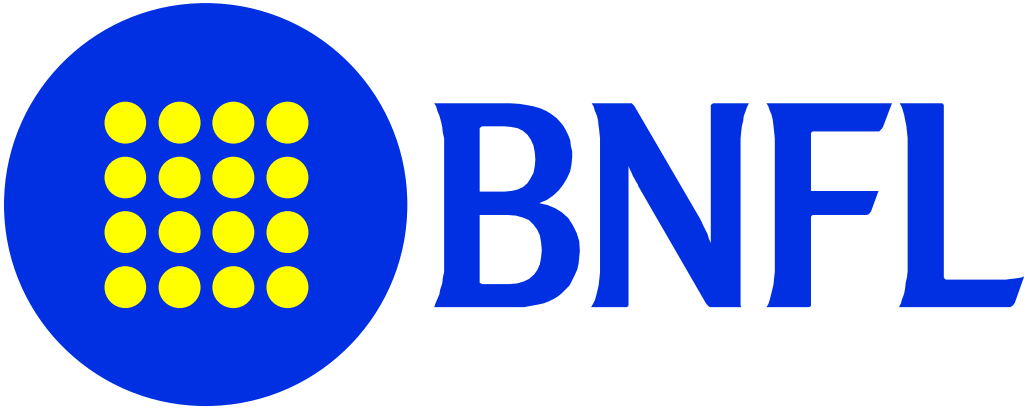


Key Issues in Fuel Cycle Options

Richard Mayson

IAEA Scientific Forum

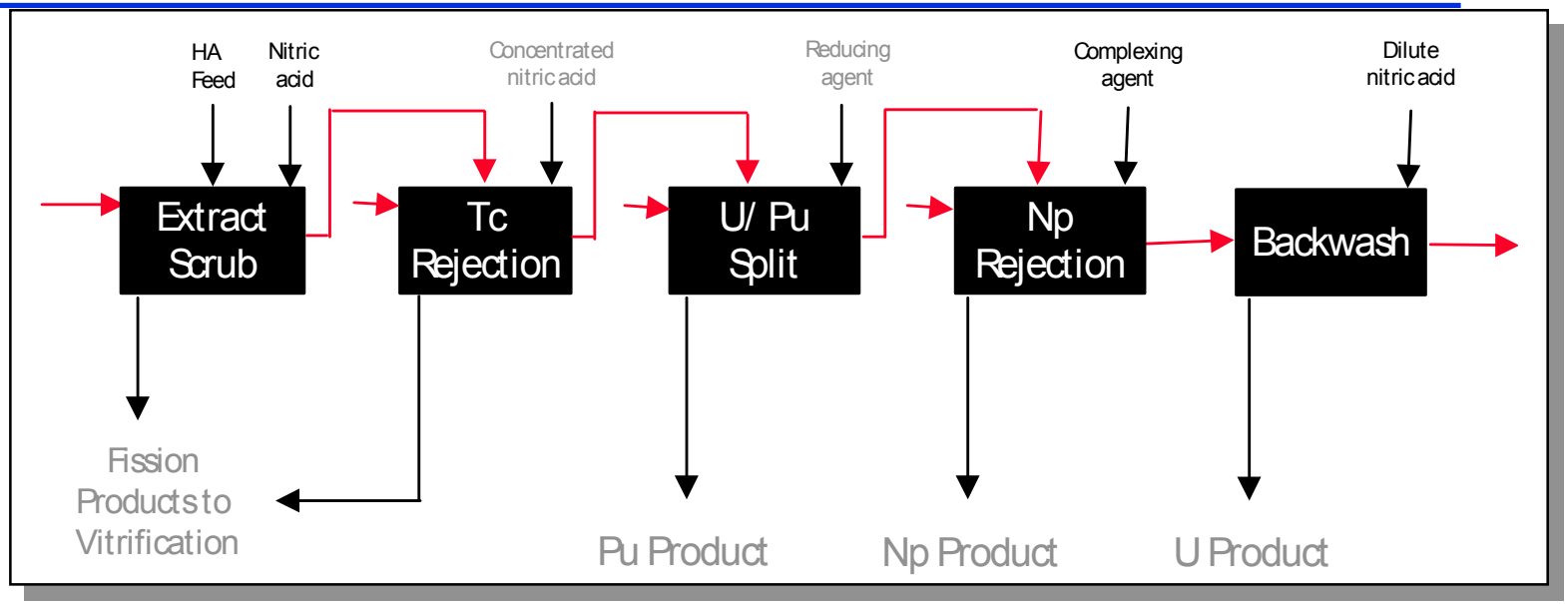
UK has Experience of Commercial Scale Reprocessing

