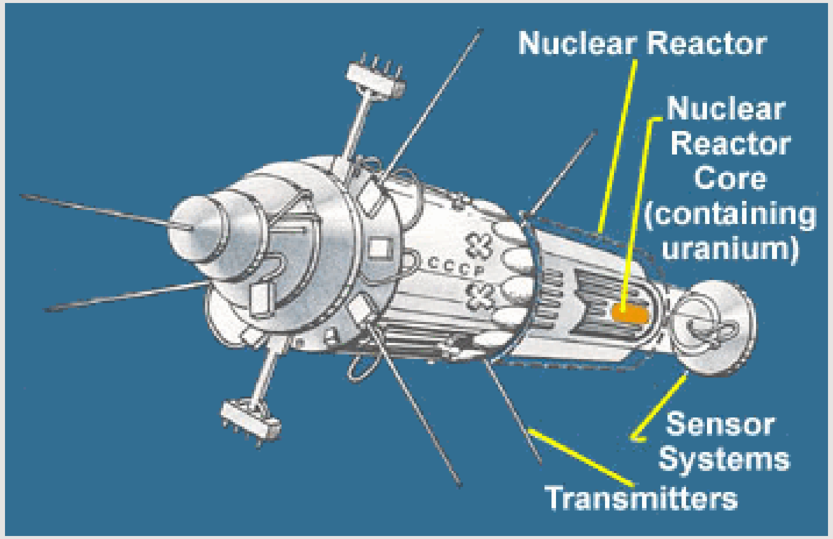
Soviet’s Cosmos 954 satellite and Canadas Operation Morning Light

Cosmos 954- on 18 Sept. 1977 launched by Soviet with onboard nuc. Reactor (with 50kg Uranium235), Jan 1978 lost control on satellite, problems in reentry. 24th Jan. 1978 Cosmos 954 entered the Earth’s atmosphere over northern Canada debris was spread over an area 600 miles long and 30 miles wide, beginning with Great Slave Lake. Under 1972 Space Liability Convention, the Canadian government gave the Soviet Union a bill for $6,041,174.70 Canadian Dollars to which USSR eventually paid C$3 million in compensation. (images credit:

(https://en.wikipedia.org/wiki/Kosmos_954 (Debris and its search operation)



Athanase Popov - DG ENERGY Legal officer - Luxembourg

Athanase Popov is a legal officer at the European Commission.

Directly reporting to the Director of Euratom Safeguards at the European Commission.

He holds a PhD in European Union law from the Luxembourg University.

LLB from King's College London, Maîtrise from the Sorbonne and LLM from Sorbonne nouvelle

Held various legal positions at Michelin , Sabev & Partners, Freshfields Bruckhaus Deringer, cabinet Haddad-Brahmi and the Court of Justice of the EU.

State support for new builds in the EU: the case-law of the Court of Justice of the EU

Athanase Popov, PhD
Nuclear law practitioner

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WG 3

26 OCTOBER, 2021

Key Treaty provisions I

- Under Article 194 of the Treaty of the Functioning of the European Union the Member States enjoy almost full discretion to determine their energy mix
- Certain Member States such as Austria, the Member State challenging the Commission's Hinkley Point C State aid decision, have decided to phase out nuclear energy following a referendum.
- Yet the Lisbon Treaty, which entered into force in 2009, confirmed and updated the Euratom Treaty, under which the facilitation of nuclear investments is still an objective of common interest in European law

Key Treaty provisions II

- Could nuclear energy be considered an objective of common interest in the meaning of article 107(3)(c) TFEU?
- In fact Article 107(3)(c) TFEU states that aid to facilitate the development of certain economic activities or of certain economic areas may be considered to be compatible with the internal market where such aid does not adversely affect trading conditions *to an extent contrary to the common interest*
- Article 106a(3) of the Euratom Treaty
- The Lisbon Treaty, which entered into force in 2009, confirmed and updated the Euratom Treaty, under which the facilitation of nuclear investments is still a Community objective

Findings of the Court in *Austria v Commission*, 22 September 2020, C-594/18 P

- Objective of common interest refers to the “principle of protection of the environment, the precautionary principle, the ‘polluter pays’ principle and the principle of sustainability”
- Yet these principles are not enshrined in the Euratom Treaty, which is more liberal and supportive of the nuclear industry
- The examination whether the planned aid enables a market failure to be remedied does not constitute a condition for declaring an aid to be compatible with the internal market (para. 66).

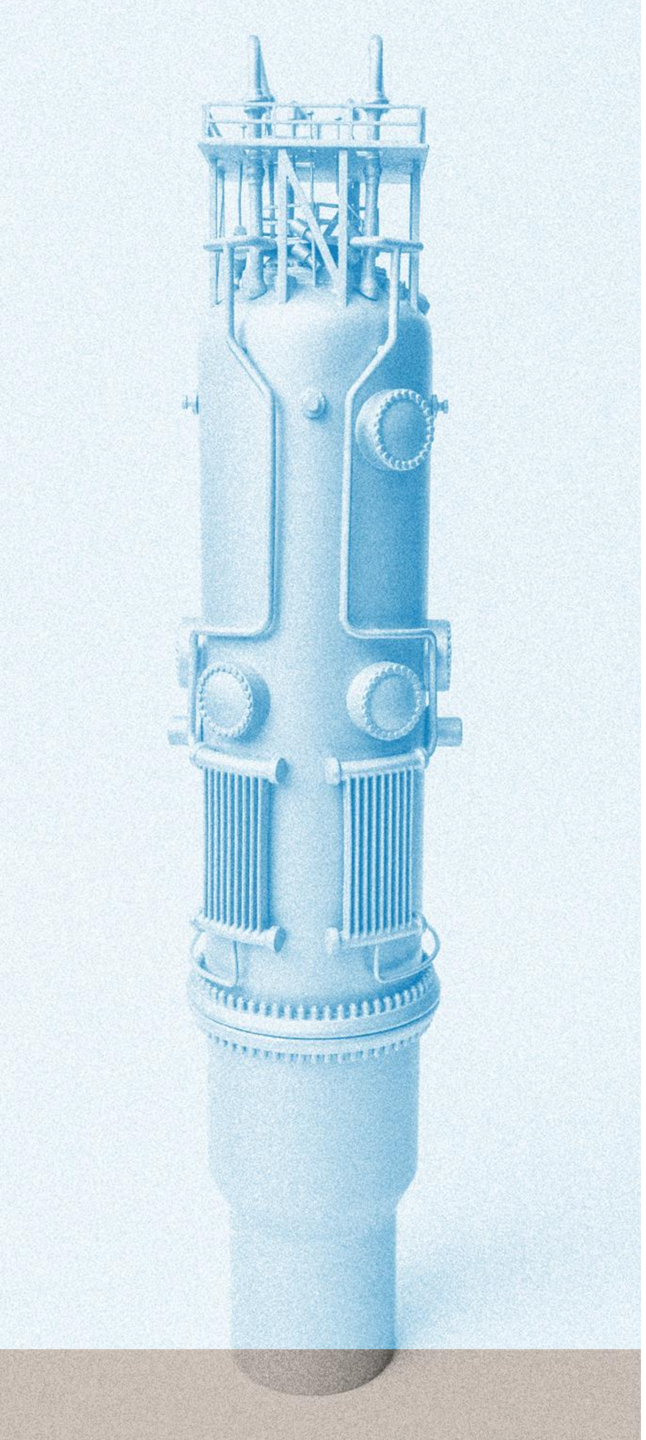
William E. Fork - Partner, Pillsbury. USA

- Will Fork represents electric utilities and companies on international energy transaction, export control, nuclear liability and domestic regulatory issues.
- Will assists clients regarding the regulation of international nuclear power plants, nuclear vendor procurement, and agreements for the construction, operation and fueling of nuclear power units.
- He has served as the General Counsel of a civil nuclear power program and attended the International School of Nuclear Law in Montpellier, France.

PROFESSIONAL HIGHLIGHTS

- J.D., Cornell Law School, 2006
- LL.M., International and Comparative Law, Cornell Law School, 2006
- B.S., Systems Engineering, United States Military Academy at West Point, 1997
- University of Montpellier, France, 2004, Diplôme d'université
- Armor Captain, U.S. Army (1997-2002)
- Fulbright Scholar (Germany)
- Member of the Projects Team, Ranked in IJ Global - Three Top 20 League Tables for First of 2017 in North America (including Project Finance, Infrastructure Finance and Power Infrastructure Finance).

pillsbury



Strategies for Overcoming Regulatory Burdens Facing SMR Deployment to Developing Nations

William E. Fork

william.fork@pillsburylaw.com

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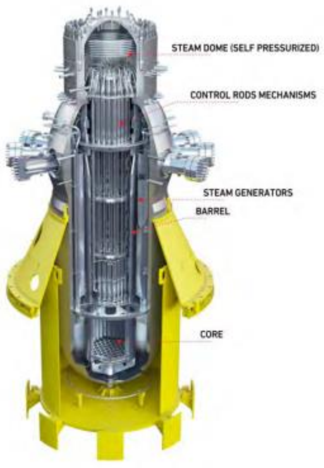
Overview

- Overview of International SMR Designs
- Key Challenges
  - Finance Issues
  - Regulatory Expertise
- Possible Solutions
  - IAEA Regulatory Assistance
  - Center of Excellence National Regulators
  - Regional Regulators

Diverse International SMR Deployment Options

- **Many SMRs?**
  - Are as different as “chalk and cheese”
  - Different technologies
    - Light Water / Metal / Salt
    - High Temp. / Fast Neutron / Molten Salt
  - Different Sizes
    - 2 MWe – 300 MWe
  - Many uses
    - Electrical, Desal.
    - Heat, Hydrogen

- **Common Characteristics**
  - Advanced safety systems
    - Fewer failure points
    - Decreased LOCA risks
  - Decreased per-unit costs
    - But economies of scale?
  - Modular construction / deployment
  - Increased safety and security designs
    - In-ground protection
  - Increased renewability
    - Some designs dispose of nuclear waste

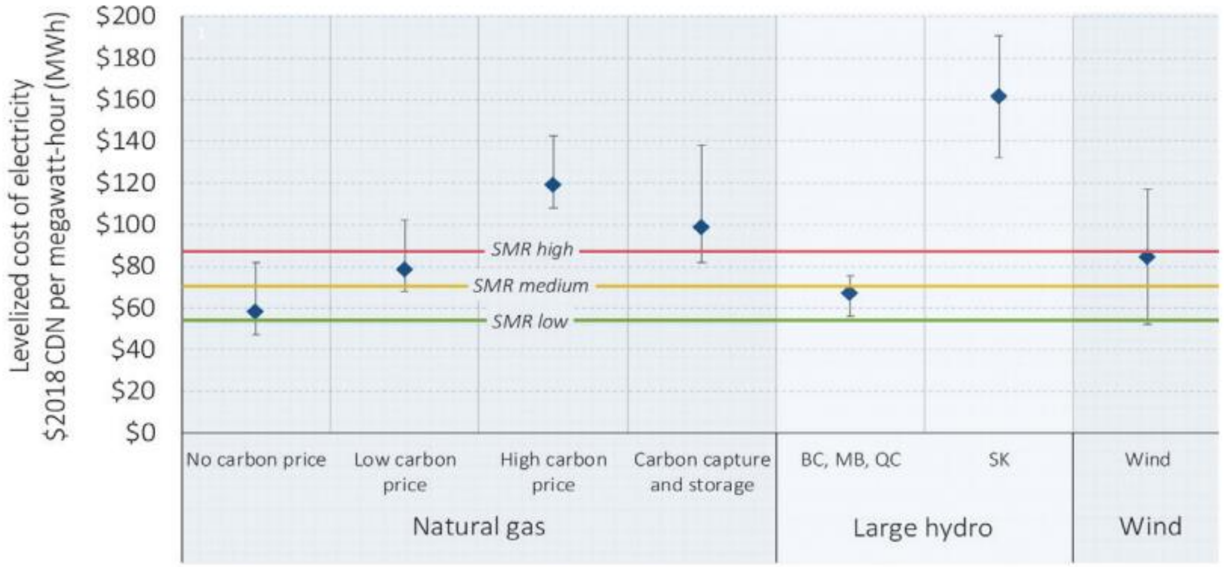


CAREM Design (Argentina)

SMR Costs

SMRs have been alluded to as a simpler alternative to conventional large reactors

- But the total cost of a country's civil nuclear program includes regulatory costs
- Regulatory costs to review and regulate advanced designs are expensive
- In the U.S. costs to develop expertise needed to review and regulate certain advanced nuclear designs can exceed $1 billion per technology
- Regulatory costs are not necessarily included in LCOE cost estimates



Comparison of levelized cost of electricity from on-grid SMRs with other options (*Credit*: Canadian SMR Roadmap Steering Committee)

Challenge: Decreasing Regulatory Costs in Developing Countries

SMRs have been alluded to as a simpler alternative to conventional large reactors

- Nuclear technologies that are safe and cost-efficient can reduce carbon emissions
- Many countries with high emissions would benefit from zero-carbon generation sources like nuclear power

Challenge: How can countries without current nuclear infrastructures safely:

- Review new and advanced technology designs?
- Regulate the continued operation of SMR plants?

Convention on Nuclear Safety / IAEA

CNS Article 8: Regulatory Body

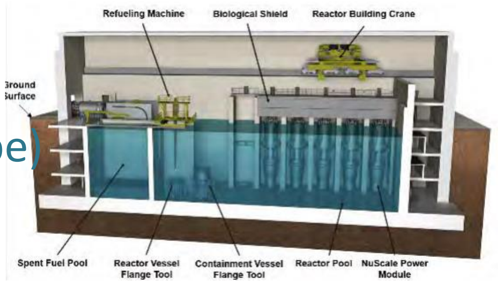
- **Art 8:** Each party to the convention shall establish a regulatory body with adequate authority, competence, and financial and human resources to fulfill its assigned responsibilities
    - Regulatory staff need competences to perform tasks related to the functions of the regulatory body.
    - Ultimate responsibility for nuclear safety belongs to each member state
- **IAEA TECDOC-1254** (Training the staff of the regulatory body for nuclear facilities: A competence framework) provides information regarding the way in which the regulatory functions of a nuclear regulatory body result in competence needs.
- **IAEA Safety Reports Series No. 79**: Managing Regulatory Body Competence of Nuclear Installations

ACP100 Demonstration NPP (China)

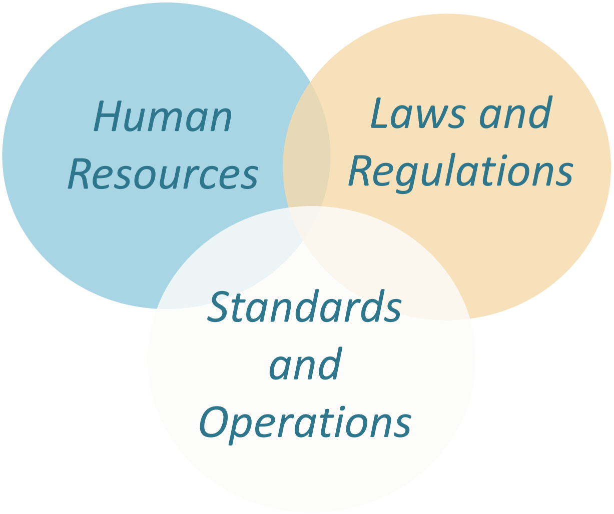
Possible Strategies for Overcoming Regulatory Burdens Facing SMR Deployment

- **Regulatory Burden / Information Sharing**
  - **Bilateral Cooperation**
    - *e.g., U.S. NRC – Canada CNSC SMR MOU*
  - **Central Trusted Regulator Framework**
    - *U.S. NRC, Stuk, Rostechnadzor, Euratom*
  - **IAEA**
    - Increasing training activity, limited technical expertise
    - Shared knowledge (*e.g.,* Int'l Nuclear Safety Group)
  - **Regional Regulatory Organizations**
    - *e.g.,* Asian Nuclear Safety Network

- **Operating Experience**
  - WANO
  - Operators' Forums (by design, type)
- **Standards Organizations**



NuScale Power Plant
(U.S.)



Example: Regional Regulatory Assistance

- **Example:** Asian Nuclear Safety Network
  - **Member Countries**
    - *11 member states:* Bangladesh, China, Indonesia, Japan, Kazakhstan, Republic of Korea, Malaysia, the Philippines, Singapore, Thailand and Viet Nam
  - **Supporting Countries**
    - *4 supporting countries*: Australia, France, Germany and U.S.
  - **Mission**
    - The ANSN continuously facilitates and supports the member states in capacity building and fosters sharing of knowledge, experience and expertise in the area of nuclear safety through human and IT networks.

ANSN
Asian Nuclear Safety Network

Key Technical Areas of Regulatory Expertise

- Security requirements
- Emergency preparedness
- Staffing, training, and qualification requirements
- Autonomous and remote operations
- Regulatory oversight
- Aircraft impact assessment
- Manufacturing licenses and transportation
- Population-related siting considerations
- Environmental considerations

Conclusion

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William E. Fork
william.fork@pillsburylaw.com

Dr. Rudiger Tscherning - Associate Professor – University of Calgary Faculty of Law - Canada

- Rudiger researches and teaches in the areas of international and Canadian energy and natural resources law, infrastructure and construction law, and private international law. His activities are focused on clean energy, including renewables and nuclear law; the construction of critical infrastructure; and the transportation of energy and commodities.

- He joined the University of Calgary in 2016 and is a PhD graduate of the Institute for Comparative Law, Conflict of Laws and International Business Law at the University of Heidelberg. Prior to his PhD studies, Dr. Tscherning was the founding Executive Director of the Center for Energy and Sustainability Law at Qatar University College of Law, where he also was a Lecturer of Law teaching in energy and sustainability law and policy. Before joining academia, he practiced as a solicitor in London, England.

- During his time in Qatar, Rudiger acted as legal consultant to the Ministry of Environment of the State of Qatar, the United States Department of Commerce Commercial Law Development Program (CLDP), the World Bank, and Qatar Diar Vinci Construction. While in the Middle East, he initiated a number of academic conferences and research programs, including the first regional academic conference on renewable energy and nuclear law and policy.

- PhD Ruprecht-Karls-Universität Heidelberg, 2019; LLM Climate Change and Energy Law and Policy, The Centre for Energy, Petroleum and Mineral Law and Policy, University of Dundee, 2011; LLM International Commercial Law, The University of Nottingham, 2003; LLB Trinity College Dublin, 2002.

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SMRs and the Decarbonization of Canada's Oil and Gas Sector

Dr. Rudiger Tscherning
Associate Professor

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Projected Canadian O&G Production Increases

Figure ES.6:
Crude Oil Production by Type, Evolving and Reference Scenarios

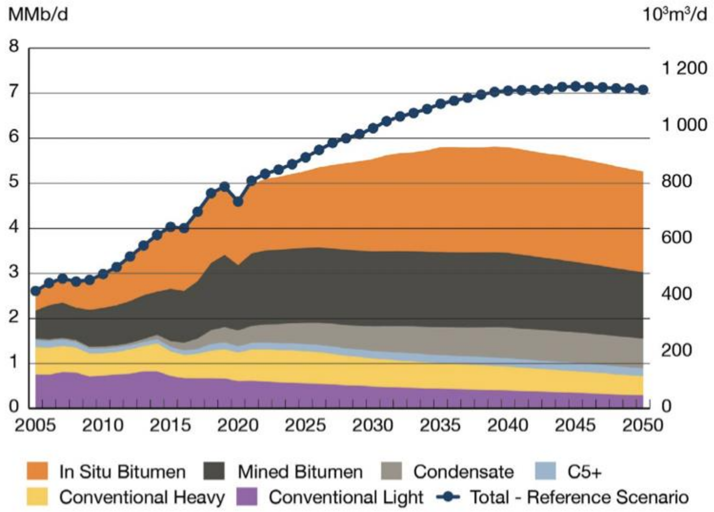
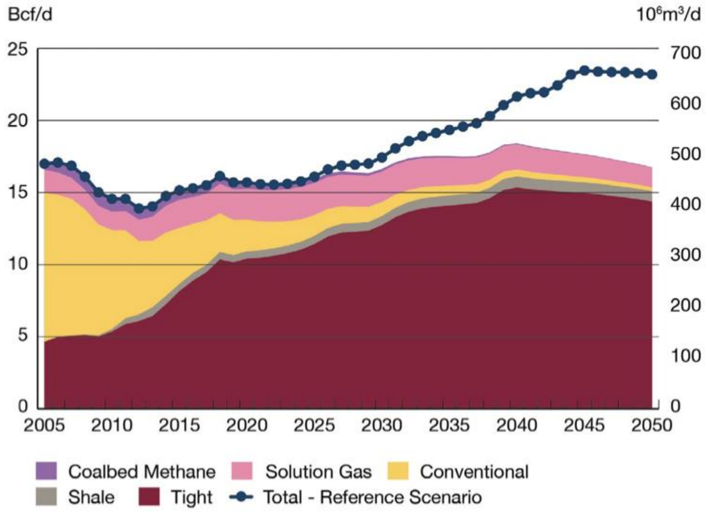


Figure ES.7:
Natural Gas Production by Type, Evolving and Reference Scenarios



CANADA'S ENERGY FUTURE 2020 – CANADA ENERGY REGULATOR

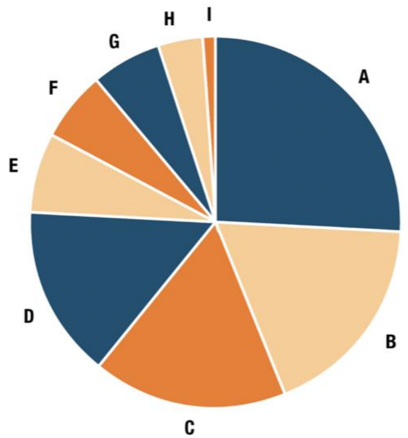
https://www.cer-rec.gc.ca/en/data-analysis/canada-energy-future/2020/canada-energy-futures-2020.pdf

The Climate and Decarbonization Context

Oil Sands
Pathways to Net Zero

Alberta's current emissions

Figure 1: Alberta emissions profile

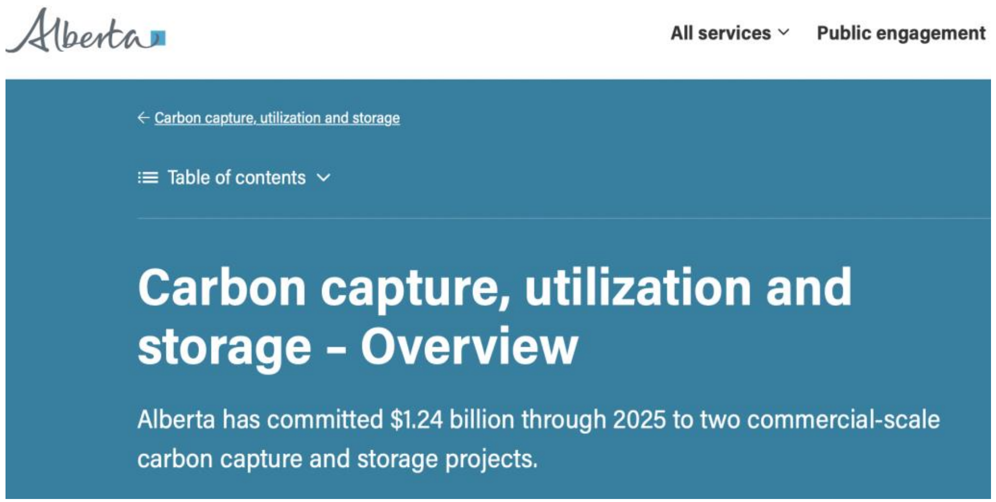


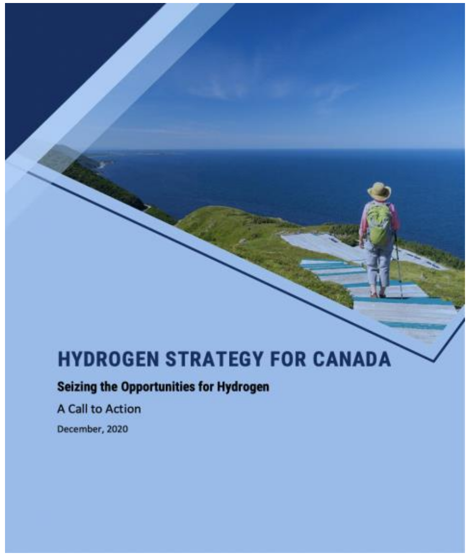
Letter	Emission source	Percentage
A	Oil sands (mining, in situ and upgrading)	26%
B	Electricity / heat generation	18%
C	Oil and gas and mining	17%

https://www.alberta.ca/climate-change-alberta.aspx#jumplinks-3

The SMR Opportunity in Oil and Gas

- Direct SMR deployment – heat and electricity
- Ancillary SMR deployment – CCUS & pink hydrogen





A Patchwork of Legal and Regulatory Issues for SMR Deployment in Canada's Oil Patch

Nuclear Law and Regulatory Regimes

SMRs in Multi-Party Oil and Gas Projects

Environmental, Climate/Carbon Considerations

QUESTIONS

INLA
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SPECIAL PRESENTATION:

William D. Magwood, IV

The New Nuclear Energy Future:
Opportunities and Challenges

William D. Magwood, IV
Director-General
OECD Nuclear Energy Agency

2021 INLA Nuclear Inter Jura Congress
26 October 2021

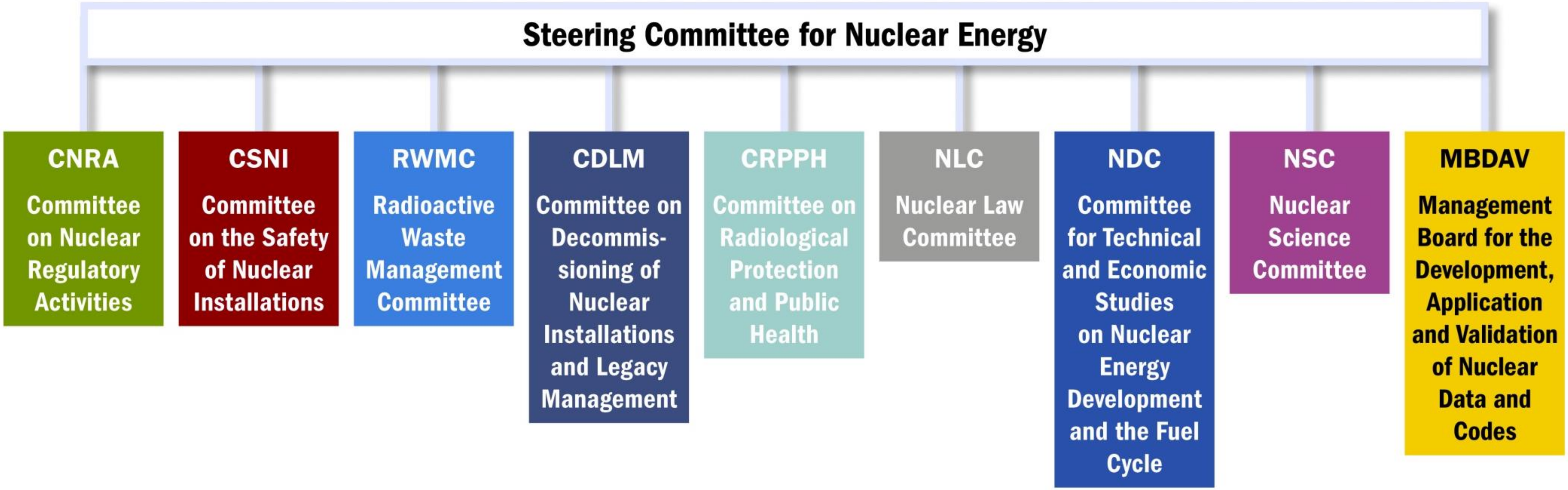
The NEA: 34 Countries Seeking Excellence in Nuclear Safety, Technology and Policy

- **A premier international platform for cooperation in nuclear technology, policy, regulation, research, education and law.**
- **34 member countries + strategic partners (e.g., China and India).**
- **8 Standing Technical Committees and more than 80 working parties and expert groups.**
- **Global relationships with industry, universities and civil society.**

Argentina	Australia	Austria	Belgium
Bulgaria	Canada	Czech Republic	Denmark
Finland	France	Germany	Greece
Hungary	Iceland	Ireland	Italy
Japan	Korea	Luxembourg	Mexico
Netherlands	Norway	Poland	Portugal
Romania	Russia	Slovak Republic	Slovenia
Spain	Sweden	Switzerland	Turkey
United Kingdom	United States		

NEA countries operate about 81%
of the world's installed nuclear capacity

NEA Standing Technical Committees



The NEA's committees bring together top governmental officials and technical specialists from NEA member countries and strategic partners to address difficult challenges, establish policies and best practices, and promote international collaboration and collective action.

Nuclear Law at the NEA

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NEA Legal Publication Programme

Nuclear Law Bulletin

- A unique publication in the nuclear law field
- Published twice each year in French and English

Special Publications

- Japan’s Compensation System for Nuclear Damage (2012)
- *Tables on Operator Liability amounts and Financial Security Limits, priority rules and principle of reciprocity*
- *Map on ratification status of all nuclear liability conventions*

On-line Nuclear Legislation

- Country reports and legislative texts

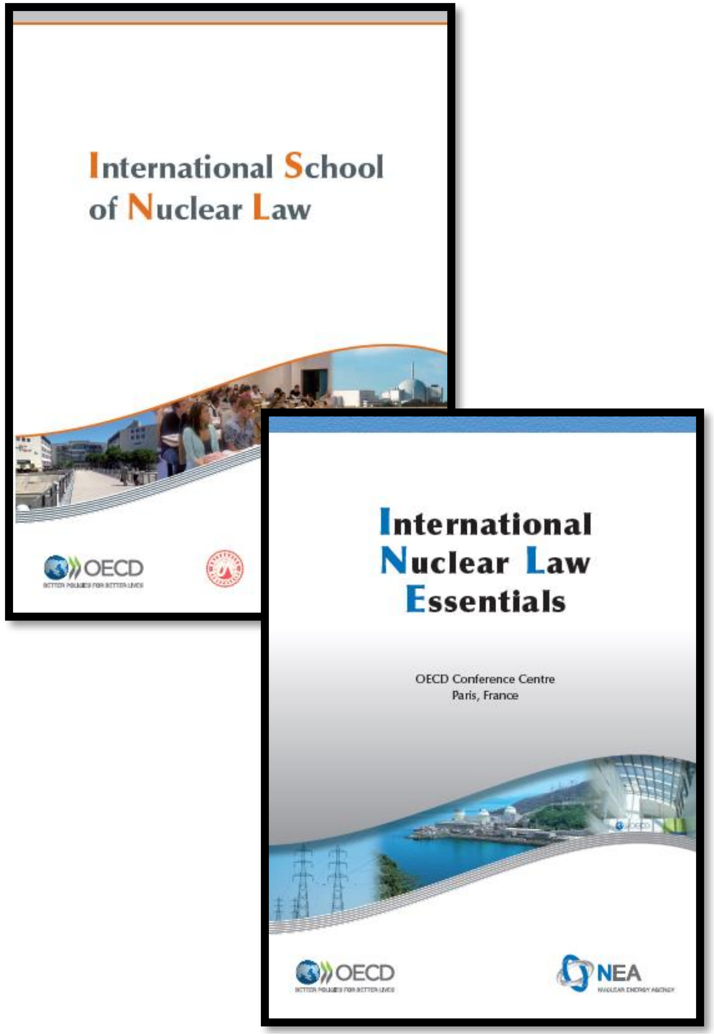
NEA Education Programmes

International School of Nuclear Law (ISNL)

- A two-week programme organised in cooperation with the University of Montpellier (Established in 2000)
- Features lectures legal and technical experts from NEA, IAEA, and from around the world
- More than 1000 people have participated since its inception

International Nuclear Law Essentials (INLE)

- A one-week course held in Paris that builds on the foundation of the ISNL (Established in 2011)
- Next session will be held on-line in February 2022.



NEA Global Forum on Nuclear Education, Science, Technology and Policy

First Global Forum Exploratory Meeting
Paris, 24-25 July 2019

The NEA has established the **Global Forum on Nuclear Education, Science, Technology and Policy** as a framework to :

Engagement with academic institutions which are responsible for developing the next generation of nuclear science and technology experts.

Bring long-term, creative thinking to address international policy challenges that nuclear energy faces today as input to NEA processes.

Provide academic institutions around the world with the world’s first global framework for interaction, cooperation, and collective action.

Major International Cooperative Frameworks

NEA Serviced Bodies

Generation IV International Forum (GIF) with the goal to develop new fission technologies with greater sustainability (including effective fuel utilisation and minimisation of waste), economic performance, safety and reliability, proliferation resistance and physical protection.

