ACHIEVING NET ZERO BY 2050

EH HTGR - EnergiHabu

Local Energy Hubs for all customers' carbon-free energy needs

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Supporting UK's industry:

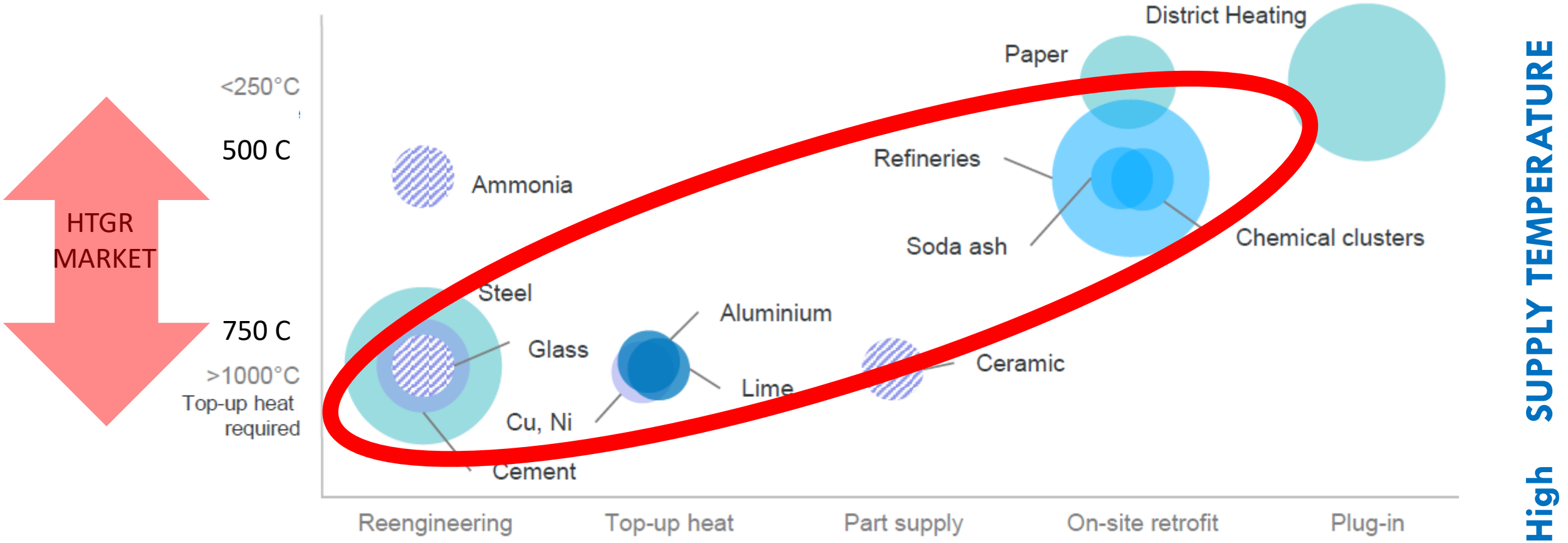
(1) The Foundation Industries are worth around £52bn to the UK economy, they provide 600,000 skilled jobs in over 31,000 firms

(2)

- **Metals (iron and steel)**
- **Chemical manufacture (including basic pharmaceutical products)**
- **Ceramics**
- **Glass**
- **Paper**
- **Cement**

(3) The UK manufacturing industry, contributing £170bn to GVA, 42% of British exports and 2.6m jobs

All are ‘HARD TO DECARBONISE’ except with AMRs



Penultimate Power UK – Technology Search

(1) Technology Agnostic - Criteria - Due Diligence

- Be indisputably safe for unrestricted deployment close to centres of demand
- Be capable of load following in support of the existing investment in renewables
- Be cost competitive against any combination of renewables with storage, or gas with CCUS
- Use fuels and components which can be strategically manufactured in UK