Mixer Settlers

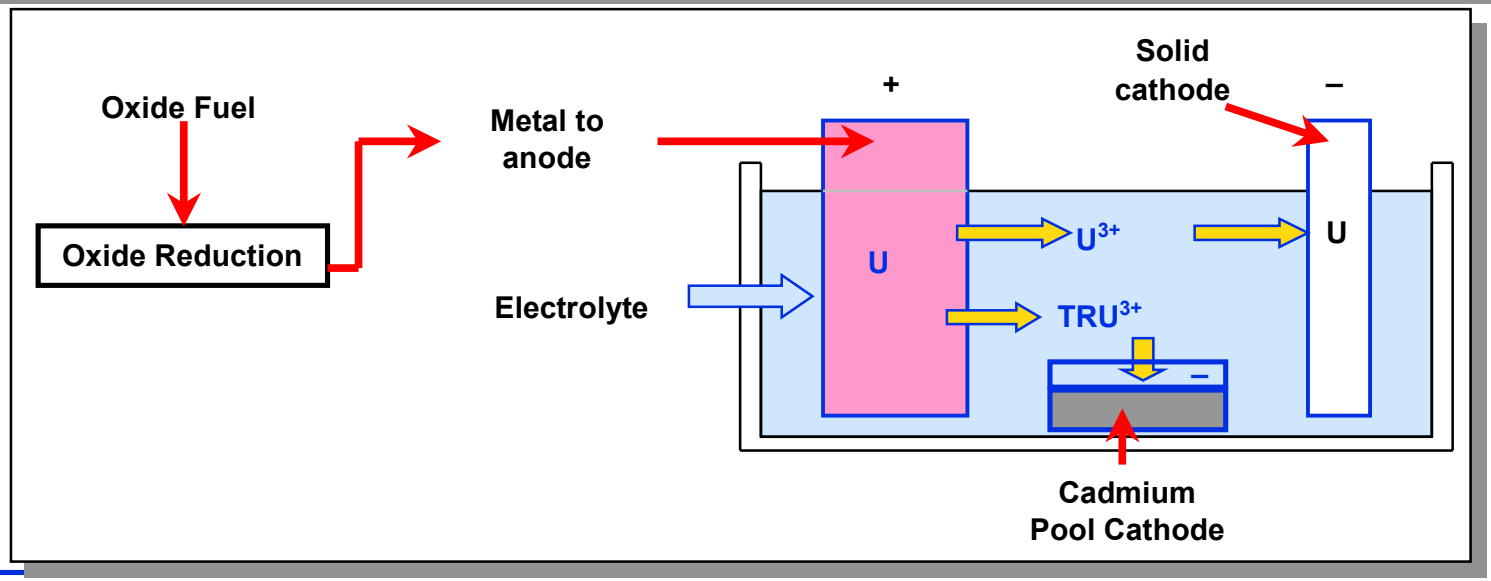
Pulsed Columns

BNFL are Investing in Advanced Fuel Cycle Studies

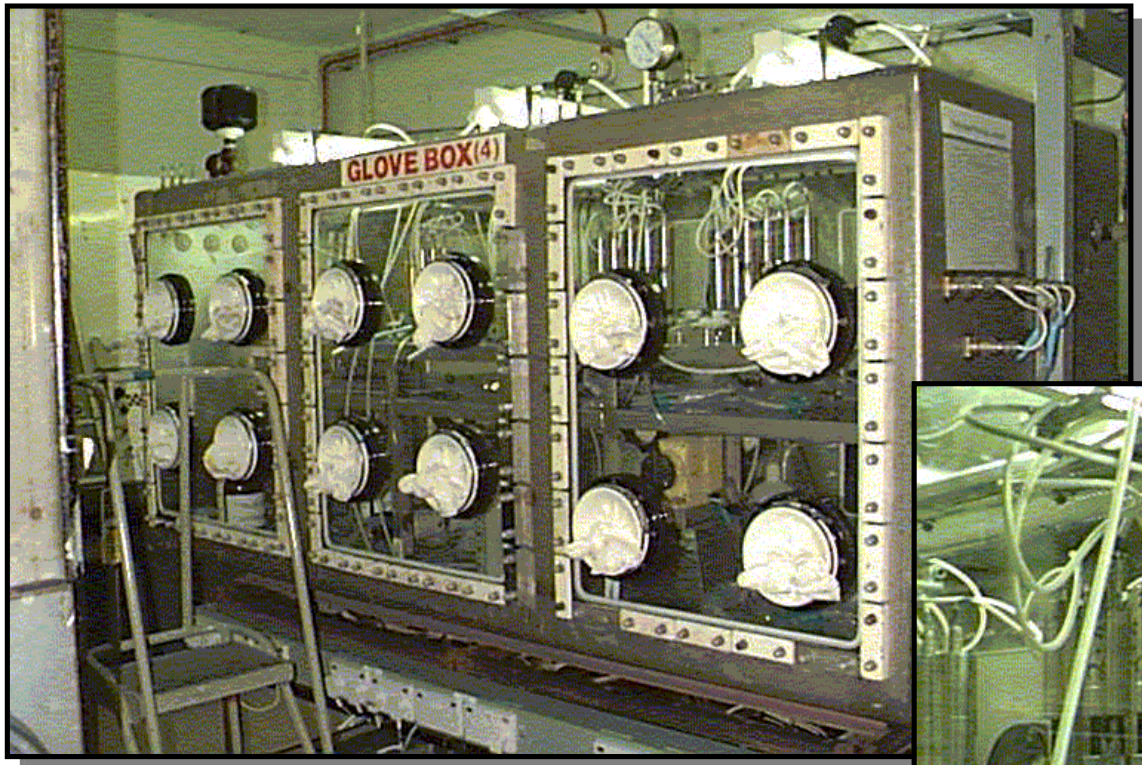
