eurad 2
European Partnership
on Radioactive Waste Management

ASTRA–FORSAFF JOINT SESSION
Perspectives on the Management of Small and Emerging Inventories

Co-funded by the European Union under Grant Agreement n° 101166718

AGENDA

Time	Duration	Item	Speaker(s)
14:00	5 min	Opening	Timothy Schatz (FORSAFF)
14:05	15 min	Theme 1: Understanding Waste	Marja Vuorio (ASTRA) / Gabriele Magugliani (FORSAFF)
14:20	15 min	Theme 2: Predisposal Challenges and Solutions	Marja Vuorio (ASTRA) / David García (FORSAFF)
14:35	15 min	Theme 3: Scalable Disposal	James Begg (ASTRA) / Sami Naumer (FORSAFF)
14:50	15 min	Theme 4: Civil Society Views	Alexis Geisler-Roblin (ASTRA) / Meritxell Martell (FORSAFF)
15:05	20 min	Guest Presentation: The possibility of Nuclear Power in Ireland.	Muhammad Maladoh Bah (SEAI, UCD)
15:25	5 min	Closing	Timothy Schatz (FORSAFF)

ASTRA (ALTERNATIVE RWM STRATEGIES)

The WP addressed complementary pathways towards safe, credible and affordable waste management.

- The topics covered immediate operational needs, potential end-point solutions, cross-cutting waste management challenges, and the knowledge-sharing mechanisms needed to support informed decision-making.

Topics	Participants	Working methods
• Long-Term storage • Deep Borehole Disposal • Solutions for small inventories • NORM and DU • Knowledge exchange	• 22 organizations from 14 MS, • 3 associated partners from outside EU • WMOs, TSOs, REs and CS	• Surveys, interviews and literature reviews • Live Discussion Forums (LDF) • Workshops

Summary: international cooperation + knowledge management + targeted RD&D can help SIMS move from prolonged interim arrangements towards credible long-term solutions.

INTRODUCTION

Identify knowledge gaps and provide recommendations for future research regarding SMR/AMR waste generation and waste management.

The scope covers SMR/AMR waste inventories, predisposal approaches and disposal routes across reactor designs as well as regulatory frameworks and stakeholder perceptions over the SMR/AMR fuel cycle.

Topics	Participants	Outputs
• Waste Generation • Waste Management • Policy & Regulatory Framework • Stakeholder Engagement	• 25 partners • 4 associate partners • WMOs, TSOs, REs and CS	• Green Paper: challenges, gaps, uncertainties • White Paper: R&D recommendations • Outcome/Impacts:

SMRs/AMRs are promising, but require targeted R&D to close the waste characterisation and waste management gaps.

THEME 1 – UNDERSTANDING WASTE

Marja Vuorio (ASTRA) and Gabriele Magugliani (FORSAFF)

ASTRA highlighted that understanding waste means:

- knowing what the waste contains,
- how it is packaged,
- how its characteristics may change over time, and
- whether the available information is sufficiently reliable to support safe storage, retrieval, treatment and eventual disposal.

Reliable, transparent waste data

Characterisation
To understand waste properties

Treatment & conditioning
To reduce volume and produce stable waste

Storage/Disposal
Meet acceptance and safety requirements

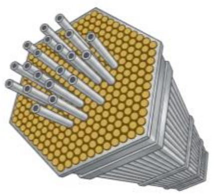
Data gaps can affect the credibility of safety assessments, hinder optimisation of monitoring programmes, and delay decisions on disposal.

LIGHT WATER SMRs

Extensive similarities with current LW fleets help in forecasting suitable characterization methods:

- Existing codes and activation simulation tools should be applicable in general, but require validation
- Current destructive and non-destructive measurement protocols are likely already applicable

Some potential challenges:



- New fuel types and unconventional utilization histories might have impact on accuracy of RN inventory estimations
  - Lack of SMR-specific experimental datasets for validation
- Accuracy of activation estimations dependent on actual alloy/materials composition and impurities
  - Access to data is sometimes difficult due to IP

Modularity and modularization of designs can be a double-edged sword:

- Modular components = repeatable material properties thanks to serial industrial production
  - Facilitates activation predictions and standardization of analytical protocols
- Reuse of components decreases waste, but might increase uncertainty in inventories in case of transfer between multiple parties

AMRs

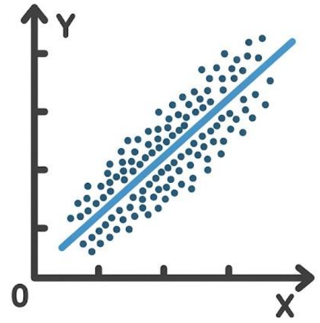
For AMRs, inventories are **largely model based**, with lack (absence) of data for validation

Conventional characterization approaches might be applicable, with some **major challenges:**

- Innovative nuclear materials (eg TRISO) and elements for which nuclear data libraries and experimental datasets are needed for code development and validation
- New coolants, moderators, alloys: relevance of composition and impurities towards eventual characterization

Emerging importance of **non-radiological characteristics**

- Chemotoxicity & chemical reactivity (Pb and Na): to be assessed for disposability
- Mechanical properties and stability: need for dedicated assessment methods
  - In some cases, desirable characteristics may become a hindrance to characterization



Note on scaling factors:

- SF need to be built *ex novo* for some designs: KN identified and correlations proven
- Complexity of correlations might increase for extensive deployment and waste treatment by 3rd parties
  - Sampling should be carefully planned to ensure robustness

THEME 2 – PREDISPOSAL/DISPOSAL CHALLENGES AND SOLUTIONS

Marja Vuorio (ASTRA) and David García (FORSAFF)

PREDISPOSAL CHALLENGES AND SOLUTIONS

Incomplete or Uncertain Waste Inventories

- Missing or inconsistent records for legacy waste
- Non-standard definitions (especially NORM/DU)
- Difficulty linking inventory data to future disposal WAC

Limited Characterisation Capability

- Heterogeneous waste (sludges, metals, Ra/Th/U residues)
- High-dose or sealed packages that cannot be opened
- Lack of mobile or advanced tools
- Limited laboratory capacity
- Treated as a resource → no characterisation for disposal (DU)

Treatment & Conditioning Gaps

- No treatment routes for certain NORM/DU residues
- Conditioning standards vary widely
- Legacy packages may contain free liquids, voids, combustibles
- SIMS cannot justify large-scale facilities

Ageing Waste Packages & Storage Conditions

- Corrosion, swelling, gas generation
- Unknown package integrity
- Limited inspection access
- Need for retrieval before conditioning/treatment

Lack of WAC

- Legacy waste not compliant with modern WAC
- Countries without disposal routes cannot define WAC
- DU often lacks disposal WAC entirely
- SIMS cannot develop bespoke WAC frameworks

PREDISPOSAL CHALLENGES AND SOLUTIONS

Improve Inventory Systems & Data Quality

- Harmonized inventory templates
- Digitisation of historical records
- Waste-family classification to reduce heterogeneity
- Modular digital systems with secure backups

Advance Characterisation Tools & Methods

- Mobile units
- Robotics for hot-cell inspection
- Standardised protocols for conditioned waste
- Methods for characterising sealed or high-dose packages

Develop Shared Treatment & Conditioning Infrastructure

- Regional treatment centres
- Mobile conditioning units
- Shared demonstrator projects (KM)
- Harmonised conditioning standards
- Reconditioning routes for legacy waste (e.g., opening drums, repackaging)

Ageing Assessment Tools

- Corrosion and gas-generation models
- Probabilistic ageing tools
- Embedded sensors for moisture, pressure, temperature
- Non-intrusive inspection (acoustic, muon tomography, imaging)

WAC Alignment Methods

- Tools to map legacy waste properties to modern WAC
- Predictive WAC modelling for future disposal concepts
- Reconditioning strategies for non-compliant waste
- Harmonised WAC for NORM/DU

FORSAFF
Waste management for SMRs and future fuels

CONSIDERATIONS ON PREDISPOSAL AND DISPOSAL

Objectives

- Identify predisposal and disposal options: conditioning, storage, transport, disposal (surface/near surface disposal, deep geological repositories, boreholes, regional or shared facilities)
- Rank options by suitability
- Identify data gaps, research needs and uncertainties to be considered
- Assess regulatory implications where possible
- Assess infrastructure and R&D needs

Ranking	Conditioning Option	References	Data gaps	Research needs	Uncertainties due to design parameters
#1	*Immobilization cementitious matrix*		*Could be that there is knowledge gap on -the design and procedure on fixing a geometry -the number of TRISO particles per canister -the chemical interaction between graphite and cement (short-/long- term, during cement setting/casting, etc) -effect of Water/Cement ratio in criticality*	*-Criticality Safety Assessment accounting for different burnup grades, geometry and immobilization of cement. -Chemical behaviour of the interface cementitious matrix-graphite (accounting for potential microstructural fractures and behaviour during cement setting/casting)*	*-Uranium enrichment -Power distribution (burnup)*
#2	*Directly stored (no conditioning)*		*Might not be the most suitable option…?*	…	…
#3	*Vitrified*		*Could be that there is poor experience of TRISO particle vitrification*	…	…

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Waste management for SMRs and future fuels

R&D NEEDS

GENERAL – OPTIONS

Treatment and conditioning
Immobilisation (cement, bitumen, geopolymers, AAM, vitrification), no conditioning...