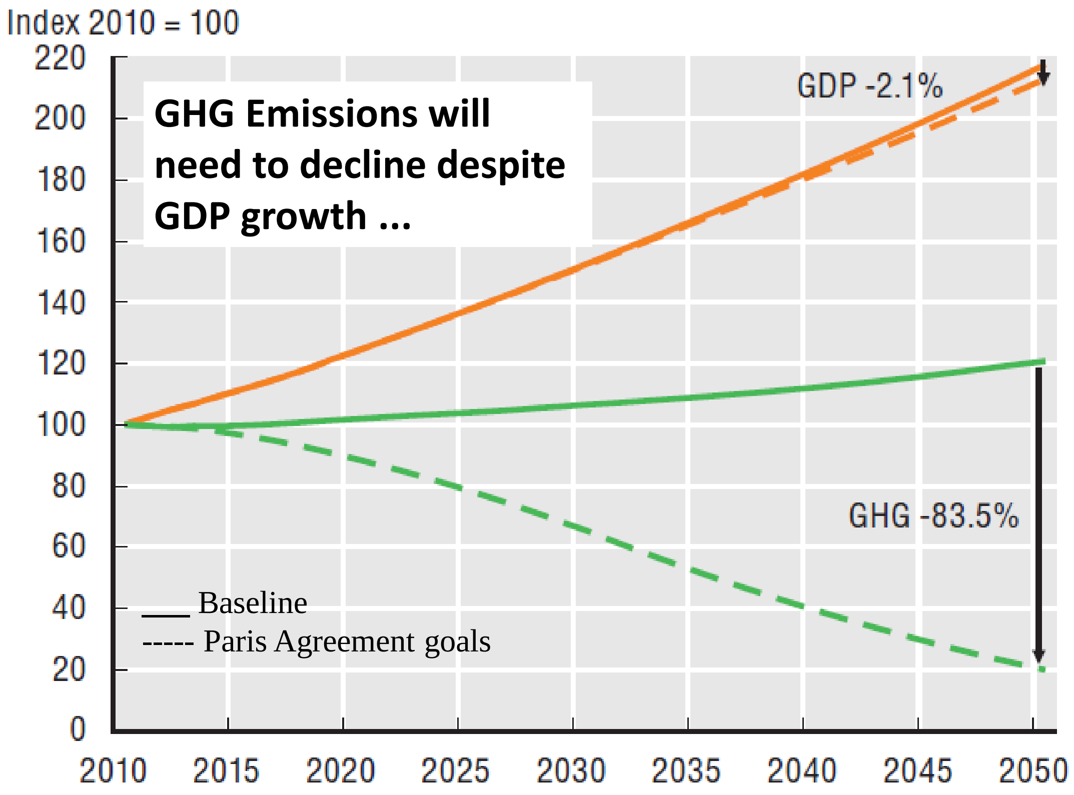
Multinational Design Evaluation Programme (MDEP) - initiative by national safety authorities to leverage their resources and knowledge for new reactor design reviews (ABWR, AES2006, AP1000, EPR, HPR1000).

International Framework for Nuclear Energy Cooperation (IFNEC) – 65-country forum for multilateral discussion and analyses of a wide array of nuclear topics involving both developed and emerging economies.

28 Major Joint Projects

- **Nuclear safety research** and experimental data (e.g., thermal-hydraulics, fuel behaviour, severe accidents).
- **Nuclear safety databases** (e.g., fire, common-cause failures).
- **Nuclear science** (e.g., thermodynamics of advanced fuels).
- **Radioactive waste management** (e.g., thermochemical database).
- **Radiological protection** (e.g., occupational exposure).
- **Nuclear Education, Skills and Technology Framework (NEST)** (promoting the development of a new generation of subject matter experts).

Paris Agreement Implies a 50 gCO2/kWh Target



Source: OECD Environmental Outlook

Paris Agreement is intended to hold "increase in global average temperature to well below 2°C".

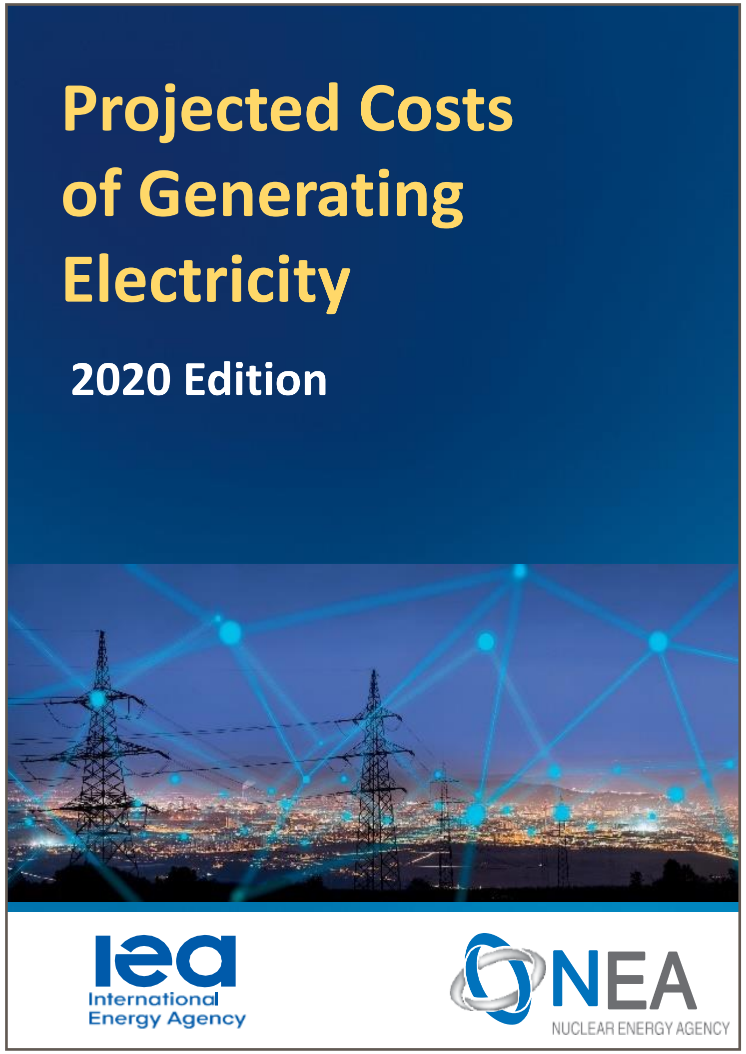
Current emission intensity is **570 gCO2/kWh** - target is **50 gCO2/kWh**

Electricity contributes 40% of global CO_2 emissions and will play key role. Annual emissions from electricity will need to decline 73% (global) and 85% (OECD countries).

Nuclear in Emissions Reduction Pathways

Organisation	Scenario	Climat e target	Nuclear innovation	Description	Role of nuclear energy by 2050	
					Capacity (GW)	Nuclear growth (2020-50)
IAEA (2021b)	High Scenario	2°C	Not included	Conservative projections based on current plans and industry announcements.	792	98%
IEA (2021c)	Net Zero Scenario (NZE)	1.5°C	Not included but HTGR and nuclear heat potential are acknowledged.	Conservative nuclear capacity estimates. NZE projects 100 gigawatts more nuclear energy than the IEA sustainable development scenario.	812	103%
Shell (2021)	Sky 1.5 Scenario	1.5°C	Not specified	Ambitious estimates based on massive investments to boost economic recovery and build resilient energy systems.	1 043	160%
IIASA (2021)	Divergent Net Zero Scenario	1.5°C	Not specified	Ambitious projections required to compensate for delayed actions and divergent climate policies.	1 232	208%
Bloomberg NEF (2021)	New Energy Outlook	1.5°C	Explicit focus on SMRs and nuclear	Highly ambitious nuclear pathway with large scale deployment of nuclear innovation.	7 080	1670%

All pathways require global installed nuclear capacity to grow significantly, often more than doubling by 2050.



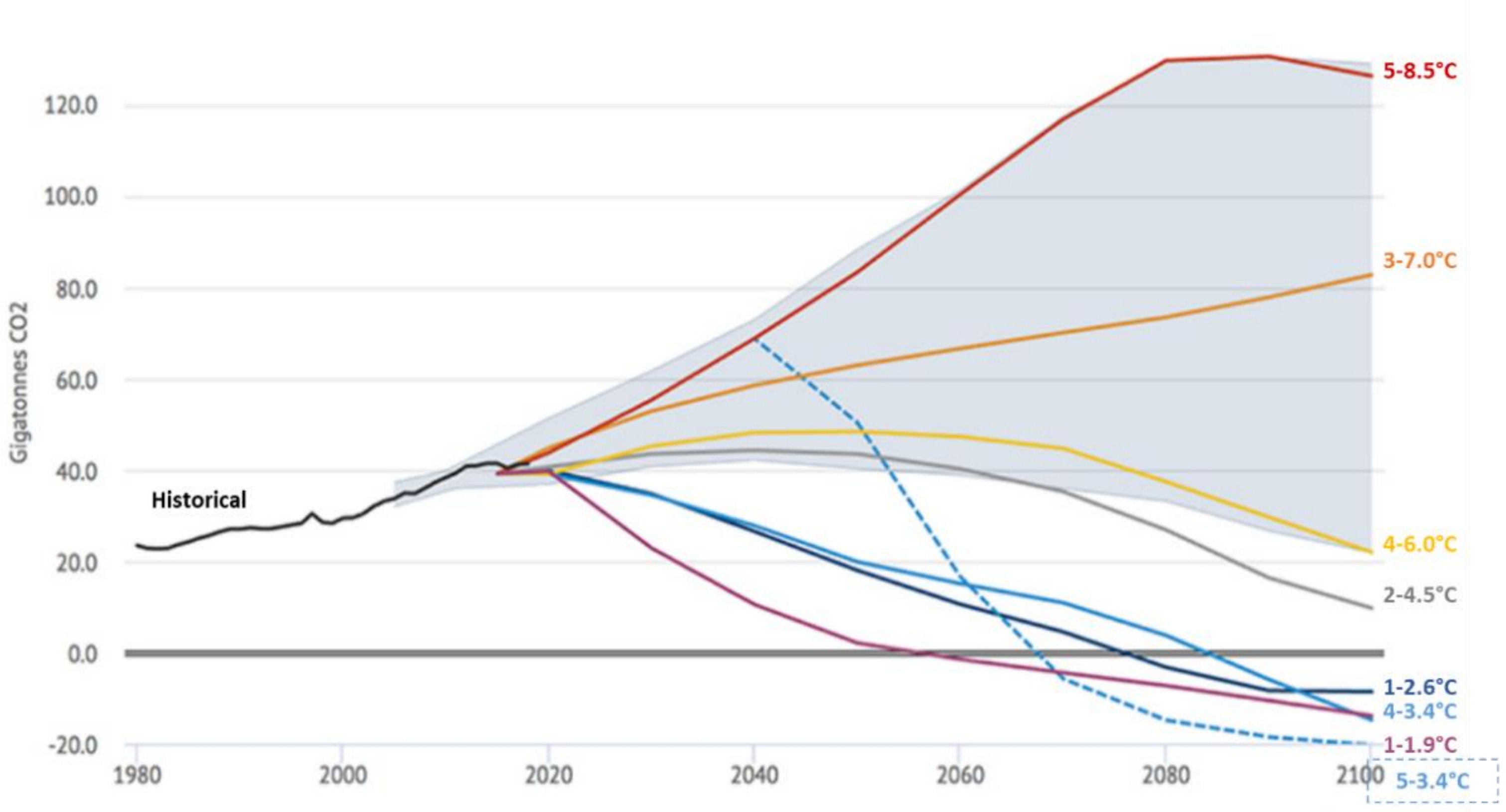
Recent NEA Work:
Broad Conclusions

- Electricity from new nuclear power plants has lower expected costs in the 2020 edition than in 2015. On average, overnight construction costs reflect cost reductions due to learning from first-of-a-kind (FOAK) projects.
- Coal is no longer competitive in most markets. Gas-fired CCGTs dependent on the gas price – very competitive in North America, less so in Asia and Europe.
- **Nuclear is the dispatchable low carbon technology with the lowest expected costs in 2025.** Only large hydro reservoirs can provide a similar contribution at comparable costs.

The World is Not on Track to Net Zero

- **The world's current path is not leading to net zero emissions of carbon.**
- The planet has a "carbon budget" of 420 gigatonnes of carbon dioxide emissions for the 1.5°C scenario.
- **At current levels of emissions, the entire carbon budget would be consumed within eight years.**
- The IPCC notes that carbon emissions need to drop 45% by 2030, but are on path to increase by 16%.

Temperature Outcomes for Various Emissions Futures



Source: Carbon Brief (2019).

Key Observations

- **Electricity use is poised to increase dramatically** across the world due to electrification of transportation and many industries.
- **Coal use is shrinking** – the US Energy Information Administration (EIA) predicts that an additional 30 GWe of US coal capacity will shut down by 2025.
- **Countries are bringing their CO_2 reduction targets forward** – generally to 2030 – thereby forcing both increased investment and reality.
- **Many countries—both OECD and emerging economies—view nuclear energy as a key element in their decarbonization strategies**

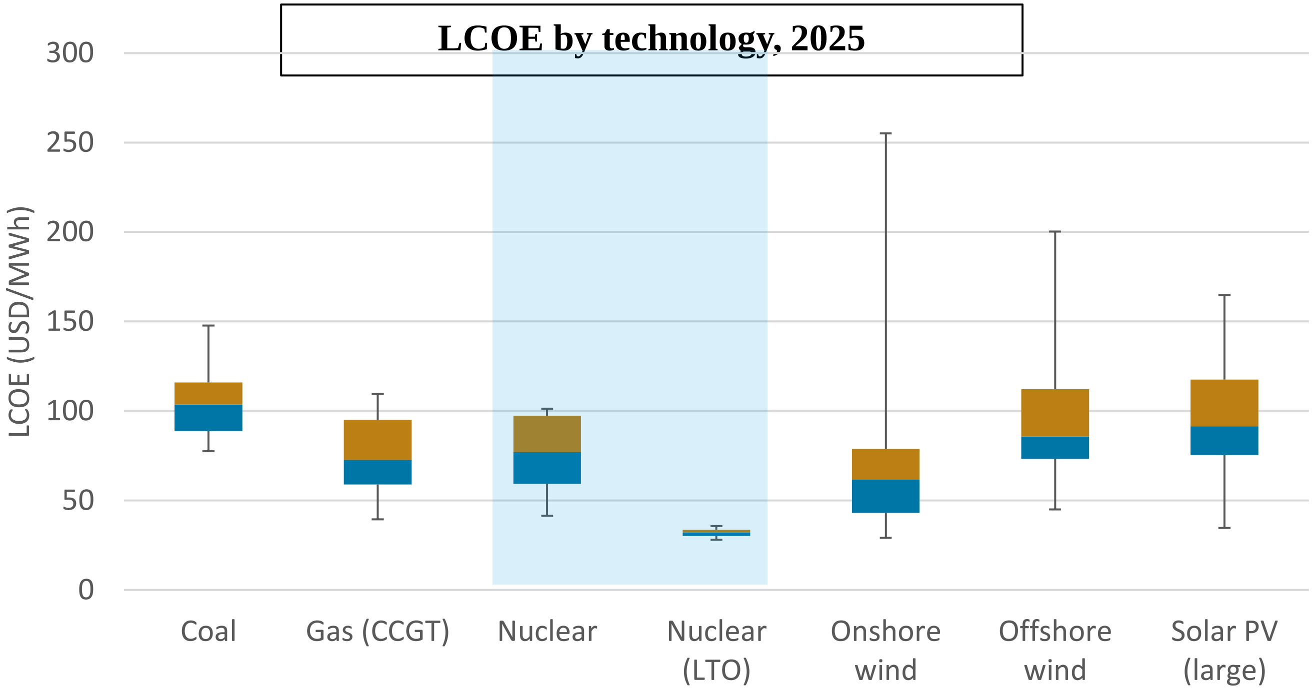
Long-Term Operation: The Least Cost Option

<u>Challenges</u>

Views of LTO vary around the world due to differing policy and regulatory approaches. For example in many countries, the 40 year mark is characterized as "plant lifetime."

Distorted, dysfunctional, and obsolete markets do not recongnise the value of existing nuclear plants to system reliability and carbon reduction.

Some governments have decided to shut down nuclear plants prematurely. **Doing so will place "net zero" further out of reach.**



Note: Coal includes lignite plants. Discount rate of 7% and carbon price of USD30/tCO2
Source: IEA/NEA (2020)

Long-term operation could save up to 49 gigatonnes of cumulative emissions between 2020 and 2050.

Recent NEA Work:
Broad Conclusions

To meet global energy and environmental requirements, **all low-carbon technologies** must be optimally applied—with all costs accurately allocated.

The **electricity markets must be modernized**. Existing market structures make investment in any unsubsidised low-carbon technology very difficult.

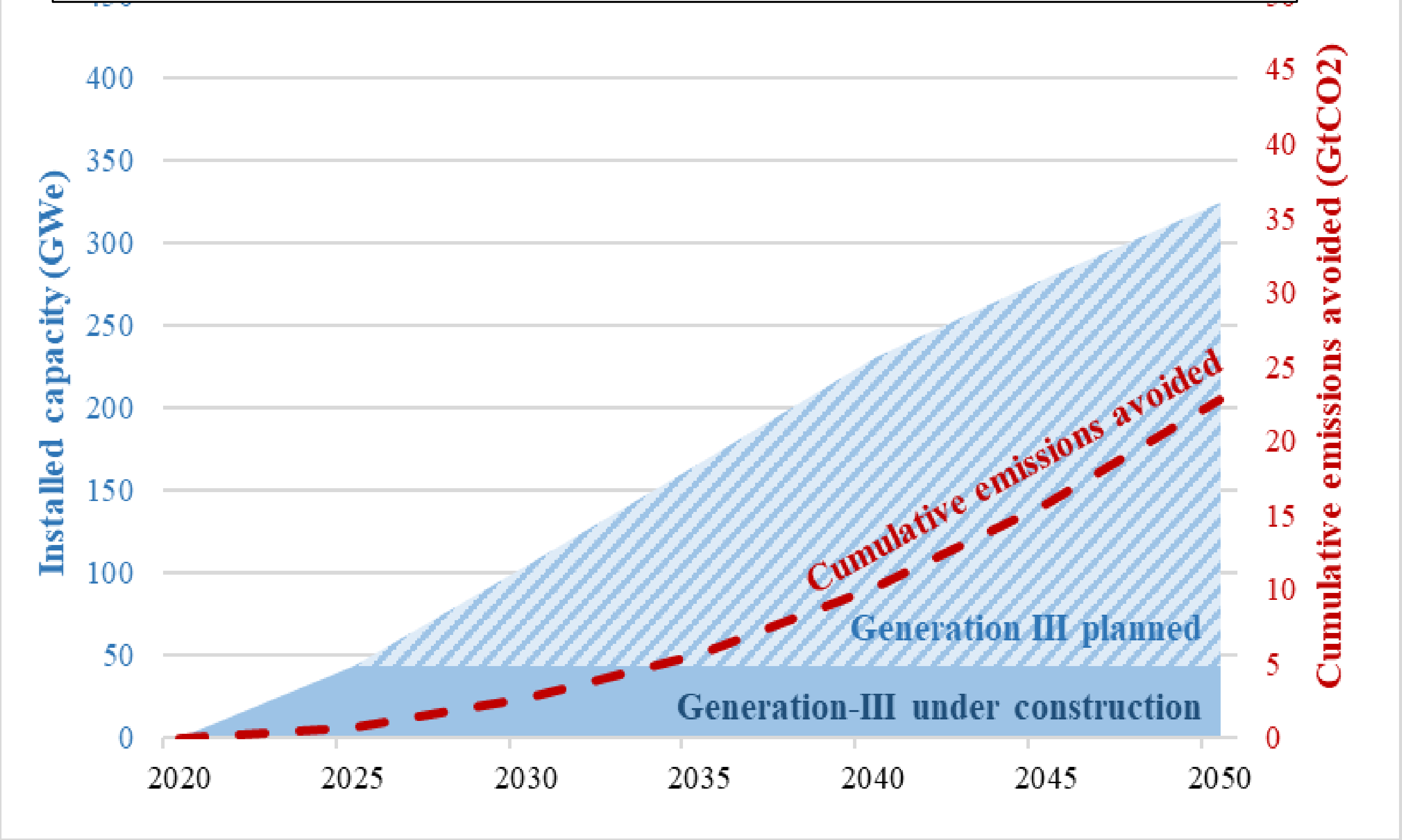
Large deployment of VRE will occur around the world – but the appropriate contribution of VRE in each country will depend on local conditions, including the cost of available resources.

Where dispatchable capacity is needed, nuclear can serve a large role—if it is compatible with evolving markets.

New Builds of Generation III Capacity

- **At the end of 2020, 55 gigawatts of new Generation III light water reactors were under construction around the world.**
- Generation III plants under construction and planned will provide over 300 gigawatts of capacity by 2050.
- **These plants will avoid 23 gigatonnes of cumulative carbon emissions between 2020 and 2050.**
- This contribution is readily expandable.

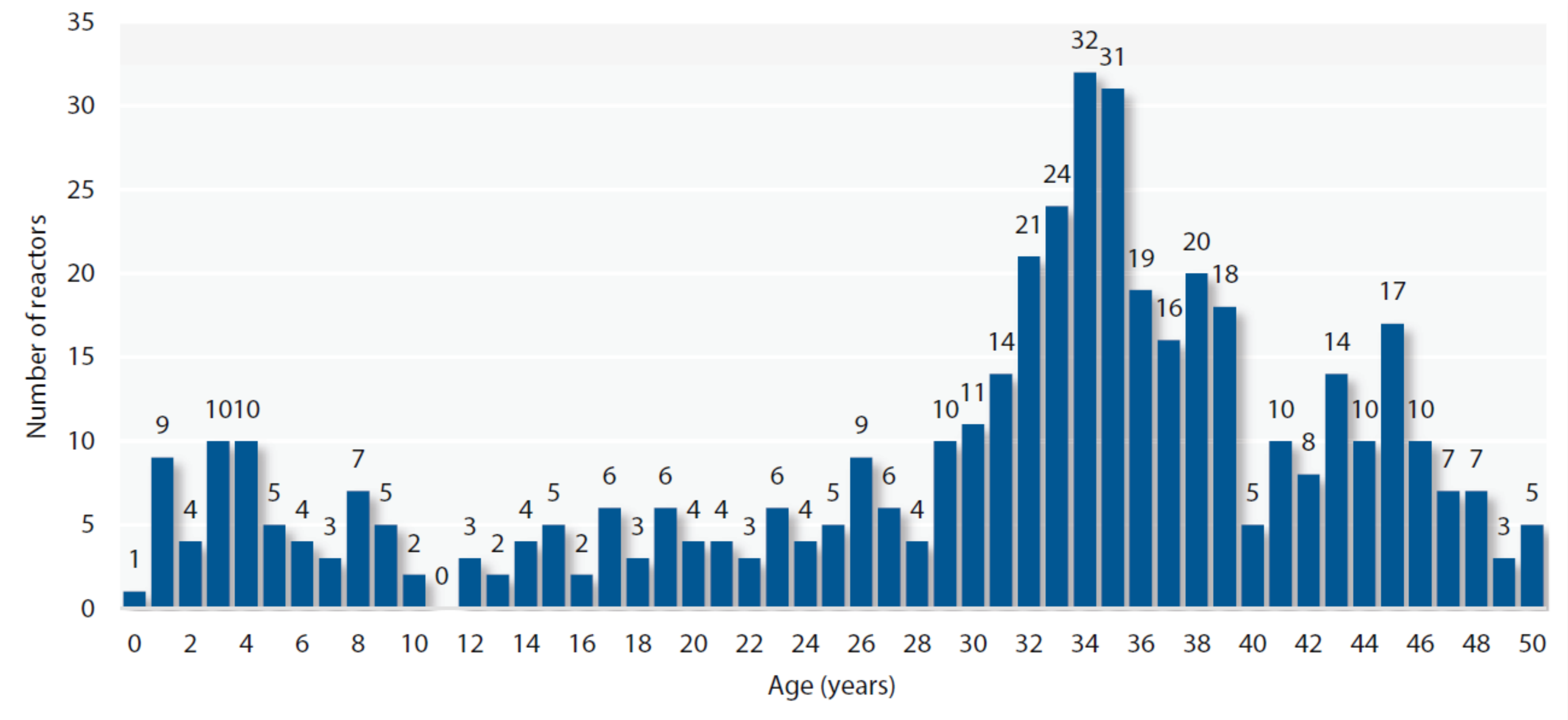
Installed Capacity And Cumulative Emissions Avoided



Source: NEA (forthcoming).

Long-Term Operation: The Least Cost Option

Figure 1.2. **Distribution of nuclear power reactors by age in the year 2019**



Source: Based on data from IAEA PRIS (accessed 21 June 2019).

www.oecd-nea.org/jcms/pl_15154/legal-frameworks-for-long-term-operation-of-nuclear-power-reactors

SMRs: Innovation in Nuclear Energy

- *New Deployment Models* — Low cost modules can be installed as needed
- *Higher Flexibility* — small reactors may load-follow and be deployed in niche markets
- *Manufacturability* — enables factory construction, increasing quality and reducing cost, uncertainty, and schedule risk
- *Safety* — SMRs typically have small potential source term and large water inventories; potential for no need for offsite emergency response

GROWING GLOBAL INTEREST IN SMRS

- **First technologies now nearing regulatory approval**
- **Major technology projects underway in US, France, UK, and other countries**
- **High interest in both OECD countries and emerging economies**

NuScale Conceptual Design

REDCOST Conclusions and Recommendations

- **The nuclear sector is transitioning from FOAK and could rapidly deliver more competitive Gen-III reactors. We can:**
  - Capitalize on lessons learned from recent Gen-III reactors
  - Prioritize maturity of design and regulatory stability
  - Consider committing to a standardised nuclear programme
- **Construction cost reduction opportunities are available at several levels**
  - Enable and sustain supply chain development and industrial performance (well articulated industrial and energy strategies)
  - Foster innovation, talent development and collaboration at all levels
- **The governance framework is essential to support competitive new nuclear construction**
  - Support robust and predictable market and financing frameworks
  - Encourage concerted stakeholder efforts
  - Tailor government involvement to programme needs

SMRs: Innovation in Nuclear Energy

- *Baseload Small Modular Reactors*
  - Low cost modules can be installed as needed
  - Higher flexibility
  - Manufacturability increases quality and reduces cost and risk
  - Safety characteristics may dispense with need for offsite EP
- *Distributed Generation/Mobile SMRs*
- *Microreactors*
- *Generation IV reactors*
  - Next generation technologies beyond LWR

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NuScale Conceptual Design

SMRs Applications and Markets

On-Grid

- Larger SMRs (200-300 MWe) are designed primarily for on-grid power generation.
- The size of SMRs is especially well-suited to coal power plant replacement.

Off-Grid

- Smaller SMRs could create an alternative to diesel generation in remote communities and at resource extraction sites.
- SMRs could be used to provide power as well as heat for various purposes such as district heating or mine-shaft heating.

Marine Merchant Shipping

- SMRs could provide a non-emitting alternative for marine merchant shipping propulsion.
- SMRs for marine merchant shipping could yield significant emissions reductions as shipping remains a very hard-to-abate industrial sector.

Heat

- Many SMRs designs will operate at higher temperatures, creating opportunities for decarbonisation of hard-to-abate sectors.
- High-temperature SMRs could create the first real non-emitting alternative to fossil fuel cogeneration by offering combined heat and power solutions for industrial customers.

SMR Categories: *Single Unit LWRs*

Design	Net output per module (MWe)	Number of modules (if applicable)	Type	Designer	Country	Status
Single Unit LWRs						
CAREM	30	1	PWR	CNEA	Argentina	Under construction
SMART	100	1	PWR	KAERI	Korea	Certified design
ACP100	125	1	PWR	CNNC	China	Construction start planned for end of 2019
SMR-160	160	1	PWR	Holtec International	United States	Conceptual design
BWRX-300	300	1	BWR	GE Hitachi	United States-Japan	Conceptual design
UK SMR	450	1	PWR	Rolls Royce	United Kingdom	Conceptual design

Lowest deployment risks

Some provide game-changing safety performance

Cost-effectiveness remains to be verified

Adapted from Oct 2019 Background Note to the Steering Committee on Nuclear Energy and IAEA Analyses

SMR Categories: *Multi-module LWRs*

Design	Net output per module (MWe)	Number of modules (if applicable)	Type	Designer	Country	Status
Multi-module LWR SMRs						
NuScale	70	12	PWR	NuScale Power	United States	Detailed design and ongoing licensing process, FOAK planned in mid-2020s
RITM-200	50	2	PWR	OKBM Afrikantov	Russia	Land-based NPP under conceptual design
Nuward	170	2 to 4	PWR	CEA/EDF/ Naval Group/ TechnicAtome	France	Conceptual Design

Lowest deployment risks

Some provide game-changing safety performance

Cost-effectiveness remains to be verified

Adapted from Oct 2019 Background Note to the Steering Committee on Nuclear Energy and IAEA Analyses

SMR Categories: *Floating SMRs*

Design	Net output per module (MWe)	Number of modules (if applicable)	Type	Designer	Country	Status
Mobile SMRs						
ACPR50S	60	1	Floating PWR	CGN	China	Under construction
KLT-40S	70	2	Floating PWR	OKBM Afrikantov	Russia	Pre-commission-ing testing

Thus far based on adapted LWR technologies (i.e., icebreaker reactors)

Uncertainties regarding regulatory and legal approach

Cost-effectiveness remains to be verified

Adapted from Oct 2019 Background Note to the Steering Committee on Nuclear Energy and IAEA Analyses

SMR Categories: *Generation IV*

Design	Net output per module (MWe)	Number of modules (if applicable)	Type	Designer	Country	Status
Generation IV SMRs						
4S	10	1	LMFR	Toshiba	Japan	Detailed design
CA Waste Burner	20	1	MSR	Copenhagen atomics	Denmark	Conceptual design
Xe-100	35	1	HTGR	X-energy LLC	United States	Conceptual design
ARC-100	100	1	LMFR	Advanced Reactor Concepts LLC	Canada	Conceptual design
KP-FHR	140	1	MSR	Kairos Power	United States	Pre-conceptual design
IMSR	190	1	MSR	Terrestrial Energy	Canada	Basic design
HTR-PM	210	2	HTGR	China Huaneng / CNEC/Tsinghua University	China	Under construction
ThorCon	250	1	MSR	Martingale Inc	United States	Basic design
EM2	265	1	GMFR	General Atomics	United States	Conceptual design
SC-HTGR	272	1	HTGR	Framatome	United States	Conceptual design
Stable Salt reactor	300	1	MSR	Moltex Energy	United Kingdom	Pre-conceptual design
Westinghouse lead fast reactor	450	1	LMFR	Westinghouse	United States	Conceptual design

Regulatory approvals still to come for non-LWR designs

Some technologies are close – others still conceptual

Cost-effectiveness remains to be verified

Adapted from Oct 2019 Background Note to the Steering Committee on Nuclear Energy and IAEA Analyses

SMR Categories: *MMRs*

Design	Net output per module (MWe)	Number of modules (if applicable)	Type	Designer	Country	Status
Micro Modular Reactors (MMRs)						
eVinci	0.2-5	1	Heat pipe reactor	Westinghouse	United States	Basic design
Oklo	2	1	LMFR	Oklo	United States	Basic design
UBattery	4	1	HTGR	Urenco and partners	United Kingdom	Basic design
MMR	5-10	1	HTGR	USNC	United States	Basic design
LFR-TL-X	5-20	1	LMFR	Hydromine Nuclear Energy	Luxembourg	Conceptual design

Adapted from Oct 2019 Background Note to the Steering Committee on Nuclear Energy and IAEA Analyses

Various regulatory issues to be resolved

Uncertainties regarding approach and approval by security officials

Cost-effectiveness remains to be verified

Deploying SMRs and Advanced Reactors is a Global Challenge

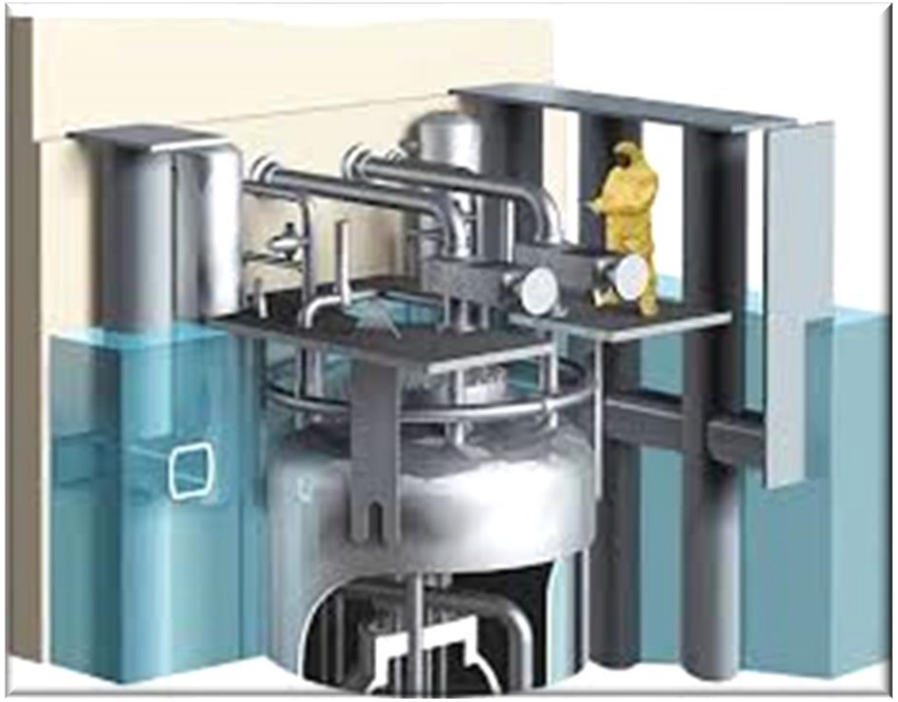
- Development and licencing of most technologies will be very expensive; some development, testing, and licencing costs could be shared

- Strategies for global deployment are highly desirable:
  - *Success for small reactors requires significant production runs; good economies of sale are difficult if they are effectively limited to home markets*
  - *Like aircraft and other high-investment products, access to global markets is essential*

- Regulators can become showstoppers to the deployment of new innovations if requirements are different in each country

More Key Observations

- A small number of national regulators already apply risk-based approaches and have the frameworks in place to license new technologies
- However, **most nuclear safety regulators in OECD countries are not prepared** to receive these new technologies
- Adopting **new nuclear technologies in emerging economies** will present special regulatory challenges
- Without a more harmonised global approach, nuclear **regulators risk becoming obstacles** to broad deployment of innovative nuclear designs



Harmonization of Regulations

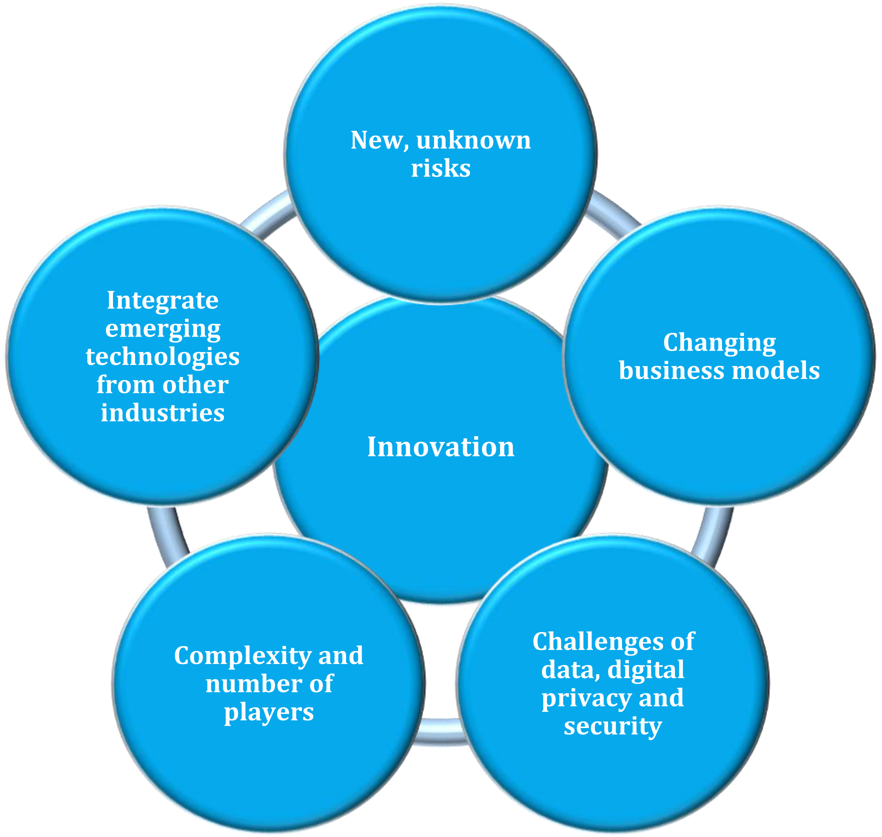
Challenges

The nuclear sector does not have an integrated global framework, which makes international harmonization very difficult

Harmonizing licensing processes is a major challenge, due in part to the structure of the industry and its regulatory framework

Nuclear is different from other sectors but there are lessons to be learned (e.g. aviation industry engages regulators at early stages)

Time is too short to re-invent the nuclear sector; we must adapt current frameworks.