- Aqueous

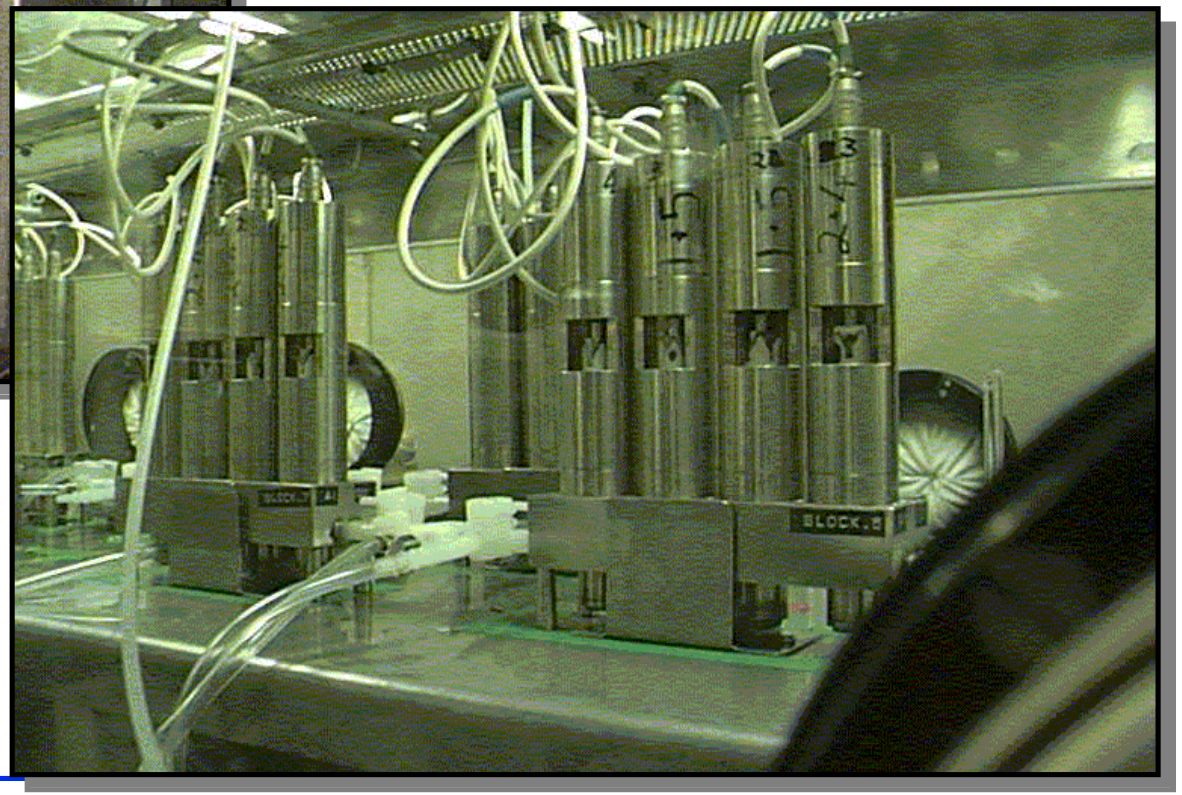


- Molten Salts



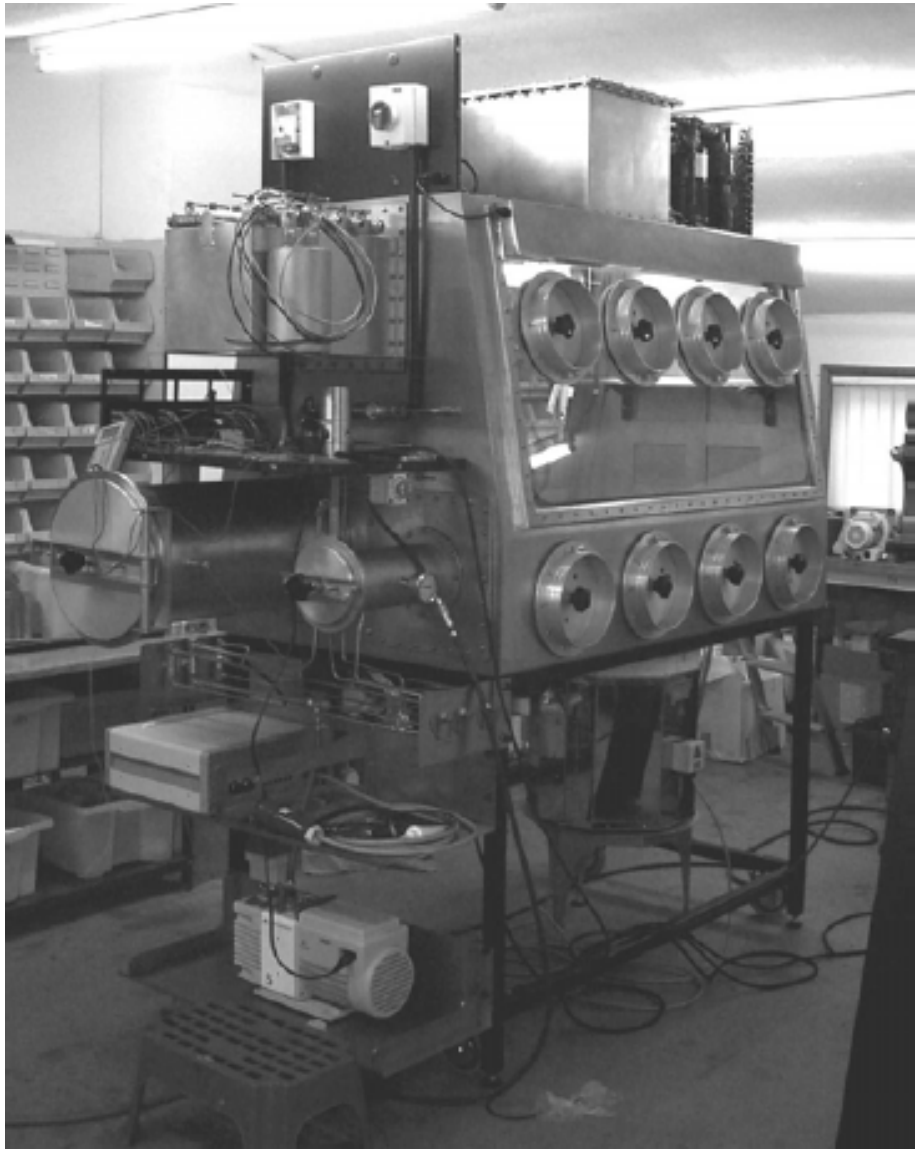
Equipment for Aqueous Fuel Cycle Studies