Storage
Wet storage in pools (SNF/HL)
Dry storage (SNF/HL, IL/LL)

Disposal
Near surface disposal (IL/LL)
Deep geological repositories (HL, ll-IL)
Deep boreholes (HL, ll-IL)
Shared, regional facilities

PREDISPOSAL – STORAGE AND TRANSPORTATION

- **Pools & casks for SNF:** criticality safety assessments accounting for different burnup grades, cask design, loading and arrangement strategies (gaps on inventory for SMR-specific fuels).
- **Metal coolants & effluents:** special safety assessments for interim storage of metals.
- **Used salts & salt-contaminated structures and components:** on-site interim storage foreseen, R&D on container salt corrosion and tritium permeation management, supported by improved thermodynamic databases for salt systems.
- **TRISO & irradiated graphite.**
  - Wet storage: long-term pond-aging experiments to monitor coating and graphite stability and RN leaching in varying conditions.
  - Dry casks: thermal testing of casks and durability trials under cycling conditions (temperature, humidity, mechanical stresses). Optimisation of casks, taking into account criticality safety.

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REPROCESSING– R&D NEEDS & CHALLENGES

REPROCESSING

- **Light Water Reactors: uranium and mixed uranium/plutonium oxides**
    - PUREX is commercially mature for U/Pu recovery. Advanced solvent extraction methods are in “proof of principle” TRL.
- **Liquid Metal Fast Reactors: oxide, nitride, metallic fuels**
    - *Oxide Fuels:* PUREX/aqueous methods may require adaptation and extra criticality safety and regulatory considerations (higher Pu content) and pyro-processing with additional head-end steps.
    - *Metallic and Nitride fuels:* pyroprocessing remains at lower TRL than aqueous methods and requires significant scaling.
- **High Temperature Gas Reactors: TRISO particles (UO2, UC, UN kernels coated in PyC and SiC)**
    - Aqueous methods applicable IF kernels are accessed.
    - Challenges: Low TRL, large C-14- bearing graphite, volatile FP off-gas treatment, scale-up of all steps…
- **Molten Salt Reactors: liquid salts of fissile and fertile isotopes in fluoride and chloride matrices**
    - Pyroprocessing methods are at a conceptual and lab-scale stage.
    - Challenges: corrosion, gradients (temperature, solubilities), continuous operation.

THREE CLOSING REMARKS

- **The SMR/AMR back end is not a completely new challenge in nature but demands special R&D needs to be able to tackle new materials and volumes**
  - *Technology-specific challenges: irradiated graphite (HTGR/MSR), sodium/lead wetted components and coolants (LMFR/MSR), salt-contaminated structures and components (MSR).*
  - *SMR-specific inventories, heat loads, volumes, designs need to be better understood.*
- **R&D is needed to guarantee that predisposal and disposal options can accommodate spent fuel and new waste streams (with specific radiological and chemical properties) safely**
  - *Understand the long-term behaviour of novel waste materials and immobilisation matrices.*
  - *Assess the adaptability of predisposal and disposal options, with R&D tailored to SMR wastes: long-term behavior in casks and pools, acceptability of wastes in repositories, environmental impact.*
- **Significant R&D is required to make reprocessing a viable back-end solution for novel fuels**
  - *PUREX deployable for LWR and oxide LMFR fuels. Other solvent methods in low TRL need maturing.*
  - *For TRISO, head-end access to fuel kernels through SiC and PyC coatings remains at an experimental stage.*
  - *Pyroprocessing (LMFR, MSR) is in low TRL.*

THEME 3 – SCALABLE DISPOSAL

James Begg (ASTRA) and Sami Naumer (FORSAFF)

Deep Borehole Disposal (DBD)

- Potentially scalable to small volumes
- A possible option for higher activity waste, once the concept is developed further
- RD&D needed

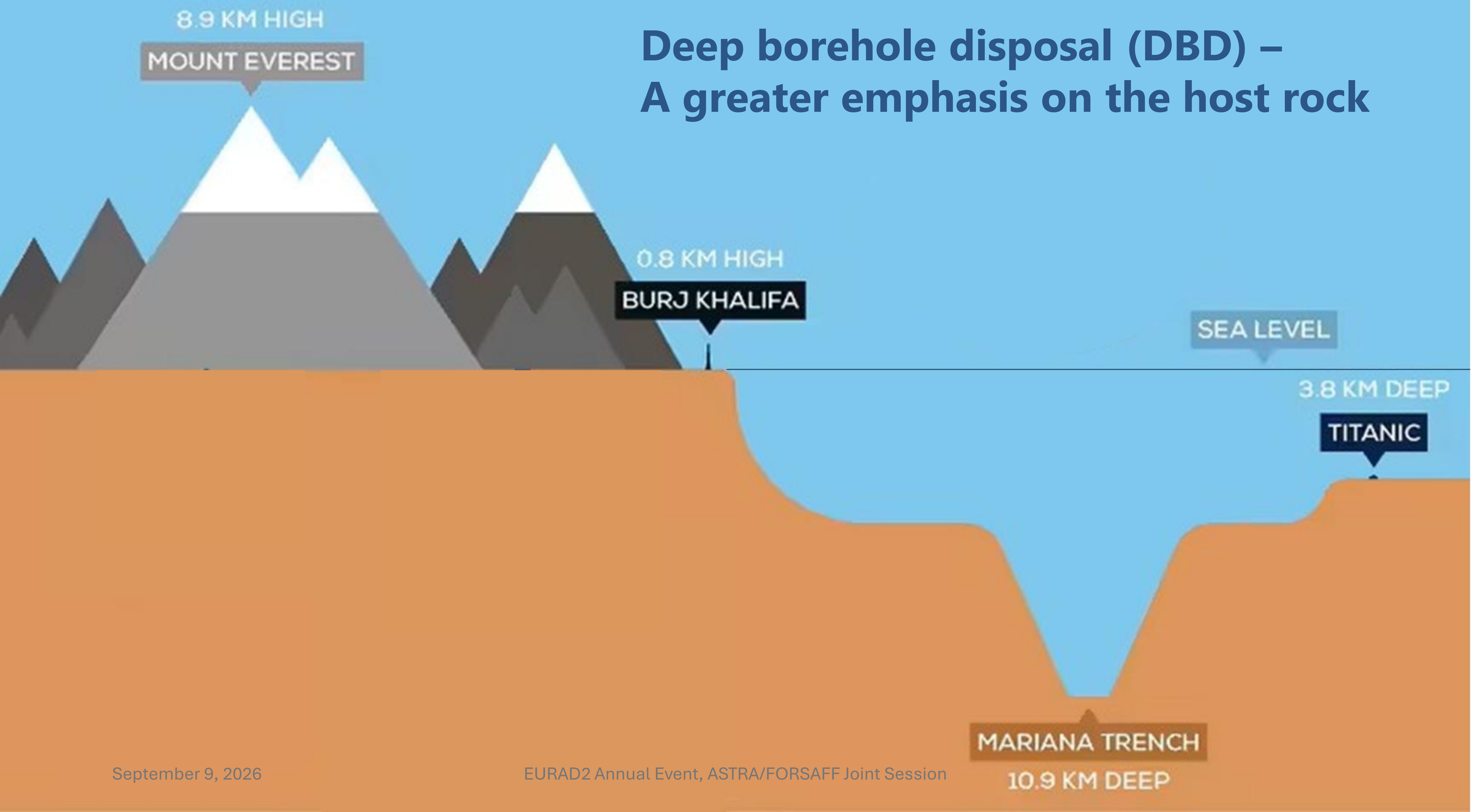
Near-surface repository (LDF presentation)

- Suitable for low-level and intermediate-level wastes, modular example from Slovenia (one silo is being built – possible to expand to 3 more)