Harmonization of Regulations

NEA Multi-sector Workshop on Innovative Regulation: Challenges and Benefits of Harmonizing the Licensing Process for Emerging Technologies

The NEA, in cooperation with the Canadian Nuclear Safety Commission (CNSC) hosted an international workshop in December 2020 that brought together regulators, industry, and various stakeholders to share information between the nuclear sector and other highly regulated industries (e.g., aviation, medical, transportation of nuclear material) towards harmonized regulatory processes in the context of innovation.

The workshop focused on practical examples of how regulators can address two key challenges:

How should regulators approach licensing of innovative and disruptive technologies?
How can regulators leverage international cooperation?

www.oecd-nea.org/jcms/pl_46728/multi-sector-workshop-on-innovative-regulation-challenges-and-benefits-of-harmonising-the-licensing-process-for-emerging-technologies

For Climate Action to be Successful,
An Enhanced Vision of the Future is Needed



If action on climate is associated with limits to life, economic growth, and freedom, a successful energy transition will be extremely difficult.

Innovative Nuclear Technologies Help Provide a Solution Set

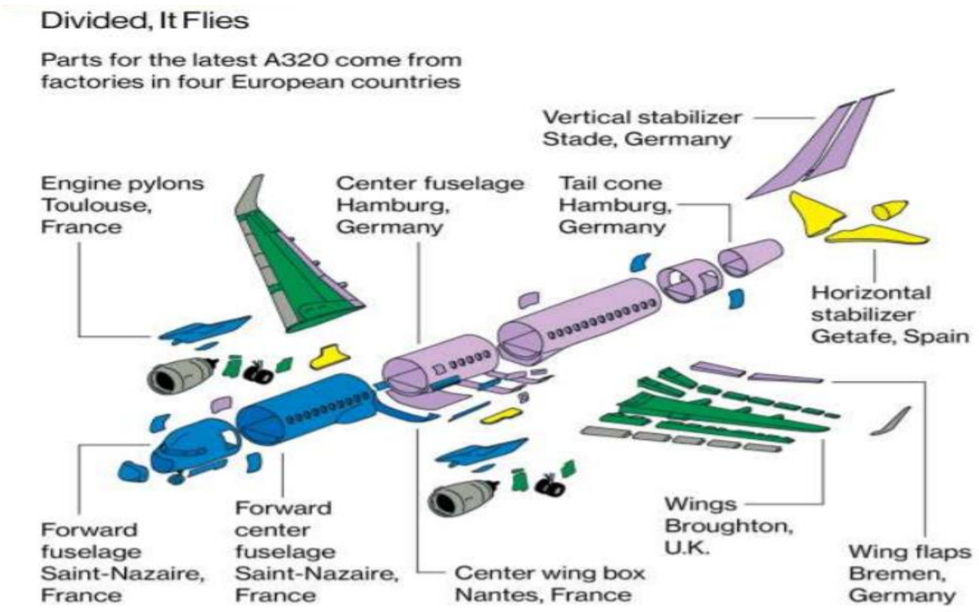
Harmonization of Regulations

Example: Lessons from the Aviation Sector

Unlike nuclear, the aviation industry developed with international exports in mind from the beginning – leading to a need to harmonize from the outset

Modernization and innovation is desired by all players in the sector (including regulators) and is built on existing structures

Governments, regulators, manufacturers, airlines, researchers, and academia collaborate to set global industry standards



The aviation example shows that design and technology are only a part of the regulation and innovation picture; there is a vital need to focus on the supporting infrastructures – especially industry standards

Thank you for your attention

More information @ www.oecd-nea.org

All NEA reports are available for download free of charge.

Follow us:

Unlocking Reductions in the Construction Costs of Nuclear:

A Practical Guide for Stakeholders

Launched July 2020

INLA
INTERNATIONAL NUCLEAR LAW ASSOCIATION

SPECIAL PRESENTATION:

William D. Magwood, IV

Director-General, Organization for Economic Co-operation and Development (OECD), Nuclear Energy Agency (NEA)

2021 Nuclear Inter Jura Virtual Congress
International Nuclear Law Association - United States Chapter

The New Nuclear Energy Future:
Opportunities and Challenges

William D. Magwood, IV
Director-General
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Bulgaria	Canada	Czech Republic	Denmark
Finland	France	Germany	Greece
Hungary	Iceland	Ireland	Italy
Japan	Korea	Luxembourg	Mexico
Netherlands	Norway	Poland	Portugal
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Spain	Sweden	Switzerland	Turkey
United Kingdom	United States		

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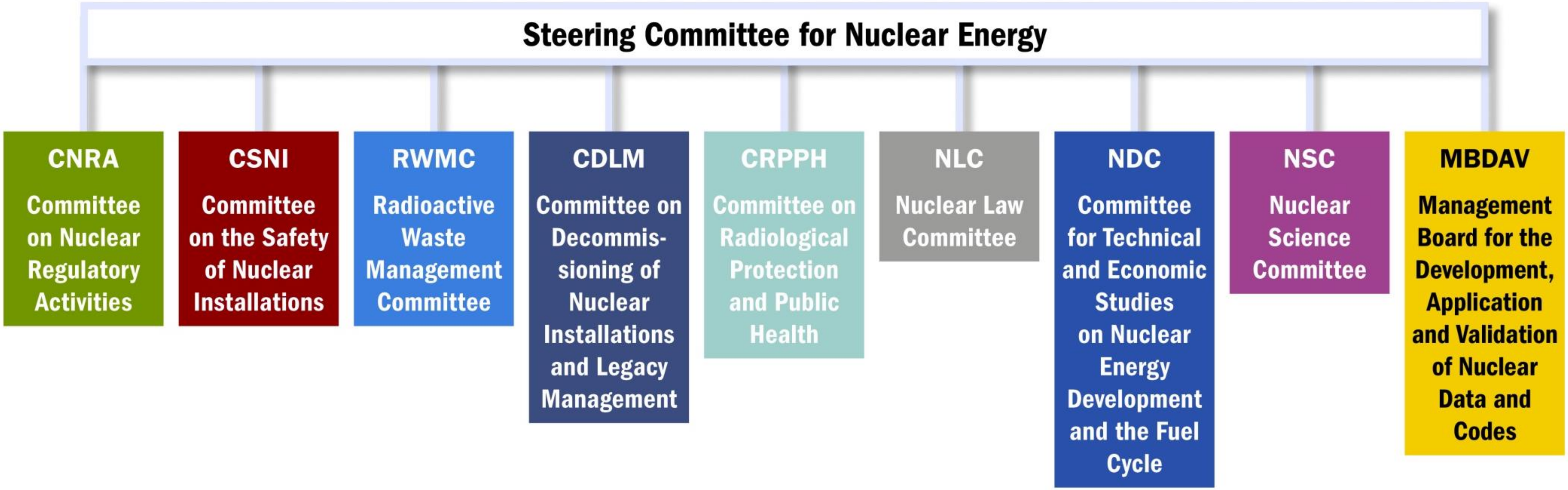

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- **Working Party on Deep Geological Repositories and Nuclear Liability (WPDGR)**: composed of lawyers, waste and RP experts, the WP assesses how the nuclear liability regimes should apply to DGR projects and whether the outcomes agreed for DGRs can also be applied to near surface disposal facilities. Report due in 2023.

NEA Legal Publication Programme

Nuclear Law Bulletin

- A unique publication in the nuclear law field
- Published twice each year in French and English

Special Publications

- Japan's Compensation System for Nuclear Damage (2012)
- *Tables on Operator Liability amounts and Financial Security Limits, priority rules and principle of reciprocity*
- *Map on ratification status of all nuclear liability conventions*

On-line Nuclear Legislation

- Country reports and legislative texts

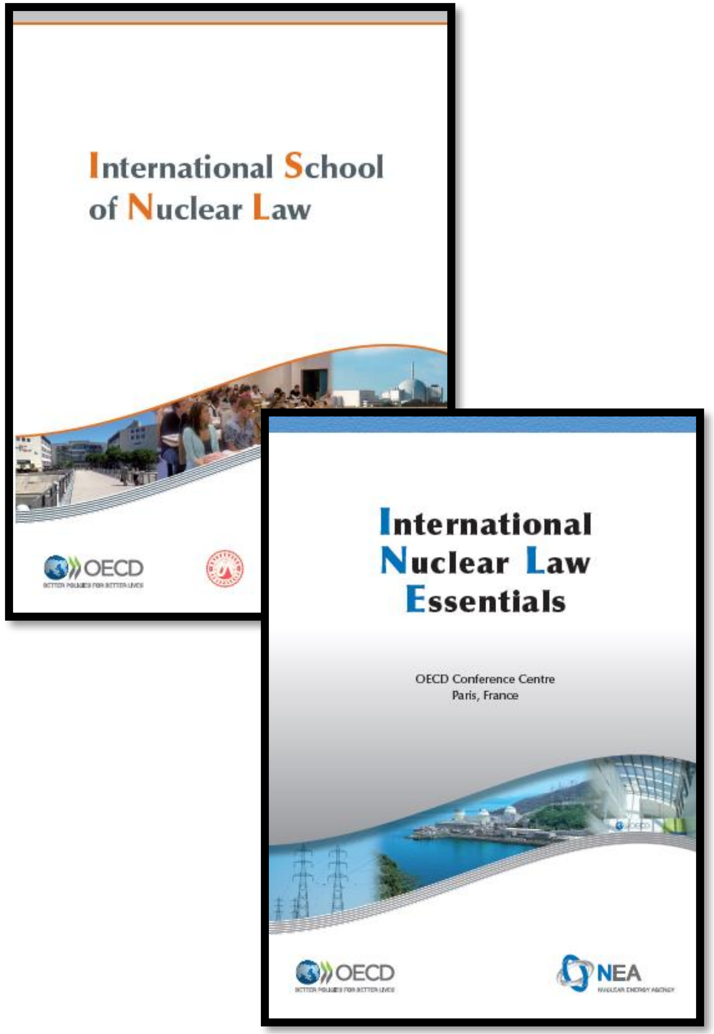
NEA Education Programmes

International School of Nuclear Law (ISNL)

- A two-week programme organised in cooperation with the University of Montpellier (Established in 2000)
- Features lectures legal and technical experts from NEA, IAEA, and from around the world
- More than 1000 people have participated since its inception

International Nuclear Law Essentials (INLE)

- A one-week course held in Paris that builds on the foundation of the ISNL (Established in 2011)
- Next session will be held on-line in February 2022.



NEA Global Forum on Nuclear Education, Science, Technology and Policy

First Global Forum Exploratory Meeting
Paris, 24-25 July 2019

The NEA has established the **Global Forum on Nuclear Education, Science, Technology and Policy** as a framework to :

– Engagement with academic institutions which are responsible for developing the next generation of nuclear science and technology experts.

– Bring long-term, creative thinking to address international policy challenges that nuclear energy faces today as input to NEA processes.

– Provide academic institutions around the world with the world's first global framework for interaction, cooperation, and collective action.

Major International Cooperative Frameworks

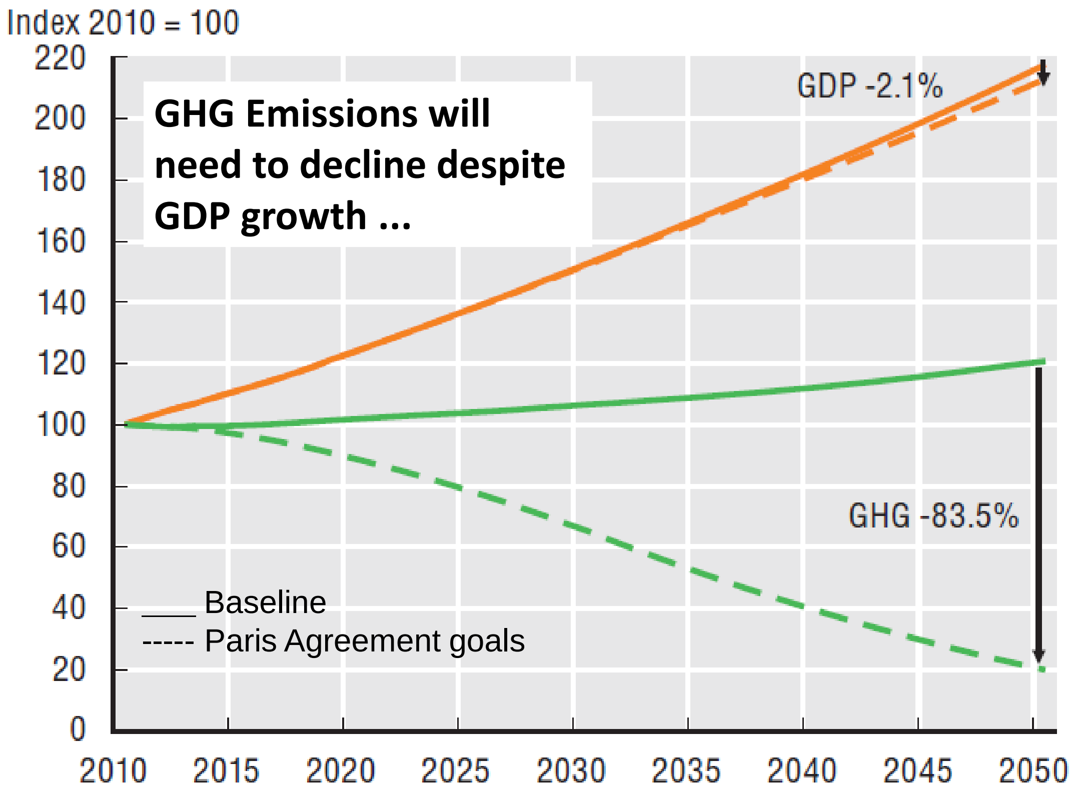
NEA Serviced Bodies

- **Generation IV International Forum (GIF)** with the goal to develop new fission technologies with greater sustainability (including effective fuel utilisation and minimisation of waste), economic performance, safety and reliability, proliferation resistance and physical protection.
- **Multinational Design Evaluation Programme (MDEP) -** initiative by national safety authorities to leverage their resources and knowledge for new reactor design reviews (ABWR, AES2006, AP1000, EPR, HPR1000).
- **International Framework for Nuclear Energy Cooperation (IFNEC) –** 65-country forum for multilateral discussion and analyses of a wide array of nuclear topics involving both developed and emerging economies.

28 Major Joint Projects

- **Nuclear safety research** and experimental data (e.g., thermal-hydraulics, fuel behaviour, severe accidents).
- **Nuclear safety databases** (e.g., fire, common-cause failures).
- **Nuclear science** (e.g., thermodynamics of advanced fuels).
- **Radioactive waste management** (e.g., thermochemical database).
- **Radiological protection** (e.g., occupational exposure).
- **Nuclear Education, Skills and Technology Framework (NEST)** (promoting the development of a new generation of subject matter experts).

Paris Agreement Implies a 50 gCO2/kWh Target



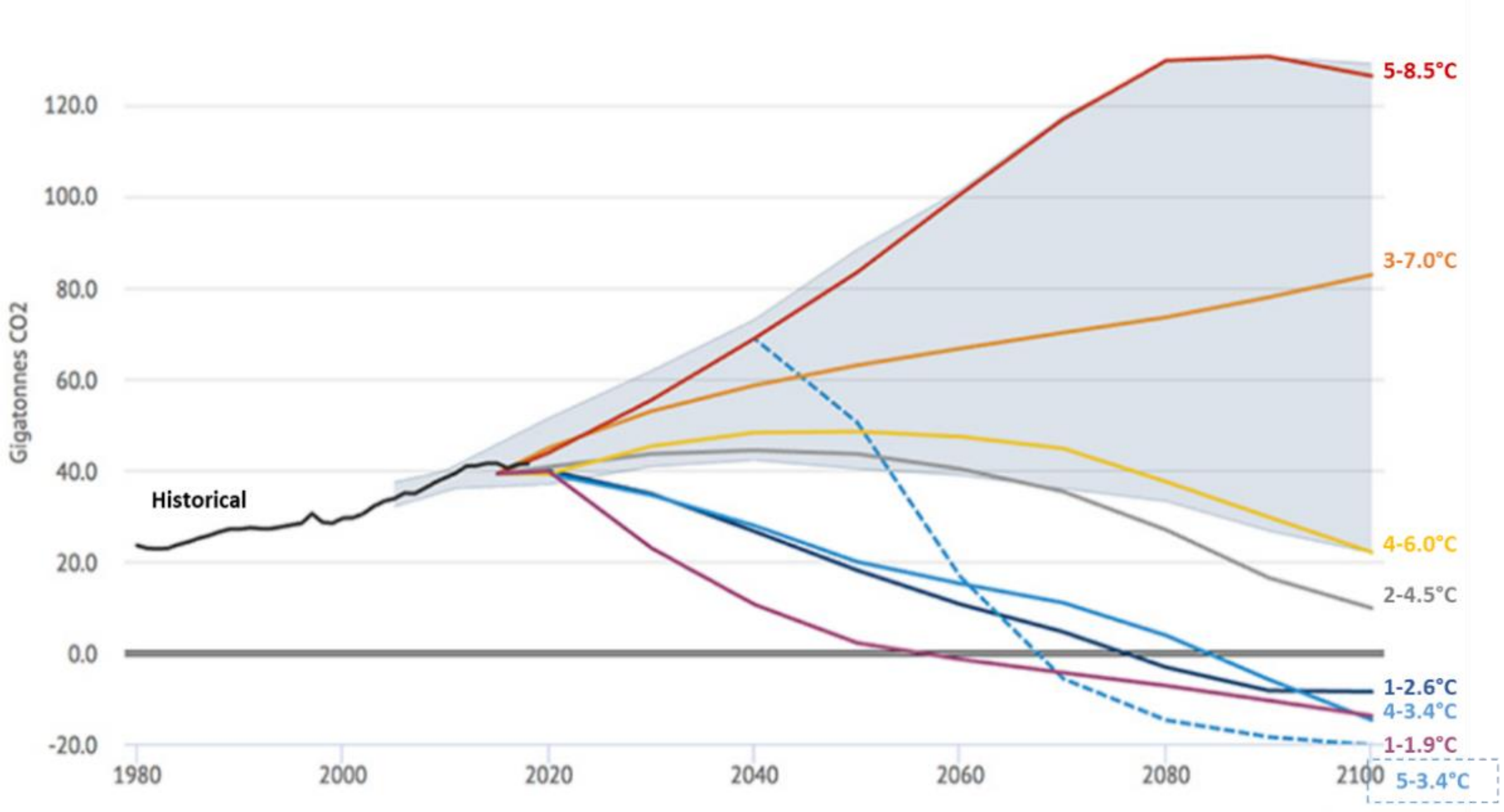
Source: OECD Environmental Outlook

- Paris Agreement is intended to hold "increase in global average temperature to well below 2°C".
- Current emission intensity is **570 gCO2/kWh** - target is **50 gCO2/kWh**
- **Electricity contributes 40% of global CO_2 emissions and will play key role.** Annual emissions from electricity will need to decline 73% (global) and 85% (OECD countries).

The World is Not on Track to Net Zero

- **The world's current path is not leading to net zero emissions of carbon.**
- The planet has a "carbon budget" of 420 gigatonnes of carbon dioxide emissions for the 1.5°C scenario.
- **At current levels of emissions, the entire carbon budget would be consumed within eight years.**
- The IPCC notes that carbon emissions need to drop 45% by 2030, but are on path to increase by 16%.

Temperature Outcomes for Various Emissions Futures



Source: Carbon Brief (2019).

Nuclear in Emissions Reduction Pathways

Organisation	Scenario	Climate target	Nuclear innovation	Description	Role of nuclear energy by 2050	
					Capacity (GW)	Nuclear growth (2020-50)
IAEA (2021b)	High Scenario	2°C	Not included	Conservative projections based on current plans and industry announcements.	792	98%
IEA (2021c)	Net Zero Scenario (NZE)	1.5°C	Not included but HTGR and nuclear heat potential are acknowledged.	Conservative nuclear capacity estimates. NZE projects 100 gigawatts more nuclear energy than the IEA sustainable development scenario.	812	103%
Shell (2021)	Sky 1.5 Scenario	1.5°C	Not specified	Ambitious estimates based on massive investments to boost economic recovery and build resilient energy systems.	1 043	160%
IIASA (2021)	Divergent Net Zero Scenario	1.5°C	Not specified	Ambitious projections required to compensate for delayed actions and divergent climate policies.	1 232	208%
Bloomberg NEF (2021)	New Energy Outlook Red Scenario	1.5°C	Explicit focus on SMRs and nuclear hydrogen	Highly ambitious nuclear pathway with large scale deployment of nuclear innovation.	7 080	1670%

All pathways require global installed nuclear capacity to grow significantly, often more than doubling by 2050.

Key Observations

- **Electricity use is poised to increase dramatically** across the world due to electrification of transportation and many industries.
- **Coal use is shrinking** – the US Energy Information Administration (EIA) predicts that an additional 30 GWe of US coal capacity will shut down by 2025.
- **Countries are bringing their CO_2 reduction targets forward** – generally to 2030 – thereby forcing both increased investment and reality.
- **Many countries—both OECD and emerging economies—view nuclear energy as a key element in their decarbonization strategies**

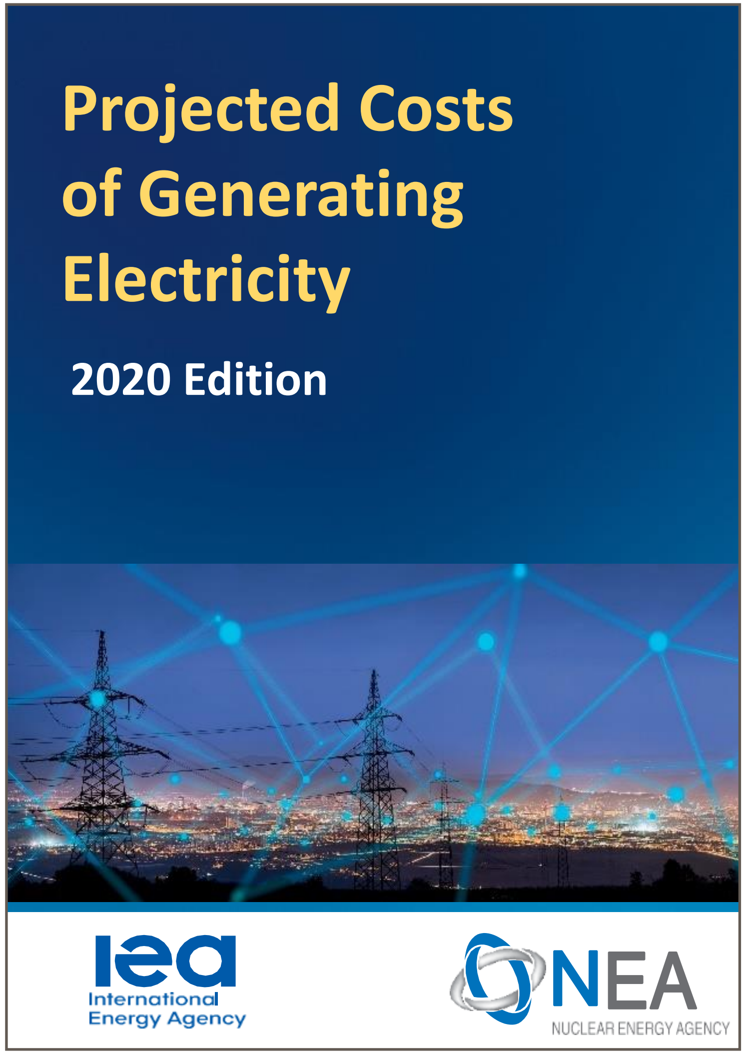
Recent NEA Work:
Broad Conclusions

- To meet global energy and environmental requirements, **all low-carbon technologies** must be optimally applied—with all costs accurately allocated.

- The **electricity markets must be modernized**. Existing market structures make investment in any unsubsidised low-carbon technology very difficult.

- Large deployment of VRE will occur around the world – but the appropriate contribution of VRE in each country will depend on local conditions, including the cost of available resources.

- **Where dispatchable capacity is needed, nuclear can serve a large role—if it is compatible with evolving markets.**



Recent NEA Work:
Broad Conclusions

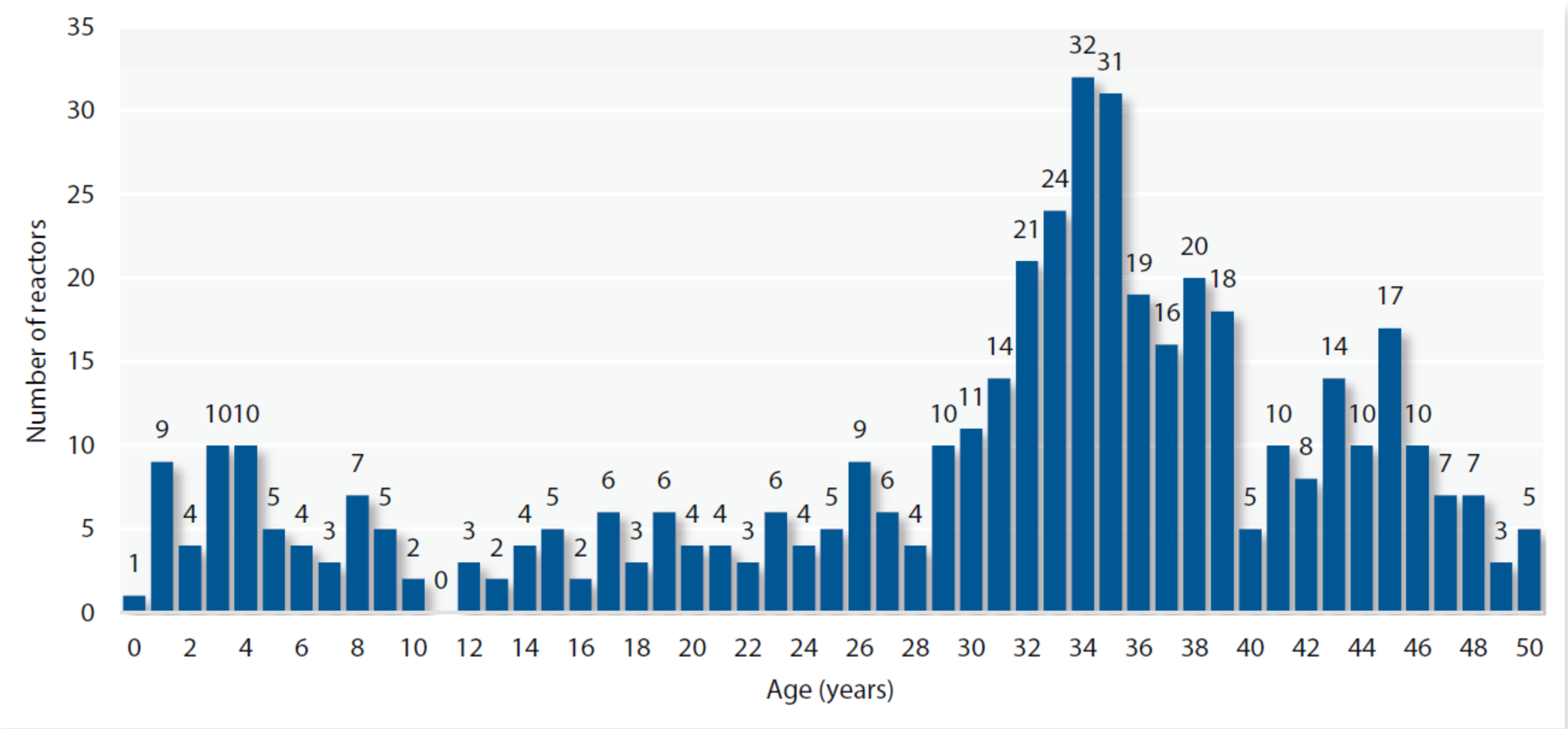
- Electricity from new nuclear power plants has lower expected costs in the 2020 edition than in 2015. On average, overnight construction costs reflect cost reductions due to learning from first-of-a-kind (FOAK) projects.

- Coal is no longer competitive in most markets. Gas-fired CCGTs dependent on the gas price – very competitive in North America, less so in Asia and Europe.

- **Nuclear is the dispatchable low carbon technology with the lowest expected costs in 2025.** Only large hydro reservoirs can provide a similar contribution at comparable costs.