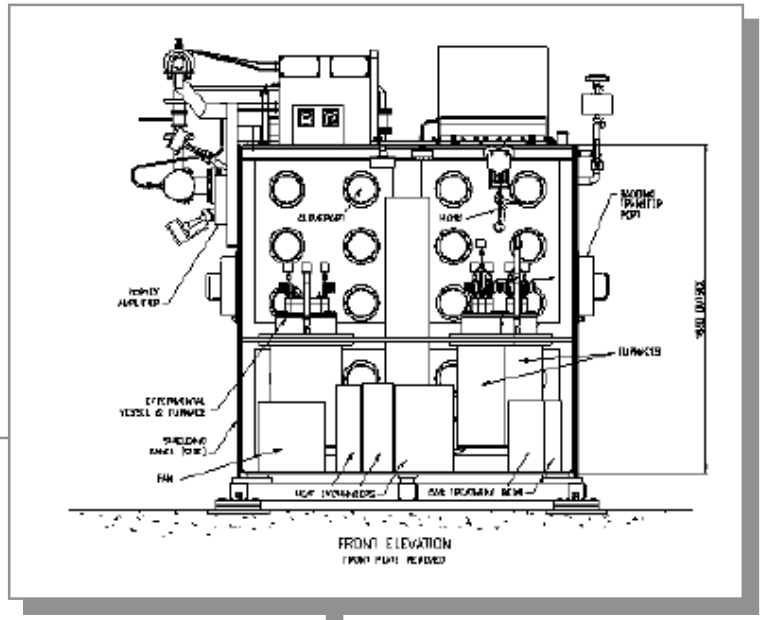


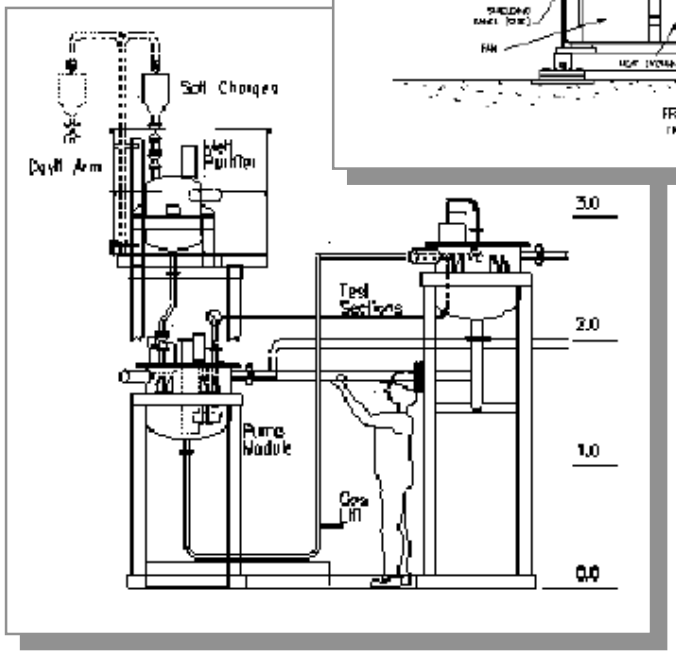


Equipment for Pyrochemical Fuel Cycle Studies

BNFL





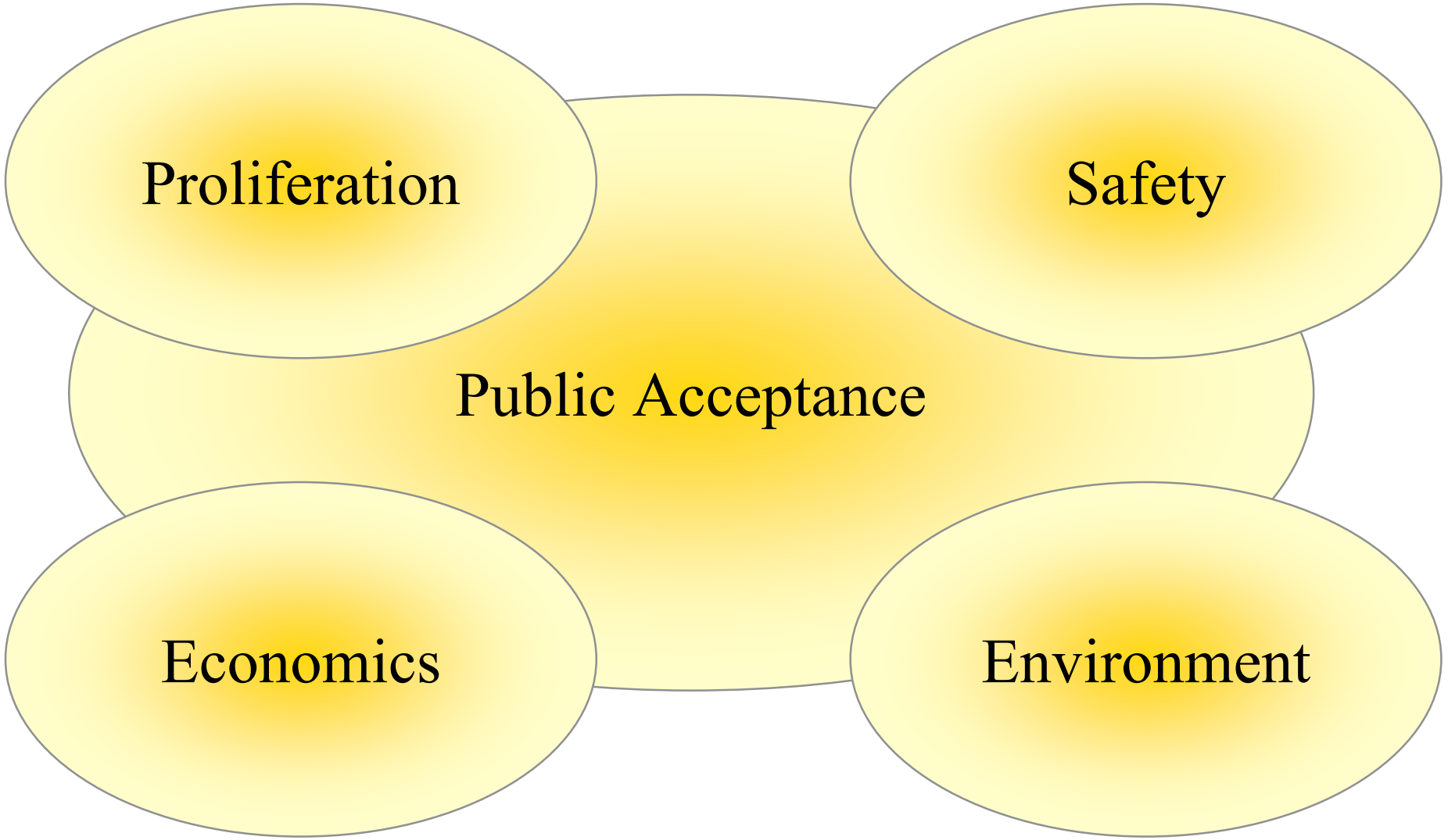


BNFL Technology Centre will have a wide range of facilities

Objectives of an Optimised Fuel Cycle

- Increased proliferation resistance
- Reduction in costs
- Reduction in effluent volumes
- Minimise waste production
- Reduce radiotoxicity of High Level Waste
- Utilisation of full energy potential of spent fuel

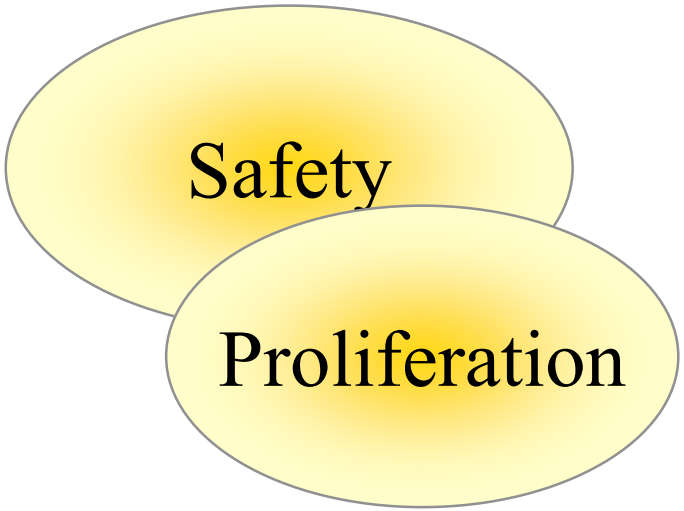
Areas to Consider in a Fuel Cycle



The Ideal Solution Overlaps these Issues

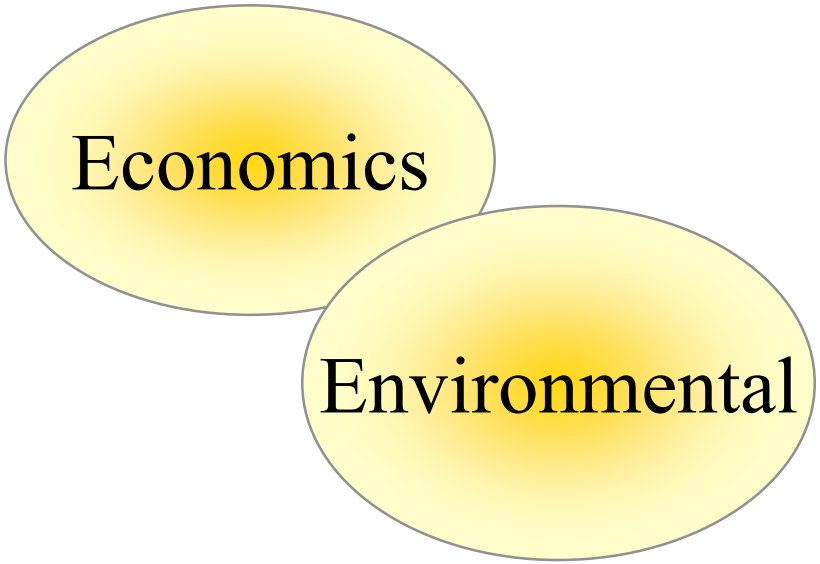
Increase proliferation resistance

- This is a major issue for public acceptance
- Producing Pu with other actinides will increase the proliferation resistance of the technology
- This is a focus for the work on aqueous flowsheets
- Pyrochemical processing can be inherently designed to be proliferation resistant
- Improvements are needed in both areas **in parallel**