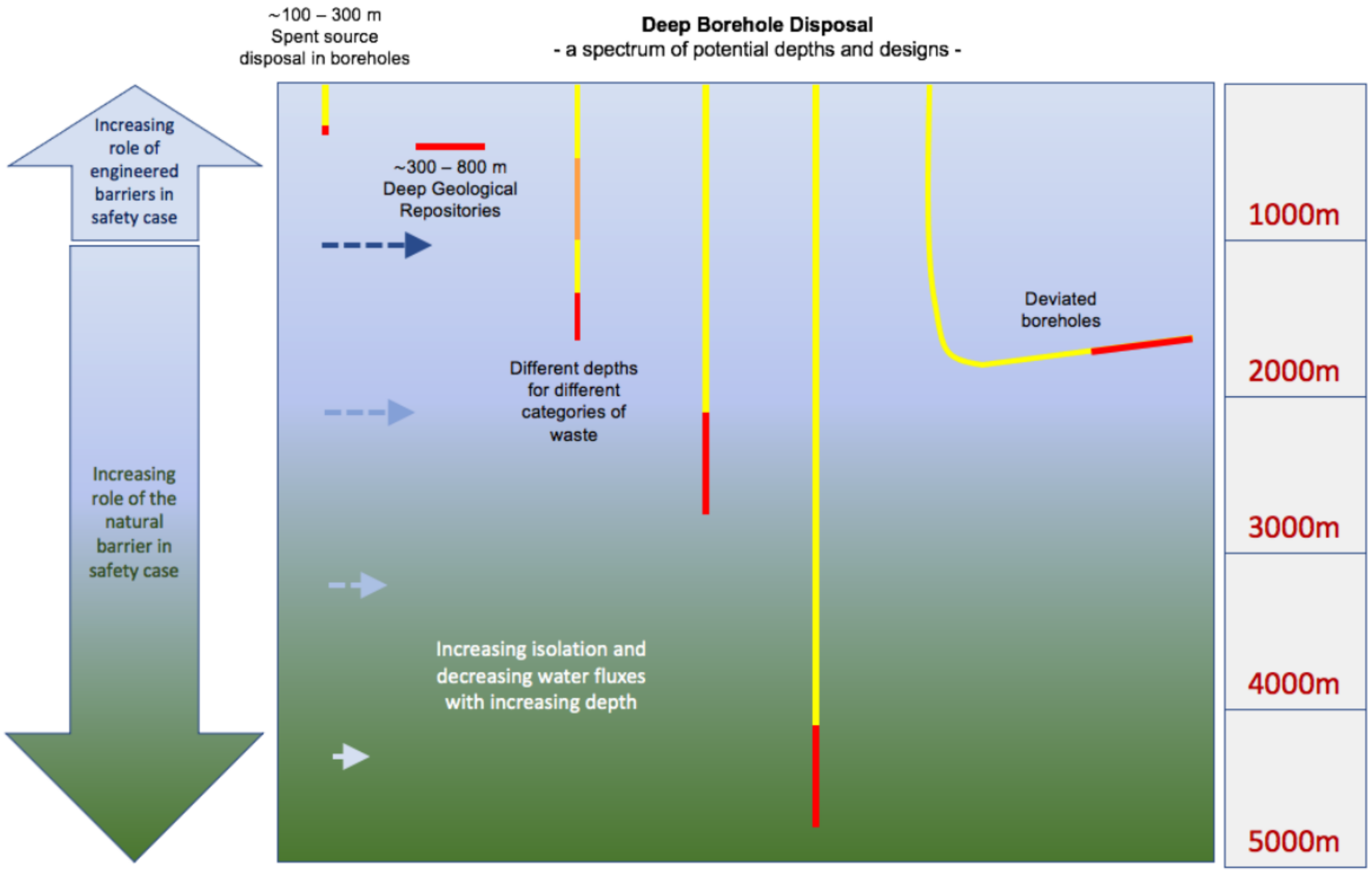
Shared/Multinational solutions

- Organisational scalability through pooled expertise and economies of scale
- Can reduce the need for dedicated national infrastructure
- Requires attention to regulations, governance, decision making, long-term responsibilities and liabilities
- DG-ENER forum for MS to work on these topics

Deep borehole disposal (DBD) –
A greater emphasis on the host rock



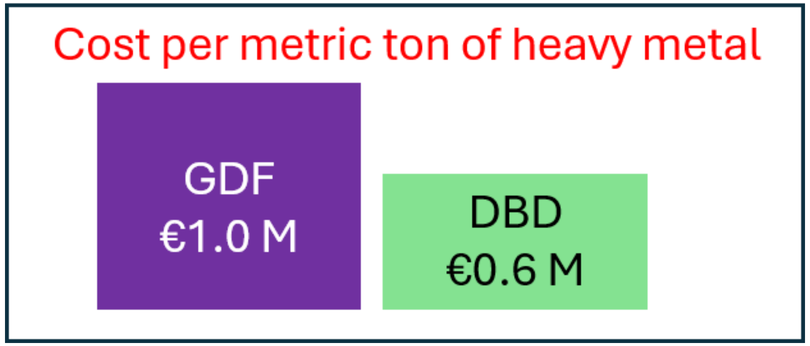
CHARACTERISTICS OF A DEEP BOREHOLE



- Safety primarily provided by host rock
- Great depth (typically 3-5 km)
- Demonstrated isolation and long residence time of deep groundwater
- Density stratification of brine at depth
- High-likelihood of slow diffusion-dominated radionuclide transport
- Geochemically-reducing conditions at depth

WHY IS DBD AN ATTRACTIVE OPTION?

- Modular approach – can allow for agility and shorter operational timeframes, and small volumes
- Lower costs per unit of waste



WM2024 Conference, March 10 – 14, 2024, Phoenix, Arizona, USA

Cost Comparison for Deep Borehole Disposal as Alternative to Mined Repository - 24820

Eric Knox and William Duggan
Amentum

- Operational safety – no workers sent underground
- Proliferation safety provided by depth
- Relatively insensitive to both the composition of the waste (if solid) and its heat
- Reduced surface footprint
- **Extraordinary** performance of engineered systems should not be required

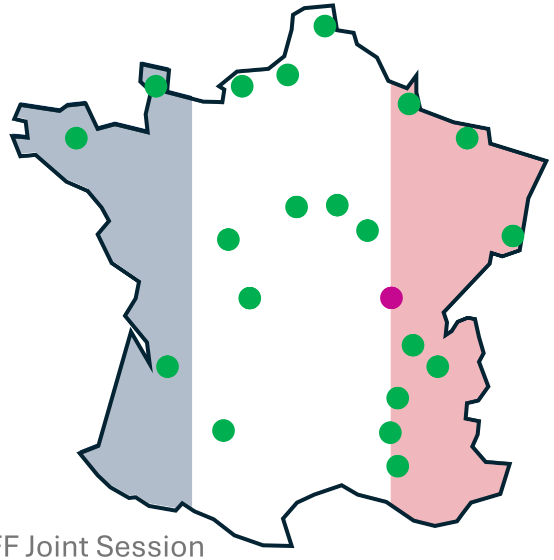
CHALLENGES FOR DBD

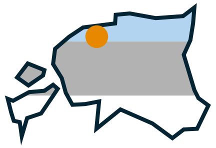
1. Perceived lack of DBD technology readiness
2. Site investigation and characterization methods exist but require improvement, particularly regarding the measurement and monitoring of deep-seated pore fluids.
3. No demonstrator to date (deep borehole field test; DBFT)
4. Demonstrating deep drilling operations at the required depths and diameters envisioned for DBD
5. Exploring the long-term performance of borehole seals and plugs
6. Emplacement and retrieval operations for radioactive waste packages containing HLW/SNF
7. Public and stakeholder acceptance challenges

SCALABILITY

- *Energy needs*
  - *Country of 70 M people*
  - *Country of 1 M people*
- *Different operators*
  - *Existing nuclear operator*
  - *New nuclear operator in a country with existing nuclear capacities*
  - *New nuclear operator in a non-nuclear country*
- *Reactor technology*
  - *LW-SMRs*
  - *Non-LW-SMRs*

- *Disposal infrastructure*
  - *Nation with existing disposal infrastructure or with advanced plans*
  - *Nation without existing disposal infrastructure*





for illustrative purposes only

Such considerations will have an ***impact on:***

- ***What is being disposed***
- ***How much is being disposed***
- ***How is it being disposed***
- ***Where is it being disposed***

FORSAFF
Waste management for SMRs and future fuels

CHALLENGES ASSOCIATED WITH SMRs/AMRs

- **SMRs/AMRs have vastly different designs resulting in diverse waste characteristics**
  - The characteristics may not align with existing waste management, storage and disposal pathways
  - Novel fuel and waste forms may therefore require technology-specific management approaches and could introduce new technical and regulatory challenges.
- **Can existing disposal systems accommodate these new waste forms?**

LWR | HTGR | MSR | LMFR

DIFFERENT WASTE FORMS
- Fuel
- Activated materials
- Graphite / salts / etc.

Compatibility? →

DISPOSAL PATHWAYS
- Dry/wet storage
- LILW repositories
- Deep geological repositories

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GENERAL WASTE MANAGEMENT CHALLENGES

- SMRs/AMRs could serve very different use cases such as:
  - Large-scale power production
  - Remote energy supply
  - District heating
  - Hydrogen production.

- The modular and potentially decentralised nature of SMR/AMR raises a strategic question:
  - **How should national waste management infrastructure balance centralisation and decentralisation?**

POTENTIAL SOLUTIONS?

- Adapt existing geological disposal
  - Deep geological disposal remains the reference endpoint, but repository concepts may need to adapt to new waste characteristics.
- Share infrastructure
  - Shared or multinational repositories could provide a more proportionate solution for operators or countries with small inventories.
- Alternative disposal pathways
  - Deep borehole disposal could offer flexibility for limited inventories but requires further technical and regulatory development.

HOWEVER: TECHNICAL FEASIBILITY ≠ IMPLEMENTABILITY
National policy · Legal frameworks · Stakeholder acceptance

THEME 4 – CIVIL SOCIETY VIEWS

Alexis Geisler-Roblin (ASTRA) and Meritxell Martell (FORSAFF)

WHY INVOLVE CIVIL SOCIETY IN RADIOACTIVE WASTE MANAGEMENT RESEARCH PROGRAMMES?

