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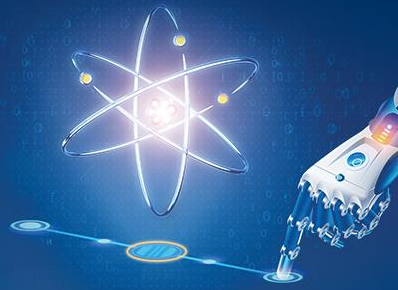

Sustaining Nuclear Skills Through Innovation

How developing innovative nuclear solutions strengthens our nuclear energy capability.

Department for Energy Security & Net Zero

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Introduction - Innovation in nuclear

Innovation in the UK nuclear sector supports the growth of skills and capabilities crucial to meeting the UK's decarbonisation commitments, both directly and indirectly.

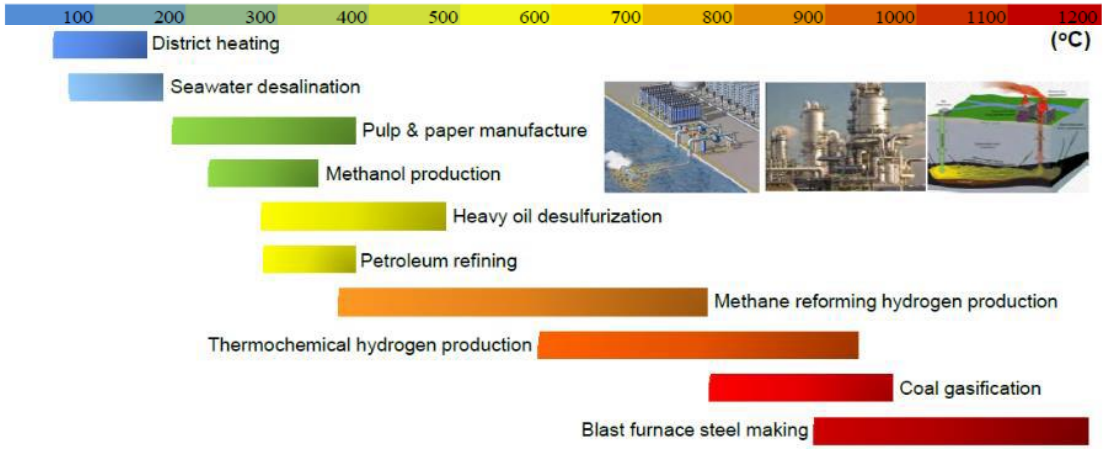
- Directly, through the development of advanced fuels to produce low carbon energy and Advanced Modular Reactor (AMR) designs to produce heat and hydrogen.
- Indirectly through the innovative use of nuclear material for non-energy applications, such as in the space and medical sectors.

Innovation helps shape a positive narrative around nuclear and build capabilities which will support our wider net zero goals.

AMR

The UK has an ambitious goal to deploy an AMR demonstrator by the early 2030's which is backed by UK Government policy.

The High Temperature Gas Reactor (HTGR) aims to show how high temperature heat from an AMR can decarbonise "hard to reach" industries to help meet net zero targets.



AMR

Key capabilities being built under the AMR programme

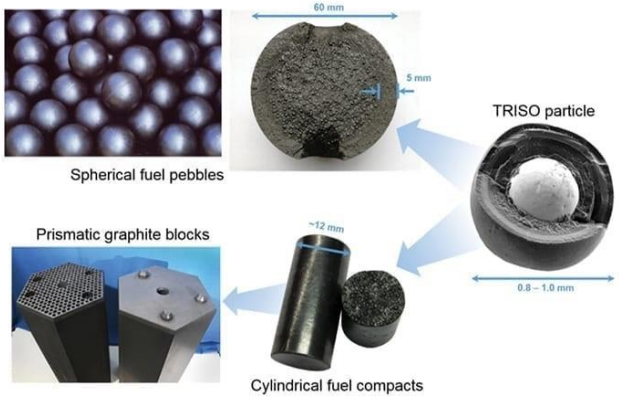
- Innovative engineering design (modular construction, designed for decommissioning, enhanced safety)
- Building capability in UK supply chains
- Ensuring legacy nuclear knowledge is captured and retained
- Ensuring the UK regulators (ONR and EA) are ready to regulate advanced technologies.

Development of these capabilities will also strengthen Small Modular Reactor (SMR) and Gigawatt Reactor capability and clean energy generation in the UK.

Advanced Fuels

- The UK is funding R&D into next generation fuel for HTGRs, Coated Particle Fuel (CPF).

- CPF is a highly robust, accident tolerant fuel, capable of withstanding elevated temperatures for a sustained period, increasing the safety of nuclear installations.
- The development of skills and capability to produce this fuel is building on funding provided to the Advanced Fuel Cycle Programme (AFCP).



Advanced Fuels

In January 2023, HMG launched the Nuclear Fuel Fund (NFF) to preserve and strengthen the UK's commercial nuclear fuel production capability.

The NFF is funding 8 projects to develop new capabilities to produce advanced fuels for current and future reactors. Including:

- Developing capability to enrich uranium up to 19.75% U-235 (both LEU+ and HALEU) to enable manufacture of advanced fuels
- Supporting commercial scale CPF manufacture
- Supporting developments in molten salt fuels

These projects will develop UK fuel cycle skills, facilitate the commercial deployment of new AMR technologies and support current and future UK energy security.