Long-Term Operation: The Least Cost Option

Figure 1.2. **Distribution of nuclear power reactors by age in the year 2019**



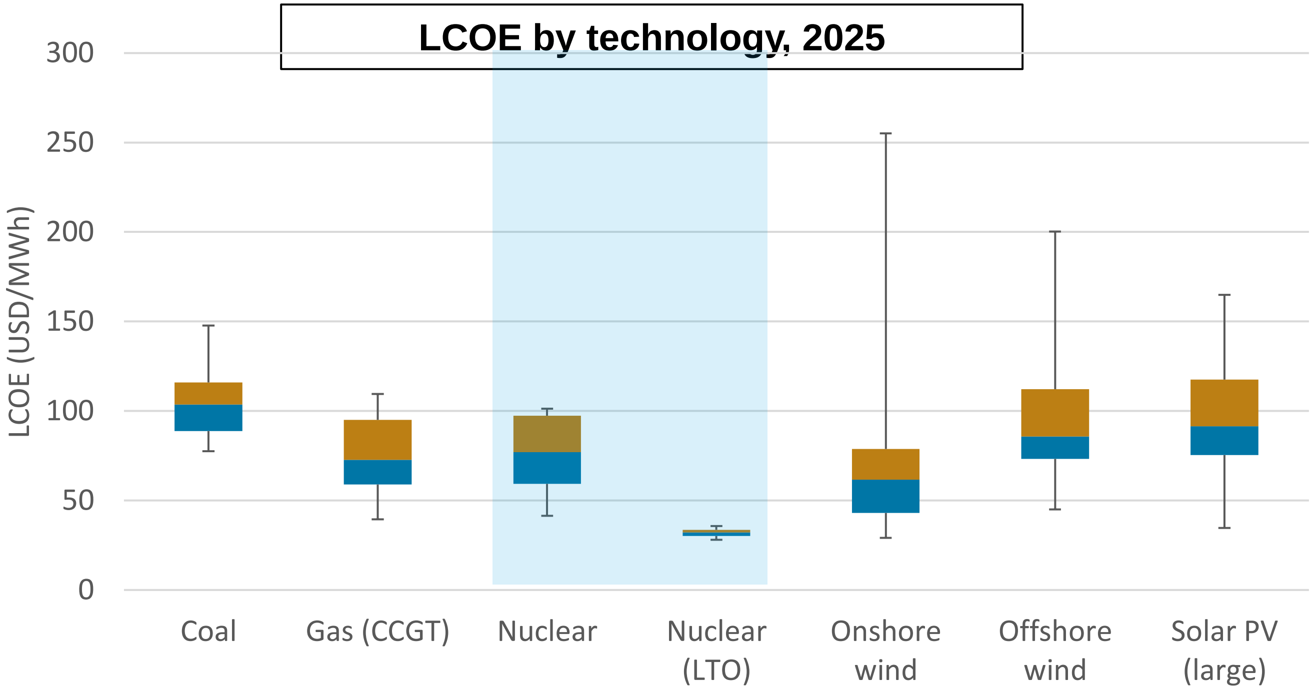
Source: Based on data from IAEA PRIS (accessed 21 June 2019).

www.oecd-nea.org/jcms/pl_15154/legal-frameworks-for-long-term-operation-of-nuclear-power-reactors

Long-Term Operation: The Least Cost Option

Challenges

- **Views of LTO vary around the world due to differing policy and regulatory approaches.** For example in many countries, the 40 year mark is characterized as "plant lifetime."
- Distorted, dysfunctional, and obsolete markets do not recongnise the value of existing nuclear plants to system reliability and carbon reduction.
- Some governments have decided to shut down nuclear plants prematurely. **Doing so will place "net zero" further out of reach.**

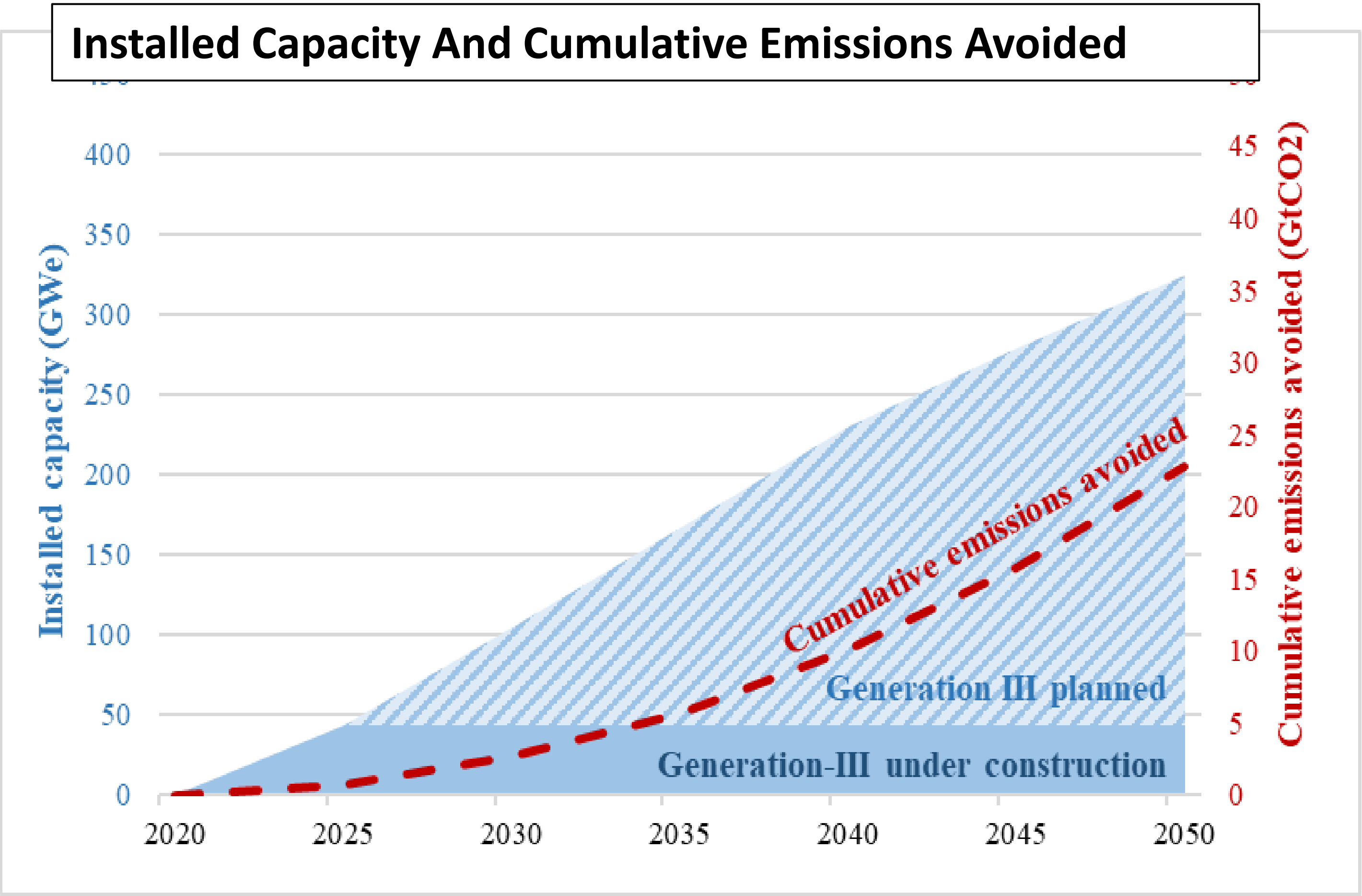


Note: Coal includes lignite plants. Discount rate of 7% and carbon price of USD30/tCO2
Source: IEA/NEA (2020)

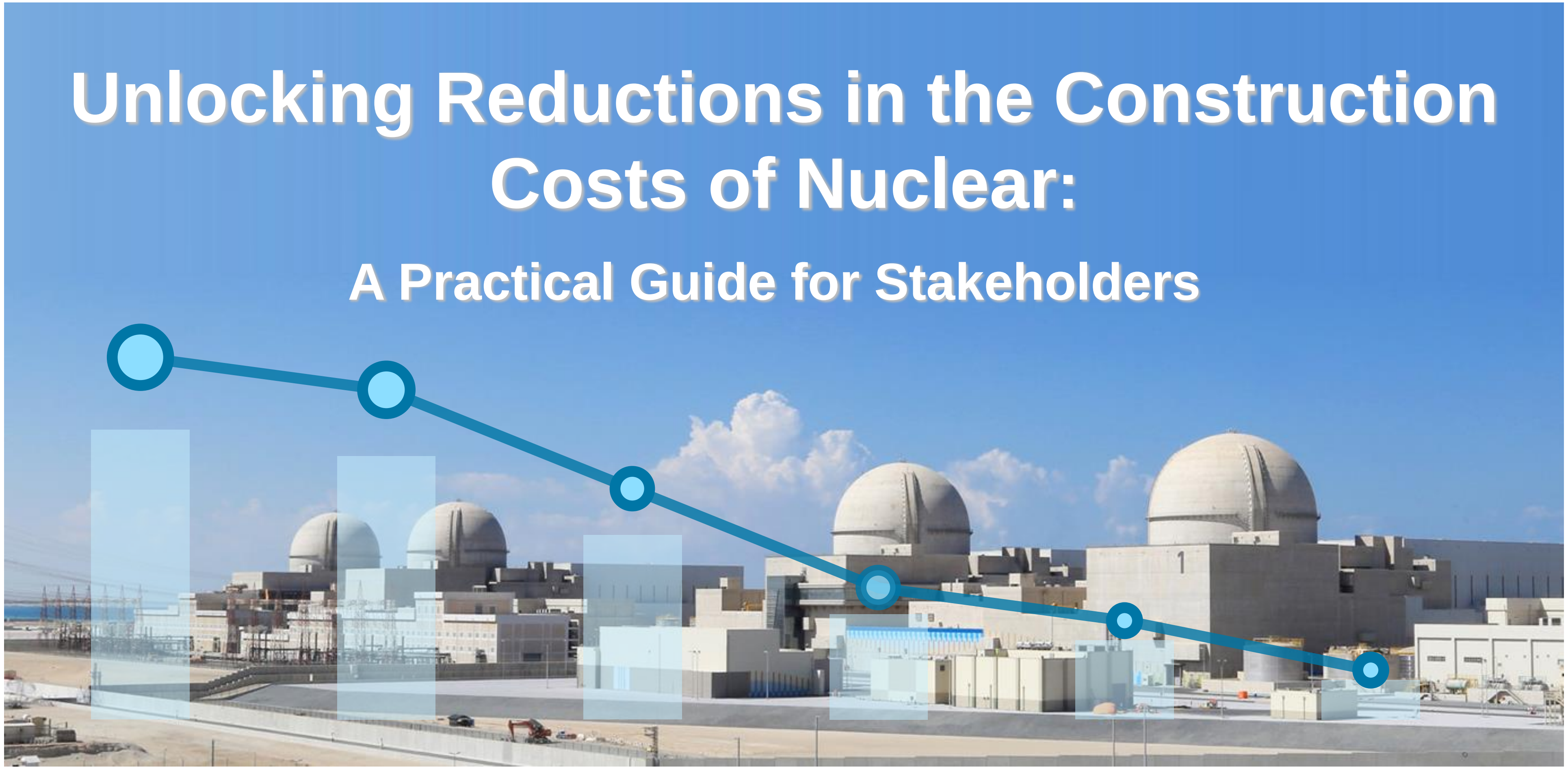
Long-term operation could save up to 49 gigatonnes of cumulative emissions between 2020 and 2050.

New Builds of Generation III Capacity

- **At the end of 2020, 55 gigawatts of new Generation III light water reactors were under construction around the world.**
- Generation III plants under construction and planned will provide over 300 gigawatts of capacity by 2050.
- **These plants will avoid 23 gigatonnes of cumulative carbon emissions between 2020 and 2050.**
- This contribution is readily expandable.



Source: NEA (forthcoming).



Launched July 2020

REDCOST Conclusions and Recommendations

- **The nuclear sector is transitioning from FOAK and could rapidly deliver more competitive Gen-III reactors. We can:**
  - Capitalize on lessons learned from recent Gen-III reactors
  - Prioritize maturity of design and regulatory stability
  - Consider committing to a standardised nuclear programme
- **Construction cost reduction opportunities are available at several levels**
  - Enable and sustain supply chain development and industrial performance (well articulated industrial and energy strategies)
  - Foster innovation, talent development and collaboration at all levels
- **The governance framework is essential to support competitive new nuclear construction**
  - Support robust and predictable market and financing frameworks
  - Encourage concerted stakeholder efforts
  - Tailor government involvement to programme needs

SMRs: Innovation in Nuclear Energy

- ***New Deployment Models*** — Low cost modules can be installed as needed
- ***Higher Flexibility*** — small reactors may load-follow and be deployed in niche markets
- ***Manufacturability*** — enables factory construction, increasing quality and reducing cost, uncertainty, and schedule risk
- ***Safety*** — SMRs typically have small potential source term and large water inventories; potential for no need for offsite emergency response

GROWING GLOBAL INTEREST IN SMRS

- **First technologies now nearing regulatory approval**
- **Major technology projects underway in US, France, UK, and other countries**
- **High interest in both OECD countries and emerging economies**

NuScale Conceptual Design

SMRs: Innovation in Nuclear Energy

- ***Baseload Small Modular Reactors***
  - Low cost modules can be installed as needed
  - Higher flexibility
  - Manufacturability increases quality and reduces cost and risk
  - Safety characteristics may dispense with need for offsite EP
- ***Distributed Generation/Mobile SMRs***
- ***Microreactors***
- ***Generation IV reactors***
  - Next generation technologies beyond LWR

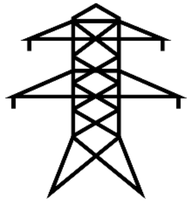
GROWING GLOBAL INTEREST IN SMRS

- **First technologies now nearing regulatory approval**
- **Major technology projects underway in US, France, UK, and other countries**
- **High interest in both OECD countries and emerging economies**

NuScale Conceptual Design

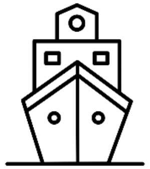
SMRs Applications and Markets

On-Grid



- Larger SMRs (200-300 MWe) are designed primarily for on-grid power generation.
- The size of SMRs is especially well-suited to coal power plant replacement.

Marine Merchant Shipping



- SMRs could provide a non-emitting alternative for marine merchant shipping propulsion.
- SMRs for marine merchant shipping could yield significant emissions reductions as shipping remains a very hard-to-abate industrial sector.

Off-Grid

- Smaller SMRs could create an alternative to diesel generation in remote communities and at resource extraction sites.
- SMRs could be used to provide power as well as heat for various purposes such as district heating or mine-shaft heating.

Heat

- Many SMRs designs will operate at higher temperatures, creating opportunities for decarbonisation of hard-to-abate sectors.
- High-temperature SMRs could create the first real non-emitting alternative to fossil fuel cogeneration by offering combined heat and power solutions for industrial customers.

SMR Categories: *Single Unit LWRs*

Design	Net output per module (MWe)	Number of modules (if applicable)	Type	Designer	Country	Status
Single Unit LWRs						
CAREM	30	1	PWR	CNEA	Argentina	Under construction
SMART	100	1	PWR	KAERI	Korea	Certified design
ACP100	125	1	PWR	CNNC	China	Construction start planned for end of 2019
SMR-160	160	1	PWR	Holtec International	United States	Conceptual design
BWRX-300	300	1	BWR	GE Hitachi	United States-Japan	Conceptual design
UK SMR	450	1	PWR	Rolls Royce	United Kingdom	Conceptual design

- Lowest deployment risks
- Some provide game-changing safety performance
- Cost-effectiveness remains to be verified

Adapted from Oct 2019 Background Note to the Steering Committee on Nuclear Energy and IAEA Analyses

SMR Categories: *Multi-module LWRs*

Design	Net output per module (MWe)	Number of modules (if applicable)	Type	Designer	Country	Status
Multi-module LWR SMRs						
NuScale	70	12	PWR	NuScale Power	United States	Detailed design and ongoing licensing process, FOAK planned in mid-2020s
RITM-200	50	2	PWR	OKBM Afrikantov	Russia	Land-based NPP under conceptual design
Nuward	170	2 to 4	PWR	CEA/EDF/ Naval Group/ TechnicAtome	France	Conceptual Design

- Lowest deployment risks
- Some provide game-changing safety performance
- Cost-effectiveness remains to be verified

Adapted from Oct 2019 Background Note to the Steering Committee on Nuclear Energy and IAEA Analyses

SMR Categories: *Floating SMRs*

Design	Net output per module (MWe)	Number of modules (if applicable)	Type	Designer	Country	Status
Mobile SMRs						
ACPR50S	60	1	Floating PWR	CGN	China	Under construction
KLT-40S	70	2	Floating PWR	OKBM Afrikantov	Russia	Pre-commission-ing testing

- Thus far based on adapted LWR technologies (i.e., icebreaker reactors)
- Uncertainties regarding regulatory and legal approach
- Cost-effectiveness remains to be verified

Adapted from Oct 2019 Background Note to the Steering Committee on Nuclear Energy and IAEA Analyses

SMR Categories: *MMRs*

Design	Net output per module (MWe)	Number of modules (if applicable)	Type	Designer	Country	Status
Micro Modular Reactors (MMRs)						
eVinci	0.2-5	1	Heat pipe reactor	Westinghouse	United States	Basic design
Oklo	2	1	LMFR	Oklo	United States	Basic design
UBattery	4	1	HTGR	Urenco and partners	United Kingdom	Basic design
MMR	5-10	1	HTGR	USNC	United States	Basic design
LFR-TL-X	5-20	1	LMFR	Hydromine Nuclear Energy	Luxembourg	Conceptual design

Adapted from Oct 2019 Background Note to the Steering Committee on Nuclear Energy and IAEA Analyses

- Various regulatory issues to be resolved
- Uncertainties regarding approach and approval by security officials
- Cost-effectiveness remains to be verified

SMR Categories: *Generation IV*

Design	Net output per module (MWe)	Number of modules (if applicable)	Type	Designer	Country	Status
Generation IV SMRs						
4S	10	1	LMFR	Toshiba	Japan	Detailed design
CA Waste Burner	20	1	MSR	Copenhagen atomics	Denmark	Conceptual design
Xe-100	35	1	HTGR	X-energy LLC	United States	Conceptual design
ARC-100	100	1	LMFR	Advanced Reactor Concepts LLC	Canada	Conceptual design
KP-FHR	140	1	MSR	Kairos Power	United States	Pre-conceptual design
IMSR	190	1	MSR	Terrestrial Energy	Canada	Basic design
HTR-PM	210	2	HTGR	China Huaneng / CNEC/Tsinghua University	China	Under construction
ThorCon	250	1	MSR	Martingale Inc	United States	Basic design
EM2	265	1	GMFR	General Atomics	United States	Conceptual design
SC-HTGR	272	1	HTGR	Framatome	United States	Conceptual design
Stable Salt reactor	300	1	MSR	Moltex Energy	United Kingdom	Pre-conceptual design
Westinghouse lead fast reactor	450	1	LMFR	Westinghouse	United States	Conceptual design

- Regulatory approvals still to come for non-LWR designs
- Some technologies are close – others still conceptual
- Cost-effectiveness remains to be verified

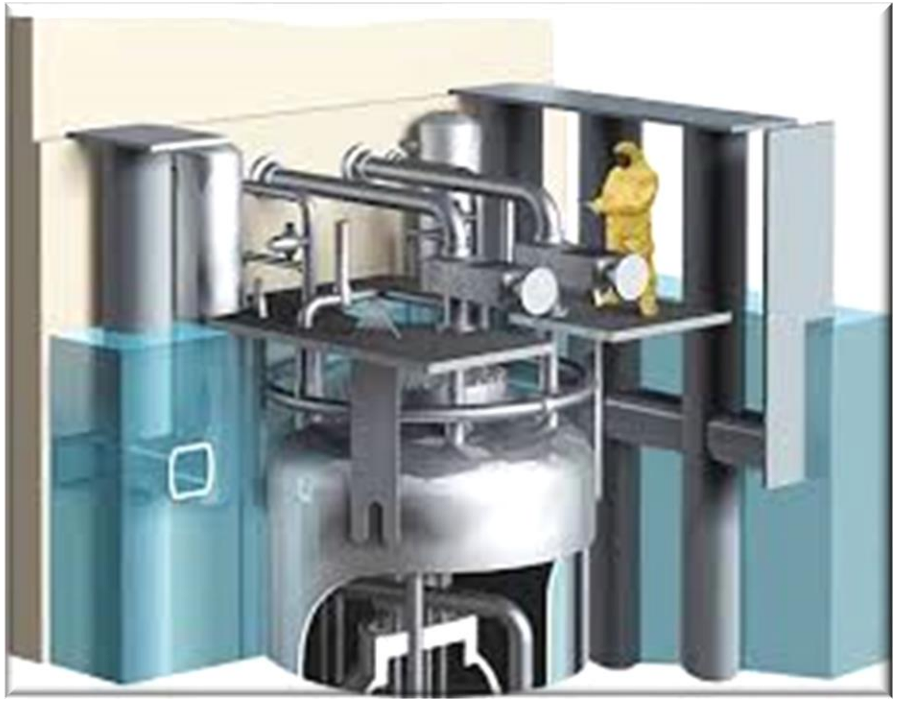
Adapted from Oct 2019 Background Note to the Steering Committee on Nuclear Energy and IAEA Analyses

Deploying SMRs and Advanced Reactors is a Global Challenge

- Development and licencing of most technologies will be very expensive; some development, testing, and licencing costs could be shared
- Strategies for global deployment are highly desirable:
    - *Success for small reactors requires significant production runs; good economies of sale are difficult if they are effectively limited to home markets*
    - *Like aircraft and other high-investment products, access to global markets is essential*
- Regulators can become showstoppers to the deployment of new innovations if requirements are different in each country

More Key Observations

- A small number of national regulators already apply risk-based approaches and have the frameworks in place to license new technologies
- However, **most nuclear safety regulators in OECD countries are not prepared** to receive these new technologies
- Adopting **new nuclear technologies in emerging economies** will present special regulatory challenges
- Without a more harmonised global approach, nuclear **regulators risk becoming obstacles** to broad deployment of innovative nuclear designs



Harmonization of Regulations

NEA Multi-sector Workshop on Innovative Regulation: Challenges and Benefits of Harmonizing the Licensing Process for Emerging Technologies

The NEA, in cooperation with the Canadian Nuclear Safety Commission (CNSC) hosted an international workshop in December 2020 that brought together regulators, industry, and various stakeholders to share information between the nuclear sector and other highly regulated industries (e.g., aviation, medical, transportation of nuclear material) towards harmonized regulatory processes in the context of innovation.

The workshop focused on practical examples of how regulators can address two key challenges:

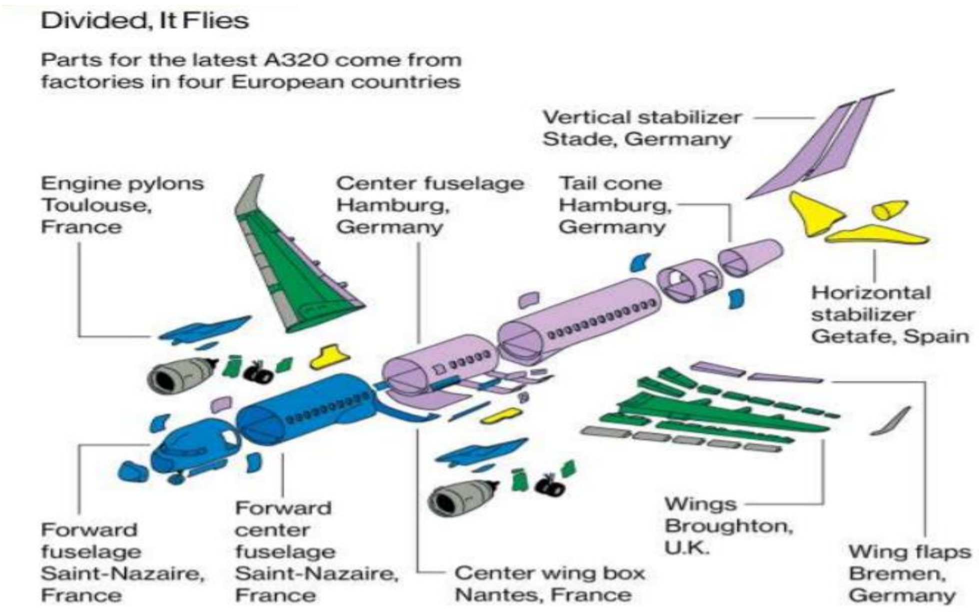
- How should regulators approach licensing of innovative and disruptive technologies?
- How can regulators leverage international cooperation?

www.oecd-nea.org/jcms/pl_46728/multi-sector-workshop-on-innovative-regulation-challenges-and-benefits-of-harmonising-the-licensing-process-for-emerging-technologies

Harmonization of Regulations

Example: Lessons from the Aviation Sector

- Unlike nuclear, the aviation industry developed with international exports in mind from the beginning – leading to a need to harmonize from the outset
- Modernization and innovation is desired by all players in the sector (including regulators) and is built on existing structures
- Governments, regulators, manufacturers, airlines, researchers, and academia collaborate to set global industry standards

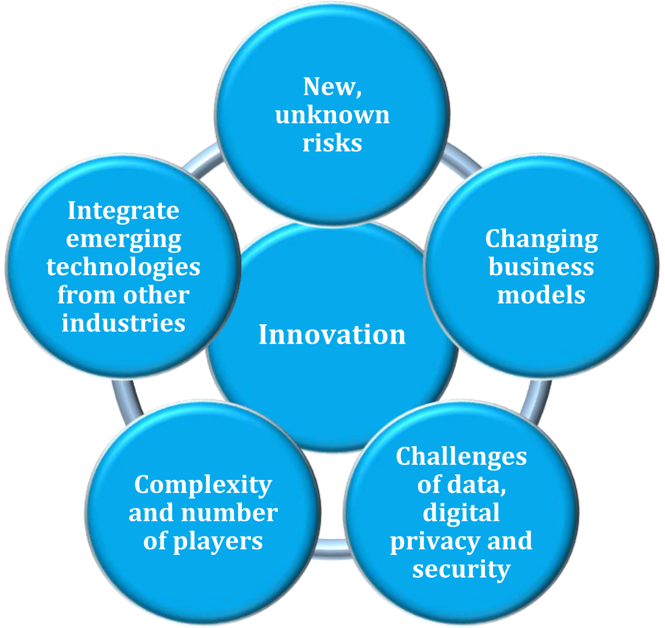


The aviation example shows that design and technology are only a part of the regulation and innovation picture; there is a vital need to focus on the supporting infrastructures – especially industry standards

Harmonization of Regulations

Challenges

- **The nuclear sector does not have an integrated global framework**, which makes international harmonization very difficult
- **Harmonizing licensing processes is a major challenge,** due in part to the structure of the industry and its regulatory framework
- **Nuclear is different from other sectors but there are lessons to be learned** (e.g. aviation industry engages regulators at early stages)
- **Time is too short to re-invent the nuclear sector; we must adapt current frameworks.**



For Climate Action to be Successful,
An Enhanced Vision of the Future is Needed

If action on climate is associated with limits to life, economic growth, and freedom, a successful energy transition will be extremely difficult.

<u>Innovative Nuclear Technologies Help Provide a Solution Set</u>

Thank you for your attention

More information @ www.oecd-nea.org

All NEA reports are available for download free of charge.

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WORKING GROUP 2:

Nuclear Liability and Insurance

2021 Nuclear Inter Jura Virtual Congress
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Nuclear Liability and the Development of New Technologies (SMRs and Fusion)
(Topic 1)

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NUCLEAR LIABILITY AND THE DEVELOPMENT OF NEW TECHNOLOGIES (SMRS AND FUSION)
(TOPIC 1)

Moderator: Fiona Geoffroy, Senior Legal Advisor, EDF SA, and WG2 Secretary

Government initiatives to establish a clear nuclear liability framework for SMRs (land, transportable, floating) and fusion

Speakers:

Jamie Fairchild	Senior Advisor, Uranium and Radioactive Waste Division, Natural Resources Canada
Ian Salter	Partner, Burges Salmon LLP, UK
Ben McRae	Assistant General Counsel for Civilian Nuclear Programs, Department of Energy, USA

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PAINTING THE LANDSCAPE : HOW DO SMRS AND FUSION FIT INTO THE INTERNATIONAL CONVENTIONS ?

DIFFERENTIATION BETWEEN DIFFERENT TYPES OF SMRS – FIXED, TRANSPORTABLE OR FLOATING

Land based: least controversial: appear to fall under the scope of application of existing conventions

Floating SMRs: difference between SMRs located on ships that are anchored in place and used exclusively for generating power for external consumption (appear to be covered) and reactors used as a source of power for a ship, whether power is used for propulsion or any other purpose associated with the operation of a ship (not covered cf. intention to exclude atomic submarines and ice-breakers)

Transportable: possibility of classification as transport of nuclear material (containing fresh fuel) or following operations (when radioactive)

Fusion: at present does not appear to fall under the scope of the conventions. Long-standing discussions at OECD/NEA Law Committee on possibility of extending scope of Paris Convention to cover fusion installations.

Future actions may be taken (e.g. OECD Steering Committee Decision, revision of Explanatory Texts of VC and CSC) to increase clarity in this respect.

Canada – Jamie Fairchild, Senior Advisor, Uranium and Radioactive Waste Division, Natural Resources Canada

> **Nuclear Liability and Compensation Act**
- Establishes Canada’s third-party liability regime.

> **Nuclear Liability and Compensation Regulations**
- Specify the limits and liability for low risk installations, including for non-power reactors (CAD $500K - $180M)

> **Small Modular Reactor Action Plan (smractionplan.ca)**
- Canada’s plan for the development, demonstration, and deployment of SMRs for multiple applications at home and abroad.

> **Clean Technology Regulatory Roadmap**
- Plan to address regulatory issues and identify opportunities for novel regulatory approaches in the clean technology sector.

United Kingdom – Ian Salter, Partner, Burges Salmon LLP

> **Changes to implement the Revised Paris Convention**

> **Nothing specific for SMRs**

> **Nuclear Installations Act 1965:**

- **Section 1** – requirement for a licence to use a site to install or operate a "nuclear reactor" other than a nuclear reactor comprised in a means of transport. Definition covers all fission reactors "whether affixed to land or not"
- **Section 7** – strict and absolute liability for "nuclear damage"
- **Section 16** – "required amounts" (limits of liability) for "low risk", "intermediate" and "standard" sites and low risk transports (categories prescribed in the Nuclear Installations (Prescribed Sites and Transport) Regulations 2018). SMRs likely to be "standard sites"
- **Section 19(1)** – requirement for financial security up to the "required amount" under Section 16
- **Section 19(2E) –** one limit per nuclear site licence (the highest if more than one applies)

> All legislation available at www.legislation.gov.uk

> UK government consultation on a regulatory framework for fusion at: www.gov.uk/government/consultations/towards-fusion-energy-proposals-for-a-regulatory-framework

United States – Ben McRae, Assistant General Counsel for Civilian Nuclear Programs, US Department of Energy

> **Price-Anderson Act - Section 170 of the Atomic Energy Act (AEA) - does not address SMR's explicitly**

> Section 170(b)(1) of the AEA provides that, with respect to **each power reactor with capacity of 100,000 megawatts or more**, the licensee must:

- Have the maximum amount of insurance available from private sources (currently 450 million USD); and
- In the event of a nuclear incident, must contribute up to approximately 121 million USD to an industry indemnification fund.

> Section 170(b)(5) of the AEA provides that **reactors, which have capacity of 100,000 to 300,000 megawatts and which are located at a single site**, shall be treated as a single facility to the extent their combined capacity does not exceed 1.3 million megawatts.

> Sections 170(b)(1) and 170(c) of the AEA provide that, with respect **to other reactors (that is, rectors with capacity less than 100,000 megawatts)**:

- The licensee must have the amount of insurance available from private sources unless NRC permits a lower amount; and
- NRC must provide an indemnification of 500 million USD which shall be reduced by the amount by which required insurance exceeds 60 million USD.

> **Price-Anderson Act must be renewed by the end of 2025**

- Treatment of SMR's may be considered as part of that process.

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Practical Arrangements of Claims Handling (Topic 2)

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PRACTICAL ARRANGEMENTS OF CLAIMS HANDLING
(TOPIC 2)

Moderator: **Ximena Vásquez-Maignan**, Head of the OECD/NEA Office of Legal Counsel, Members of the INLA Board of Management and WG2 Co-Chair

Speakers:	**Caj Weckström**	Managing Director, Nordic Nuclear Insurers (NNI)
	Daniel C. DeMerchant	Vice President, Claims – Legal, American Nuclear Insurers (ANI)
	Gilles Trembley	Chairman, GEIE Claims Handling System (CHS)

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INTRODUCTION – LESSONS LEARNED FROM THE FUKUSHIMA ACCIDENT

- no direct casualties; mostly mental anguish and damage to the environment, property and businesses
- 3 million applications (2 million threshold was already reached in 2013)
- more than 12 000 persons were involved in the claims handling process
- indemnification procedure was reviewed several times to simplify it
- quickly set up a bi-lingual website to provide information (at one moment in 4 languages)
- call centers and offices were set up throughout surrounding prefectures and where evacuees relocated

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Caj Weckström, Managing Director, Nordic Nuclear Insurers (NNI)

NNI
Nordic Nuclear Insurers

NORDIC NUCLEAR INSURERS CLAIMS HANDLING DATABASE

- Developed in 2010
- Sweden, Finland and Hungary
- Claims handled by 7 member insurance companies: 4 in Sweden and 3 in Finland
- The 3 insurance companies in Finland have about 90% of the households as customers
- Claims handling - from registration to payment
- Full reporting capabilities
- Multiple languages
- One size does not fit all
- Web based, can be accessed from anywhere
- Source code owned by the Pool, Operator, TPA etc. Not a license
- Data ”owned” by the owner, can be stored in the cloud, server etc.

Website for more information: www.atompool.com/en

Daniel C. DeMerchant, Vice President, Claims – Legal, American Nuclear Insurers (ANI)

ANI EMERGENCY RESPONSE

- ❑ Two call centers
- ❑ Website claim intake
- ❑ Central claim office
- ❑ +1,000 adjusters
- ❑ 1 to 2 on-location claim offices
- ❑ 48 to 72-hour response time
- ❑ Dark ER Information website
- ❑ Nuclear data capture module
- ❑ Debit card financial assistance
- ❑ ANI ER platform
- ❑ TPA data interface
- ❑ Summary data reporting

Emergency Planning Coordination

- Internal planning and exercises
- External coordination and planning:
  - ❑ Liaise with government and local responders
  - ❑ Educate at industry workshops and conferences
  - ❑ Participate during industry drills and exercises

Online program description: www.amnucins.com/insurance/emergency-response-program

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Gilles Trembley, Chairman, GEIE Claims Handling System (CHS)

chs Claims Handling System

Our strong conviction: the nuclear insurance market needs one uniform claims handling system, accessible to all stakeholders involved in a nuclear accident, to indemnify all the victims, in line with the outcome of the NLA OECD Working Group on Claims Handling in Lisbon.