- Integration of civil society views in research fulfils requirements of transparency and participation in accordance with the **Aarhus Convention** (access to information, access to participation, access to justice).
- Being involved in the core of the radioactive waste management research allows civil society actors to **have access to information and participation** at the very beginning of the knowledge chain
- Interactions with civil society are a way to ground **mutual understanding** on research topics and content and by this contributing to the quality of research process.
- Interactions with civil society can contribute to an **establishment of mutual trust.**

SOME KEY ASPECTS FROM CIVIL SOCIETY PERSPECTIVE ON ASTRA TOPICS

- **Challenging waste:**
  - All radioactive waste and material should be under Directive 2011/70/Euratom, including uranium mine
  - Similarly hazardous radioactive wastes and materials should be managed with harmonized, highest safety and security standards and mill tailings
- **Longterm interim storage:**
  - Definition of design life for old storage facilities and casks are needed
  - For any lifetime extension of old storage facilities and casks an Environmental Impact Assessment is needed

KEY ASPECTS FROM CIVIL SOCIETY PERSPECTIVE FOR ASTRA TOPICS

- **Deep Borehole Disposal:**
  - As long-term safety and security are top of the list of importance to civil society, a very strong and robust safety case is needed
  - Retrievability of radioactive waste is discussed to be a positive quality of deep geological (mined) repositories; this contradicts with possible positive security aspects of non-retrievability in DBD – more discussion is needed
- **Long-term governance and intergenerational stewardship culture:**
  - Final disposal, but also long-term interim storage, affect many generations
  - An intergenerational stewardship culture and stewardship models are needed in the view of civil society experts to avoid undue burden for future generations
  - Research on stewardship models should be started soon

Transparency & engagement gaps
Aarhus principles not yet fulfilled with risks including decisions perceived as being made behind closed doors and limited public access to information due partly to industrial confidentiality and commercial secrecy

Trust deficit
Trust is fragile; connected with history of nuclear; unproven first-time SMR vendors; cancelled or stalled projects; imposed projects

Unclear accountability
Long-term liability and decommissioning duties undefined; new licence holders, owners and operators in backend services

Disproportionate burden of disposal costs on newcomers

Develop and institutionalise specific **engagement frameworks** tailored to SMR/AMR challenges

Test methods for communicating **uncertainty and evidence** in R&D contexts

Co-produce RWM scenarios and **decision points** with stakeholders

Develop and validate **governance and fairness** mechanisms (e.g., intergenerational responsibility, long-term liabilities)

GUEST PRESENTATION

The Possibility of Nuclear Power in Ireland

Muhammad Maladoh Bah[a,b]

Sustainable Energy Authority of Ireland (SEAI), Dublin
UCD Energy Institute, University College Dublin (UCD), Ireland

EURAD-2 Annual Meeting
ASTRA/FORSAFF Joint Session

Dublin, Ireland
8-10 September 2026

SUSTAINABLE ENERGY AUTHORITY OF IRELAND

Overview

Context and objective

Policy and regulatory constraints

SMR maturity & timelines

Infrastructure constraints

Economics of nuclear power and social considerations

Summary

Context
Debate on nuclear power in Ireland remerges in public discourse

Editorials

The Irish Times view on nuclear power: a debate worth revisiting

Other countries are embracing nuclear due to developments in safety along with climate and energy security concerns

Taoiseach says Ireland should 'consider seriously' nuclear power option

Story by Andrew Walsh • 2d • 2 min read

Environment

Ireland considering nuclear power as Government attitude shifts amid fresh energy crisis

Politics

How quickly could Ireland have a nuclear power plant (if the Government wants one)?

Analysis, public consultations and political wrangling could make delivery a lengthy process

GOING NUCLEAR

Poll: Should Ireland lift the ban on nuclear power?

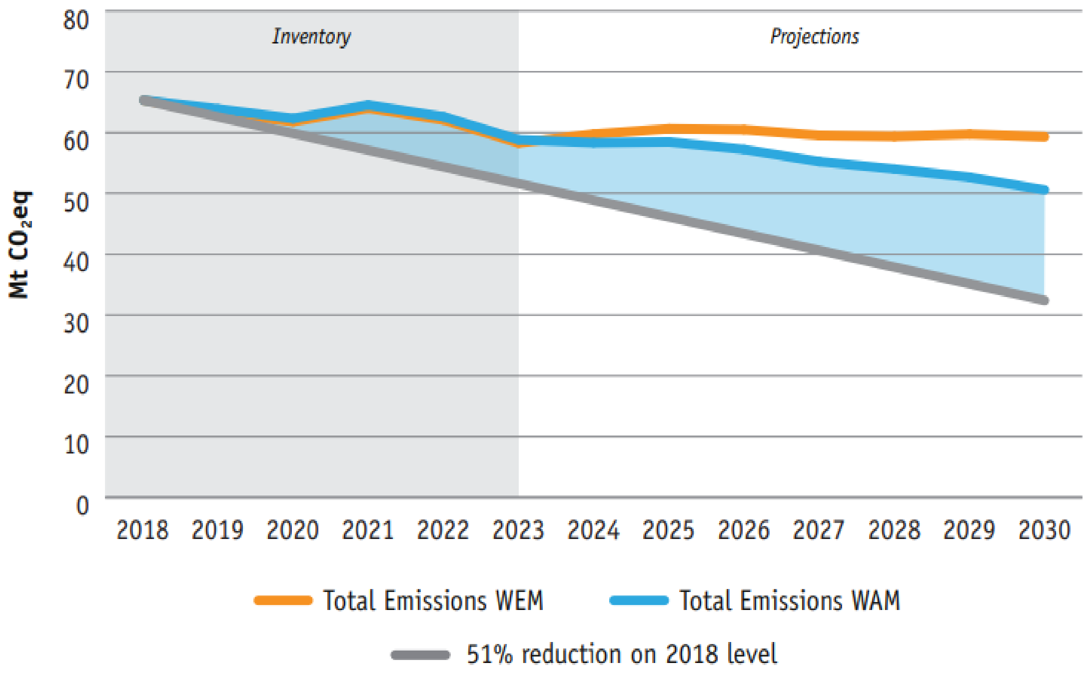
Taoiseach Micheál Martin suggested Ireland could revisit its ban on nuclear power at a European summit yesterday.

8.01pm, 5 May 2026 29.9k 96 Comments Share

SUSTAINABLE ENERGY AUTHORITY OF IRELAND

Context

- Ireland has set an ambitious target of reducing its Greenhouse gas emissions (GHG) by 51% by 2030 and achieving carbon neutrality by 2050
- There are **multiple challenges** to achieving these objectives
- There is a critical need to evaluate a **broad set of clean technologies** to bridge the final gap
- Is nuclear a viable technology for the Irish case?
- We provide a **multi-dimensional assessment of what might be required** for the potential deployment of nuclear power in Ireland.



Total GHG emissions out to year 2030 and emissions gap
Source: EPA 2026

Policy and Regulatory Constraints

Irish nuclear history

- A Nuclear Energy Board (An Bord Fuinnimh Núicléigh) was established in November 1973 under the Nuclear Energy Act of 1971

- Electricity Supply Board (ESB) submitted a planning permission for a 500-700 MW nuclear plant at Carnsore, Co. Wexford in 1974
  - Cost of €350 million (approx. €3.35 billion in 2025 values)

- Project was shelved and disbanded due to multiple reasons:
  - Three Mile Island accident in Pennsylvania
  - Environmental opposition
  - Recessionary impact of the late 1970s oil price crisis

- Ireland switched focus to the construction of the coal-fired plant, Moneypoint in County Clare

Carnsore Point, County Wexford (South-East Ireland, on the coast of the Irish Sea)

SEAI SUSTAINABLE ENERGY AUTHORITY OF IRELAND

Regulatory Frameworks

- **Statutory bans on nuclear power**
  - **Electricity Regulation Act 1999 Section 18(6)**
    - *"An order under this section shall not provide for the use of nuclear fission for the generation of electricity"*
  - **Section 182 of The Planning and Development Act 2024**
    - *"Nothing in this Act shall be construed as enabling the authorisation of development consisting of an installation for the generation of electricity by nuclear fission."*

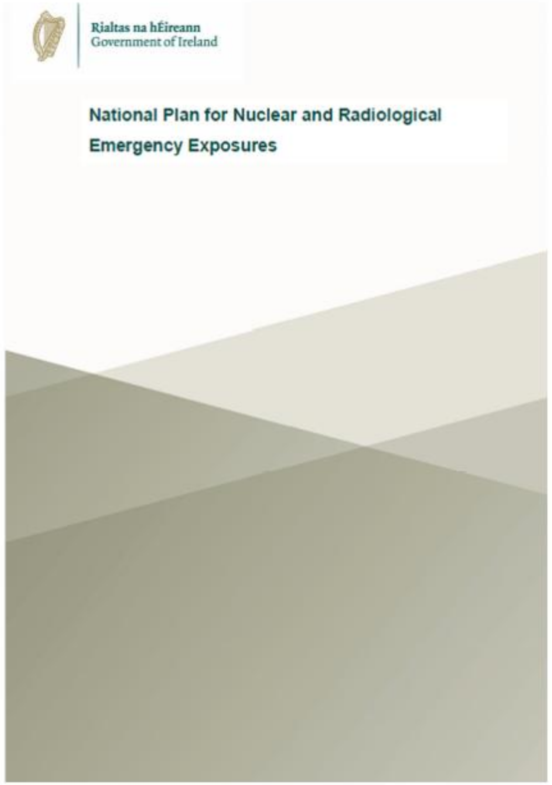
- **Existing regulatory frameworks**
  - **As an EU member, Ireland's legal framework for nuclear is shaped by the Euratom treaty, IAEA conventions and standards, and Nuclear Energy Agency (NEA)**

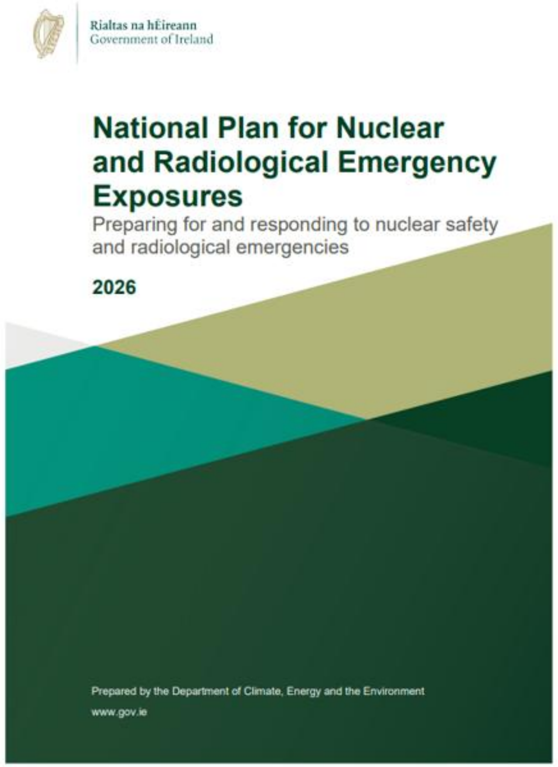
  - Ireland has '**existing basic frameworks**' for regulating ionising radiation currently under the purview of the Environmental Protection Agency (EPA)
    - **The Radiological Protection Act 1991 (Ionising Radiation) Regulations 2019**
    - **The Medical Exposure to Ionising Radiation Regulations (2018)**

SEAI SUSTAINABLE ENERGY AUTHORITY OF IRELAND

Regulatory Frameworks

- **Emergency preparedness (Updated July 2026)**
  - Ireland's emergency planning is based on nuclear accidents outside the state, primarily at UK facilities.
  - Lead Government Department (LGD) during an emergency is the **Department of Climate, Energy and Environment (DCEE)**
  - The **EPA** is the National Competent Authority for nuclear accidents and radiological emergencies
  - Several hazard assessment studies have been carried out to evaluate the implications of a nuclear accident for Ireland.