Reduction in Costs

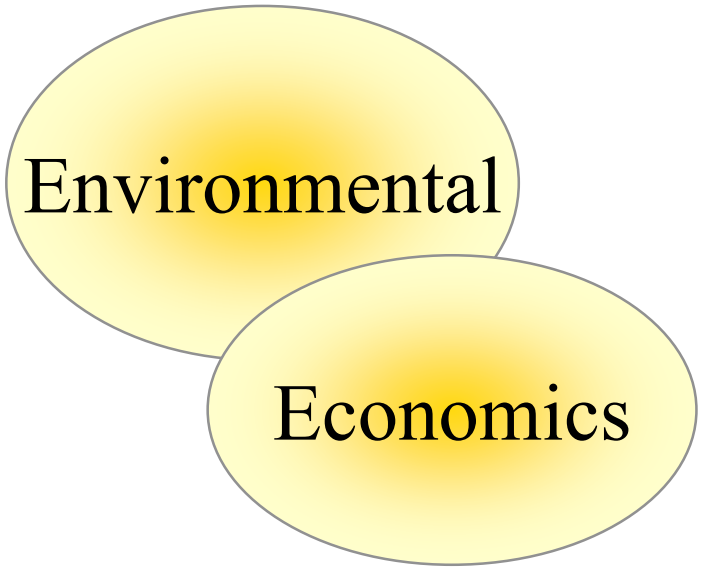
- Cost reduction can be be achieved by a reduction in building size
- Minimise technology risks through use of stagegates
- A simplified process with low environmental impact will lead to a reduction in costs



Reduction in Effluent Volumes

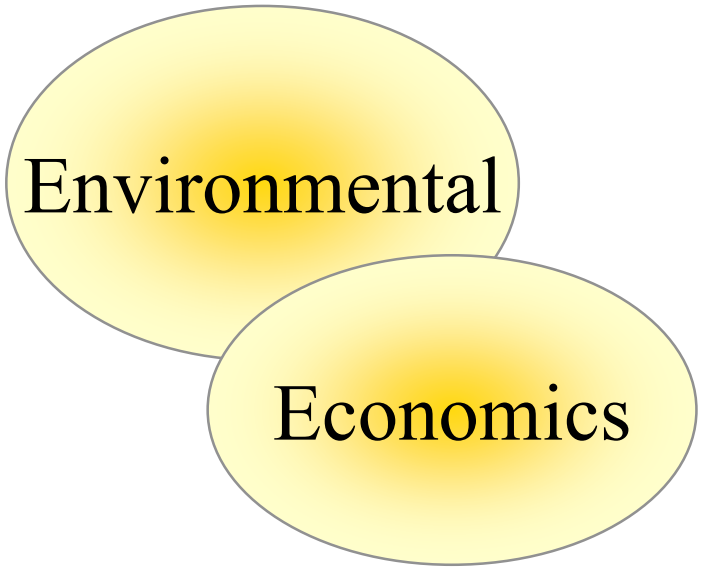
- Pyrochemical processing
  - –Essentially a dry process hence will avoid liquid or aerial discharges

- Aqueous
  - – Reduction in effluent volumes can be achieved by a reduction in solvent use



Minimise Waste Production

- The choice of fuel cycle is important in minimising the waste produced
- Reprocessing has a major role to play in minimising waste volumes
- Waste volumes can be minimised by increasing the efficiency of waste treatment processes e.g.
  - Vitrification
  - Ceramics



Reduce Radiotoxicity of High Level Waste

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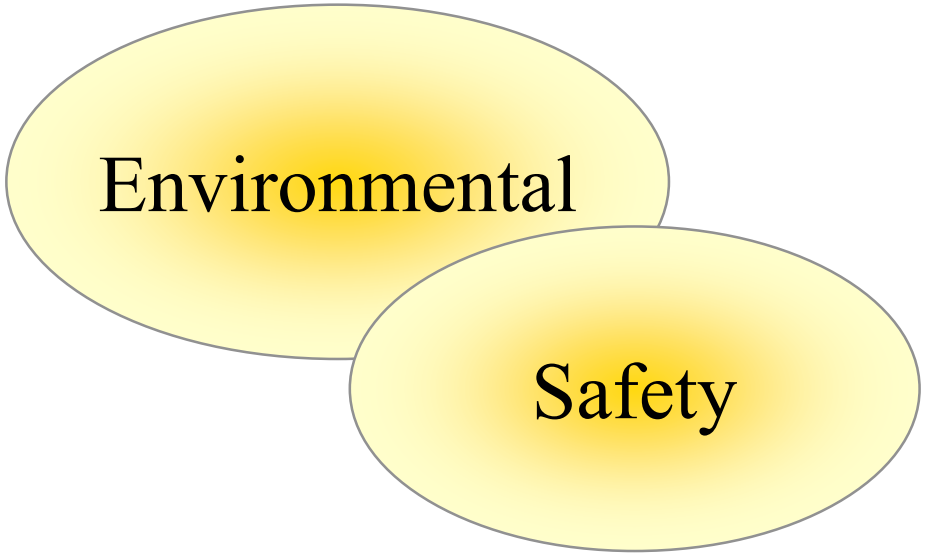
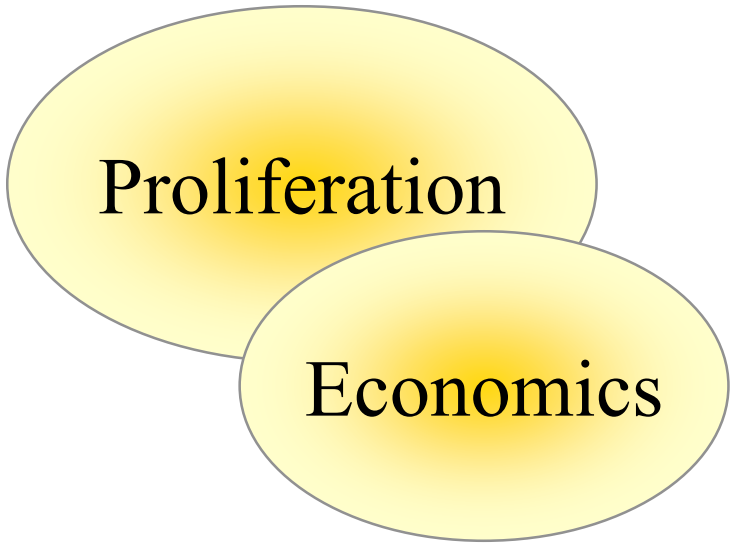
- The challenge to the technology is to prove that transmutation can deliver.
- The viability of transmutation will depend on economics and political decisions
- Technically validated solutions are needed to allow decision makers to have options
- International collaborations in transmutation needed to enable quick success

