

Nuclear Innovation in the UK

Rob Arnold, Nuclear Engineering
Science & Innovation for Climate and Energy
BEIS, UK

3rd October 2022


Department for
Business, Energy
& Industrial Strategy

Background

The UK undertook a five year £180m nuclear theme in the 2016-2021 Energy Innovation Programme, which delivered R&D across a number of areas:

Advanced Nuclear Fuels	Advanced Nuclear Manufacturing and Materials
Digital Nuclear Reactor Design	Nuclear Fuel Recycle and Waste Management
Nuclear Safety and Security Engineering	Nuclear Facilities and Strategic Toolkit
AMR Feasibility and Development Study	

For 2022 onwards UK has recently announced a £1.2 billion programme Net Zero Innovation Portfolio – nuclear and AMR technology is a key area of development.

Ten Point Plan



- Launched Nov 2020
- £12 billion of government investment, and potentially 3 times as much from the private sector
- Development of a Hydrogen Economy
- Production of hydrogen and electricity from nuclear, renewables and CCS.
- Key role for nuclear in delivering deep decarbonisation of electricity system, alongside renewables and other technologies
- Likely role for AMRs in decarbonising industry, heat and transport



Point 1
Advancing Offshore Wind



Point 2
Driving the Growth of Low Carbon Hydrogen



Point 3
Delivering New and Advanced Nuclear Power



Point 4
Accelerating the Shift to Zero Emission Vehicles



Point 5
Green Public Transport, Cycling and Walking



Point 6
Jet Zero and Green Ships



Point 7
Greener Buildings



Point 8
Investing in Carbon Capture, Usage and Storage



Point 9
Protecting Our Natural Environment



Point 10
Green Finance and Innovation

Energy White Paper

- Commitment to open the Generic Design Assessment to SMR technologies in 2021.
- Bring *at least* one large scale nuclear plant to Final Investment Decision (FID) by the end of this Parliament.
- Develop a SMR design by the early 2030s.
- Build an AMR Demonstrator by the early 2030s.
- Build a commercially viable fusion power plant by 2040.



<https://www.gov.uk/government/publications/energy-white-paper-powering-our-net-zero-future>

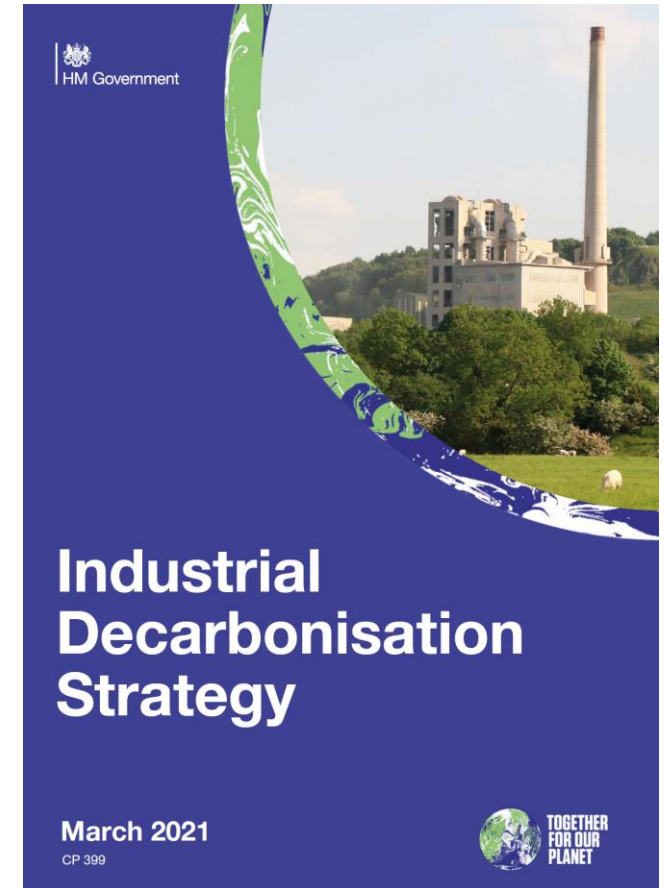
Department for
Business, Energy
& Industrial Strategy

Decarbonising Industry

Aims to further potential applications for non-electric applications of nuclear 'beyond the grid', such as:

- Industrial process heat.
- Low carbon hydrogen production.
- Synthetic fuel production.

Announces funding vehicles for advanced nuclear technology.



<https://www.gov.uk/government/publications/industrial-decarbonisation-strategy>

Department for
Business, Energy
& Industrial Strategy

UK Regulatory Developments

Generic Design Assessment (GDA)

- Process for new nuclear power plant designs – it is not mandatory.
- GDA provides confidence that the proposed design is capable of being constructed, operated and decommissioned in accordance with the standards of safety, security and environmental protection.
- For the Requesting Party, offers a reduction in uncertainty and project risk.
- BEIS funding since 2017 has enabled ONR to shape multilateral and bilateral cooperation towards practical deliverables, common regulatory positions and harmonisation on key technical regulatory expectations that are aligned with the UK regulatory framework.
- **May 2021: UK opened the Generic Design Assessment to SMRs and AMRs**
- **April 2022: Rolls Royce SMR Ltd. commenced first step of GDA on 470 MWe LWR SMR**

Modular Nuclear Technologies Public Dialogue

- BEIS worked with Sciencewise to deliver a number of virtual ‘public dialogue’ events to explore views around modular nuclear technologies (SMR and AMR). Public dialogues are events where invited members of the public interact with policy makers, scientists and stakeholders to deliberate on issues relevant to future policy decisions.
- In November 2021, 30% of participants had some awareness of Small Modular Reactors.
- Results suggested majority of participants showed caveated support of AMR technology:
 - It must be essential and one of several energy solutions to supporting renewables in net-zero.
 - Health and safety must be prioritised.
 - No long-term risks or negative legacy.
 - Robust and independent regulation.
 - Siting must ensure health and safety and make the most of existing sites and infrastructure.