Assuratome and ELINI have decided to set up an independent structure, EEIG Claims Handling System, to maintain and develop a common IT Tool with an independent, irrefragable and unlimited access for the EEIG CHS members.

EEIG CHS is a non profit driven structure, and only shares the costs the maintenance cost to keep the system ready at anytime, amongst its members

The CHS is a dormant web based platform, a common and uniform system from registration to last payment of the victim's claims, multi currencies, accessible to all parties involved, providing required reporting. It registers and processes the claims on the long run, prepares the payment to be made by the insurers to the victims, monitors the payment and the reserves and the exhaustion of the limits, set up the reporting to the stakeholders and the authorities, ready for transboundary claims (multilingual).

The GEIE only provides the IT Tool. The resources to handle the claims and the payments are under the sole control of the insurers, not under the EEIG one.

We welcome all nuclear insurers who share our convictions!

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THANK YOU FOR YOUR ATTENTION!

2021 Nuclear Inter Jura Virtual Congress
International Nuclear Law Association - United States Chapter

SPECIAL PRESENTATION:

Dr. Kathryn D. Huff

Acting Assistant Secretary and Principal Deputy Assistant Secretary, Office of Nuclear Energy, United States Department of Energy

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WORKING GROUP 7:

Transport

2021 Nuclear Inter Jura Virtual Congress
International Nuclear Law Association - United States Chapter

WORKING GROUP 7 –Transport

Khalil Bukhari
General Counsel – Nuclear Transport Solutions

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INLA WG7 FOCUS

- Purpose & Aims –Practical solutions for Transport Industry Issues
- Align with organisations with similar focus (WNTI, NEA WPNLT, WNA, IAEA)
- Range of Issues e.g.
  - Non-standard contracts
  - Qualification of nuclear materials
  - Denial of shipments
  - Marine law liability v nuclear liability
  - Salvage insurance gap
  - Protestors
  - Sanctions

Standard Contracts

- Initial Focus on Standardised transport contracts
- Benefits:
  - Shorter Deal Cycle Times
  - Agreed Minimum Requirements
  - Consistent approach on Safety/Security

Industry Support

- WNA – World Nuclear Association
- WNTI – World Nuclear Transport Institute
- BIMCO
- International Chamber of Shipping
- Joint WNA/WNTI Workshop –2022
- Endorsement/approval by relevant industry bodies

Summary

- Realistic?
- Timescale
- Next steps

Areas of Interest - 2022

- Qualification of nuclear materials
- Denial of shipments
- Marine law liability v nuclear liability
- Salvage insurance gap
- Protestors
- Sanctions

QUALIFICATION OF NUCLEAR SUBSTANCES AND NUCLEAR LIABILITY

Elena de Boissieu
Legal Adviser, Office of Legal Counsel
OECD Nuclear Energy Agency

INLA WG7
2021 INLA Nuclear Inter Jura Congress, 26 October 2021

Qualification: Challenges

- Organising **transport of nuclear substances** presents a number of **challenges**, including **how to properly qualify**, from a nuclear liability perspective, the substances being carried

- Nuclear liability conventions provide for a **generic definition** of “nuclear substances”/“nuclear material”, giving **wide discretion to national legislations** in its interpretation

- Conventions also **exclude certain categories of nuclear substances**, subject to specific conditions being met, to ensure that the risk associated to their transport may be dealt with under general tort law

- Implementation or application of these exclusions is carried out by each concerned country in accordance with its own domestic legislation, which may lead to **discrepancies in the qualification of substances** to be transported by different stakeholders

NTPL Conventions: What is Covered?

PC/ VC/ RVC/ CSC

Nuclear substances/ material

Covered

Nuclear substances/ material

Radioactive products or waste

Nuclear fuel
(*other than natural or depleted uranium*)

Not covered

Radioisotopes

*(outside a nuclear installation)*** *which have reached the final stage of fabrication so as to be usable for any industrial, commercial, agriculture, medical, scientific or educational purpose*

***** *PC only +*
***Recommendation** of the Steering Committee*
[NEA/NE(2018)3/FINAL]

NTPL Conventions: What is Covered? (cont'd)

Nuclear substances/ material

Radioactive products or waste

any radioactive material produced in or made radioactive by exposure to the radiation incidental to the process of producing or utilizing nuclear fuel

Nuclear fuel
(*other than natural or depleted uranium*)

Remaining radioactive products or waste

No detailed technical description/ reference to technical regulations to define what is radioactive products/waste or nuclear fuel covered by the NTPL Conventions

⇒ left to the national legislation and courts

PC/ VC/ RVC/ CSC

Small quantities of nuclear substances outside a nuclear installation

Board of Governors ***Resolution***
[GOV/2014/63]

Decision *of the Steering Committee*
[NEA/NE(2016)8/FINAL]

PC

Certain kinds of nuclear substances

Decision *of the Steering Committee*
[NE/M(77)2]

Qualification: Need for a Common Understanding

- A **common understanding** of the types of substances covered by the conventions is important to determine **whether the nuclear liability regime** established by such conventions or **general tort law** would apply in case of damage caused by an accident

- **Lack of harmonisation** in this area has a **practical impact on the organisation of transport** of nuclear substances: all carriages need to be covered by a relevant insurance or other financial security to cover liability for damage in case of an accident, and therefore require to clearly identify which legal regimes apply to the substances being transported throughout the whole journey

- A **clear understanding** of the process of qualification of nuclear substances based on the applicable legal regime(s) in countries that an international transport will cross **enhances visibility of the requirements** necessary to organise the **appropriate insurance** or financial security

NEA Working Party on Nuclear Liability and Transport (WPNLT)

- WPNLT is entitled to examine issues relating to the interpretation and **application of international nuclear liability instruments to nuclear transport**; and promote the exchange of legal information and the sharing of related experience, with an emphasis on **finding practical solutions**
- A **topical session** was held in June 2019 on the issue of **qualification of nuclear substances to be transported** (from legal, insurance and technical perspectives)
- In **March 2021**, WPNLT organised the ***Workshop on the Qualification of Nuclear Substances and Nuclear Liability*** to further discuss the issue of qualification

Workshop on the Qualification of Nuclear Substances and Nuclear Liability
(29-30 March 2021)

More than **70 experts** representing **19 NEA member countries**, **two non-NEA member countries**, the **European Commission** and the **IAEA**. Representatives from the nuclear insurance industry, the **World Nuclear Association** (WNA) and the World Nuclear Transport Institute (WNTI) also participated. See press release here.

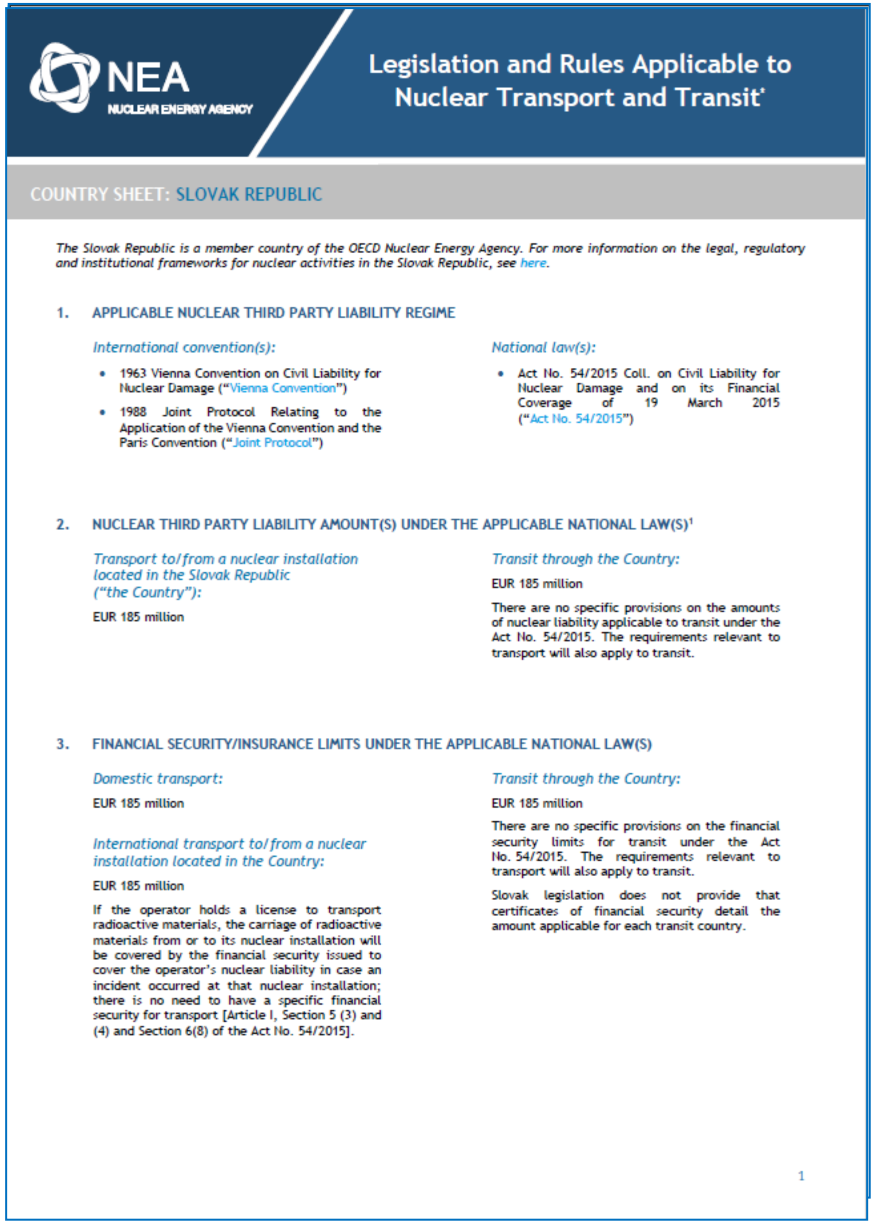
Outcomes of the Workshop

Potential path forward on the qualification of nuclear substances:

- **Further clarify which liability regime(s)** and insurance requirements (if any) apply to the excluded substances;
- **Facilitate insurance coverage** by: (i) clarifying the interpretation of relevant definitions in the conventions; (ii) clarifying the assessment to be made to provide cover; (iii) establishing a process to identify the excluded substances; and (iv) identifying the entity in charge of qualifying the nuclear substances; and
- **Raise and increase awareness** of all the stakeholders involved in international transport/transit of nuclear substances of the application of nuclear liability regime(s), including the exclusions

LEGISLATION AND RULES APPLICABLE TO NUCLEAR TRANSPORT AND TRANSIT

Available here



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NUCLEAR ENERGY AGENCY

Legislation and Rules Applicable to Nuclear Transport and Transit*

COUNTRY SHEET: SLOVAK REPUBLIC

The Slovak Republic is a member country of the OECD Nuclear Energy Agency. For more information on the legal, regulatory and institutional frameworks for nuclear activities in the Slovak Republic, see here.

1. APPLICABLE NUCLEAR THIRD PARTY LIABILITY REGIME

International convention(s):

- 1963 Vienna Convention on Civil Liability for Nuclear Damage ("Vienna Convention")
- 1988 Joint Protocol Relating to the Application of the Vienna Convention and the Paris Convention ("Joint Protocol")

National law(s):

- Act No. 54/2015 Coll. on Civil Liability for Nuclear Damage and on its Financial Coverage of 19 March 2015 ("Act No. 54/2015")

2. NUCLEAR THIRD PARTY LIABILITY AMOUNT(S) UNDER THE APPLICABLE NATIONAL LAW(S)[1]

Transport to/from a nuclear installation located in the Slovak Republic ("the Country"):

EUR 185 million

Transit through the Country:

EUR 185 million

There are no specific provisions on the amounts of nuclear liability applicable to transit under the Act No. 54/2015. The requirements relevant to transport will also apply to transit.

3. FINANCIAL SECURITY/INSURANCE LIMITS UNDER THE APPLICABLE NATIONAL LAW(S)

Domestic transport:

EUR 185 million

International transport to/from a nuclear installation located in the Country:

EUR 185 million

If the operator holds a license to transport radioactive materials, the carriage of radioactive materials from or to its nuclear installation will be covered by the financial security issued to cover the operator's nuclear liability in case an incident occurred at that nuclear installation; there is no need to have a specific financial security for transport [Article I, Section 5 (3) and (4) and Section 6(8) of the Act No. 54/2015].

Transit through the Country:

EUR 185 million

There are no specific provisions on the financial security limits for transit under the Act No. 54/2015. The requirements relevant to transport will also apply to transit.

Slovak legislation does not provide that certificates of financial security detail the amount applicable for each transit country.

1

Thank you!

NEA

NUCLEAR ENERGY AGENCY

Hogan Lovells

Working Group 7 – Transport

Transport of Radioactive Waste from Decommissioning Projects

Daniel F. Stenger

26 October 2021

2021 Nuclear Inter Jura Virtual Congress
International Nuclear Law Association - United States Chapter

Background

- Decommissioning is part of the life cycle of nuclear power plants (NPP)
- NPP decommissioning is on the rise in the US, UK, Japan, Germany, France, Belgium
- Projects involve transport of large quantities of low-level radioactive waste (LLRW) from component removal to contaminated rubble and soil
- **Goal**: Protect public health and safety and the environment, including during transport

Special Considerations

- New commercial contracts needed
  - Nuclear liability is a key issue for the ***public interest***
- Decommissioning plants may reduce liability insurance due to low risk of offsite harm
  - In US, coverage can often be reduced to $100M after Zircaloy fire window
  - May exclude certain on-site harms or damage to transportation vehicles carrying radioactive materials
- Trans-boundary shipments may involve multiple nuclear liability regimes

Key Issues

- Transfer of title and risk of loss
  - An authorized entity must always be responsible for nuclear materials
- Nuclear liability
  - As general rule, parties should allocate nuclear liability to party with most liability coverage
  - Facility operator usually has most robust coverage
    - In US, even if coverage is reduced for decommissioning, facility operator has Price-Anderson Act indemnity agreement with Nuclear Regulatory Commission
    - PAA coverage applies to transportation accidents that release nuclear waste that harms third parties

Key Issues

- Nuclear Liability (cont'd)
  - Contract must ensure nuclear liability coverage for each leg of transportation
  - For trans-boundary transactions, NPP facility coverage may only apply to in-country transit
    - American Nuclear Insurers created Supplier's and Transporter's ("S&T") policy to cover transportation between nuclear facilities where PAA's protection may not apply
  - Convention on Supplementary Compensation (CSC) clarifies liability and strengthen protections for suppliers and transporters

CSC Guidance

- CSC provides options for apportioning liability for a nuclear incident during transport of materials to or from a nuclear installation
  - Default position is that prior operator is responsible for nuclear liability in transportation until “liability with regard to nuclear incidents involving the nuclear material has been assumed, pursuant to the express terms of a contract in writing, by the operator of another nuclear installation.”
    - CSC Annex §§ 3(1)(b)(i), 3(c)(i) (emphasis added); CSC Annex § 1(1)(b)(iii) (defining “nuclear installation” as “any facility where nuclear material is stored”)

Case Study

- Canadian NPP decommissioning project
- Operator shipping LLRW to US disposal facility
- Transferred transportation-related nuclear liability from operator at the US-Canadian border
  - Existing nuclear liability insurance policy for facility did not cover damages from a nuclear incident that "occurs outside Canada"
  - Transporter and affiliate maintained relevant insurance policies for transit and processing of LLRW in the US

Conclusion

Sound nuclear liability provisions for LLRW transport contracts serve the public interest

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WORKING GROUP 4:

Radiological Protection

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WORKING GROUP 4 – Mark Sanders

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Linear No-Threshold Model and Standards for Radiation Protection (2021) – Proposed NRC Rule

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In 2015, US NRC received three similar petitions

Request that the NRC amend 10 CFR part 20, “Standards for Protection against Radiation,” to discontinue use of the LNT model as the primary scientific basis for the agency's radiation protection standards.

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LNT Model

Radiation has always, and will continue to be, part of humankind's daily experience.

Linear No-Threshold Model ASSUMES RISK/DOSE - but always a level of risk

The causality between linked negative health effects to radiation doses below 100 mSv is difficult to show

ALARA

"Radiation exposure to the workers and the public caused by a nuclear installation shall be kept as As Low As Reasonably Achievable"
- Article 15, Convention on Nuclear Safety

The nuclear industry expends lots of time and money to implement ALARA.

Petitioners assertion is that the use of the LNT model in no longer valid based on various scientific studies submitting 36 references in support

In particular, the petitioners advance the concept of radiation hormesis, which promotes that low doses of ionizing radiation protect against the deleterious effects of high doses of radiation and result in beneficial effects to humans

Petitioner amendments

Maintain worker doses “at present levels, with allowance of up to 100 mSv (10 rem) effective dose per year if the doses are chronic”;

Remove the As Low As Is Reasonably Achievable (ALARA) principle entirely from the regulations, because they claim that “it makes no sense to decrease radiation doses that are not only harmless but may be hormetic”;

Requested Amendments cont.

Raise the public dose limits to be the same as the worker doses, because they claim that “these low doses may be hormetic”; and

“End differential doses to pregnant women, embryos and fetuses, and children under 18 years of age.”

NRC Response

The LNT model assumes that, in the long term, biological damage caused by ionizing radiation (i.e., cancer risk and adverse hereditary effects) is directly proportional to the dose

The NRC acknowledges the difficulties inherent in determining the amount of damage to the human body caused by low doses of radiation

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NRC Response

The NRCdoes not use the LNT model to assess the actual risk of low dose radiation

Instead, the NRC uses the LNT model as the basis for a regulatory framework that meets the "adequate protection" standard of the Atomic Energy Act of 1954, as amended

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NRC Response

The LNT model is applied so that the framework can be effectively implemented by an agency that regulates diverse categories of licensees, from commercial nuclear power plants to individual industrial radiographers and nuclear medical practices

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NRC Response

The NRC's use of the LNT model as the basis for its radiation protection regulations is premised upon the findings and recommendations of national and international authoritative scientific bodies, such as the ICRP, that have expertise in the science of radiation protection

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Conclusions

NRC has determined that the LNT model continues to provide a sound regulatory basis for minimizing the risk of unnecessary radiation exposure to both members of the public and occupational workers

The NRC will retain the dose limits for occupational workers and members of the public in 10 CFR part 20 radiation protection regulations

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Conclusions

NRC concludes there is scientific uncertainty and no compelling evidence as to whether the hormesis concept is valid for application to radiation protection requirements

The NRC will retain the dose limits for occupational workers and members of the public in 10 CFR part 20 radiation protection regulations

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Linear No-Threshold Model and Standards for Radiation Protection (2021)

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Welcome to Day 2 of the 2021 NUCLEAR INTER JURA CONGRESS!

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SPECIAL PRESENTATION:

Peri Lynne Johnson

Legal Adviser and Director, International Atomic Energy Agency, Office of Legal Affairs

2021 Nuclear Inter Jura Virtual Congress
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2021 Nuclear Inter Jura Virtual, 26-27 October 2021

IAEA and the Next 50 Years of Nuclear Power

Ms Peri Lynne Johnson

IAEA Legal Adviser and
Director of the IAEA Office of Legal Affairs

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WORKING GROUP 5:

Waste Management

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The establishment of a National Radioactive Waste Management Facility in Australia

Karyn McIntosh, Australia

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OPAL research reactor | Nuclear Medicine Production


OPAL research reactor


Molybdenum-99 manufacturing facility

Australia’s Waste

Low level

Intermediate level

~~**High** level~~

Australian Radioactive Waste Agency

Australian Government
Department of Industry, Science, Energy and Resources
Australian Radioactive Waste Agency

- Agency established in mid-2021
- Dedicated national radioactive waste agency
- Responsible for the establishment and operation of the national facility

National Radioactive Waste Management Act 2012 (Cth)

The object of this Act is to provide for:

1. The selection of a site for a national radioactive waste management facility on voluntarily nominated land in Australia; and

2. The establishment and operation of such a facility on the selected site.

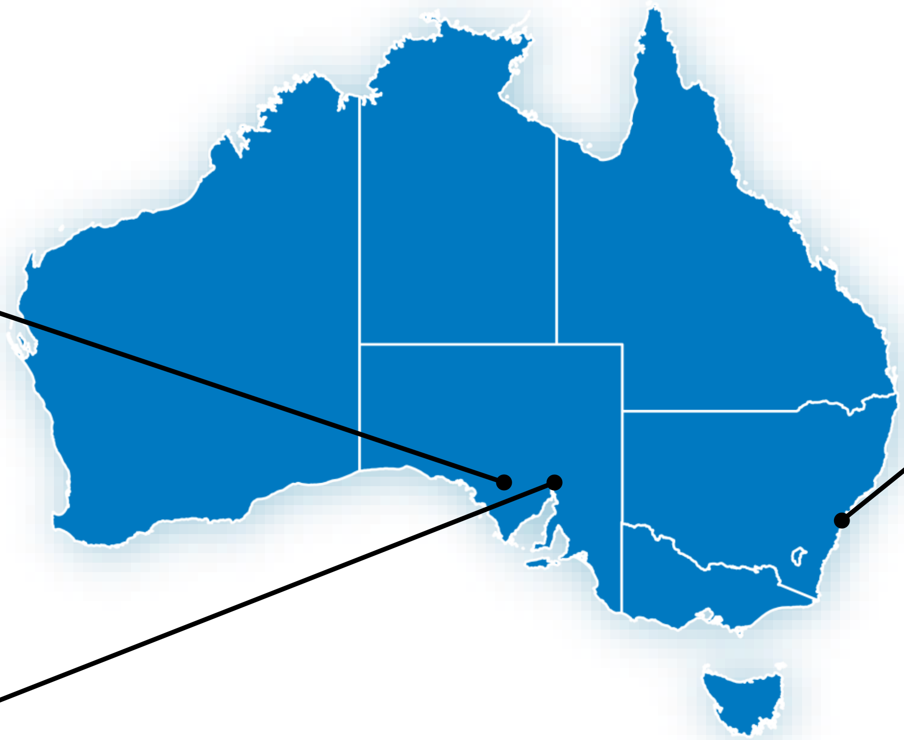
Site Selection

Kimba | South Australia

Lyndhurst | Napandee

Hawker | South Australia

Wallerberdina Station



OPAL Reactor

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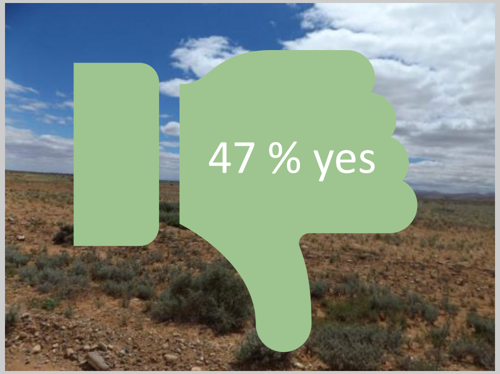
Community Ballot

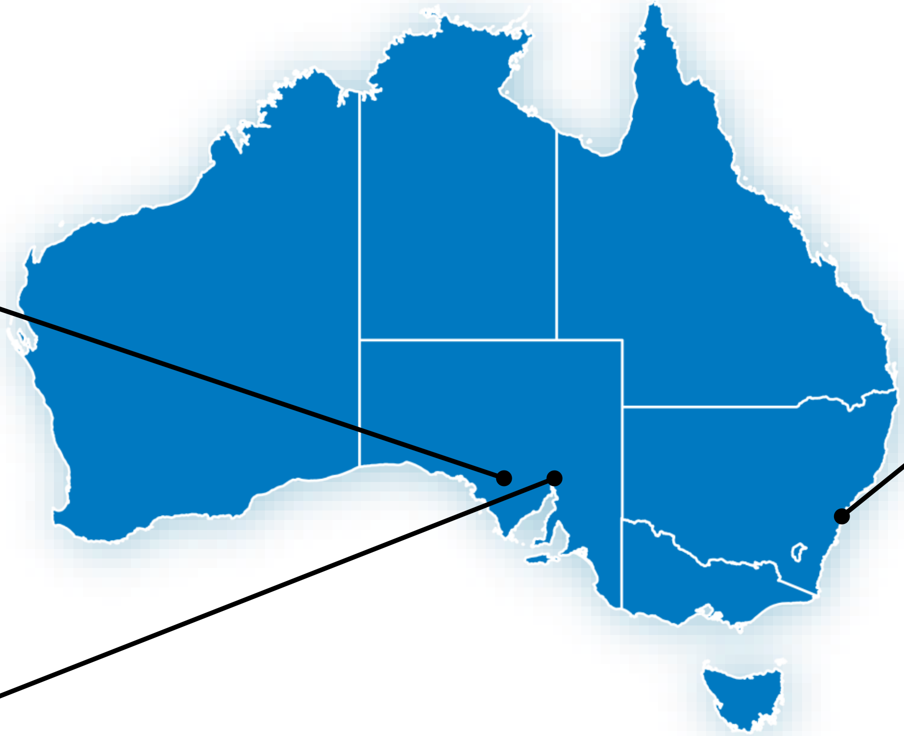
Kimba | South Australia

Lyndhurst | Napandee

Hawker | South Australia



Wallerberdina Station



OPAL Reactor

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FEDERAL COURT OF AUSTRALIA, Barngarla Determination Aboriginal Corporation RNTBC v District Council of Kimba (No 2) [2020] FCAFC 39, 13 March 2020

"It is not correct to say that BDAC's members were excluded from the ballot. Membership of BDAC was not a characteristic that disqualified any person from the franchise. Rather, the effect of the resolutions was that possession of native title rights and interests was not included among the various qualifying criteria [to vote]. The distinction is important. For as the primary judge concluded, any person who fulfilled one or more of the s 14 criteria could participate in the ballot irrespective of the person's race. Similarly, the classes of persons who were excluded from the franchise included persons who were Aboriginal and persons who were not. The primary judge was correct to find that these features of the resolutions militated against a conclusion that the relevant act involved an exclusion based on race."

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National Radioactive Waste Management Amendment (Site Specification, Community Fund and Other Measures) Bill 2020

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Site Selection

Kimba | South Australia

Napandee

- Napandee, 24km west of Kimba on South Australia’s Eyre Peninsula was identified as the preferred site in January 2020
- On 11 August 2021, the Minister for Resources and Water, the Hon Keith Pitt MP announced the intention to declare part of the land at Napandee as the site to host the National Radioactive Waste Management Facility

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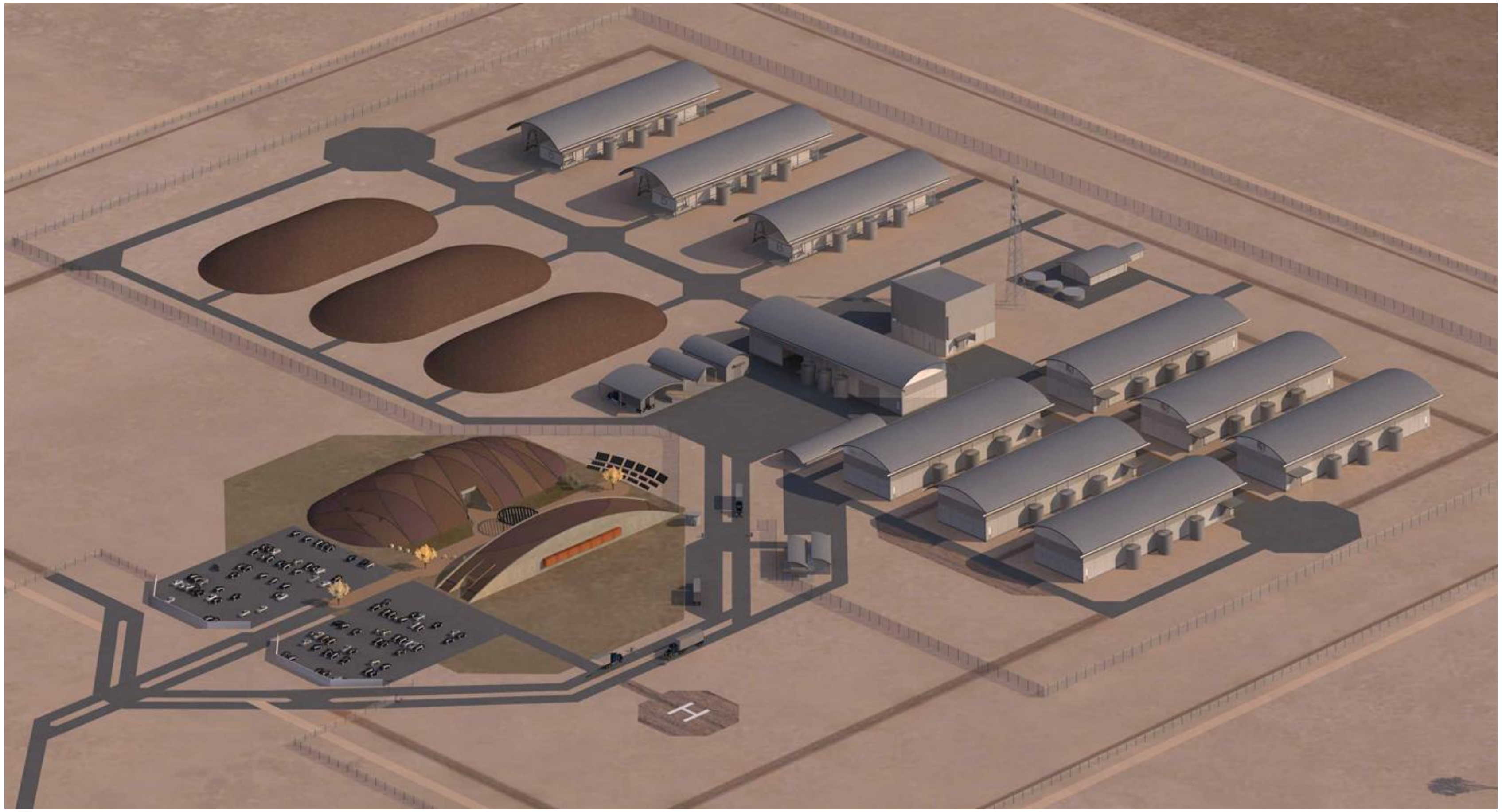
National Radioactive Waste Management Facility Concept Design



Source: industry.gov.au/arwa

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Policy, strategy and legal issues related to implementing a regional repository

Charles McCombie, ERDO/ARIUS Associations

Leon Kegel, ERDO Association/ARAO

WORKING GROUP 5 - Waste Management
2021 Nuclear Inter Jura Virtual Congress
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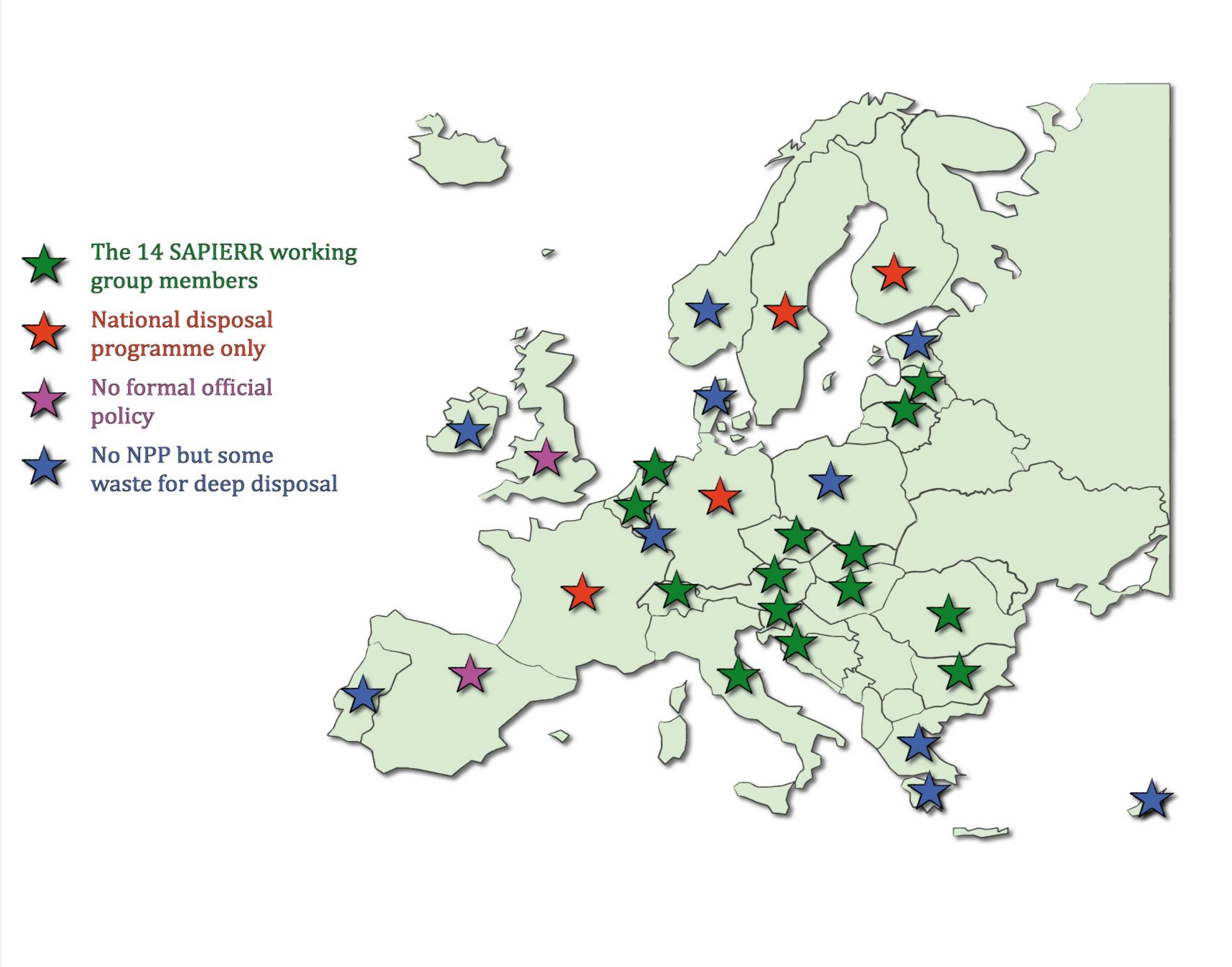
Interest in Multinational Repositories (MNR)

