



**Kyoto
Fusioneering
Global Program**

**GRIPS
Policy Roundtable**



Colin Baus

- Introduction of Kyoto Fusioneering and private industry
- Funding of private industry
- Safety and regulations
- Waste production

Company Profile

Established: October 2019

Funding (VC): ¥2.1B JPY (~\$17M USD)

Investors:



JAFSCO



global
brain

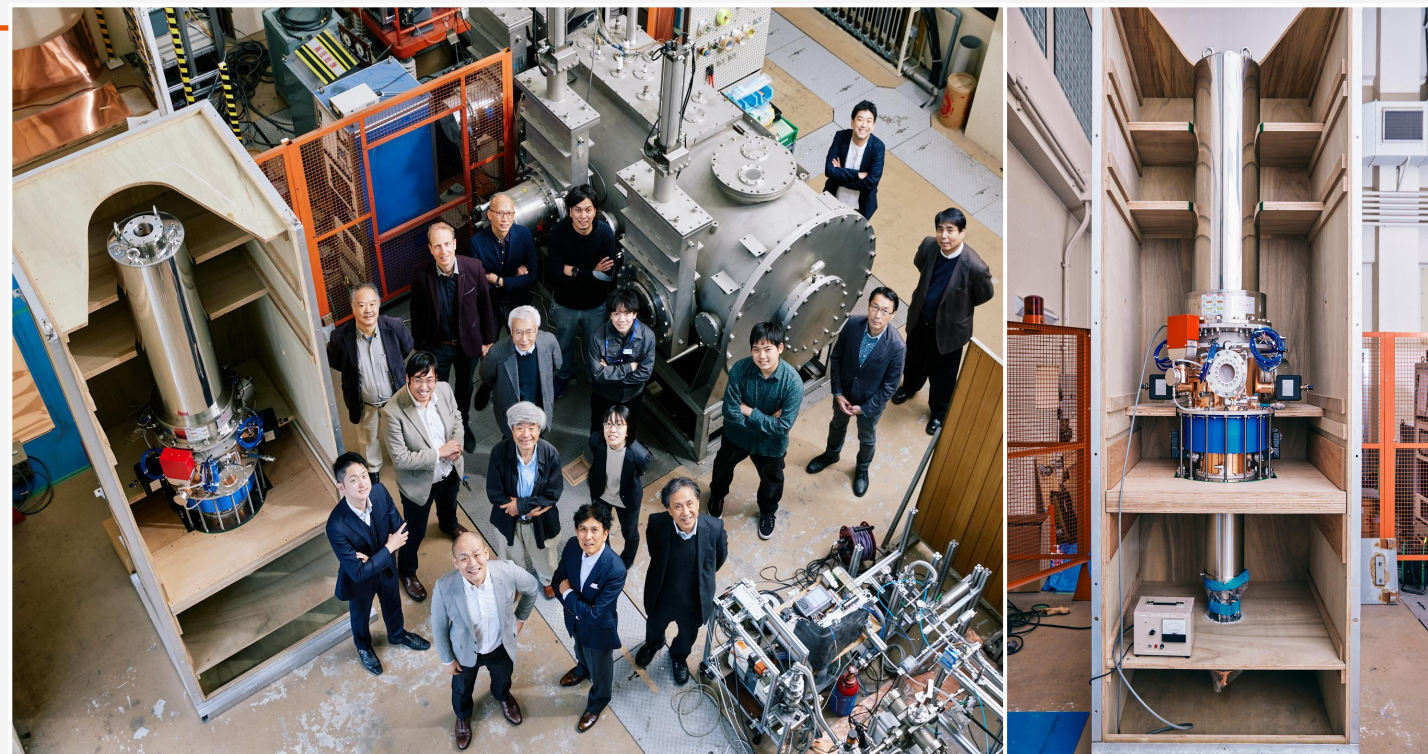
Locations: Kyoto (Laboratory)

Tokyo (Business HQ)

Reading (UK HQ)