Advanced Fuels

Key capabilities being built under the CPF and NFF programmes

- R&D into CPF, towards commercialisation
- Developing UK knowledge and experience on advanced fuels (plant design, safety, security, safeguards)
- Progress towards the deployment of HALEU fuels



These projects will develop UK fuel cycle skills, facilitate the commercial deployment of new AMR technologies and support UK energy security.

Medical Radionuclides – legacy extraction

- The UK depends on imports for reactor-produced radionuclides.
- Ageing European infrastructure and increasing demand could result in ongoing shortages in supply.
- Understanding our legacy inventory and developing extraction techniques for useful materials could help boost domestic supply, support research and potentially patient demand.
- Example: NNL's successful extraction of Lead-212 from legacy material. Lead-212 could be used for Targeted Alpha Therapy/TAT, an emerging treatment.
- NNL, alongside Queen Mary University of London and Kings College London aim to develop more extraction routes supporting radiopharmaceutical R&D.

Medical Radionuclides - MRIP

- In 2022 the DESNZ launched the up to £6 million Medical Radionuclide Innovation Programme (MRIP) to support innovation and development in the extraction of medical radionuclides from our legacy inventory
- Under MRIP, HMG is working with the Nuclear Decommissioning Authority (NDA) to understand whether there are radionuclides of value held in the civil inventory for medical applications.
- Next stage - develop a robust strategy for the management any such radionuclides of value identified in the UK nuclear inventory.
- MRIP is also funding a series of innovation projects relating to the UK production and supply of medical radionuclides. Successful projects will be announced in the Autumn.

Medical Radionuclides

- Key capabilities being built;

Each MRIP-funded project will;

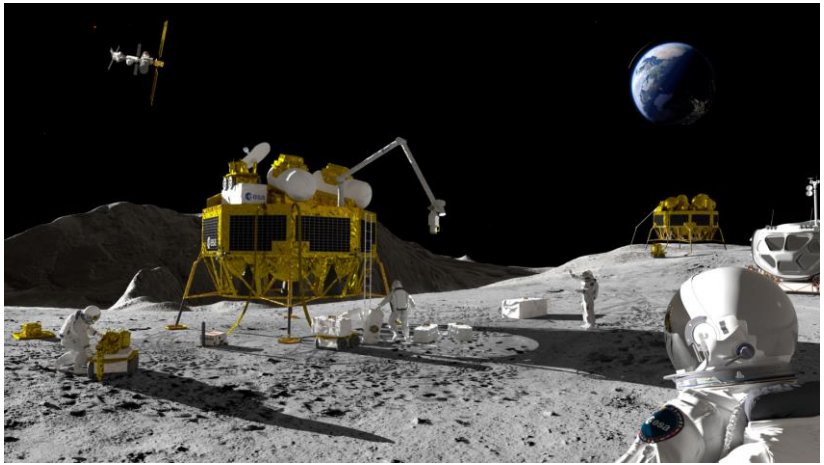
- Support skilled jobs across the UK
- Increase capability, knowledge and IP across the UK supply chain.

While some will be specific to medical radionuclide development, areas with parallel benefits across the nuclear sector include:

- Radiochemistry
- Alpha handling skills
- Radioisotope science and extraction

Nuclear for Space Applications

- Where solar panels are not an option, Radioisotope Power Sources (RPS) use the heat of decaying Plutonium-238 (Pu-238) to provide a constant supply of energy to planetary and deep space missions.
- Low availability, high prices and geopolitical issues, have made Pu-238 almost inaccessible.
- Americium-241 (Am-241) produces similar heat and its longer half-life makes it better for long duration missions.



Artist's impression of the Terrae Novae Moon surface scenario showing Argonaut in the centre ©ESA-ATG

The National Nuclear Laboratory (NNL), funded by the UK Space Agency is building a new laboratory (PuMA-2) which will "harvest" Am-241 from the UK's civil separated Pu stockpile to power an RPS for the European Space Agency's lunar missions in the early 2030s.

Nuclear for Space Applications

Key capabilities being built:

- Inspiring applications of the UK's unique nuclear materials and skills build a strong positive narrative around nuclear as an exciting and varied career path.
- Innovate projects help maintain and grow the UK nuclear skills pool.

- In particular, this work builds alpha-handling skills, which are in short supply, can take years to grow and which support work across the sector.
- For example; Plutonium science, radiochemistry, alpha handling skills for radioisotope science and extraction, advanced fuels development and PIE to study damage to irradiated material from both the civil and defence sectors.

Conclusions

Leveraging the UK's unique nuclear heritage through innovative technology development builds our net zero capability, both directly and indirectly.

- Advanced fuel development strengthens our current, and future, low-carbon energy generation capacity.
- Innovative reactor designs could help decarbonise our heat-heavy industries and enable options for hydrogen production.
- Isotopes found in "waste" have the potential to help address medical radionuclide supply issues and to power space exploration.

While nuclear skills have declined, and can take a decade to grow, innovative projects can help maintain a vibrant, attractive and flexible nuclear sector.

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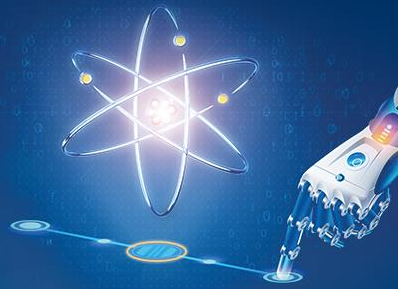

Thank You

2023