Past and current involvement with ERDO-WG
Austria
Bulgaria
Croatia
Denmark
Ireland
Italy
Lithuania
Netherlands
Norway
Poland
Romania
Slovakia
Slovenia



SAPIERR WG Member Countries (2006-2009)

Austria
Belgium
Bulgaria
Croatia
Czech Republic
Hungary
Italy
Latvia
Lithuania
Netherlands
Romania
Slovenia
Slovakia
Switzerland

MNR: Advantages and Requirements

ADVANTAGES

- Economies of scale
- Wide access to safe disposal
- Enhanced global nuclear security
- Lower environmental impact
- More geological siting options

REQUIREMENTS

- Ethical
- Environmentally sound
- Safe in a radiological sense
- Secure against terrorist acts
- Economic

RAW repositories: ethical requirements

- Generations using NPP are responsible for their RAW
- Each country is responsible for safe management of its RAW
    - This responsibility can also be fulfilled with disposal abroad
    - Transparency is required
- Local acceptance
    - No repository should be sited against the will of the host
    - No advantage to be taken of politically weak, less developed or poor areas
    - Fair compensation to host region and/or community

Pre-requirements for Implementing an MNR Approach

- An appropriate national **Policy**
  - Set by Government based on the IAEA Fundamental Safety Principles , but content will depend on country specific aspects, including the types and quantities of waste arising, the financial and human resources available, and the geology and demographics of the country
- An appropriate national **Strategy**
  - Sets out the means for achieving the goals and requirements set out in the national policy. Strategy is normally established by the relevant waste owner or operator, either a governmental agency or a private entity
- An appropriate national Programme
  - Sets out how the national policy and strategy are transposed into practical solutions; normally executed by Waste Disposal Organisation (WMO) or other RAW holders
- Appropriate national **Legislation**
  - Must cover international and national requirements; ultimate responsibility for safety is national

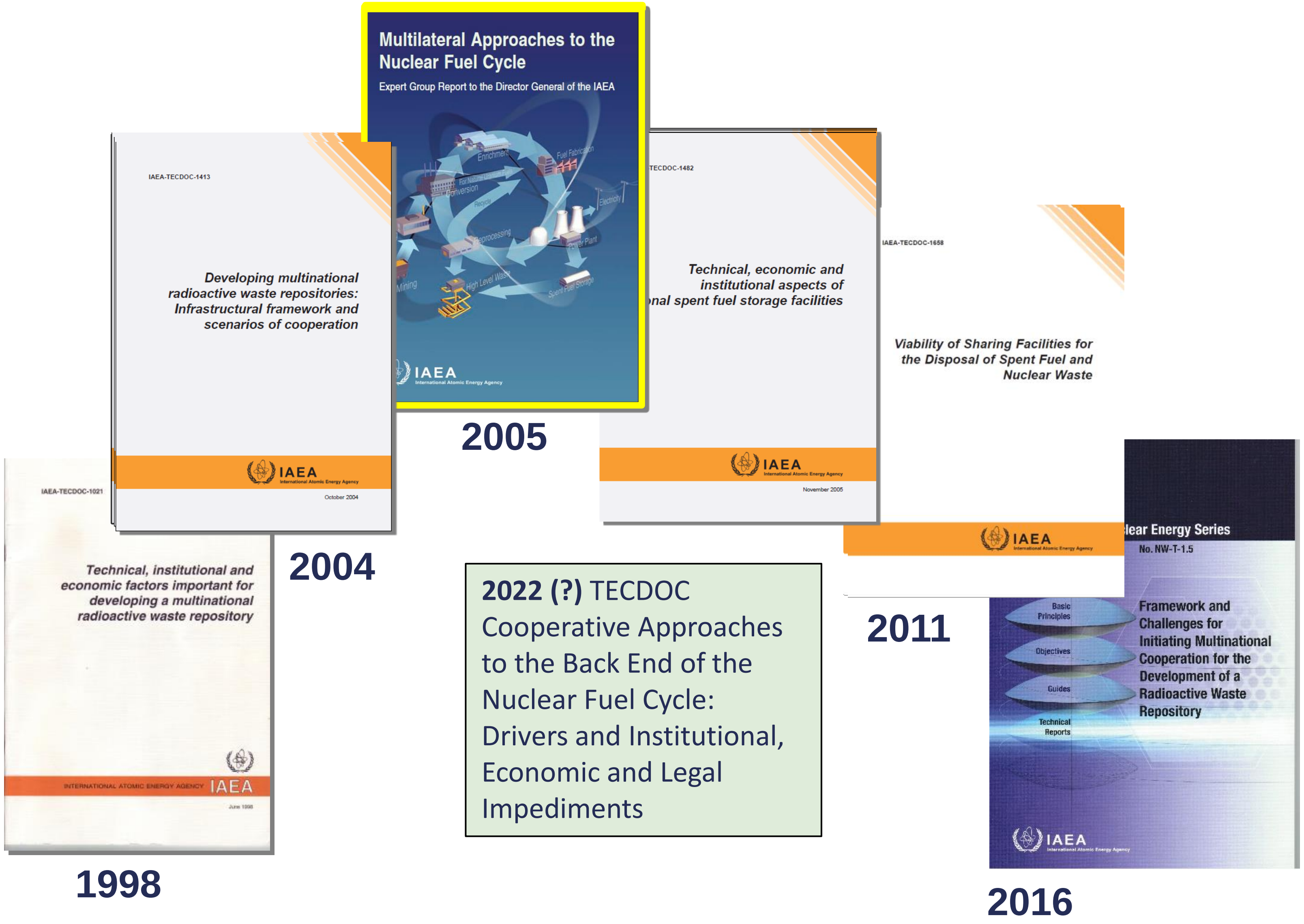
NOTE: countries should also have a parallel national disposal programme – i.e. should follow a "Dual Track" approach!

IAEA Requirements – Joint Convention 1997

- Article 1: Objective
  - “to achieve and maintain a high level of safety worldwide in spent fuel and radioactive waste management, through the enhancement of national measures and international co-operation, including where appropriate, safety-related technical co-operation”.
- Preamble: Some of the most relevant points made are as follows:
  - the ultimate responsibility for ensuring the safety of spent fuel and radioactive waste management rests with the State;
  - the definition of a fuel cycle policy rests with the State
  - the importance of international co-operation through bilateral and multilateral mechanisms is emphasized
  - radioactive waste should, as far as is compatible with the safety of the management of such material, be disposed of in the State in which it was generated
  - however, safe and efficient management of spent fuel and radioactive waste might be fostered through agreements to use facilities in one country for the benefit of the others
  - any State has the right to ban import into its territory of foreign spent fuel and radioactive waste.

These requirements make clear that each country must ensure that a credible path to safe disposal of its radioactive wastes is established – but that cooperation, including sharing of activities and facilities can be a component of this path.

Key IAEA documents addressing multilateral disposal



2022 (?) TECDOC Cooperative Approaches to the Back End of the Nuclear Fuel Cycle: Drivers and Institutional, Economic and Legal Impediments

EC **Recommendation** 2008/956/Euratom 4 Dec 2008

- Specifically on criteria for the export of radioactive waste and spent fuel to third countries (i.e. countries outside the EU). In addition to its basic message that all countries exporting or importing wastes must have appropriate national capabilities and arrangements, the recommendation points out explicitly that:
  - The decision to authorise shipments of radioactive waste or spent fuel to third countries is the responsibility of the competent authorities of the exporting Member State
  - Considerations, such as political, economic, social, ethical, scientific and public security matters, may be taken into account for authorising shipments of radioactive waste or spent fuel to a third country
  - States that treat wastes from others or that reprocess fuel from others have a right to return the wastes to the country of origin.

Current European **legislation** (see next slide) allows export to third countries under specified conditions – although EU policy statements have been made against export out of the EU

EC Waste Directive 2011

- Preamble
  - (32)"Cooperation between Member States and at an international level could facilitate and accelerate decision- making through access to expertise and technology"
  - (33) "Some Member States consider that the sharing of facilities for spent fuel and radioactive waste management, including disposal facilities, is a potentially beneficial, safe and cost-effective option when based on an agreement between the Member States concerned"

EC Waste Directive 2011: Legally binding article 4

- Radioactive waste shall be disposed of in the Member State in which it was generated, unless at the time of shipment an agreement ….. has entered into force between the Member State concerned and another Member State or a third country to use a disposal facility in one of them.
- Prior to a shipment to a third country, the exporting Member State shall inform the Commission of the content of any such agreement and take reasonable measures to be assured that:
  - (a) the country of destination has concluded an agreement with the Community covering spent fuel and radioactive waste management or is a party to the Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management ('the Joint Convention');
  - (b) the country of destination has radioactive waste management and disposal programmes with objectives representing a high level of safety equivalent to those established by this Directive; and
  - (c) the disposal facility in the country of destination is authorised for the radioactive waste to be shipped, is operating prior to the shipment, and is managed in accordance with the requirements set down in the radioactive waste management and disposal programme of that country of destination.

An interesting difference concerns conditions for export to another EU Member State relative to those for export to a third country. In the latter case, an authorised disposal facility must be operating

A positive legal example: Swiss Nuclear Law 2003

For the import of radioactive waste from nuclear facilities that do not originate in Switzerland but are to be disposed of in Switzerland, a license can exceptionally be granted if, ..

- a. Switzerland has agreed to import radioactive waste for disposal in an international agreement;
- b. a suitable disposal facility that corresponds to the international state of the art in science and technology is available in Switzerland;

A positive legal example: Swiss Nuclear Law 2003

As an exception, a license can be granted for the export of radioactive waste for storage if

- a. the recipient country has approved the import of the radioactive waste … in an international agreement;
- b. a suitable disposal facility corresponding to the international state of the art in science and technology is available in the recipient country;

2013 Response of Swiss Government to Parliamentary Question

- … for the import of radioactive waste from nuclear facilities that do not originate in Switzerland but are to be disposed of in Switzerland, exceptionally and under strict conditions, a permit can be granted. As a counterpart to this, a license for the export of radioactive waste for disposal can also only be granted in exceptional cases and under strict conditions.

- In the parliamentary deliberations on the KEG, applications that contained a general ban on imports or exports were rejected. The majority in the councils advocated keeping the option of international cooperation on the issue of radioactive waste management open.

- According to the legal concept, according to which import and export are only permitted in exceptional cases, Switzerland is looking for a solution in its own country for the disposal of its radioactive waste within the framework of the sectoral plan for deep geological repositories.

Thus, in principle, Switzerland has a “dual track” policy – but with emphasis on a national solution

Current Policies and Legislation: Europe

	Import of RAW: policy	MNR for disposal: policy
AT	Import not allowed.	Open option; Member of ERDO-WG
BE	Yes (under certain conditions)	Open option
BG	Import not allowed.	Open option
HR	Yes (under certain conditions)	Open option; Member of ERDO
CH	Yes, under an international agreement	Focus on national solution
CY	Import not allowed	Open option
CZ	Import not allowed	Open option
DK	Yes (under certain conditions)	Open option; Member of ERDO
EE	Import not allowed	Not considered
FI	The import of RAW is not prohibited.	Not considered
FR	Import not allowed (except Monaco)	Not considered
DE	Not indicated	Not considered
EL	The import for disposal is prohibited.	Not indicated
HU	Yes (under certain conditions)	Not indicated

	Import of RAW: policy	MNR for disposal: policy
IE	Import not allowed from third countries	Not indicated
IT	Yes (under certain conditions)	Open option Member of ERDO-WG
LV	Import not allowed.	Open option
LT	Import not allowed	Not considered
LU	Not indicated	Waste disposal in Belgium
MT	Import not allowed	Open option
NL	Yes	Open option
NO	Yes (under certain conditions)	Open option; Member of ERDO
PL	Import not allowed	Open option; Member of ERDO
PT	Import not allowed	Not considered
RO	Import not allowed	Not considered
SK	Import not allowed	Open option
SI	Yes (under certain conditions)	Open option
ES	Not indicated	Not indicated
SE	Import not allowed, except small quantities.	Not considered
UK	Policy is no import, exception for small quantities	Not considered

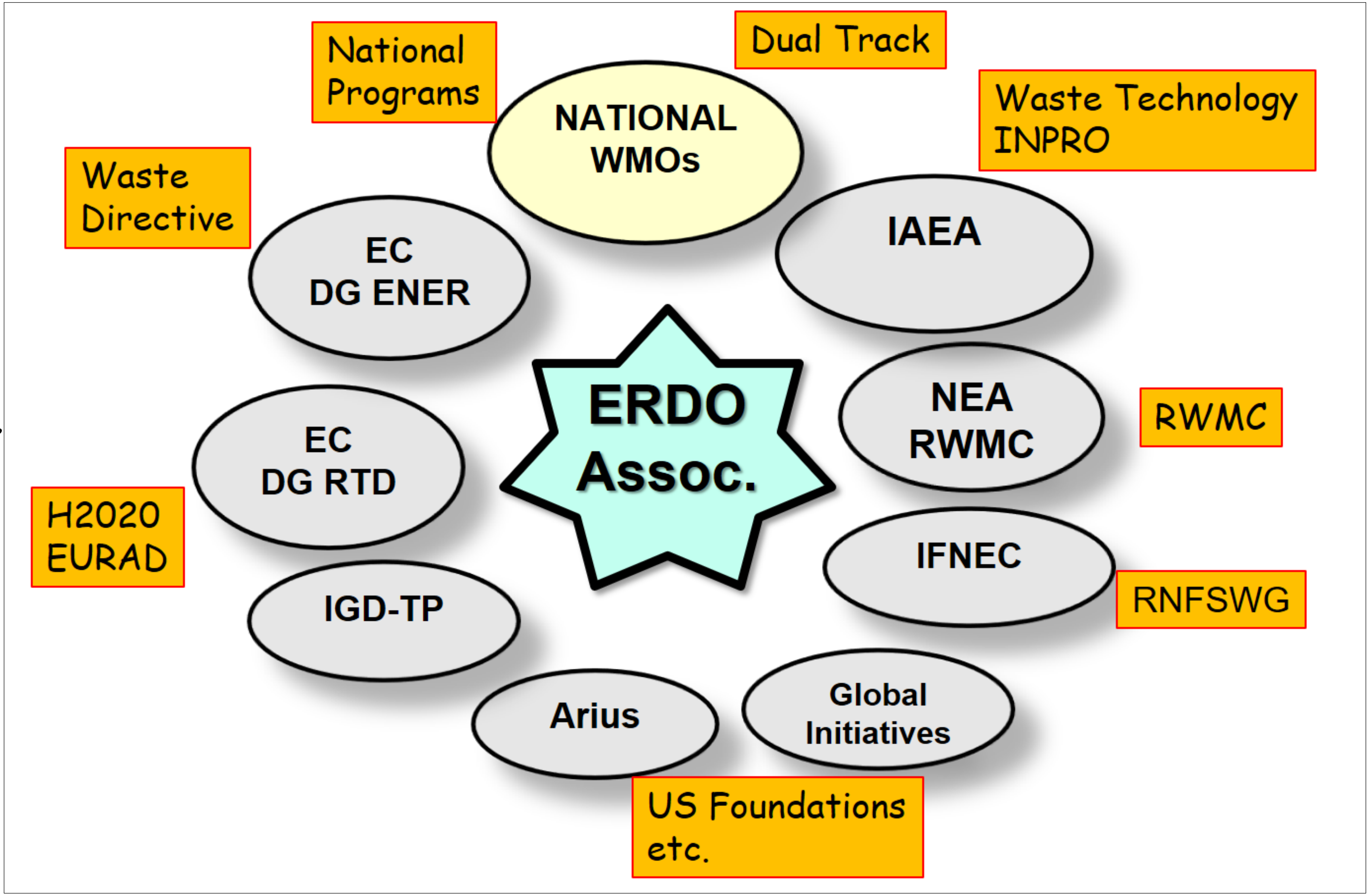
Current Policies and Legislation: Rest of the World

- Current Nuclear Countries
  - South Korea
  - Taiwan
  - Mexico
  - South Africa
  - …
- Potential Newcomers
  - Jordan
  - Vietnam
  - Ghana
  - ….

Analysis in progress

Widespread interest in the MNR option

– as shown by the Interactions of the new ERDO Association



Conclusions

- MNR offer multiple advantages
- MNR are ethically justified
- International legislation allows MNRs
- Different legal positions in countries
- Large differences in politics/policies
- Export to foreign MNR more often allowed than is import
- Growing MNR support in international organisations
- Widespread national interest in MNR + dual track policy

END

A positive legal example: Swiss Nuclear Law 2003

For the import of radioactive waste from nuclear facilities that do not originate in Switzerland but are to be disposed of in Switzerland, a license can exceptionally be granted if, ..

- a. Switzerland has agreed to import radioactive waste for disposal in an international agreement;
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WORKING GROUP 5 - Waste Management

The different regulation of decommissioning activities at the European Union: a survey

by Nuria Prieto Serrano, 27th Oct. 2021
Lawyer and technician at Dept. of international cooperation and R&D, **ENRESA**
Chairperson of INLA WG5

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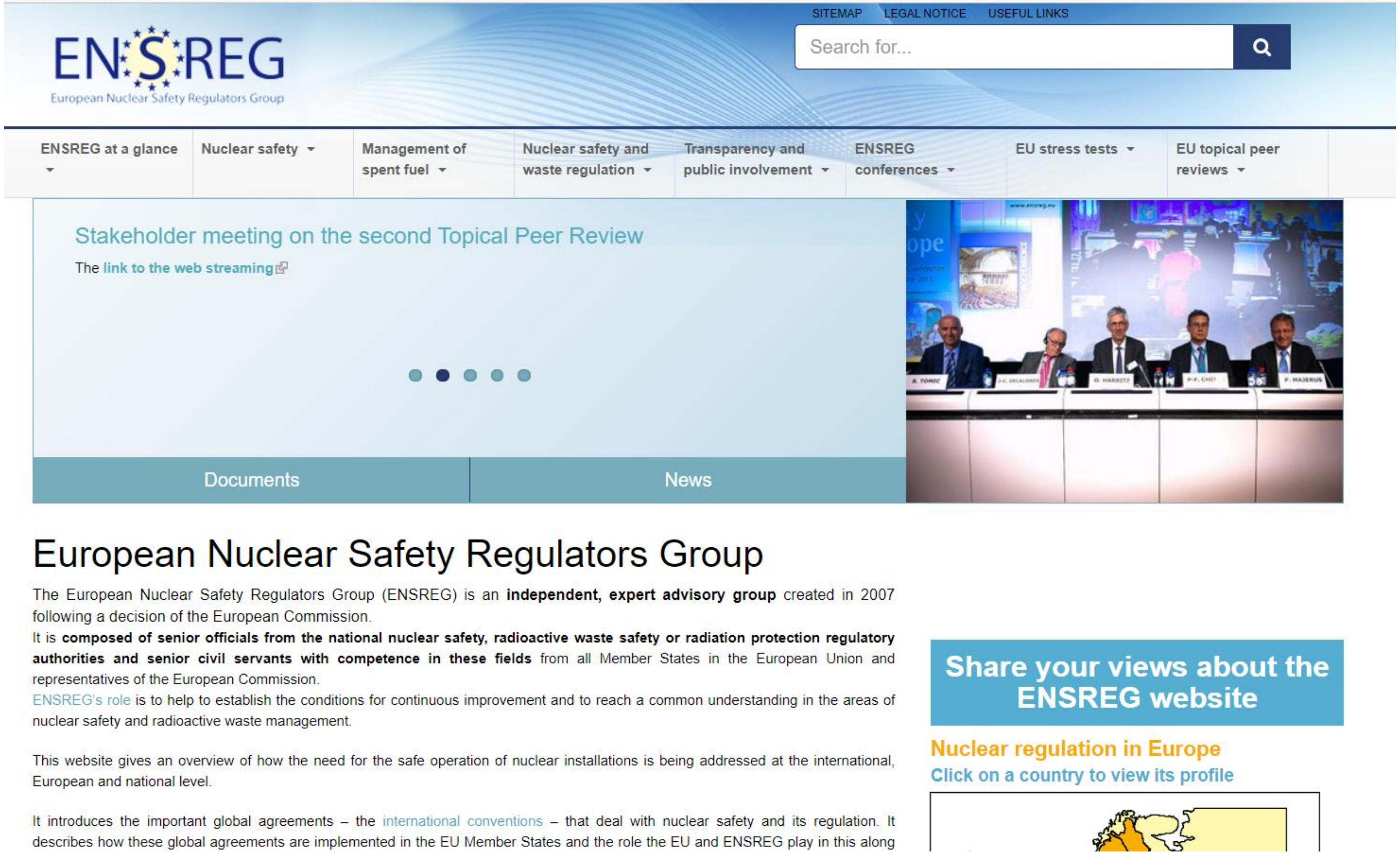
What is ENSREG?



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Today's presentation:

- Describes answers to a survey conducted in ENSREG Working Group 2 (Waste Management) in July 2021
- "Survey on national policy and strategy for decommissioning as well as legal and regulatory requirements for implementing decommissioning actions"
- 9 countries answered: Belgium, Denmark, France, Germany, Italy, Lithuania, Poland, Slovenia and Spain. The deadline for provision of answers is still open.
- **Does not represent ENSREG's opinion**: WG 2 has not elaborated an analysis, nor an opinion on the answers received so far.

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The reasons behind this survey:

Summary of the Fifth ENSREG Conference on Nuclear Safety (6th - 7th June 2019)
http://www.ensreg.eu/sites/default/files/attachments/summary_report_0.pdf

Session 2

In the session on decommissioning and waste management, panellists shared their experience on the matter in France, Sweden, and Italy from a regulatory perspective and in Slovakia from the operator's perspective. The view of the Spanish radioactive waste management agency was also expressed. Presentations and discussions indicated a preference for immediate dismantling if all legal and technical requirements are in place.

Nowadays, 93 reactors in the EU are in shutdown mode and more than 75% of operating reactors are over 30 years old. It is estimated that about 50 additional reactors will be closed by 2025. Mature dismantling and waste management technologies are present with the exception of graphite waste.

The following issues arose from the discussion:

- Decommissioning raises challenges in terms of transparency, choosing adequate methodologies, knowledge management, costs assessment, and associated provisions.
- It is important to standardize decommissioning approaches to ensure getting the most benefit in terms of safety, timing and costs from the first successful projects already ongoing in Europe
- It is important to define in detail what is considered as the 'decommissioning end state' of a nuclear installation in Europe in order to have homogenous cost evaluations.
- The issue of the 'polluter pays' principle applying to the nuclear sector was also raised.

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The questions submitted

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Overarching issues

1. National decommissioning policies, strategies or legal requirements may call for immediate dismantling, deferred dismantling, or options for defining such approaches on a case-by-case basis.
    a. Are such options defined in a national document (policy/programme/legal requirement), and if so, do these provisions call for immediate dismantling, deferred dismantling or decisions made on a case-by-case basis?
    b. How are such provisions applied to multiple facility sites?

2. National decommissioning policies, strategies or legal requirements may refer to requirements or preferences for the desired end-state for decommissioning – e.g. "green field" or "brown field" – reflecting requirements or intentions for future use.
    a. Do national documents (policy/programme/legal requirement) specify such end-states, and if so, are end-state criteria (e.g. dose constraints) defined?
    b. How are such provisions applied to multiple facility sites?

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Licensing procedures:

3. Considering the number of topics to face up during decommissioning activities (nuclear safety, environmental protection, public and workers' health, ...), different licensing procedure involving different Regulators may be required:
    a. Does the National regulatory framework require authorizations from different regulators, and if so, what regulators are involved and which regulator is tasked with the leading role in the overall process?
    b. Is the timing for the release of the authorizations established by law?

Planning for decommissioning

4. Planning / preparing for decommissioning ideally takes place already at the planning stages for a new nuclear installation. As the end of operations for a facility is approached, the plans for decommissioning should become more detailed and comprehensive. The plans for decommissioning may include an overarching decommissioning plan, defining and coordinating the sum of all decommissioning tasks foreseen during decommissioning. Individual decommissioning tasks may require more detailed planning in separate documents.
Please describe the legal and regulatory provisions for planning for decommissioning with respect to:
   a. The preparation and contents of an initial decommissioning plan
   b. The preparation and contents of an overarching decommissioning plan
   c. The preparation and contents of detailed decommissioning plans

End of operations and transitional phase

5. In the period between an operational phase and decommissioning, there may be a transitional period. In the transitional phase there may be a need for conducting operations (e.g. removal of fuel, post-operational cleanout etc.) in preparation for the actual dismantling works. This may serve to bring the facility in a state which enables a safe decommissioning process.
Please describe your legal and regulatory framework for the transition from operation to decommissioning with respect to:
   a. Activities required / allowed to be performed under an operating license
   b. Activities defining the end of operations under the operating license
   c. Requirements for a separate license for a transitional phase
   d. Time limits for completion of operational/transitional activities
   e. Requirements for the state of a facility before start of decommissioning

Decommissioning:

6. Licensing for decommissioning may include an "overarching license" for decommissioning, referring to the overall decommissioning plan, and outlining the general limits and conditions for the decommissioning project as a whole. The conduct of specific dismantling tasks (e.g. removal of peripheral systems, removal of biological shielding, reactor internals etc.) may require further licensing/approval.

   Please describe your legal and regulatory framework for licensing/approval for decommissioning with respect to:

   a. Requirement for, and contents of, an overarching license
   b. Requirements for, and contents of, individual licenses/approval for specific dismantling tasks

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Decommissioning implementation:

7. Delays in implementation/completion of decommissioning can arise from many reasons (licensing procedure, tender procedures, changes of strategies, unexpected findings, interdependencies among onsite multiple units, lack of disposal facilities, ...).
    a. Has the decommissioning authorisation foreseen a time limit for completion of the works?
    b. From a regulatory point of view, what are the major causes for decommissioning implementation/completion delays?

End of decommissioning and release from regulatory control:

8. Upon completion of decommissioning, the achievement of the decommissioning goals should be documented and approval by the regulatory authority may be required. Depending on the desired end state of decommissioning, the process for release of the facility (or site) from regulatory control may be integrated in the decommissioning process or may take place in a separate process.
   Please describe your legal and regulatory framework for decommissioning and release from regulatory control with respect to:
   a. Requirements for documentation and approval of achievement of the end state for decommissioning.
   b. Requirements for documentation and approval of compliance with criteria for release from regulatory control (if relevant)
   c. Limitations in time (if any) between the end of decommissioning and clearance from regulatory control (if relevant).

Some very preliminary conclusions

Preferred approaches: immediate decommissioning strategy and green field

→ Arguments quoted to prevent deferred dismantling: nuclear safety and radiological protection aspects, interdependencies between civil structures, buildings and installations in the site, burdens to future generations, possible loss of knowledge and competence…

Important initial question: who is the licensee at these decommissioning works?

Dedicated Agency vs. NPP. This can be important:

→ Cost as a factor to decide, as well as duration of the process

→ Transitional phase between operation and decommissioning will be key in the transfer of responsibilities

Important differences in the regulation:

→ Level of “freedom” of the operator to decide on strategy and concrete steps

→ Time for the licensee to perform its tasks

→ Time for the authorities to adopt their decisions (administrative deadlines)

→ Does every single operation need a particular license? Does this entail more bureaucracy?

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WORK IN PROGRESS

(thank you for your attention)

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WORKING GROUP 6:

Nuclear Security and Non-Proliferation

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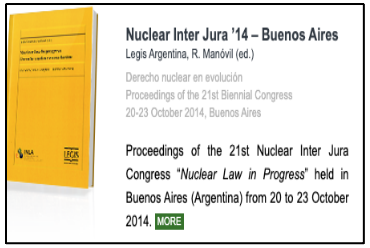
Why re-launch Working Group 6 ?

- INLA Working Group 6 initially focused on nuclear security

- Had been inactive in the last few years, but had already envisaged an expansion to cover non-proliferation

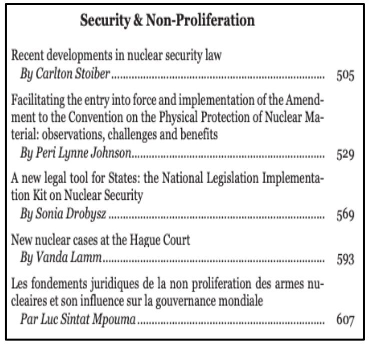
- Pressing issues such as the upcoming review conferences for the NPT and the amended Convention on the Physical Protection of Nuclear Material, as well as the entry into force of the Treaty on the Prohibition of Nuclear Weapons, encouraged some of its members to reactivate the Group and expand its scope to also cover nuclear non-proliferation



Nuclear Inter Jura '14 – Buenos Aires
Legis Argentina, R. Manóvil (ed.)

Derecho nuclear en evolución
Proceedings of the 21st Biennial Congress
20-23 October 2014, Buenos Aires

Proceedings of the 21st Nuclear Inter Jura Congress "*Nuclear Law in Progress*" held in Buenos Aires (Argentina) from 20 to 23 October 2014. MORE



Security & Non-Proliferation

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Working Group 6 Re launch

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NEWSLETTER
INLA UPDATE – NO. 2 (20) – FALL, 2021

- Working Group 6 on Nuclear Security and Non-Proliferation

The Board of Management considered the proposal to broaden the terms of reference of WG 6 with a view to cover explicitly, in addition to security issues, the legal aspects of the non-proliferation of nuclear weapons and international safeguards. That proposal was approved by the Board and, as a result, the title of the Group now reflects the dual dimension of its field of work.

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Working Group 6 revised Scope

Nuclear security: the prevention of, detection of, and response to, criminal or intentional unauthorized acts involving or directed at nuclear material, other radioactive material, associated facilities, or associated activities

Nuclear non-proliferation: prevention of the spread of nuclear weapons and related technology. Nuclear non-proliferation includes related verification activities such as nuclear safeguards

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Working Group 6 Objectives

- Encouraging, within the membership of the International Nuclear Law Association, the exchange of knowledge on legal issues related to nuclear security and non-proliferation

- Developing analysis on legal issues related to nuclear security and non-proliferation, including possible ways to support and strengthen the related legal and regulatory frameworks

Working Group 6 Composition

Chair:
Ms Sonia Drobysz

Co-secretary:
Mr. Sylvain Fanielle

Co-secretary:
Mr. Jonathan Herbach

Contact: inla.wg6@gmail.com

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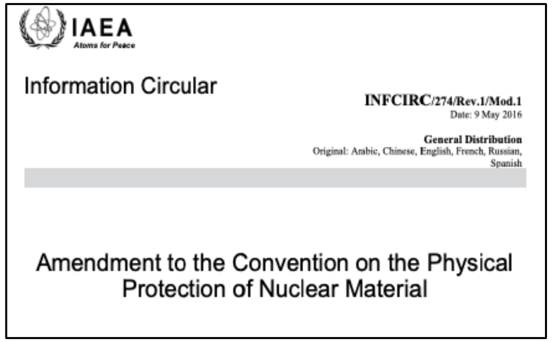
Working Group 6 Topics for discussion


IAEA
Atoms for Peace

Information Circular

INFCIRC/274/Rev.1/Mod.1
Date: 9 May 2016

General Distribution
Original: Arabic, Chinese, English, French, Russian, Spanish

Amendment to the Convention on the Physical Protection of Nuclear Material

Nuclear security

- Conference of the Parties to the Amendment to the Convention on the Physical Protection of Nuclear Material

- Framework against illicit trafficking

- National implementation of nuclear security instruments/ national legal frameworks for nuclear security

Suggestions?

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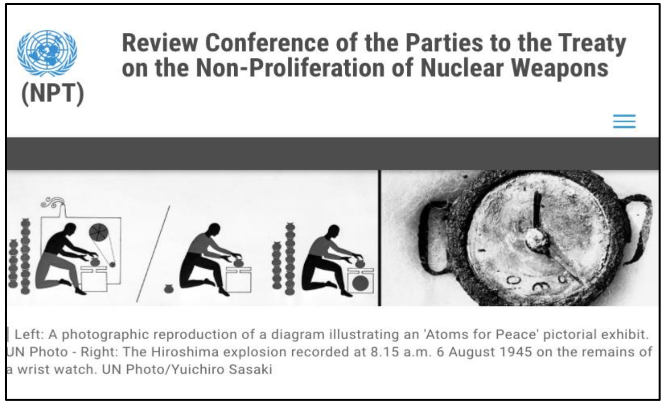
Working Group 6 Topics for discussion

Non-proliferation

- Treaty on the Prohibition of Nuclear Weapons

- AUKUS deal and safeguards

- Review Conference of the Parties to the Treaty on the Non-Proliferation of Nuclear Weapons



Suggestions?

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Working Group 6 Topics for discussion

Cross-cutting issues

- New/emerging technologies: implications for non-proliferation and nuclear security

Suggestions?

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Working Group 6 Activities

- Meetings, webinars, participation in INLA events

- Reports and publications

- Resources repository and book reviews

Suggestions?