(2) 2018 – JAEA's HTGR chosen as preferred technology

(3) 2019 JAEA and Government of Japan

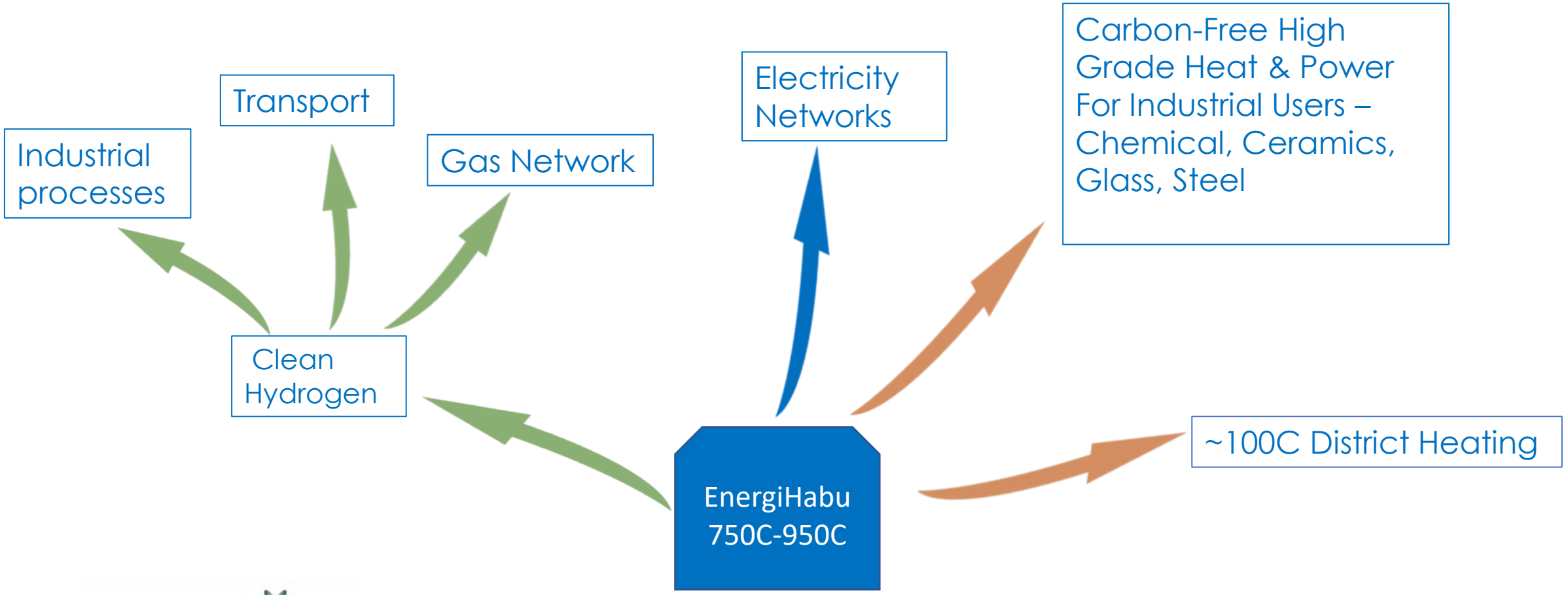
Why EnergiHabu – EH HTGRs?

21st Century High Temperature Gas-Cooled Reactors – rethinking nuclear technology

- ✓ (1) **Inherently safe** - physics not probability
- ✓ (2) **30% lower capital cost** than legacy PWRs
- ✓ (3) **75% less waste** than current reactor designs
- ✓ (4) **Accelerated, de-risked** option with trusted international collaboration
- ✓ (5) **New applications to decarbonise** heat, hydrogen & industrial processes

EnergiHabu™

Carbon-free High Temperature Energy Hub



Penultimate Power UK

Our Mission

- To contribute to decarbonisation in a safe, and practical manner, affordable to consumers and to advance the UK industrial competitiveness through distinctively economic, secure, indigenous, carbon-free heat, power and green hydrogen
- To create and sustain 15-20,000 jobs in the Northern Powerhouse region
- To build a £2bn/year minimum throughput factory on Teesside producing:

  Low case: 20 units/yr/20 years @ £40bn installed plant CAPEX by 2050

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Why Teesside?

EH HTGR

Product Summary

Responsive to seasonal heat and power load patterns without added storage and thus is complementary to the increasing role of variable renewables.