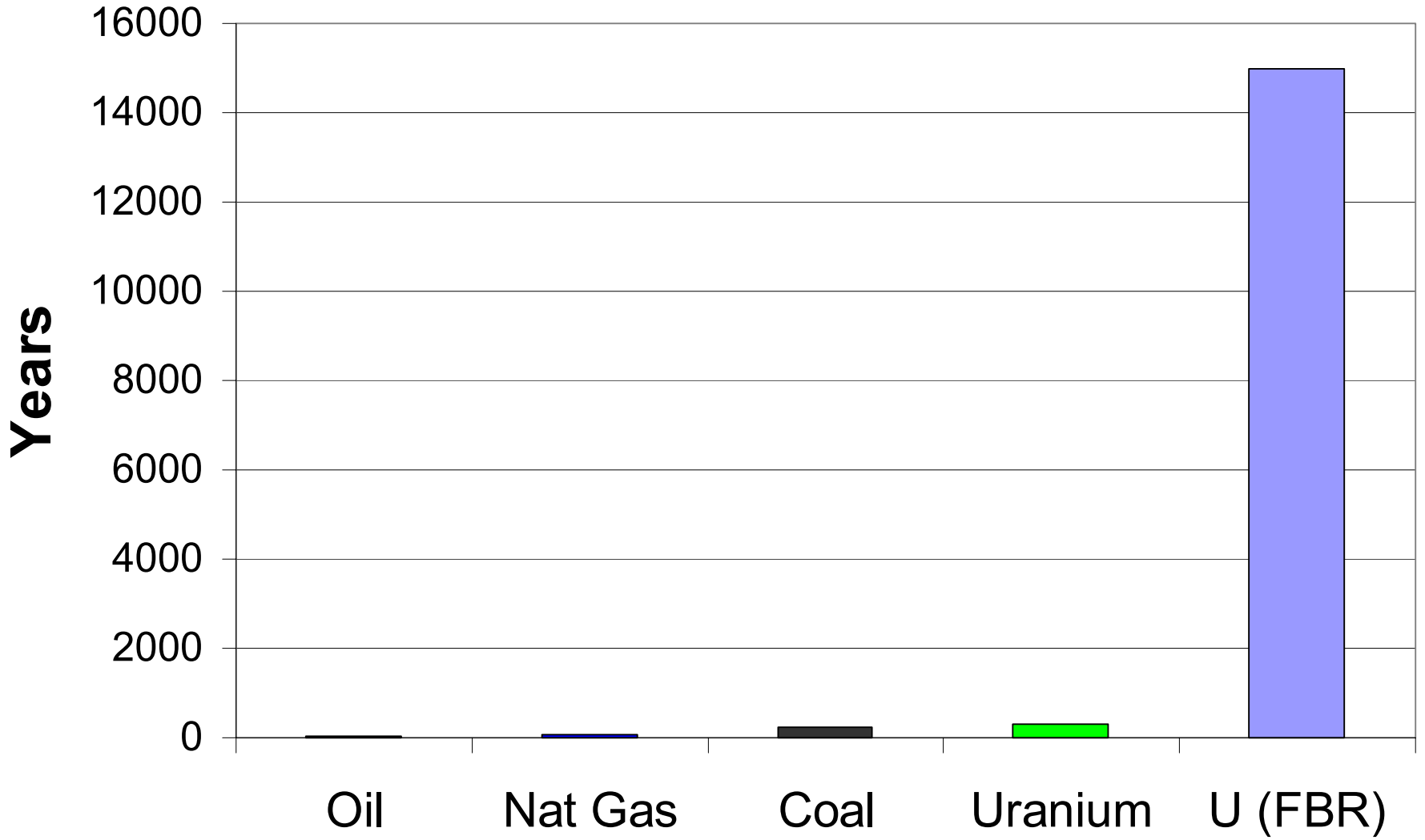


Maximise Use of Energy Potential

- Energy source must be secure
- Energy source must be sustainable
- Efficient use of uranium is needed
- The choice of fuel cycle is important to maximise use of energy potential



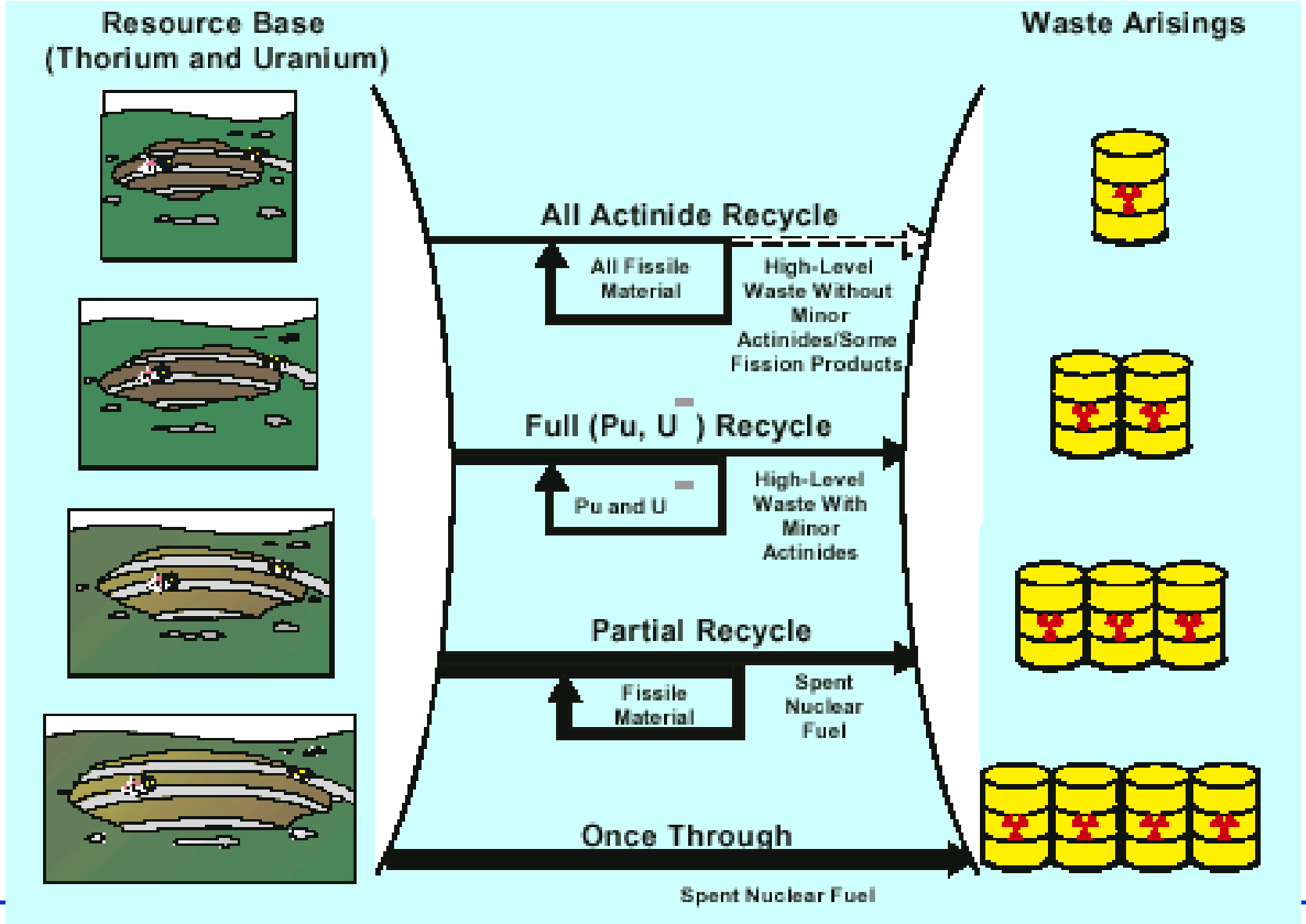
Potential for Long Term Use of Uranium



Public Acceptability is Key

- The benefits of nuclear power outweigh the disadvantages
- The biggest challenges are social & political
- We must encourage and inform the debate