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Working Group 6 Next steps

Join us!

- Working Group 6 meeting

- Work Plan

- Preparations for 2022 Inter Jura

SPECIAL PRESENTATION:

Stephen G. Burns

(Retired) General Counsel, and Chairman, of the United States Nuclear Regulatory Commission, Head of Legal Affairs for OECD/NEA

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WORKING GROUP 1:
Safety and Regulation

WORKING GROUP 8:
Nuclear Fusion

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Joint Session of Working Group 1 (Safety & Regulation) & Working Group 8 (Nuclear Fusion)

2021 Nuclear Inter Jura Virtual Congress
October 27, 2021
2:00PM-3:30PM

Introduction of WG1 and WG8 and of the session

Ian SALTER
Chairperson - INLA WG1 on Safety & Regulation
William E. FORK
Co-Chairperson - INLA WG8 on Nuclear Fusion

Lifetime extensions and environmental impact assessment

Sam EMMERECHTS
Council of the European Union
Pierre BOURDON
OECD Nuclear Energy Agency

Background to the situation in the European Union

- *Directive 2011/92/EU of the European Parliament and of the Council of 13 December 2011 on the assessment of the effects of certain public and private projects on the environment, as amended (**EIA Directive**) – applies in all EU member states*

- *Convention on Environmental Impact Assessment in a Transboundary Context (**Espoo Convention**) – the EU and its member states are contracting parties*

Applicability of the Espoo Convention to lifetime extensions

- *2014:* The Meeting of the Parties to the Espoo Convention endorses findings by its Implementation Committee that Ukraine was in non-compliance with the Convention with respect to the ***lifetime extension of Rivne 1&2 nuclear power reactors***

- *2017:* The Meeting of the Parties to the Espoo Convention decides to work on guidance on the applicability of the Convention to the lifetime extension of nuclear power reactors

Applicability of the Espoo Convention to lifetime extensions

- *2020:* The Meeting of the Parties to the Espoo Convention endorses the ***Guidance on the Applicability of the Convention to the Lifetime Extension of Nuclear Power Reactors***. However, the situation remains uncertain for countries with operating licences for an indefinite term.

- *2021:* **Seven cases** pending before the Implementation Committee (Belgium, Bulgaria, Czech Republic, France, Netherlands, Spain and Ukraine), for a total of ***56 nuclear power reactors***

EU Court of Justice Judgment in case C-411/17 (1)

- ***Central question:*** should an EIA be conducted prior to authorising the lifetime extension (USA: “licence renewal”) of nuclear power reactors in the European Union?

- ***Current situation in the European Union:*** unlike the USA where an environmental review is obligatory, the answer differs from one State to another in the EU. Sometimes yes, sometimes no but very often the answer is unclear in the legislative and regulatory framework

EU Court of Justice judgment in case C-411/17 (2)

Judgment relates to the situation in one EU Member State, Belgium:

- 2 reactors at Doel nuclear power station near Netherlands and Germany

- operating licence for indefinite term, unlike 40-year licence in USA

- Nuclear Phase Out Act (2003): cease operation after 40 years

- Nuclear Lifetime Extension Act (2015) revisits 2003 Act: lifetime extension until 50 years conditional upon safety improvement investment of EUR 700 million (USD 815 million)

- Nuclear Safety Regulator decided that there was no need to conduct EIA

- Plea for annulment of Nuclear Lifetime Extension Act for failure to conduct EIA prior to authorising lifetime extension

EU Court of Justice judgment in case C-411/17 (3)

Court ruled that conducting an EIA was obligatory prior to authorising lifetime extension of Doel nuclear power reactors because of the combination of two factors:

- Significant extension of the lifetime of the reactors by 10 years
- Major upgrading works to bring the reactors into line with safety standards required physical alterations to the site

The Court concluded that the risk of the environmental effects resulting from these combined factors is comparable to the risk when these reactors were first put into service

Conclusion & Take Away Points

- ***Increasing number of disputes on need of EIA for lifetime extensions in European Union***

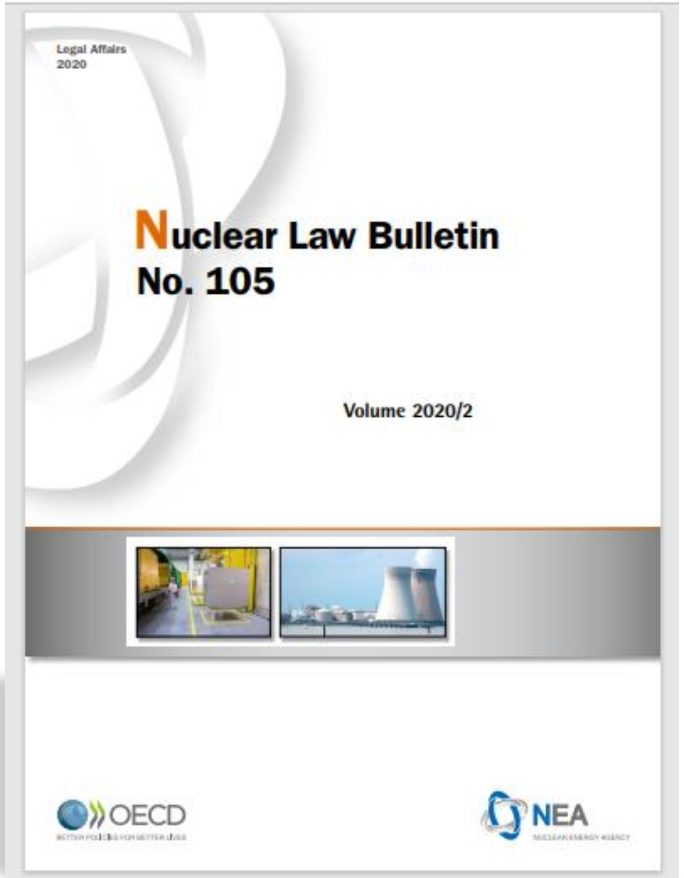
Grey zone in international and EU environmental law whether or not an EIA must be conducted prior to lifetime extension of nuclear reactors in the EU-27 increasingly leads to disputes in courts and international bodies

- ***Growing tendency to enhanced environmental scrutiny in European Union***

Growing tendency in judicial and regulatory environment in EU-27 towards increased environmental scrutiny over lifetime extensions of nuclear power reactors, as illustrated by the Espoo Convention Guidance on Lifetime Extensions (2020) and the EU Court of Justice judgment on Doel nuclear power reactors (2019)

More information

Article « Environmental impact assessments and long-term operation of nuclear power reactors: Increasing importance of environmental protection in the European Union? », by Sam Emmerechts and Pierre Bourdon, published in Nuclear Law Bulletin No. 105/VOL. 2020/2. Available at: www.oecd-nea.org/jcms/pl_58810/nuclear-law-bulletin-no-105-volume-2020/2



More information

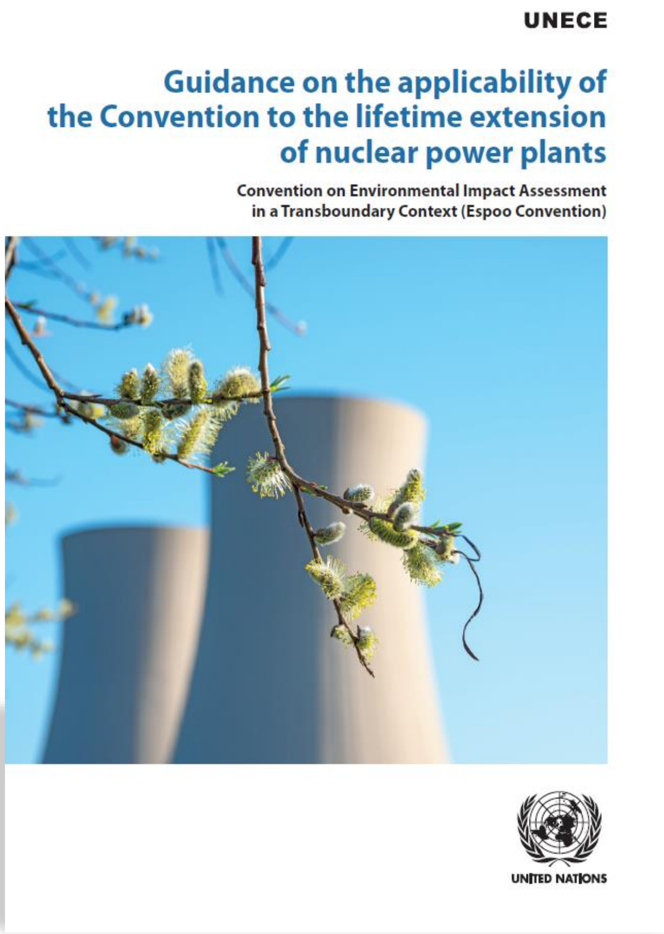
Report «Legal Frameworks for Long-Term Operation of Nuclear Power Reactors by the OECD NEA». Available at:

www.oecd.org/publications/legal-frameworks-for-long-term-operation-of-nuclear-power-reactors-c7b6dbb2-en.htm

More information

Guidance on the Applicability of the [Espoo] Convention to the Lifetime Extension of Nuclear Power Plants. Available at:

https://unece.org/sites/default/files/2021-07/2106311_E_WEB-Light.pdf



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Licensing of SMRs

Konsta VÄRRI
FORTUM

Small Modular Reactors
- A brief overview on licensing and other hurdles

INLA Working Group 1 & 8 Webinar

Konsta Värri, 27th of November, 2021

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Fortum at a glance

INCLUDING UNIPER

3rd largest
power generator
in Europe and Russia

3rd largest
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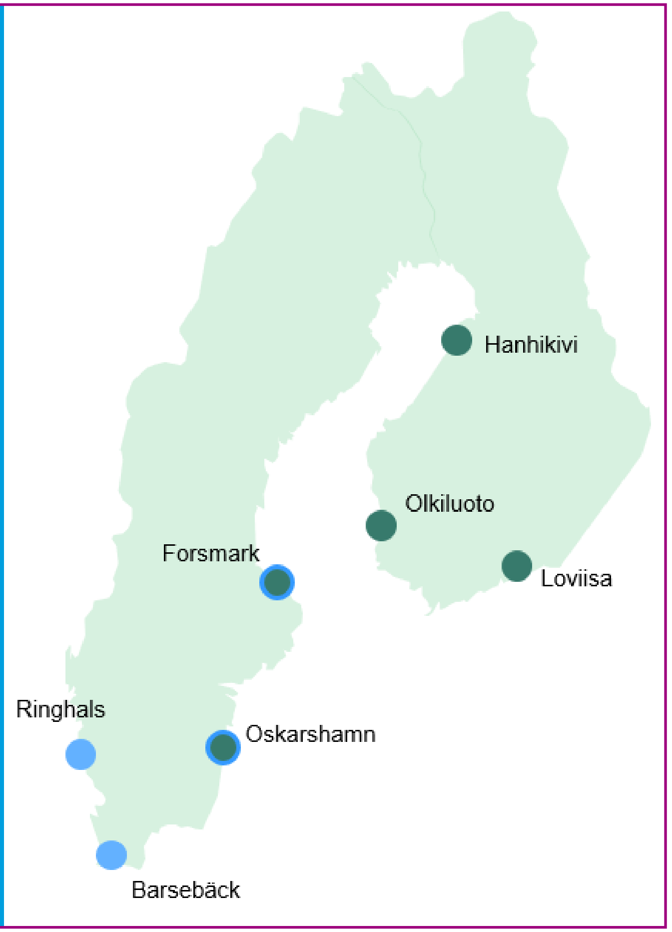
3rd largest nuclear
generator
in Europe



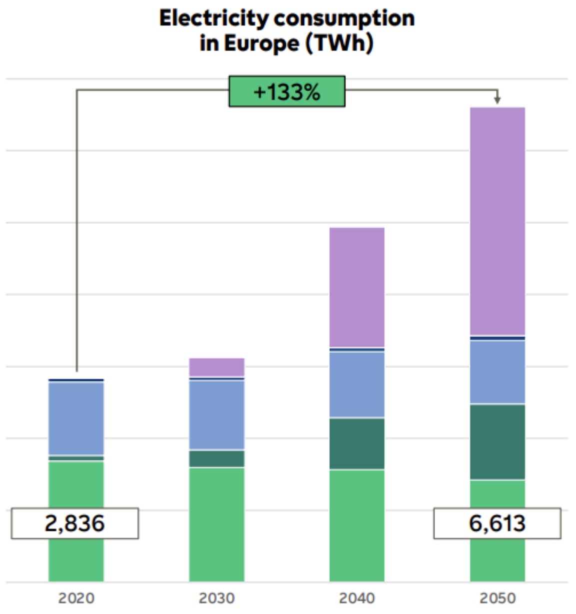
What are SMRs

- By traditional definition, a nuclear reactor design producing less than 300 MWe
- SMR as a term is very flexible and can be used to refer to a variety of designs that don't necessarily have much in common
  - Even thought it is a useful shorthand, being more specific about what is being talked about is critical to staying on the same page.
  - Current proposed SMR designs range size wise from micro modular reactors (MMRs) that produce under 50MWt to the UK SMR with a 470 MWe single reactor unit.
  - Reactor designs range from fairly traditional light water reactors to Gen-IV designs including high temperature gas cooled reactors, molten salt designs etc.

Why SMRs?

Rationale for SMRs

- Large part of the current power generation capacity in Europe will be phased out in order to reach the decarbonization targets
- At the same time, the demand for electricity is expected to significantly increase



Presented in Fortum Capital Market's Day on 3 Dec, 2020

- Today, investments in newbuild nuclear do not seem realistic in the current market situation
- However, due to the aggressive **decarbonization targets**:
  - Demand for dispatchable and reliable carbon-free power generation to supplement intermittent renewables is expected to increase as the degree of decarbonization increases
    - → **New nuclear may become one of the key technologies**
  - Nuclear power has the potential to significantly reduce the cost of deep decarbonization

- SMRs will not replace traditional nuclear, but are expected to have their own use cases
  - Flexible operation / load following capabilities
  - capabilities for cogeneration or heat only production
    - **Expand the use of nuclear to district heating, industrial heat and hydrogen generation**
- SMRs need to be economically viable considering
  - Technology
  - Project implementation and project risks (incl. licensing risks)
  - Financing

SMR Deployment – Licensing and other hurdles

- SMRs may achieve economy of scale only through modularisation/factory pre-fabrication and high level of standardisation, enabling serial production
  - Keeping the designs uniform across countries will be critical for the economics of these plants → challenges for licensing
    - International licensing and regulation seems unlikely, conflict with national level laws?
    - Some of the same advances should be achievable by maximising the use of pre-existing licensing material from the First-of-a-Kind plant or later from following sister plants.
    - National regulatory bodies to leverage on the work of foreign regulatory bodies
      - Sovereignty of national regulatory bodies not to be endangered
    - No country specific design modifications other than those arising from site and environmental conditions.
      - National regulations should set safety targets compatible with international practice (such as IAEA), but would avoid setting detailed, prescriptive requirements.
      - National legislation should make it possible to adopt requirements of the foreign country where the reference plant has been licensed.

SMR Deployment – Licensing and other hurdles

- Liability considerations
  - New use cases will bring new end users, this could be seen to lead to a situation where more experienced nuclear operators would offer plant operations as a service and divide the (at least for us) more traditional owner/operator role.
    - Who is willing to take the liability and who will foot the bill
      - Insurance considerations

Thank you

For more information, please visit

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Licensing of new fusion plant in the UK – latest UK Government proposals

Ian TRUMAN
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2021 Nuclear Inter Jura Virtual Congress
International Nuclear Law Association - United States Chapter

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The existing fission regulatory regime:

> Section 1 of the Nuclear Installations Act 1965 prohibits any person from using a site for the purpose of installing or operating any nuclear reactor or any other prescribed installation

> A "nuclear reactor" is specifically defined as a reactor designed or adapted for the production of atomic energy from a nuclear fission process

> The regulations which prescribe installations that require a licence include those used for the bulk storage of radioactive matter which has been produced or irradiated in the course of the production or use of nuclear fuel

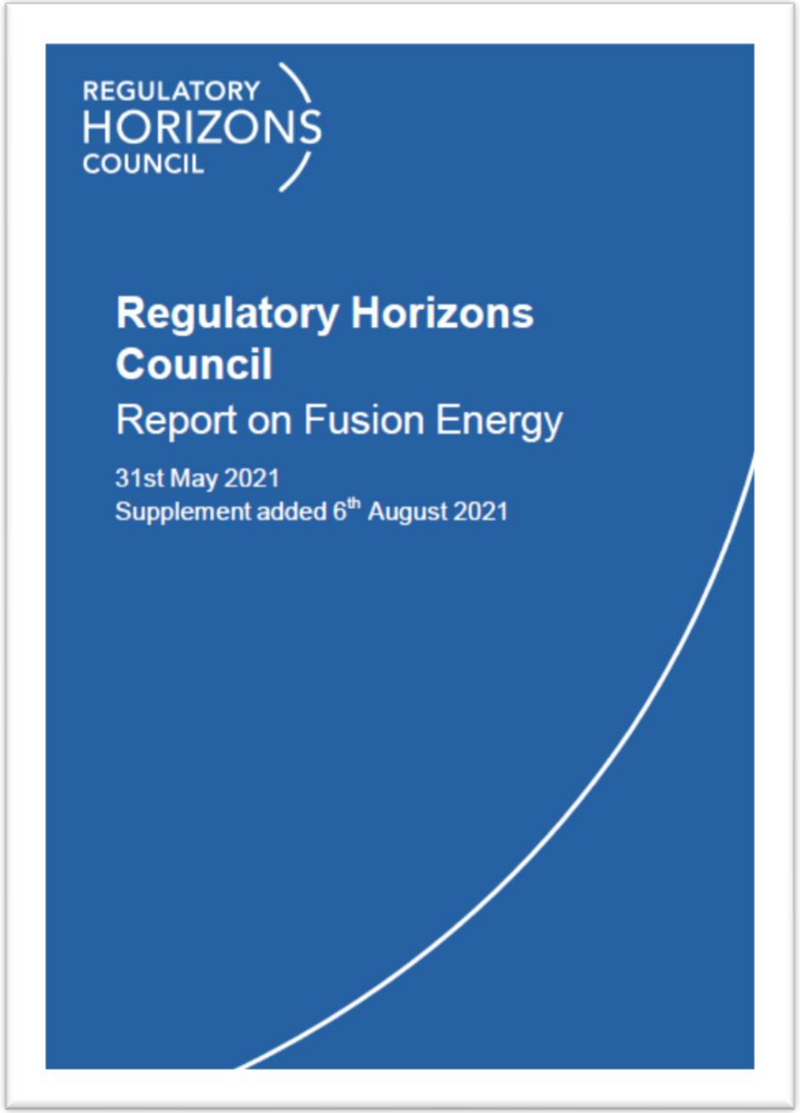
> 'Bulk quantities' exemption – STEP could have a tritium inventory of a few kilograms which may trigger the need for a nuclear site licence

> Different categories of sites subject to different liability limits low, intermediation and standard

Regulatory Horizons Report

Options considered:

- > Existing regime i.e. HSE and the EA
- > Existing fission regime i.e. ONR and EA
- > Brand new regime with new regulator



Factors considered:

> **Proportionality and agility** – regulation be proportionate to risk

> **Perception and trust** – social licence

> **Lessons learnt and understanding** – will STEP be different from JET?

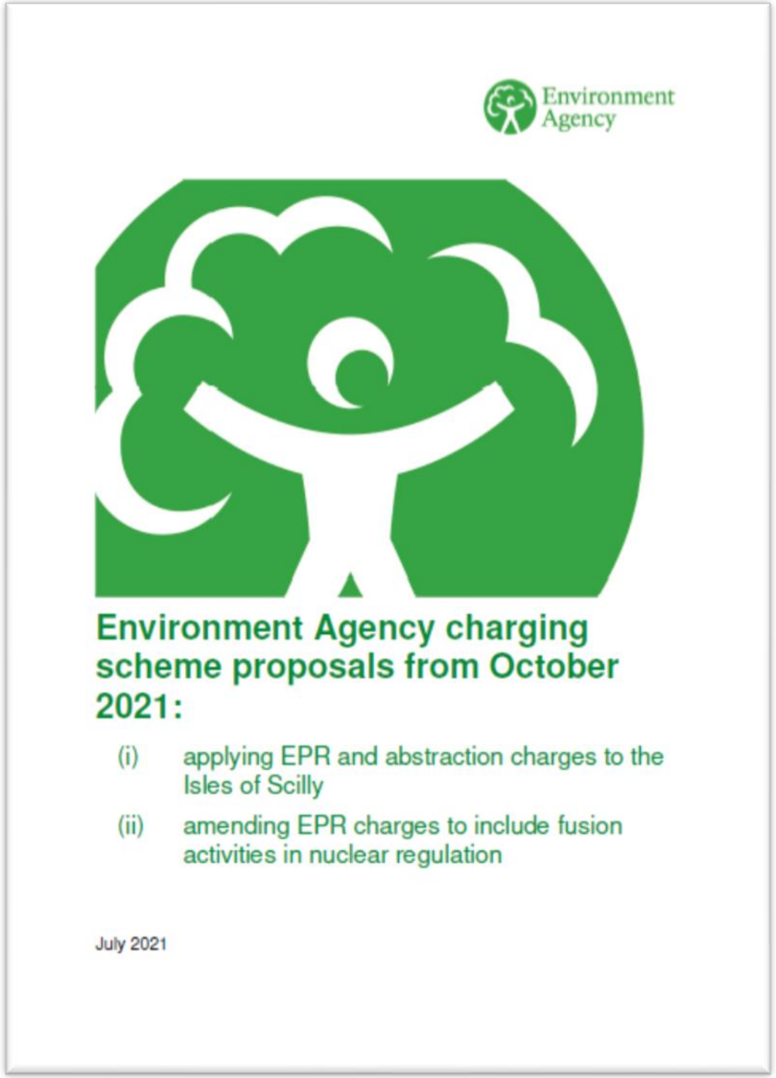
> **Experimentation and innovation** – are HSE and EA competent?

> **Support and collaboration** – an 'enabling' regulator?

Consultation on a change to the Environmental Nuclear Regulator’s charging scheme:

> Fusion will be included as a ‘specified radioactive substances activity

> The EA will be able to support pre-application engagement and recover its costs


Environment Agency

Environment Agency charging scheme proposals from October 2021:

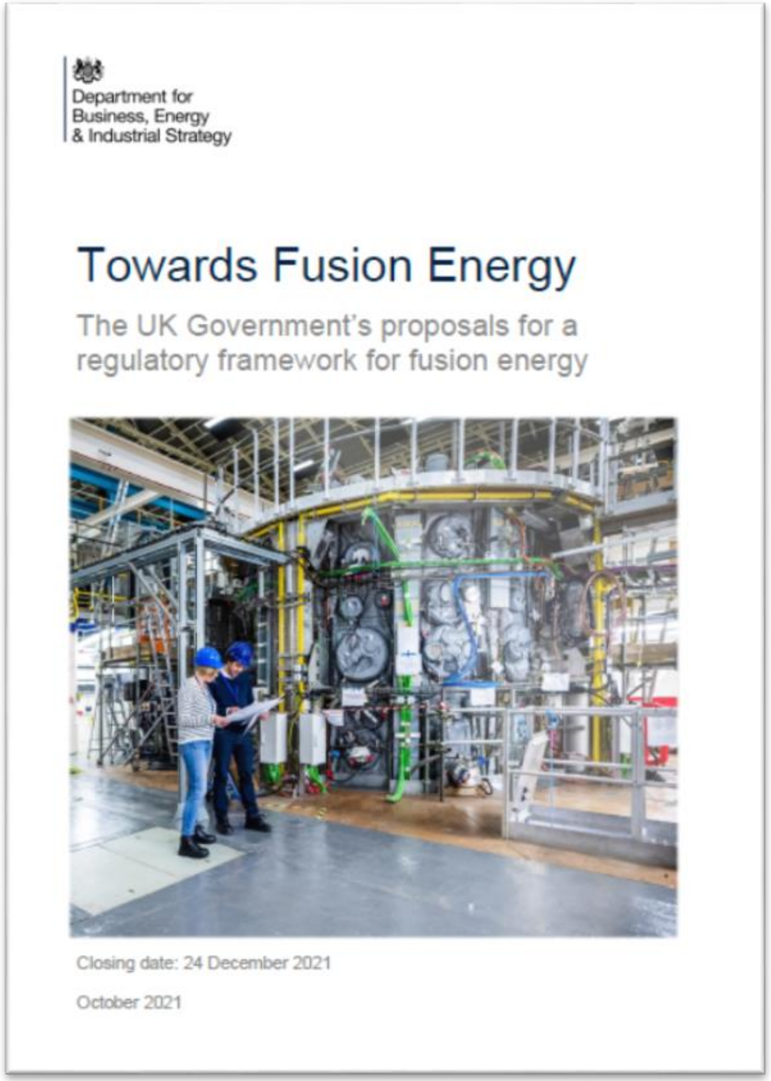
(i) applying EPR and abstraction charges to the Isles of Scilly

(ii) amending EPR charges to include fusion activities in nuclear regulation

July 2021

Government consultation:

- Maintain existing approach i.e. HSE and EA
- Clarify existing regulations and introduce new provisions
- Enhance engagement and develop new guidance
- Keep related policy under review


Department for
Business, Energy
& Industrial Strategy

Towards Fusion Energy

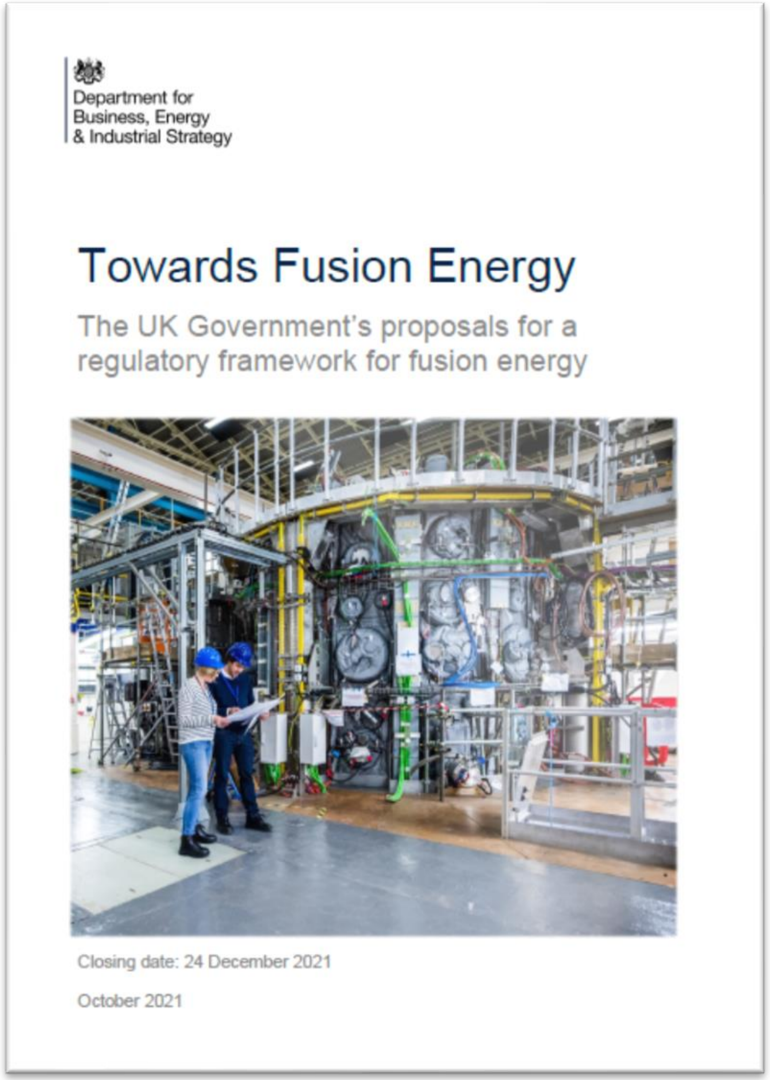
The UK Government's proposals for a regulatory framework for fusion energy

Closing date: 24 December 2021

October 2021

UK Government Consultation on the regulation of fusion:

> Justification required
> Key legislation to be amended
> Fusion National Policy Statement
> Special third party liability regime - TBC
> Cyber regulations - TBC
> Early engagement encouraged but not compulsory
> Additional regulatory guidance - TBC
> UKAEA's Fusion Safety Authority as a TSO to regulators
> Existing radioactive waste management committee to advise on waste but existing policy and strategy to apply -> FDP?
> No nuclear safeguards
> Export controls to apply
> Review every 10 years
> Focus on international collaboration


Department for
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Towards Fusion Energy

The UK Government's proposals for a regulatory framework for fusion energy

Closing date: 24 December 2021

October 2021

Closing thoughts:

- > Is adopting existing nuclear liability principles necessary? Will that approach stifle development?
- > If included through the Revised Paris Convention will we end up with the same global patchwork?
- > Will commercial scale fusion change anything?
- > Some sort of funded decommissioning programme likely?
- > Public acceptance will be vital
- > What is going to happen internationally?

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Questions?