Compact, inherently safe design with small environmental footprint

Little requirement for water means it can be located near areas of demand

British-originated principles of inherent safety cuts complexity, reducing capital and operating cost

Walk-away stability with no human intervention required so can export responsibly to large markets

Natural shutdown decay heat dissipation without requirement for off-site water , electricity or help

Ceramic fuel is tested safe to 1600°C – well above any physically possible excursion case

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Product Summary – Key Technical Parameters

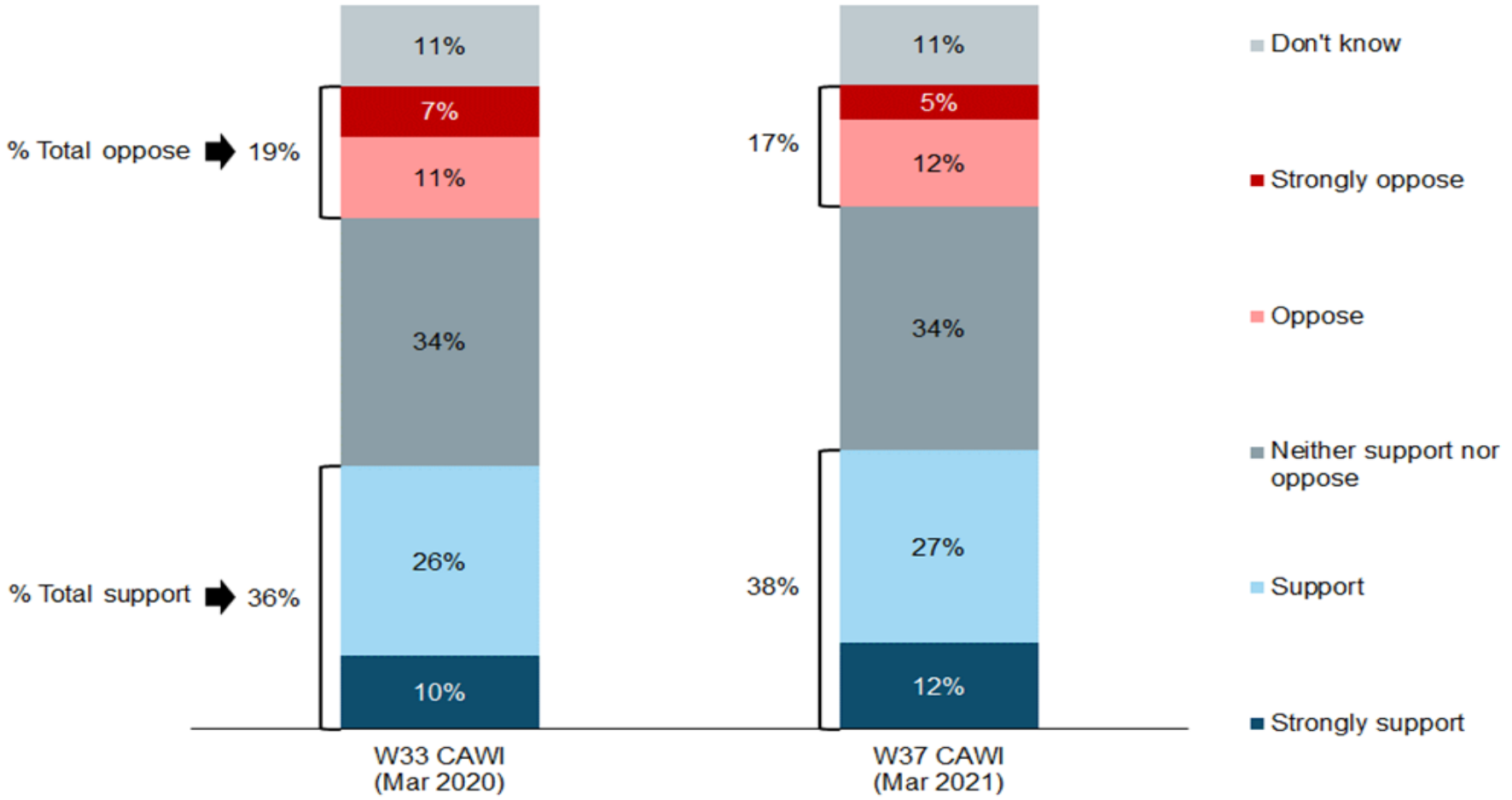
Reactor status	In Service 1998
Reactor Type	HTGR AMR
Thermal Capacity (MWt)	50MWth
Electricity Capacity (MWe)	22MWe
Estimated thermal efficiency	45%
Economic/Design Life	25/60 years
Regulatory Status	Licensed in Japan
Reactor Outlet Temperature	Up to 950C
Coolant	Helium
Coolant pressure	4 MPa
Fuel Type	TRISO ceramic
Fuel Assembly	Prismatic
Fuel Enrichment %	9.9%
Fuel burn-up GWd/tU)	120
Fuel cycle	4 years

Challenges?