Several Fuel Cycle Options Exist



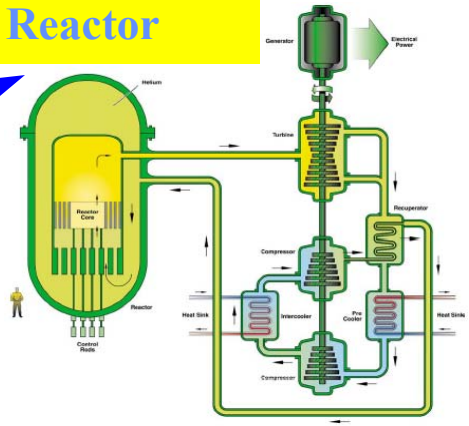
A gas-cooled reactor technology path

Diagram shows
natural development
for gas cooled systems
& technology challenges
to be addressed

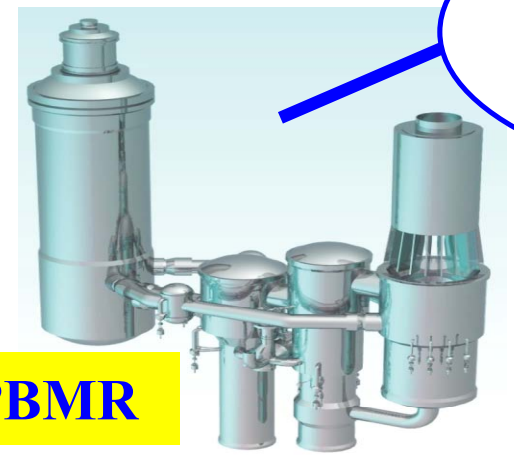
ETDR

GFR R&D
fuel materials & fabrication
materials for high fluence
fuel cycle technology
safety systems

Gas-cooled Fast Reactor



NGNP / VHTR R&D
fuel materials & fabrication
high temperature materials
hydrogen production technology
graphite technology