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Regulatory considerations for fusion development in the US

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US Fusion Regulation

Status & Recent Developments

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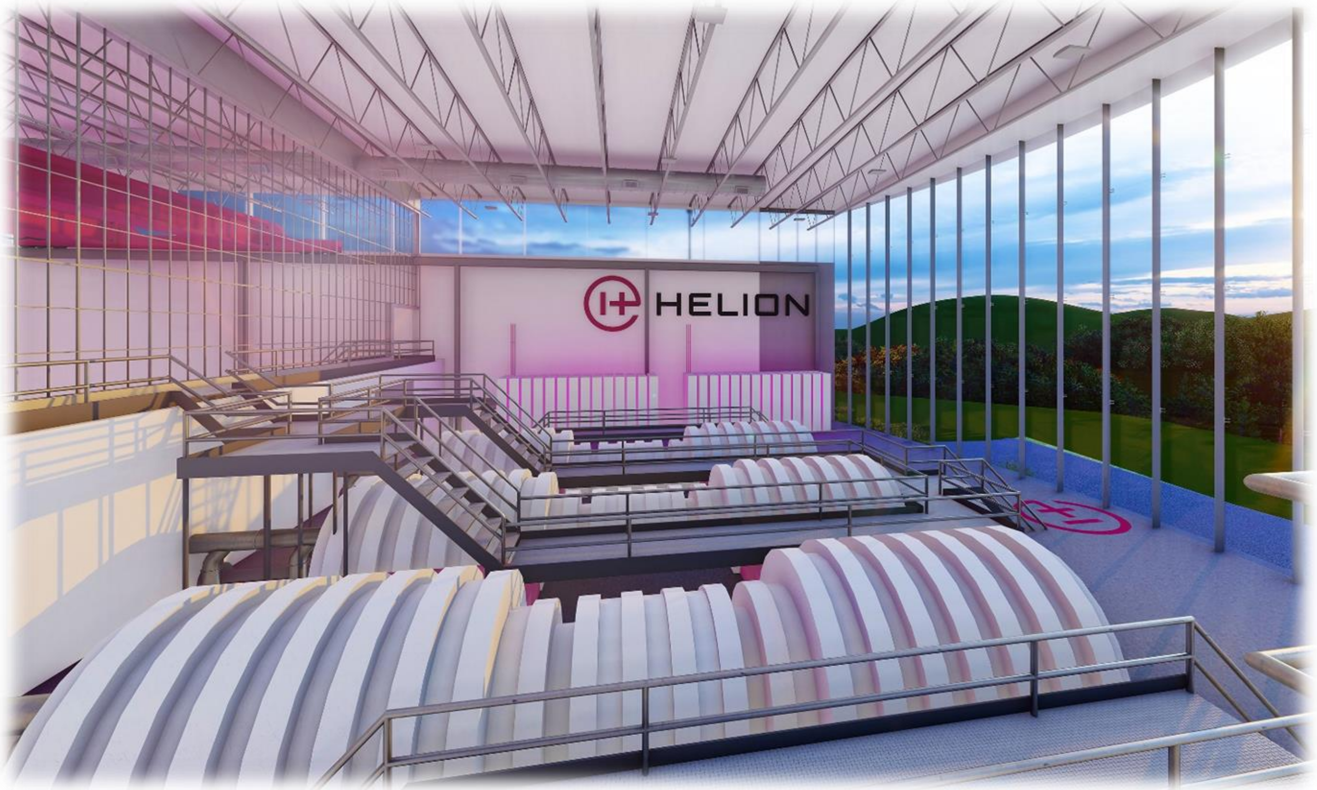
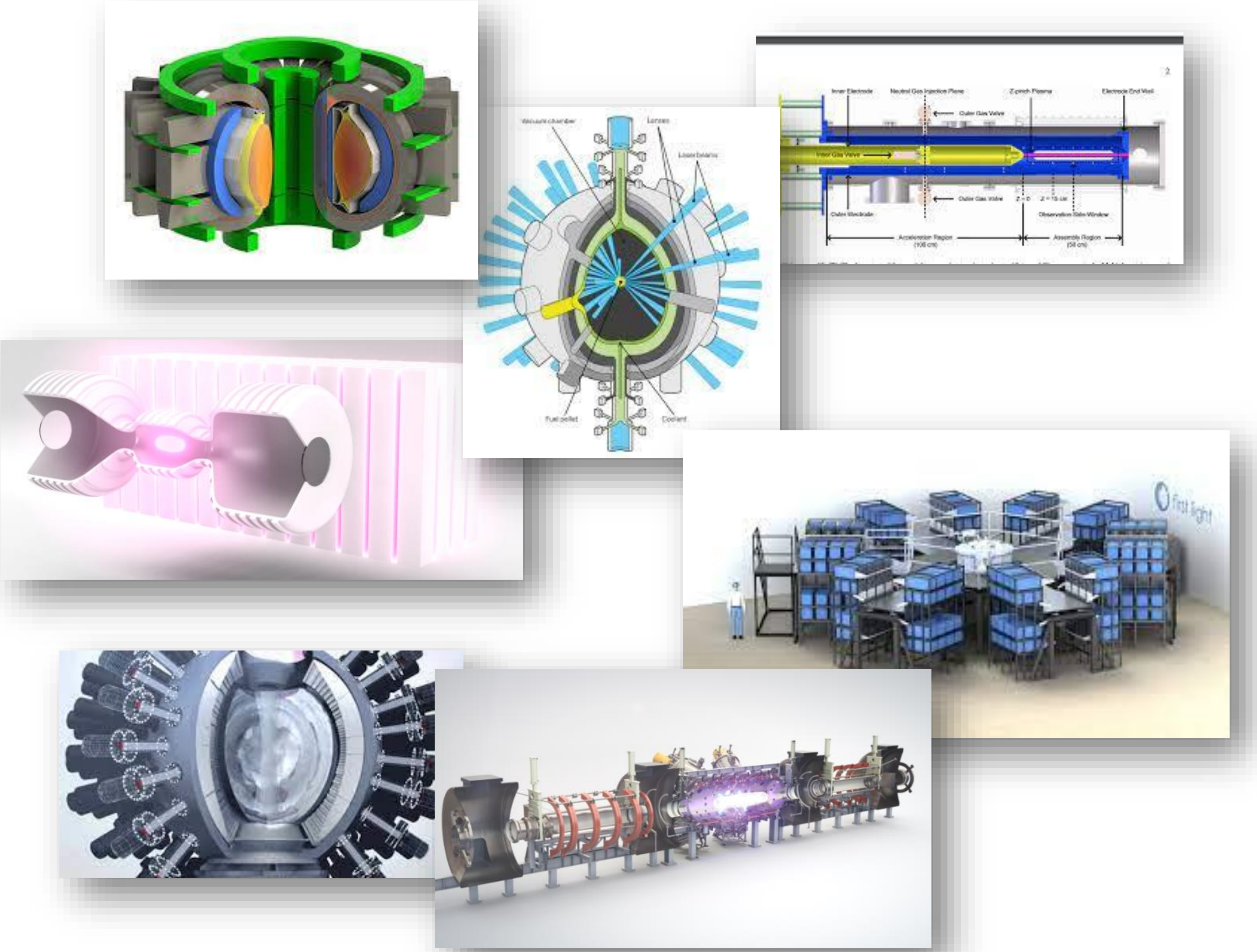
**Views presented herein are in an individual capacity and do not represent any person or organization*



Wide Variety of Fusion Approaches in US & UK

Fusion Industry Association Member Companies (Oct. 2021)



Various Concepts (Company Websites)

Current State of Regulation

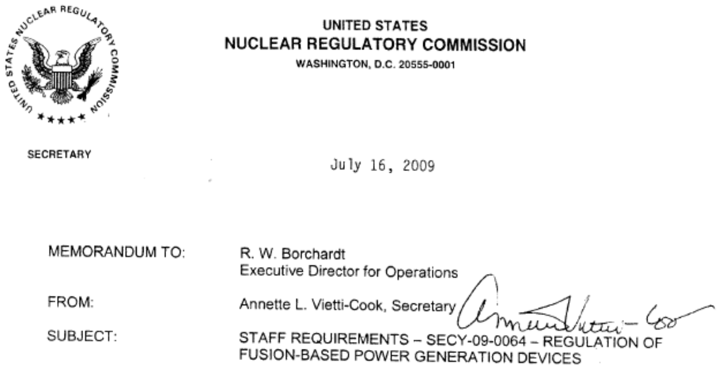
- Distributed regulation (states v. federal)
- Atomic Energy Act regulatory scheme largely segments by materials
- States regulate particle accelerators

NRC Website (Oct. 2021)

Federal (NRC)	States (If Delegated by NRC)	States (alone)
• Nuclear Power Plants • Fissile Materials	• Non-fissile radioactive materials • Small amounts of fissile material	• Particle Accelerators • Naturally occurring radmaterials • Fusion experiments/tests

NRC Examining Fusion Regulation Today

- In 2009, NRC takes jurisdiction over "commercial fusion energy devices" … but punted on the details until now.



UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

SECRETARY

July 16, 2009

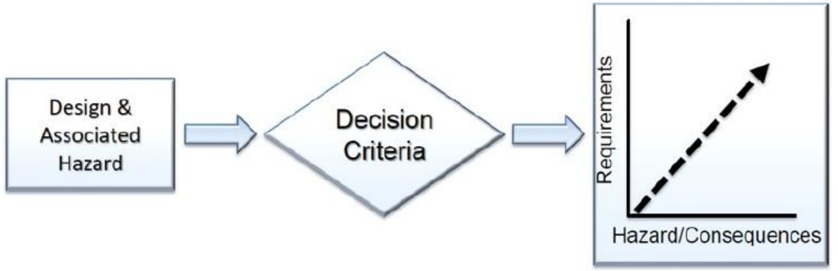
MEMORANDUM TO: R. W. Borchardt
Executive Director for Operations

FROM: Annette L. Vietti-Cook, Secretary

SUBJECT: STAFF REQUIREMENTS – SECY-09-0064 – REGULATION OF FUSION-BASED POWER GENERATION DEVICES

- NRC staff to propose a framework to Commission in 2022.
  - ➢ Nuclear reactor framework
  - ➢ Extend the current approach
  - ➢ Something Else

- Key Issues:
  - ➢ Fitting today's fusion into a Cold War statute
  - ➢ Appropriate regulation for appropriate risks
  - ➢ Creating an adaptable, long-lasting framework



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Panel discussion on fusion regulatory and legal developments in the US and the UK

Moderator: **William E. FORK** Co-Chairperson - INLA WG8 on Nuclear Fusion

Panelists:

Jay BRISTER General Fusion

Sachin S. DESAI Hogan Lovells LLP

Fiona REILLY FiReEnergy

Ian TRUMAN Burges Salmon LLP

Jean-Denis TREILLARD ELINI

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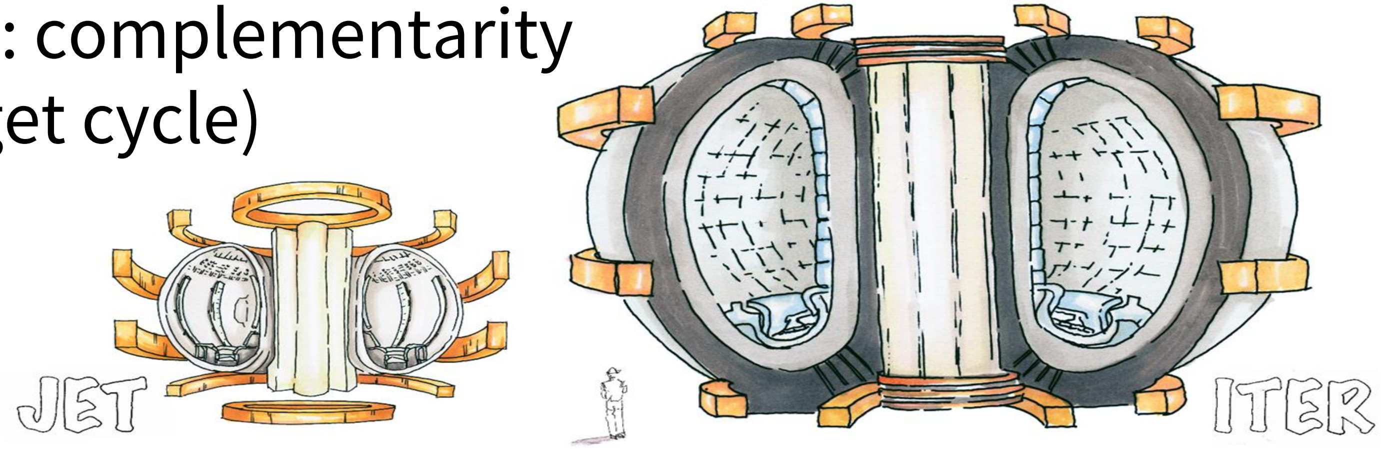
Considerations for a European Fusion Demonstration Reactor – the lessons Europe can learn from the US and the UK

Karoly Tamas OLAJOS
Co-Chairperson - INLA WG8 on Nuclear Fusion

European leadership in fusion R&D (today)

- Deliberate strategy unaltered since 1983
- **"European Research Roadmap to the Realisation of Fusion Energy"** (2012 & 2018): focus on electricity production
- Supranational public research (basic & applied) with focus on **magnetic confinement** (tokamak & stellarator concepts)
- **JET** - successful project: delivered on budget & time
- **ITER** - Europe's flagship project in the South of France
- Coordinated research effort: complementarity
- Stable funding (7-year budget cycle)



Euratom’s relevance for the future: fusion R&D led by an international organisation

Supranational law

- Euratom law - **regional** outreach
- Possibility of adopting **binding standards**
- Compulsory **enforcement mechanism**
- Existence of enhanced **collaboration of national nuclear safety authorities**

Joint investment vehicle

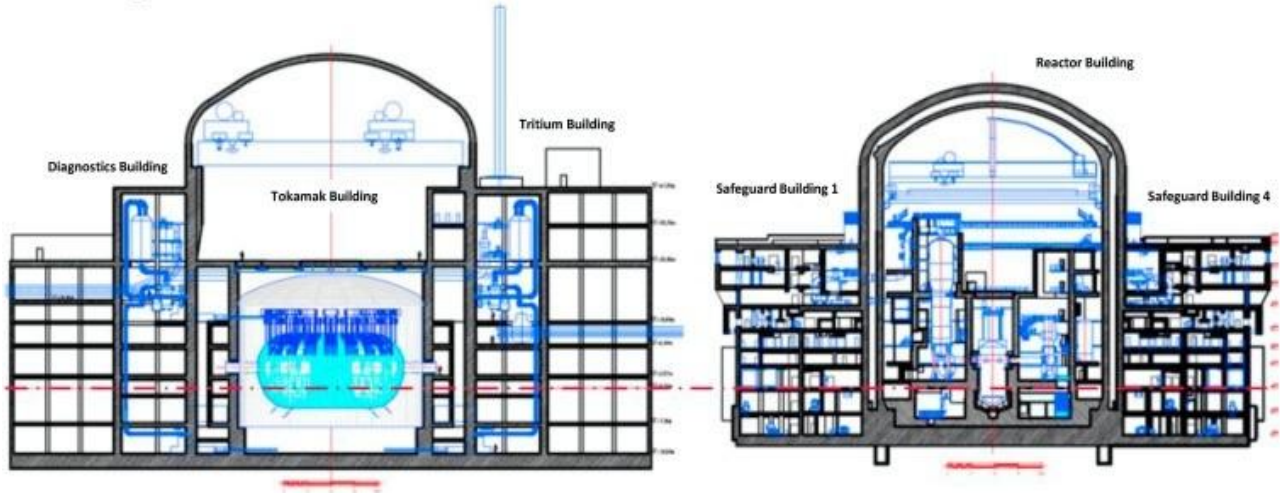
- Joint undertakings
- Privileges & immunities - **flexibility to apply nuclear regulation**
- Third countries / international organisations may become members & provide financing
- **No concern of state aid** in Euratom R&D efforts

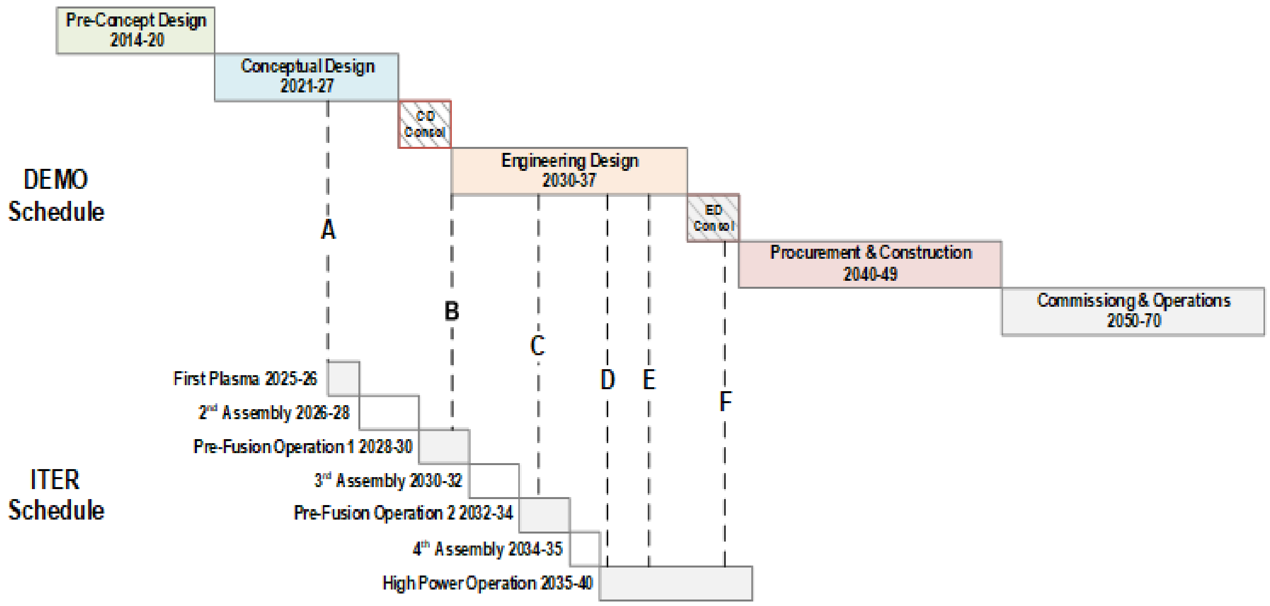
Stability & credibility

- Euratom is a political endeavour with a stable & **extendable** legal system
- Several decades of **day-to-day collaboration** among national actors reinforcing mutual trust
- Credible actor in the international fora that strives for the highest level of nuclear safety

European Fusion Demonstration Reactor (DEMO)

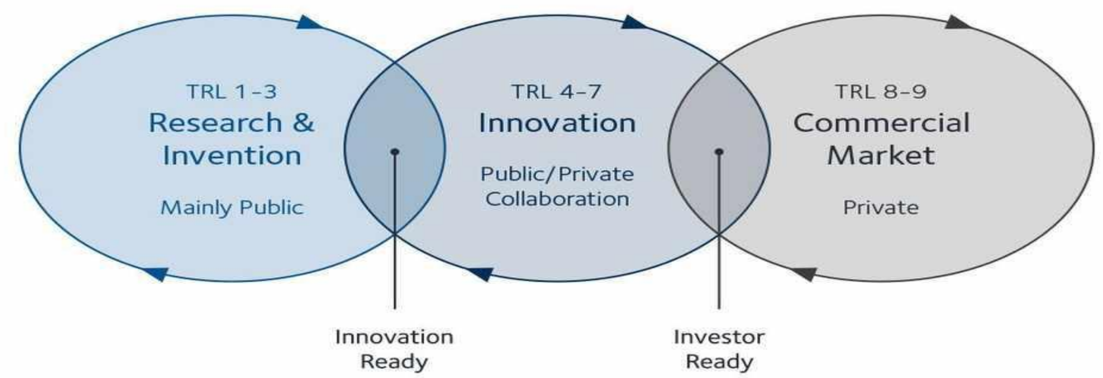
- DEMO depends on the **success of ITER**
  - Stage gate process, aligned with the ITER schedule
  - No firm political commitment yet to construct
  - Decision to construct not before 2038; operations not before 2050
- DEMO will be **bigger than ITER** & a European Pressurised Reactor
  - Capital cost-intensive; special attention to the cost of the ITER Hot Cell
  - Likely to be based on the ITER Tokamak
  - ITER's electricity would cost **USD 130/kWe** that challenges DEMO's economic viability
  - Innovation required to build Tokamaks faster
- DEMO will be regulated as a **"nuclear installation"** as per Euratom Nuclear Safety Directive (2009/71/Euratom)

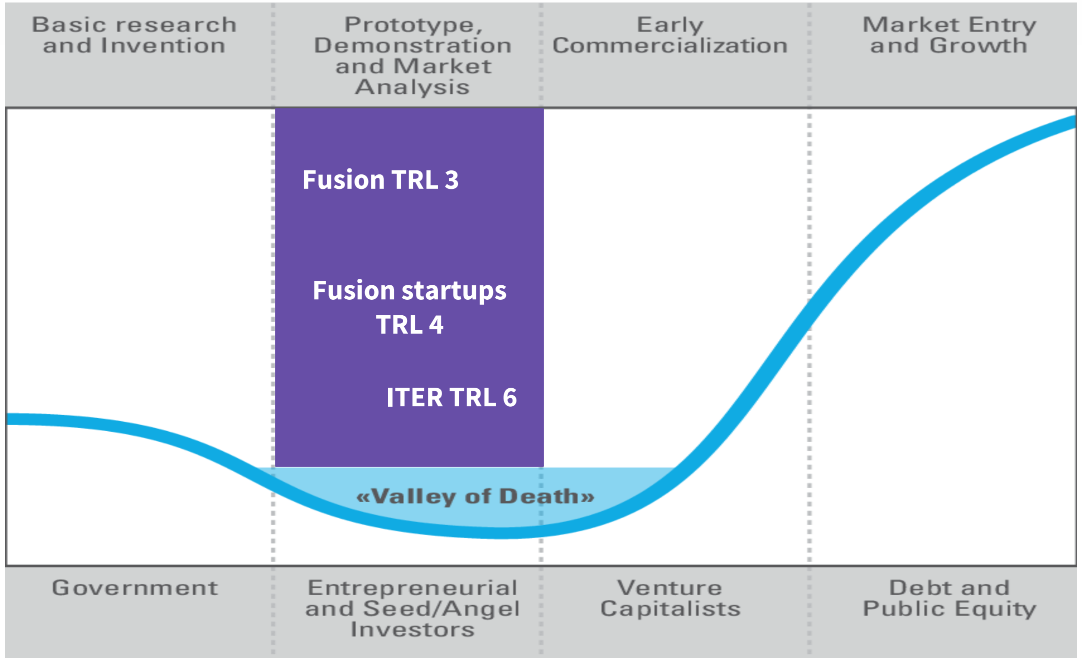




Lessons Europe can learn from the US and the UK

- **Credible signalling** to move the fusion quest fast forward:
  - Emergent strategy: bottom-up approach with flexibility
  - Diversification of fusion concepts (fuel, confinement, & technology)
- **Entrepreneurial state** & ARPA-E / ARDP:
  - Enabling entrepreneurship by fusion startups
  - Encouraging formation of an industry (Fusion Industry Association)
  - Pushing fusion from science to engineering
  - Crowd in private investment
- **Public-private partnerships**:
  - Milestone-based co-financing
  - Celebrating failure: the power of taking risks & thinking big





Market strategy for the fusion enterprise

Product / markets

- What will be the product?
- Which market to enter?
- When to enter the market?

Customers / wants

- Who will be the customers?
- What will customers want?

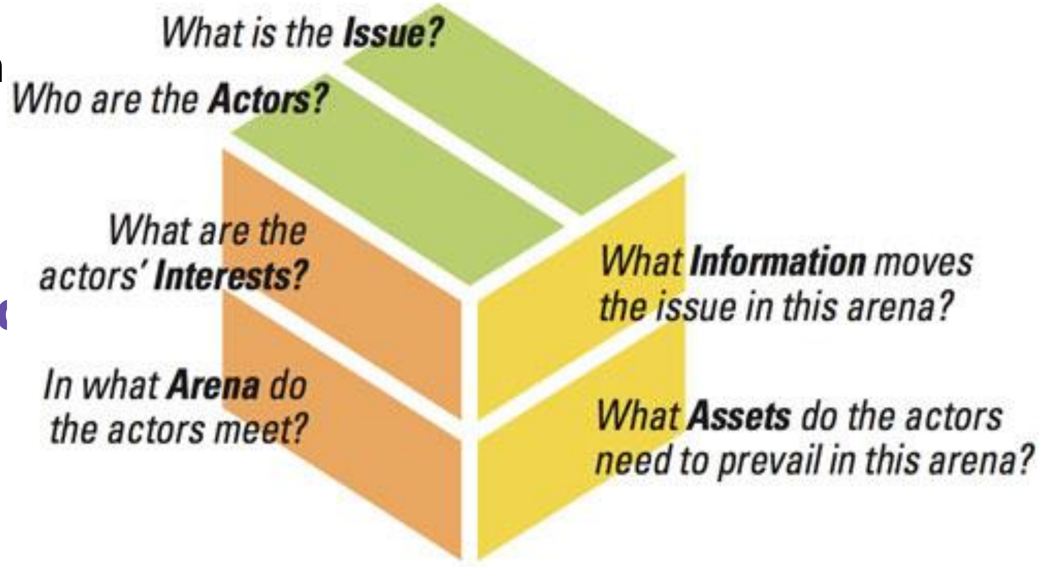
Competitors / strategy

- What will drive competition?
- Who will be the competitors?
- What strategy to follow (cost, differentiation, or focus)?

- Uncertainties remain in fusion's product development
- **Substitutability** is a key challenge for fusion's potential products (electricity, heat, hydrogen, etc.)
- Early fusion technology will not likely be able to compete on cost

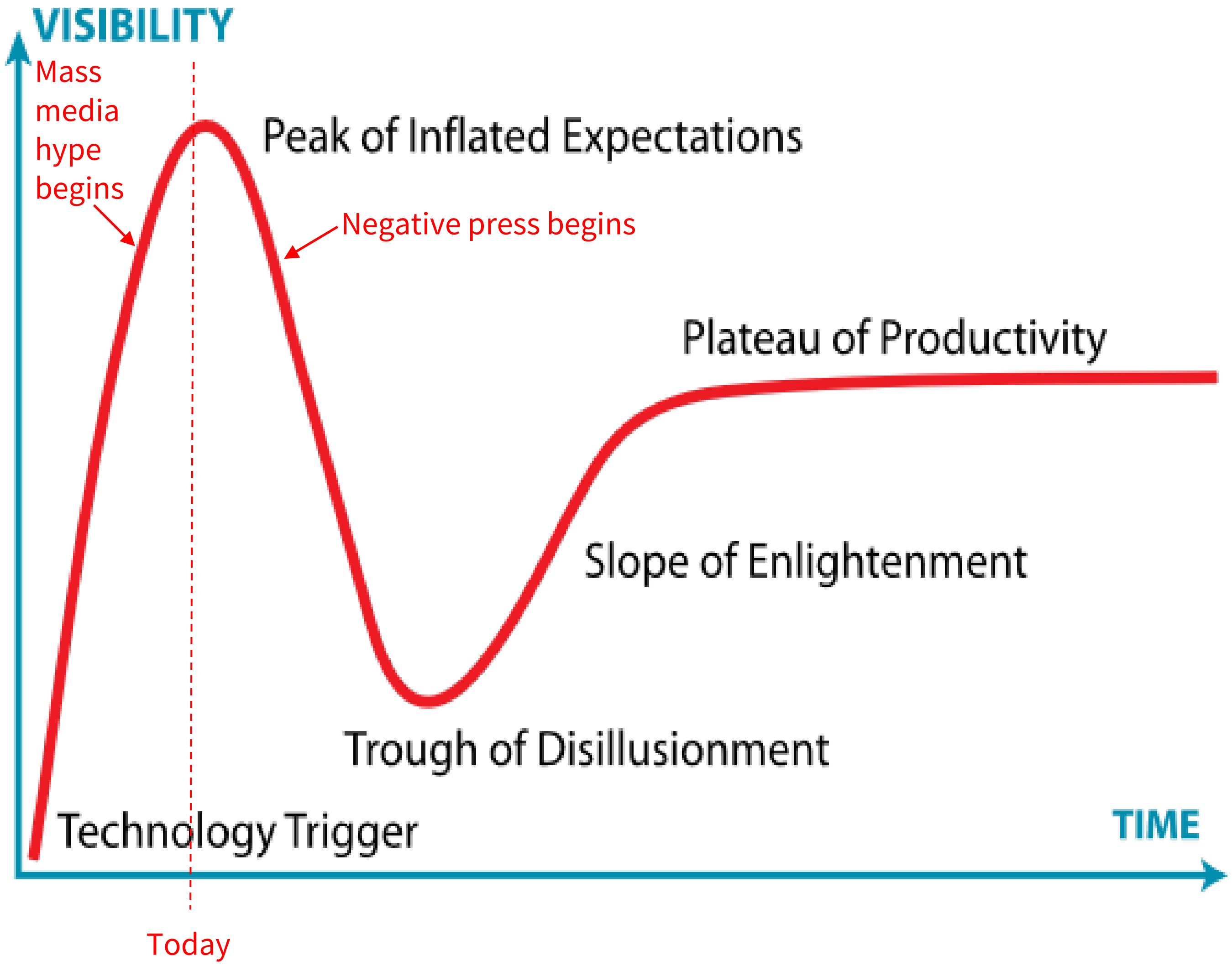
Nonmarket strategy for fusion (change)

- Accelerating fusion R&D requires a nonmarket strategy
- Regulation is said to:
  - Bring down cost if application of nuclear regulation ca be "spared"
  - Give certainty for fusion startups & investors
- Yet, early fusion technology is not expected to compete on cost; hence, **regulation must be looke at differently**
- Change the structure of the game:
  - Move from technocracy-led development to **politics-led** development
  - Move the arena from national/European to **international** politics
  - Create coalitions & **win-win games** by designing cooperative solutions for rivals



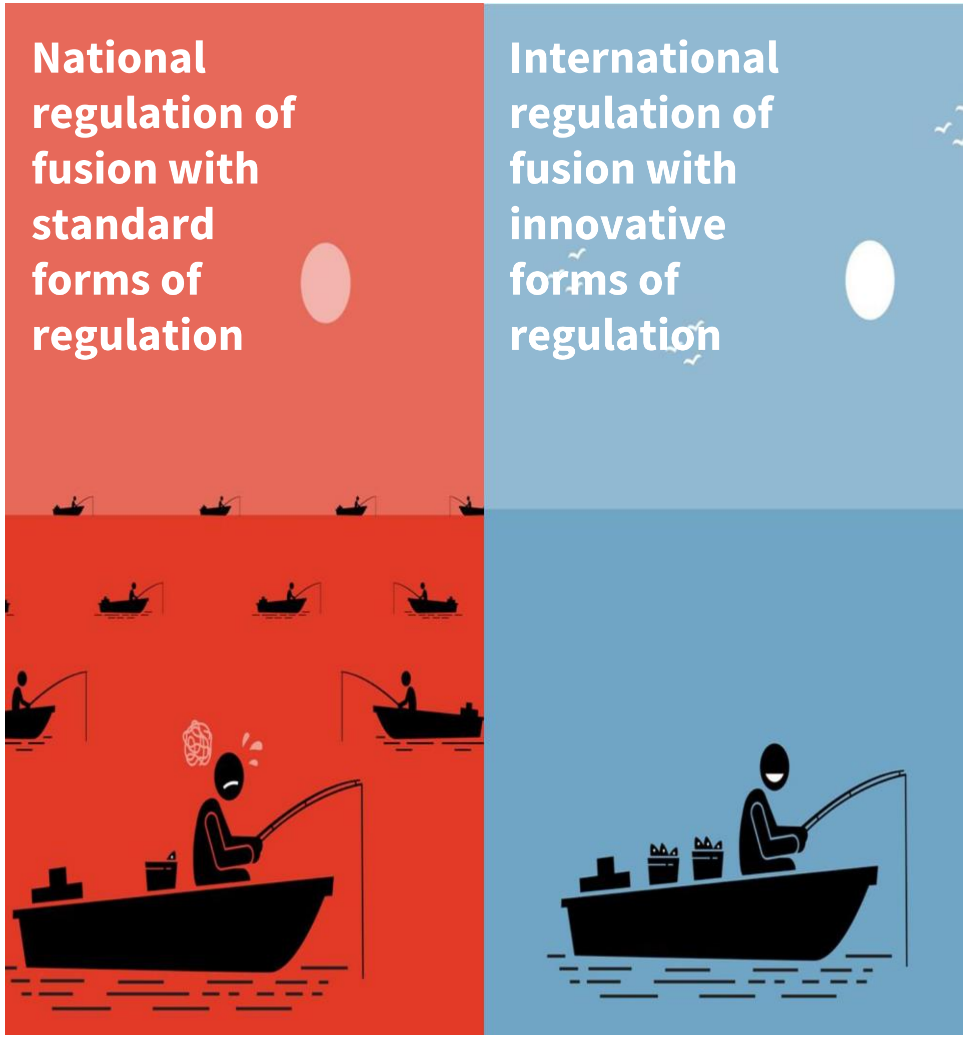
Nonmarket strategy for fusion (momentum)

- Fusion may be described on the Gartner Technology Hype Cycle:
  - **Momentum** for taking action before "peak of inflated expectations" is reached
- **Global consensus**: an agreed baseline & a plan for action
  - What are the requirements of the international community?
  - Do we need fusion as a new general purpose technology?
  - When do we need it?
  - What will be the dominant design & technology standard?
  - How to develop the industrial capacity needed for its worldwide deployment?



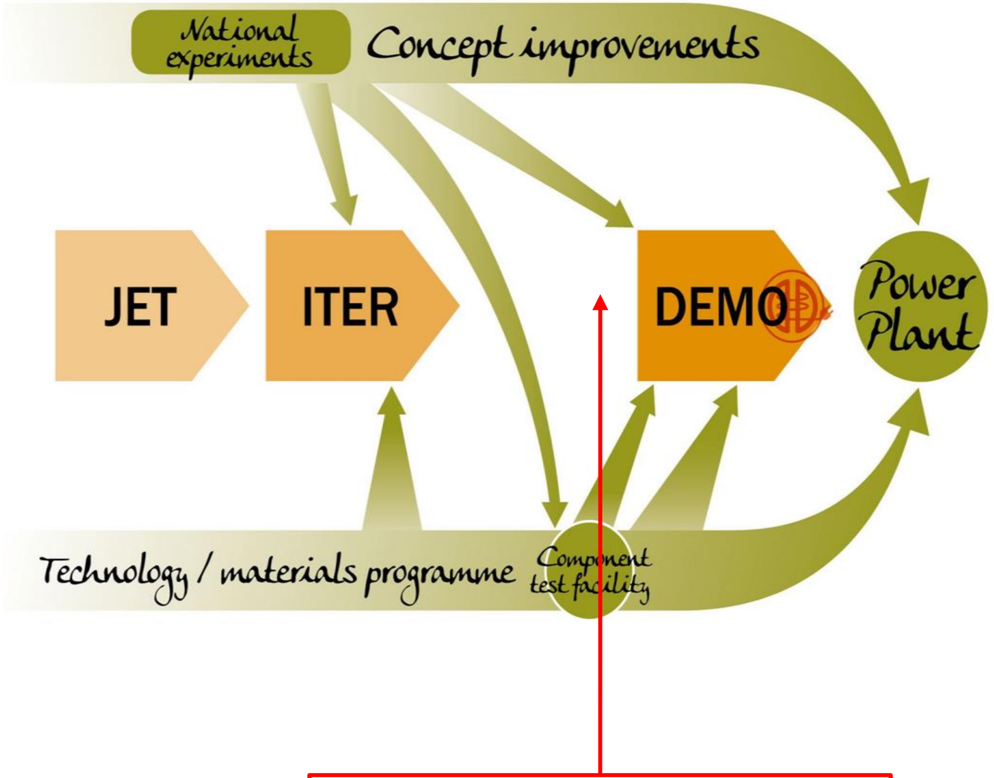
Blue ocean strategy for fusion

- Reconceptualise fusion as a **product of "international development"** (Global North-Global South co-development)
- Rebrand fusion as **"climate technology"** to accelerate its development & to bridge the "valley of death"
- Create:
  - **New market** with the help of public international law where competition is irrelevant
  - **New customer segments** for existing products (fusion electricity, heat, hydrogen, etc.): sovereign states as subjects of international law
  - **New demand** because fusion products will be produced & taken over as fulfilment of international obligations of subjects of international law "for the benefit of all humankind"
- Focused **differentiation strategy** based on sovereign equality
- **Regulation as governance network** (ecosystem) can help gradually reduce fusion's deployment cost (**value & low cost**)
- International cooperation must be extended horizontally & vertically to unprecedented levels, requiring **organisational & governance innovation**



Leadership in fusion RD&D (tomorrow)

- Today the need for **international cooperation** in fusion R&D is widely accepted; such a need will be even greater if the fusion endeavour finally produces the promised results
- One nation's regulation will not create a fit-for-purpose regulation for other nations
- **Rapid deployment of fusion worldwide** will only be possible if concerted efforts are made by the international community
- Regulation primarily concerns today the creation of an **international governance network** that can flexibly regulate fusion in view of a rapid development & deployment worldwide
- Leadership in tomorrow's fusion RD&D will be decided by whom is able to create a **coalition & international consensus** for the adoption of such an international governance



Highest incentive level for nation states to adopt international governance for fusion RD&D

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Thank you for your attention!

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We look forward to seeing you next year in 2022 in Washington, DC!