(1) UK Government – risk profile and enablers

(2) Nuclear continues to be wrongly judged by its current application, geographical restrictions and high capital cost

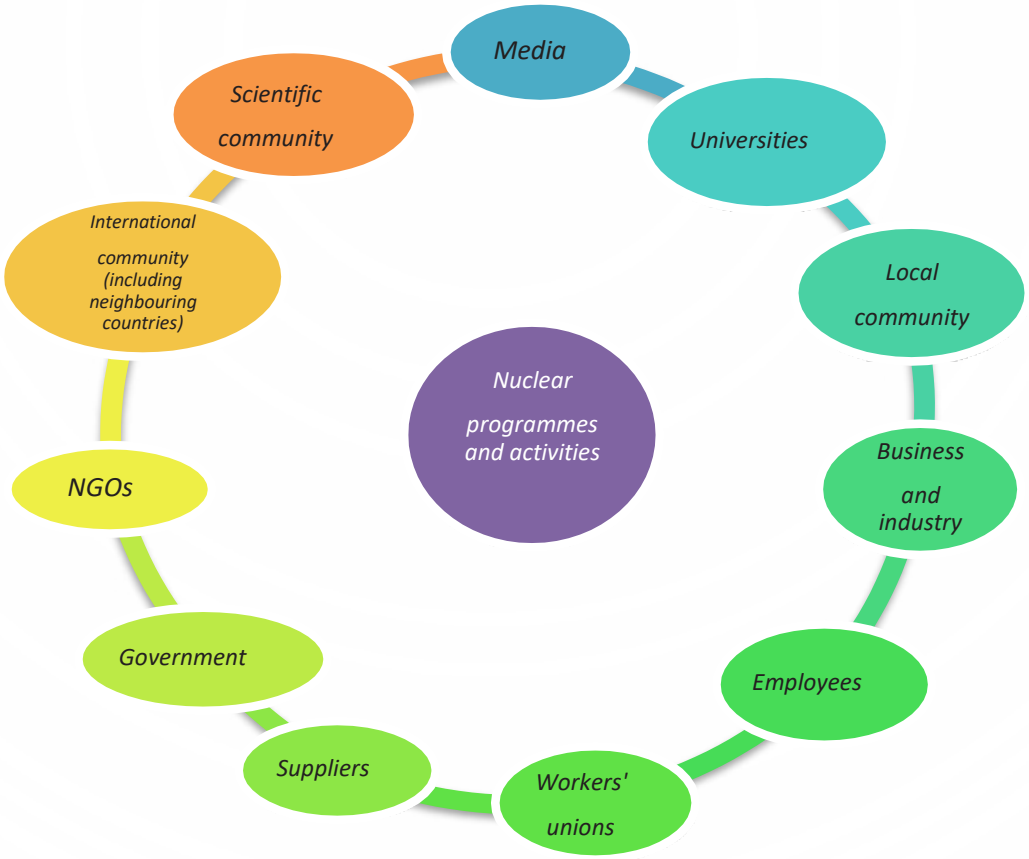
(3) Public acceptance – confidence comes from knowledge



Source: BEIS Public Attitude Tracker Wave 27 UK

Figure 18: Whether support or oppose nuclear energy (based on all people), March 2020 and March 2021*

Challenges …..cont



Source: IAEA Stakeholder Engagement in Nuclear
FIG. 1. Non-exhaustive list of stakeholders in a nuclear programme (see Appendix II for a stakeholder prioritization methodology)

Challenges …..cont

(4) Financing – Nuclear eligibility for ESG and Green Financing

(5) Regulatory cross acceptance

Teamwork

- ✓ UK Government
- ✓ Government of Japan
- ✓ JAEA – Japan Atomic Energy Agency
- ✓ Nuclear Advanced Manufacturing Research Centre
- ✓ National Nuclear Laboratory
- ✓ UK universities
- ✓ UK supply chain
- ✓ Japan Nuclear Industry

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Local Energy Hubs for
Carbon-free
Hydrogen, Heat & Power

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