Funding R&D into Advanced Nuclear

The UK Government's policy framework includes:

- Common approaches to all Advanced Nuclear Technologies that enable deployment.
- Policies tailored to the different needs of SMR and AMR technologies.

The UK Government is committed to innovation in the nuclear sector and has established a £385m Advanced Nuclear Fund:

- £215m for Small Modular Reactors (SMR)
- Up to £170m for Advanced Modular Reactors (AMRs).

The up to £170m for AMRs in the Advanced Nuclear Fund will be used to support an ambitious AMR programme, including the selection and development of a demonstrator by the early 2030s.

Plus £40m to develop regulatory frameworks and support UK's supply chain.

AMR Feasibility and Development

Two phases of the study

- Phase 1 – Feasibility studies for 8 AMR Designs (completed) – successful applicants covered SFR, HTGR, MSR, LFR and compact fusion designs.
- Phase 2 – Development studies 3 AMR Designs (completing 2022) – successful applicants covered HTGR, LFR and compact fusion designs

UK continues to consider all AMR technology families that could support Net Zero

Department for
Business, Energy
& Industrial Strategy

AMR RD&D Programme

- The Advanced Nuclear Fund includes funding for an AMR Research, Development & Demonstration (RD&D) programme with the aim of enabling an AMR demonstration by the early 2030s, at the latest, to understand the potential of the technology.
- The key objective of the RD&D Programme is to demonstrate that AMRs can produce high temperature heat which could be used for low-carbon hydrogen production, process heat for industrial and domestic use and cost-competitive electricity generation, in time for any potential commercial AMRs to support Net Zero by 2050.
- The programme focuses on High Temperature Gas Reactors (HTGR) as this technology optimises opportunities for decarbonising industrial heat by 2050.

AMR RD&D Programme

- Phase A of the RD&D programme launched on 8th April. Phase A aims to identify and understand the feasibility of credible, cost-effective, innovative HTGR reactor and fuel solutions that could best decarbonise heat and hydrogen.
- The specific objectives for Phase A are to understand the feasibility of technology solutions that can be developed within budget and identify the most cost-effective way to overcome market failures to enable HTGRs as an option to support Net Zero.

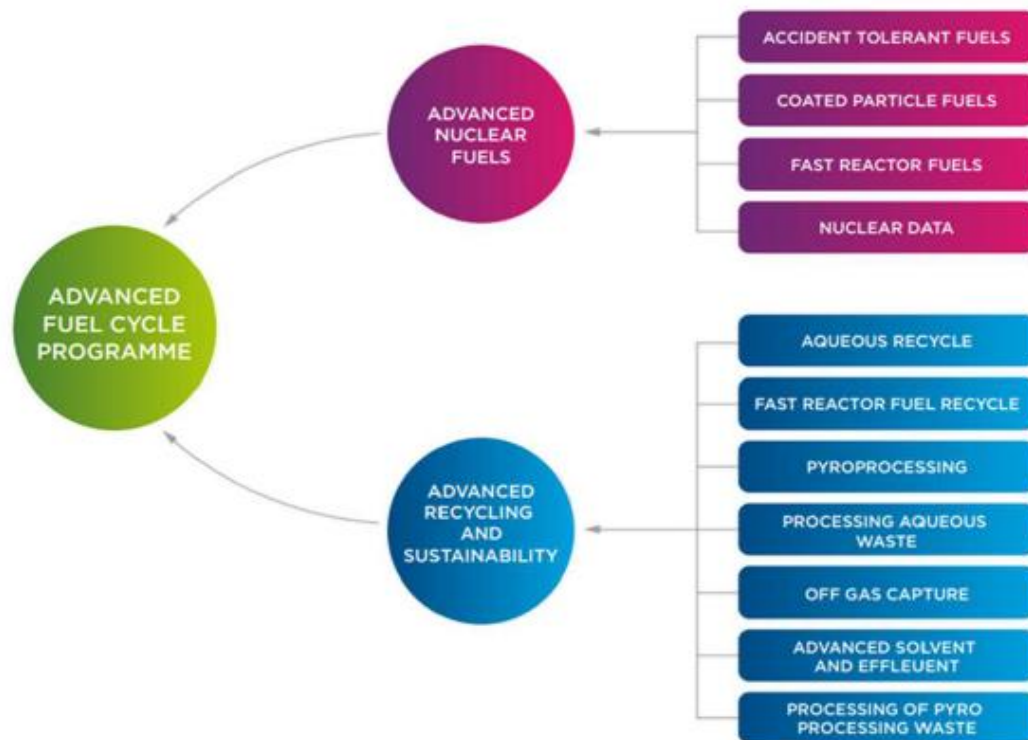
AMR RD&D Programme

- Successful proposals for a suite of pre-FEED studies were announced in September 2022.
 - U-Battery: HTGR size optimisation, costing and delivery method development.
 - EDF Energy: developing HTGR end-user requirements.
 - USNC Corp UK: MMR-based design best suited to UK process heat demands.
 - NNL / JAEA: Leveraging HTGR baseline designs for innovative build and operation.
 - Springfields Fuels / Urenco: fuel support for potential HTGR technologies.
 - NNL: UK domestic commercial fuel supply development for HTGR.

Advanced Fuel Cycle Programme

Partnership between BEIS (Energy Department) and National Nuclear Laboratory.

The programme



Thank you for your attention

More information available from:

<https://www.gov.uk/government/publications/advanced-nuclear-technologies/advanced-nuclear-technologies>