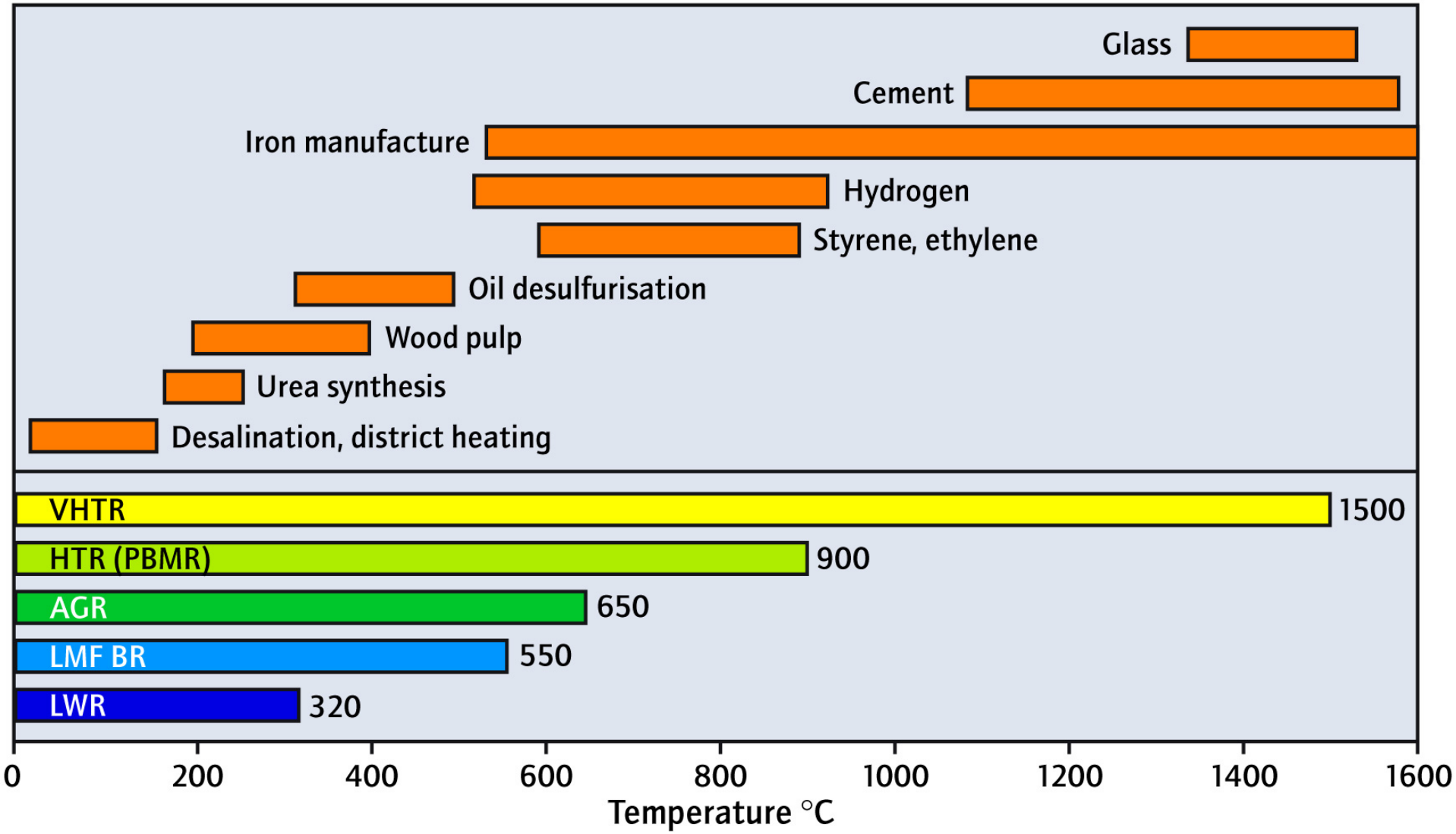


PBMR

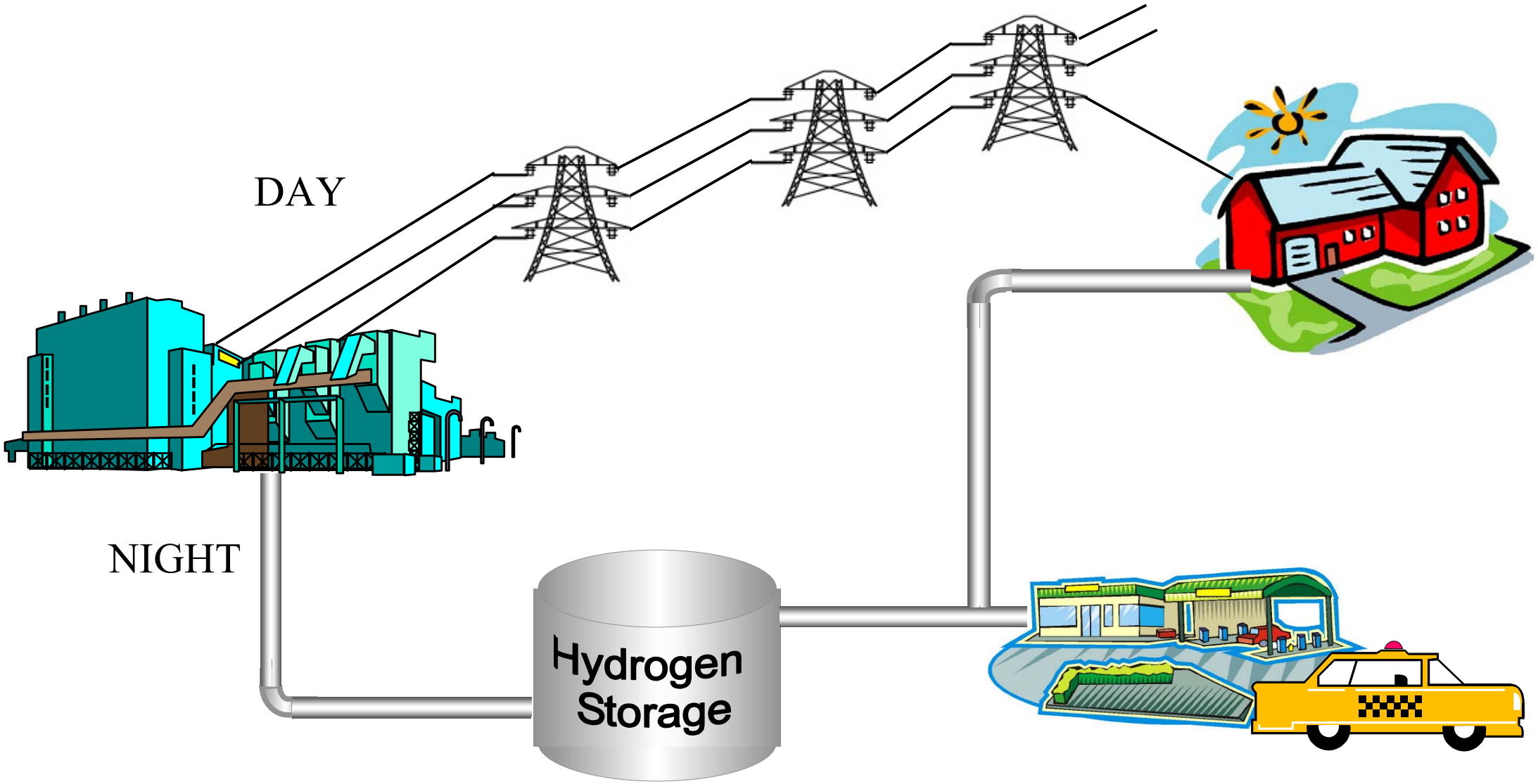
VHTR

Idaho NGNP

Multiple Uses for the Heat from High Temperature Reactors



Optimise Use of Nuclear Power by Hydrogen Generation

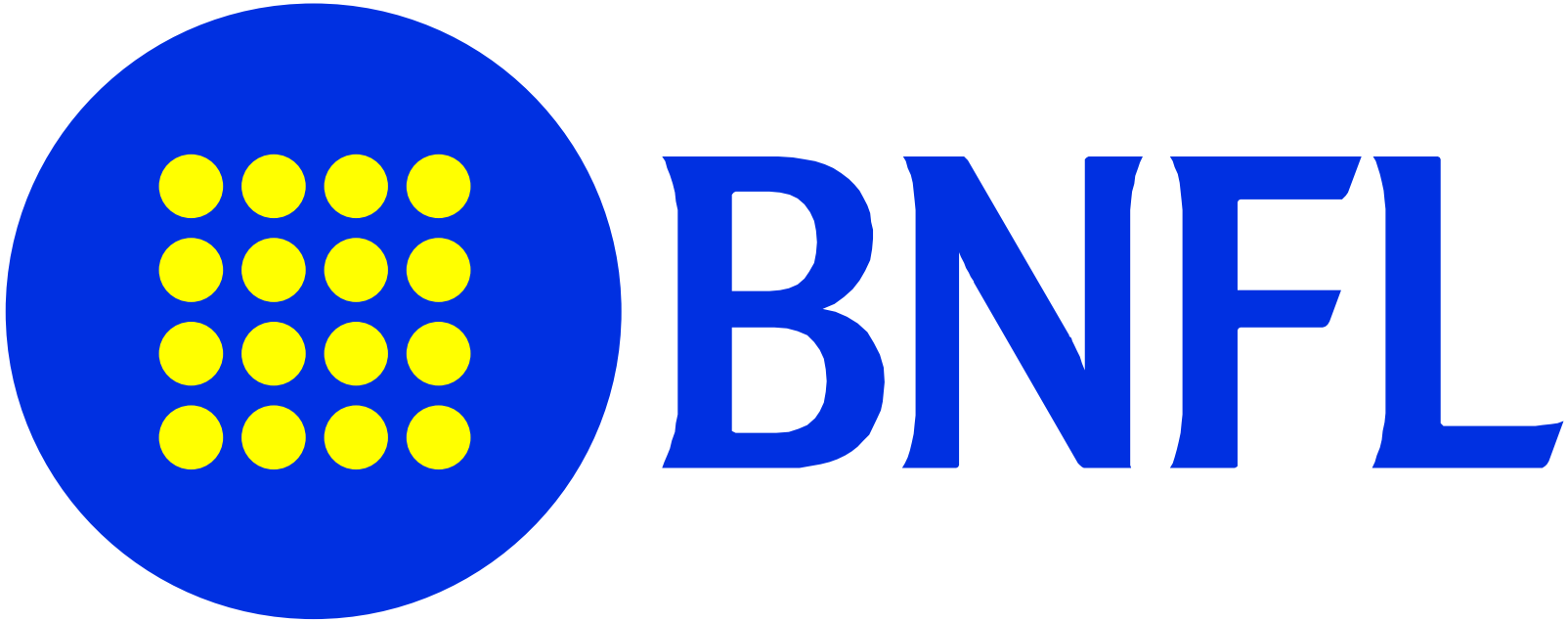


Fuel Cycle will be Needed in the Future

- The need for a fuel cycle will come back in the long term due to
  - –limited uranium
  - –costs of uranium
  - –resurgence of nuclear
  - –the need to act against global warming

- BUT the industry must focus on social and political issues as well as technical issues to allow the right decision to be made

- Both **evolution** of current systems and a **revolution** to the next generation of systems are needed for reactors and fuel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