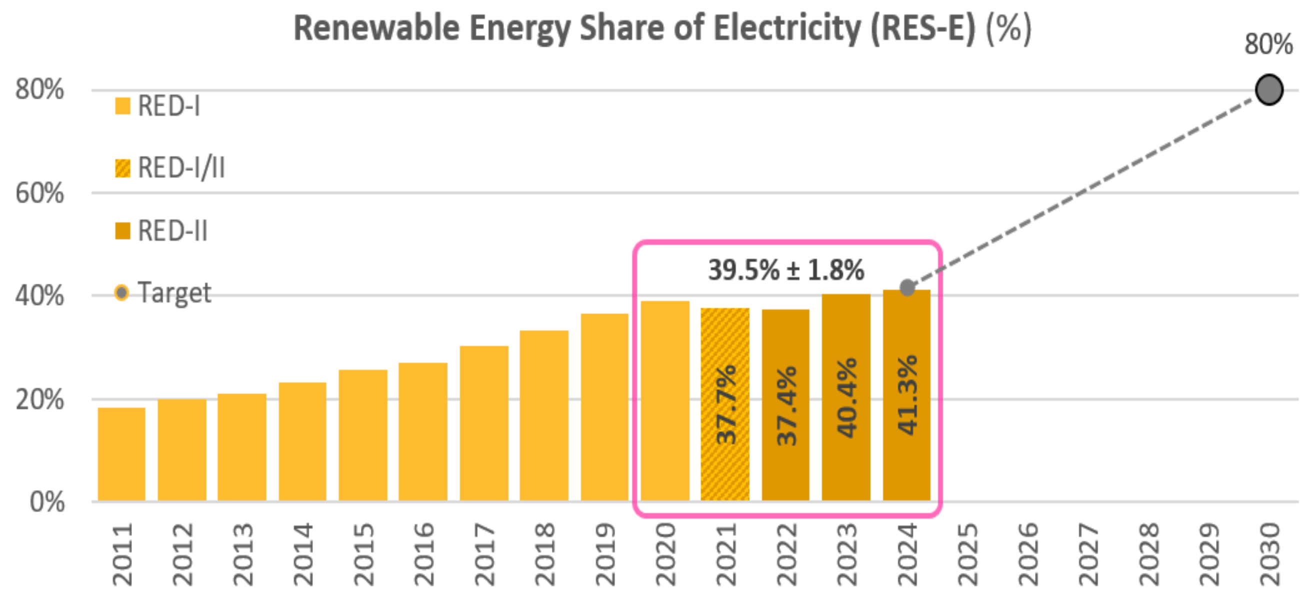
Spent nuclear fuel (SNF) management in Ireland

- The EPA is responsible for licensing a nuclear waste facility
  - Regulation 17(4) of the Radiological Protection Act 1991 (Ionising Radiation) "*The Agency shall, in considering a decision to grant a licence for a radioactive waste management facility or a practice involving radioactive waste management…*"

- Owner/Operator is fully responsible for financing, safety, and management of a waste facility during development, operation, and decommissioning phases.

- Regulations recommend that nuclear waste should be handled domestically (i.e., stringent guardrails on exports)
- If Ireland follows international best practice of disposing waste in a geological repository following a period of interim storage
  - Are there any locations suitable for a deep geological repository in Ireland?
  - Can counties object to the siting of nuclear waste repositories?
  - Does the Government have the final determination for siting a nuclear waste repository?
  - Will host communities receive compensation?

National energy policy targets
Climate Action Plan (CAP)



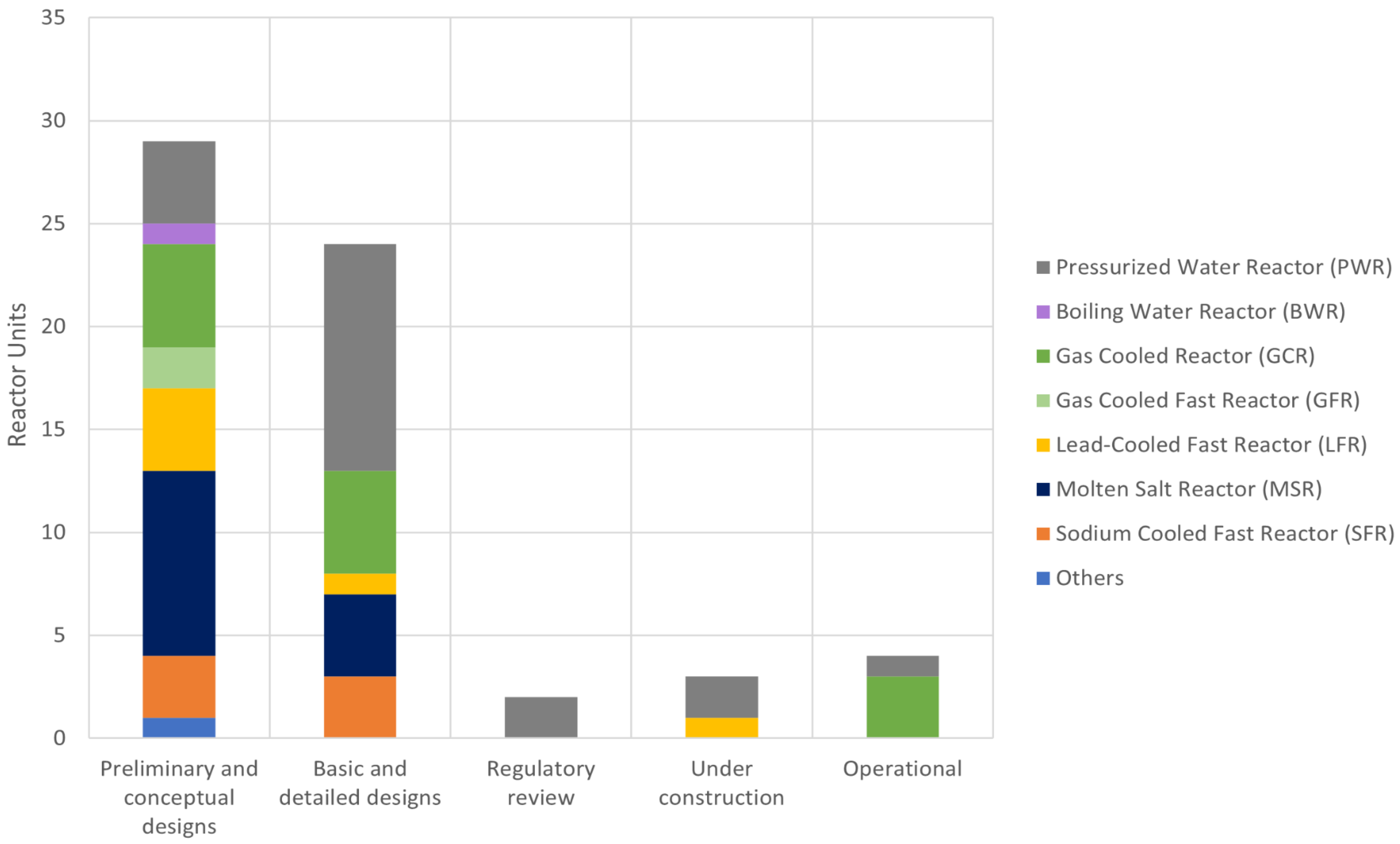
Source: SEAI. 2025. Energy in Ireland 2025 Report

National Target	2030
Renewable electricity share	80%
Onshore wind	9 GW
Solar	8 GW
Offshore wind	At least 5 GW
New flexible gas plant	At least 2 GW
Demand side flexibility	20-30%

SUSTAINABLE ENERGY AUTHORITY OF IRELAND

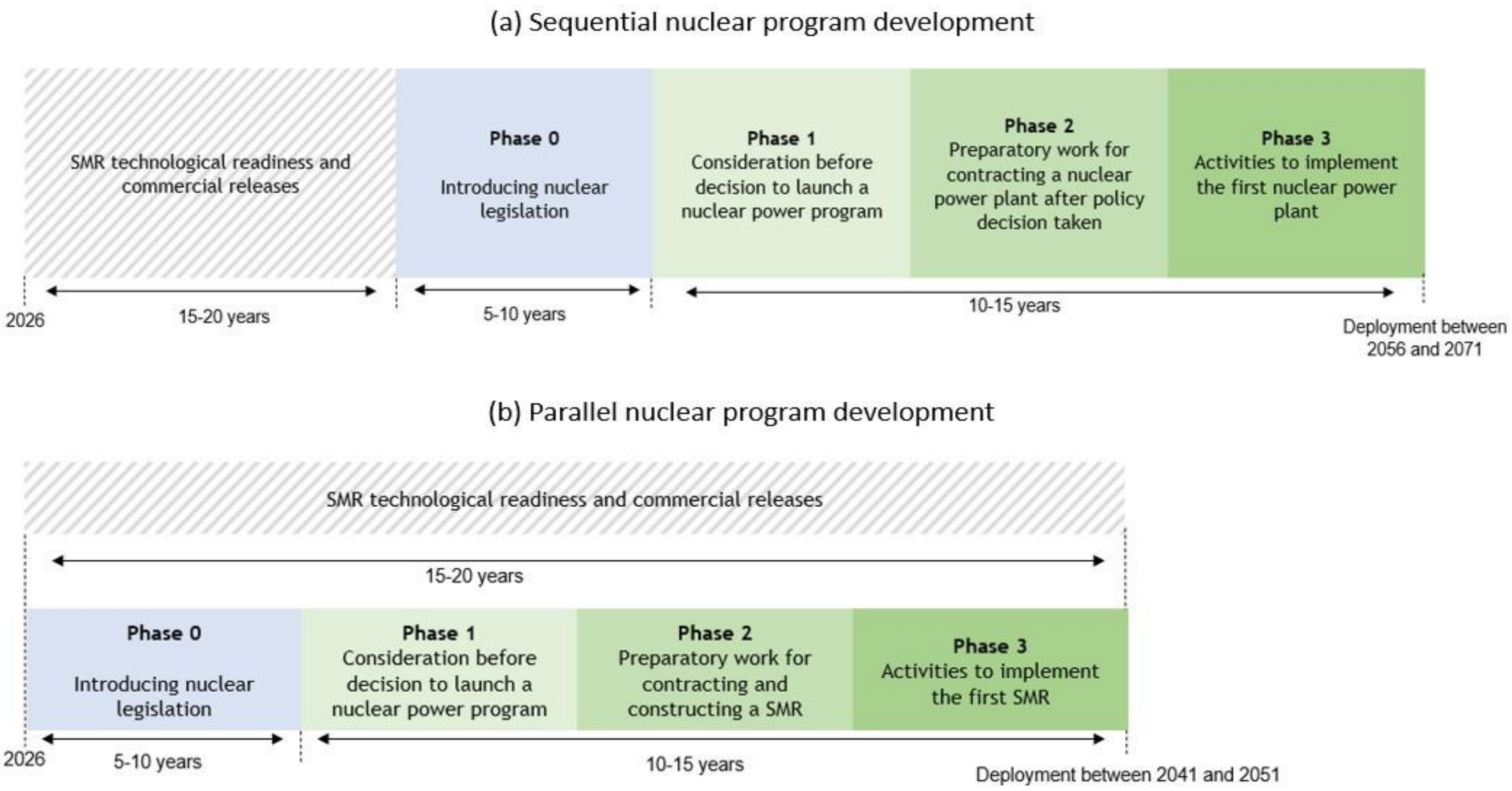
SMR maturity, and deployment timelines

SMR maturity levels



Source: IAEA. 2026. Advanced reactor information system.

Indicative deployment timelines



SUSTAINABLE ENERGY AUTHORITY OF IRELAND

Infrastructure Constraints

Infrastructure constraints
Carnsore Point site selection

Factors influencing the selection of Carnsore Point (1974)

- Adequate quantities of cooling water
- Rock foundation at suitable level
- Fresh water requirements
- Low population density
- Minimised interference with high amenity value areas or intensive land use
- Distance to load centres

Limitations

- ESB’s 1974 report did not address **long-term nuclear waste** management in depth
    - Envisaged plan: store waste on-site temporarily and then export waste for reprocessing
- Freshwater sources were not investigated in-depth

SUSTAINABLE ENERGY AUTHORITY OF IRELAND

Infrastructure constraints
Selected siting criteria

- **Exclusion buffer and Population**
  - a nuclear facility should be located in a sparsely populated area and away from dense population areas
  - Ireland's particularly dispersed settlement patterns may present a challenge in relation to this criteria

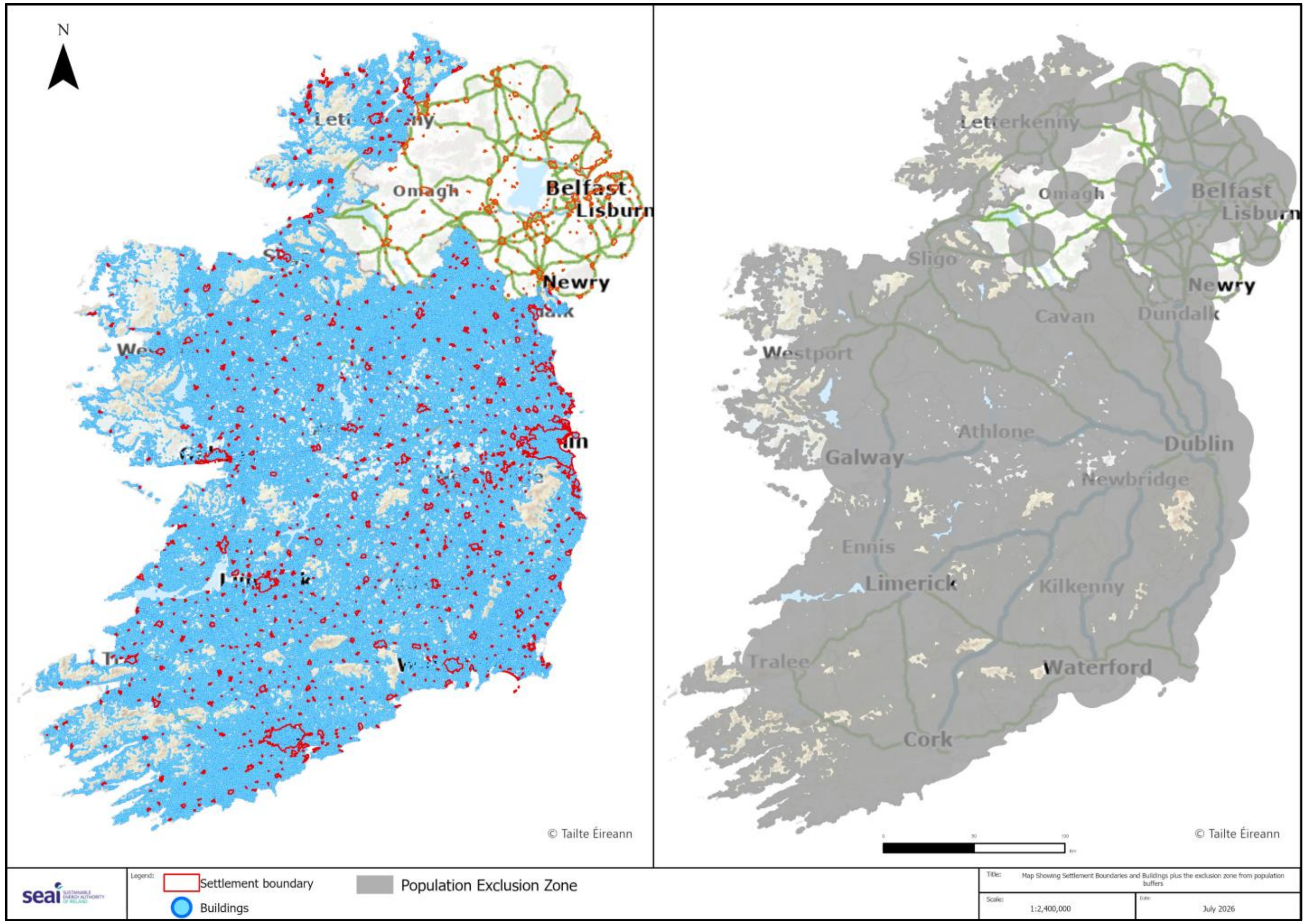
- **Access to water**
  - Strict regulations govern water extraction from inland rivers, lake, and aquifers in Ireland
  - Unlikely for a nuclear plant to be located inland

- **Geotechnical aspects and hazards**
  - Ideal features: firm bedrock, stable geology, away from fault lines, deep groundwater table, and avoiding potential cavities such as caverns, surface depression, mines, and specific rock types

- **Flooding risks**
  - Ireland has been exposed to major flooding incidents over the past decade

- **Terrain: slope and elevation**

Exclusion buffers and population constraints



- Buffer of 1 km was applied to each building (approx. 2.15 million points) to create the extent of non-usable sites
- A CSO settlement layer was added and buffered based on population per settlement, where different conditions apply to small, medium, and large cities
- All these buffers are merged and dissolved into one single layer as seen on the right of the map in grey. This is the exclusion zone.

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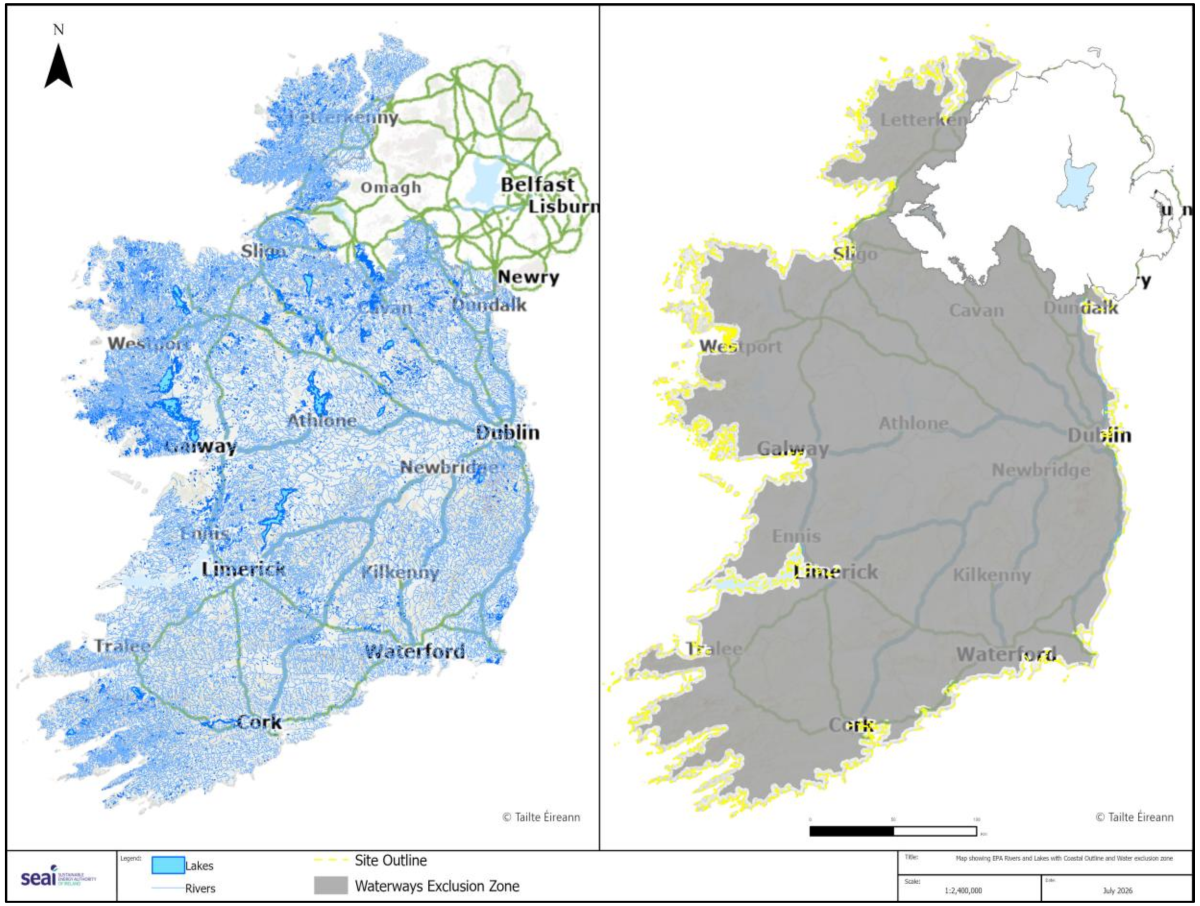
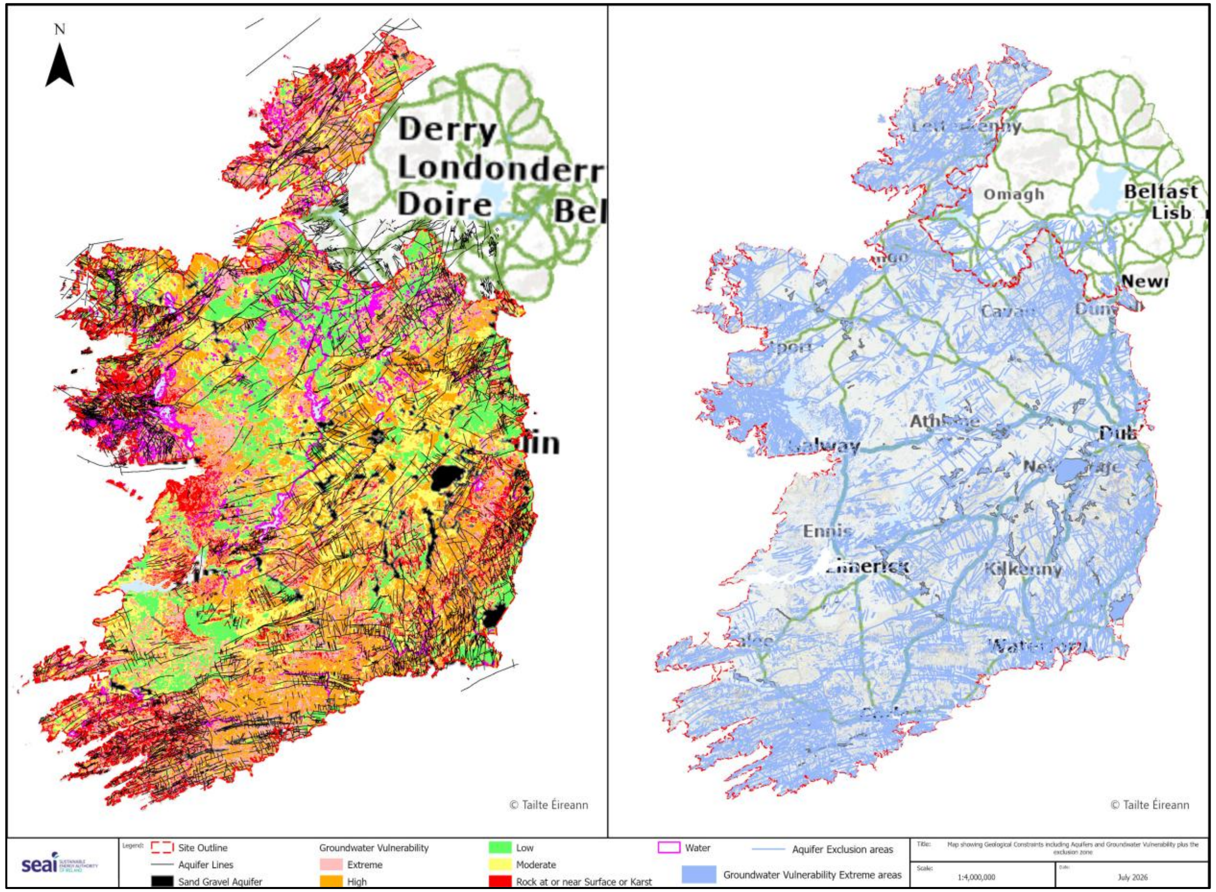
Water sources



- Map on the right shows the EPA Waterways which include Rivers and Lakes
- Map on the left illustrates exclusion zone showing buffers applied to rivers, lakes and the coastline

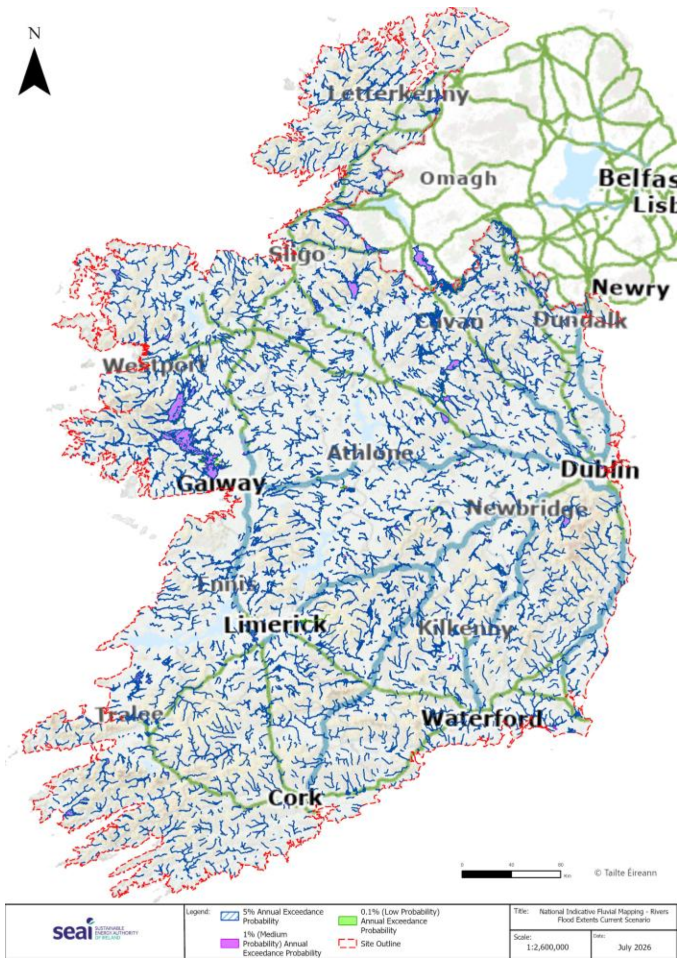
Geology: Groundwater vulnerability



- Left Map: Groundwater vulnerability with aquifer lines
- Right Map: Areas of exclusion. In this constraint all aquifers and areas of extreme groundwater vulnerability are excluded

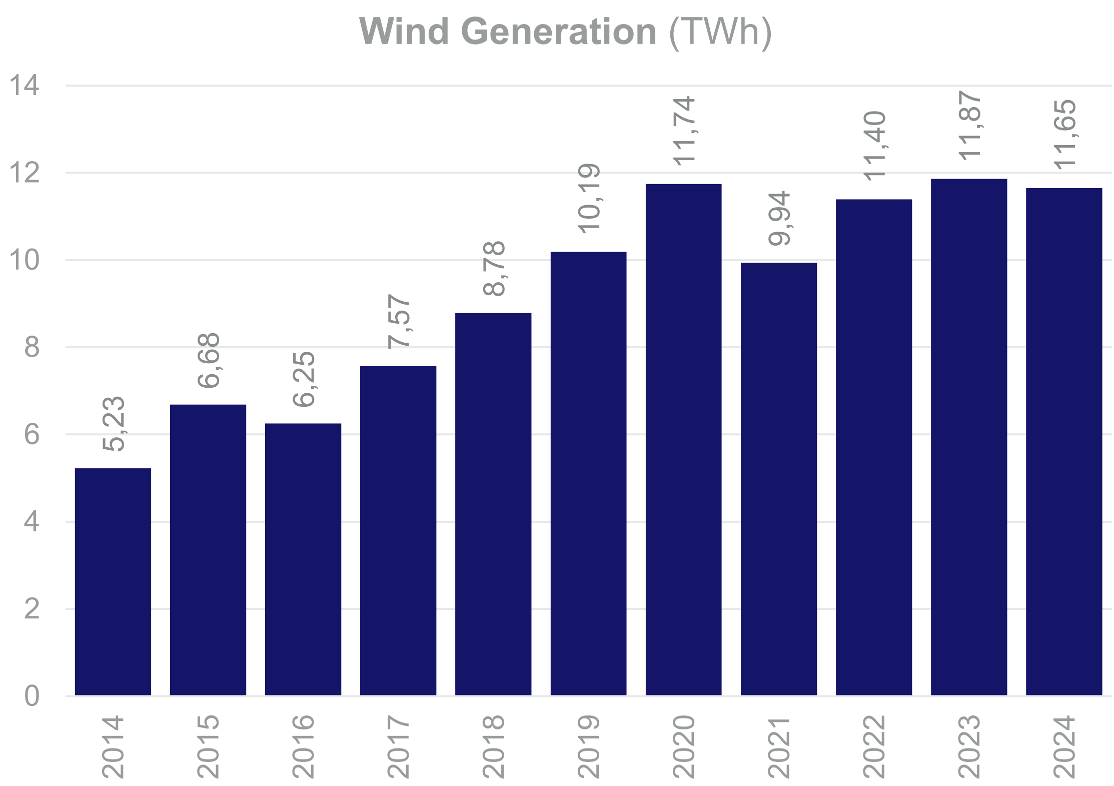
Flooding

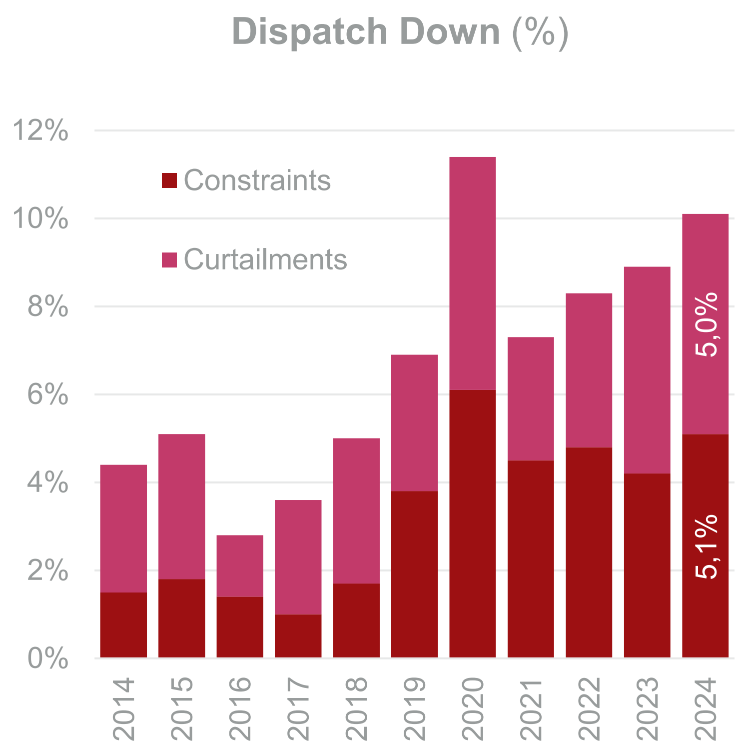
River/fluvial flooding



Coastal flooding

Integration of nuclear in the Irish energy system
Grid constraints

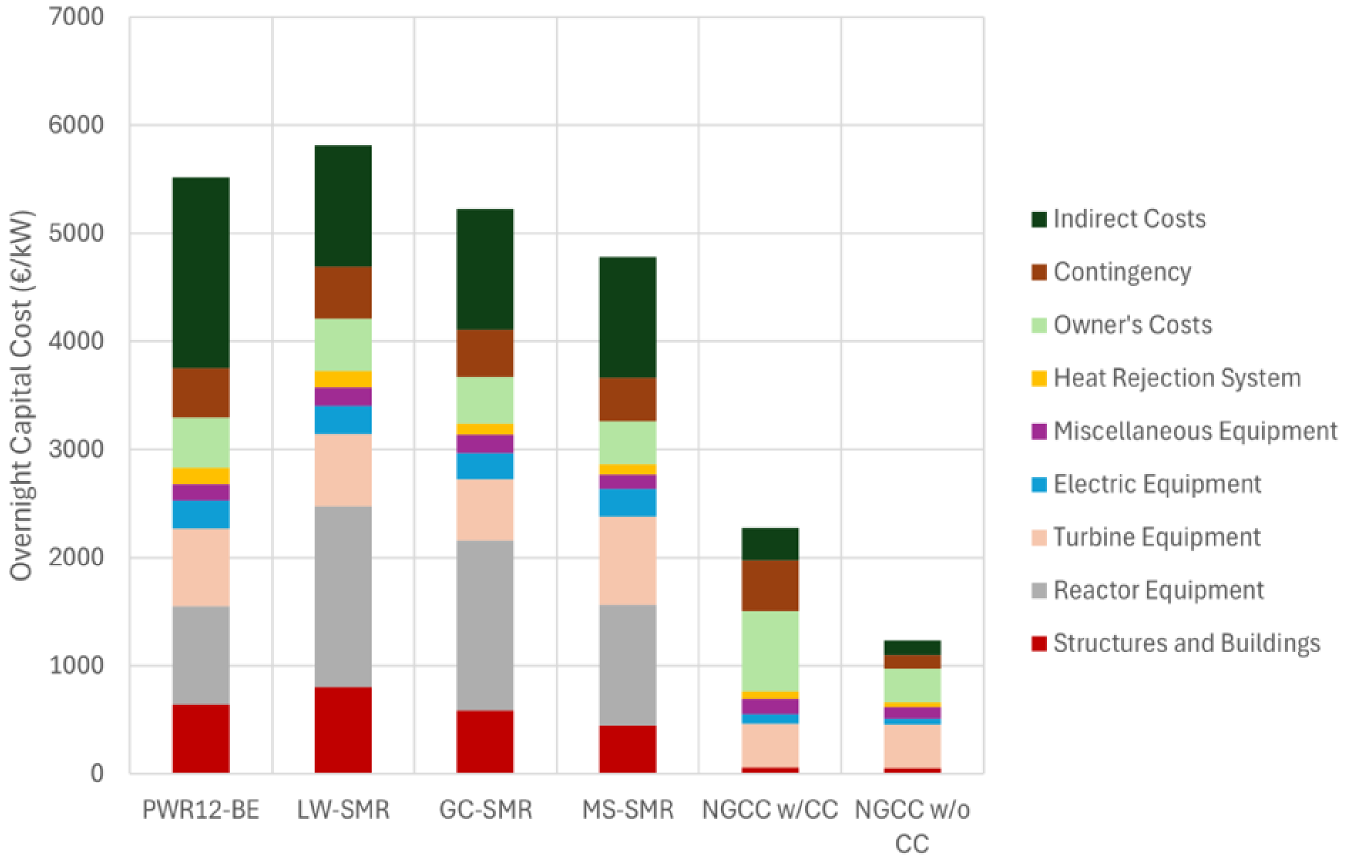




Source: SEAI. 2025. Energy in Ireland.

Economics of nuclear power and social considerations

Economics of nuclear power
Overnight capital costs of nuclear archetypes



Source: Bah and Keane (2026)

Public opinion

- Limited research into the public acceptance of nuclear power in Ireland.
- Public acceptance level for nuclear is generally low but tends to change depending on how the question is framed.
- Public's attitudes are predominantly influenced by **safety concerns** and issues surrounding **nuclear waste management** (Lynch and Wright 2012).
- Given the impact of public acceptance on power system developments acceptance issues may **increase the rollout timeline** and costs for nuclear energy.

Summary

Conclusion

- Given the necessary **regulatory, legislative, and infrastructural requirements**, an indicative timeline suggests that deployment would not be sufficiently timely to meaningfully contribute to Ireland's decarbonisation objectives through to 2050.

- With this level of timeline uncertainty, a comprehensive technoeconomic feasibility study on nuclear power could provide additional clarity for policymakers.

- The **Decarbonised Electricity System Study (DESS)** will provide evidence-based decarbonisation pathway for the electricity system to 2050 and evaluates a broad set of technologies

- In the short to medium-term, expanding electricity interconnection with Great Britain and France allows Ireland to access low-cost nuclear-generated power while avoiding the financial, regulatory, and deployment risks associated with domestic SMR development.

Thank You!
Any Questions?

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