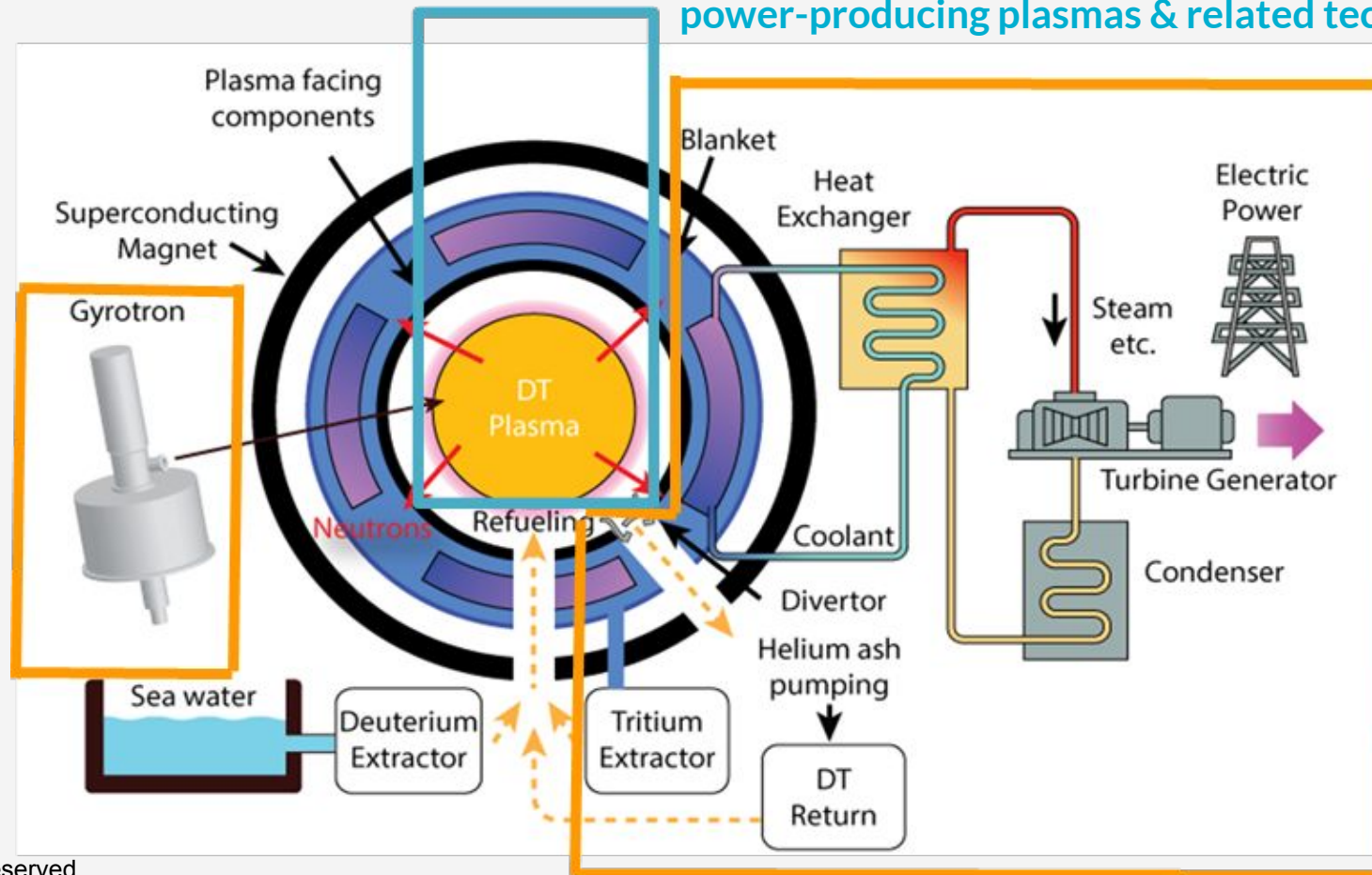
Seattle (US HQ)

Company size: 70+ staff (incl. part-time)



Kyoto Fusioneering is the only company completely focused on developing *critical path* fusion reactor technologies in the world

Fusion developers around the world are working on power-producing plasmas & related technologies



Kyoto Fusioneering is focused on reactor technologies and engineering.





UNITY (UNique Integrated Testing facilitY)

World-first integrated testing facility for fusion power plant equipment.
Electricity generation with fusion relevant technologies planned by 2024.

Map of the Fusion World

Total	Tokamaks	Stellarators/Heliotro..	Laser/Inertial	Altern. Concepts	Exp	Demo
142	77	15	11	39	130	12

● Tokamaks
● Stellarators/Heliotrons
● Laser/Inertial
● Altern. Concepts

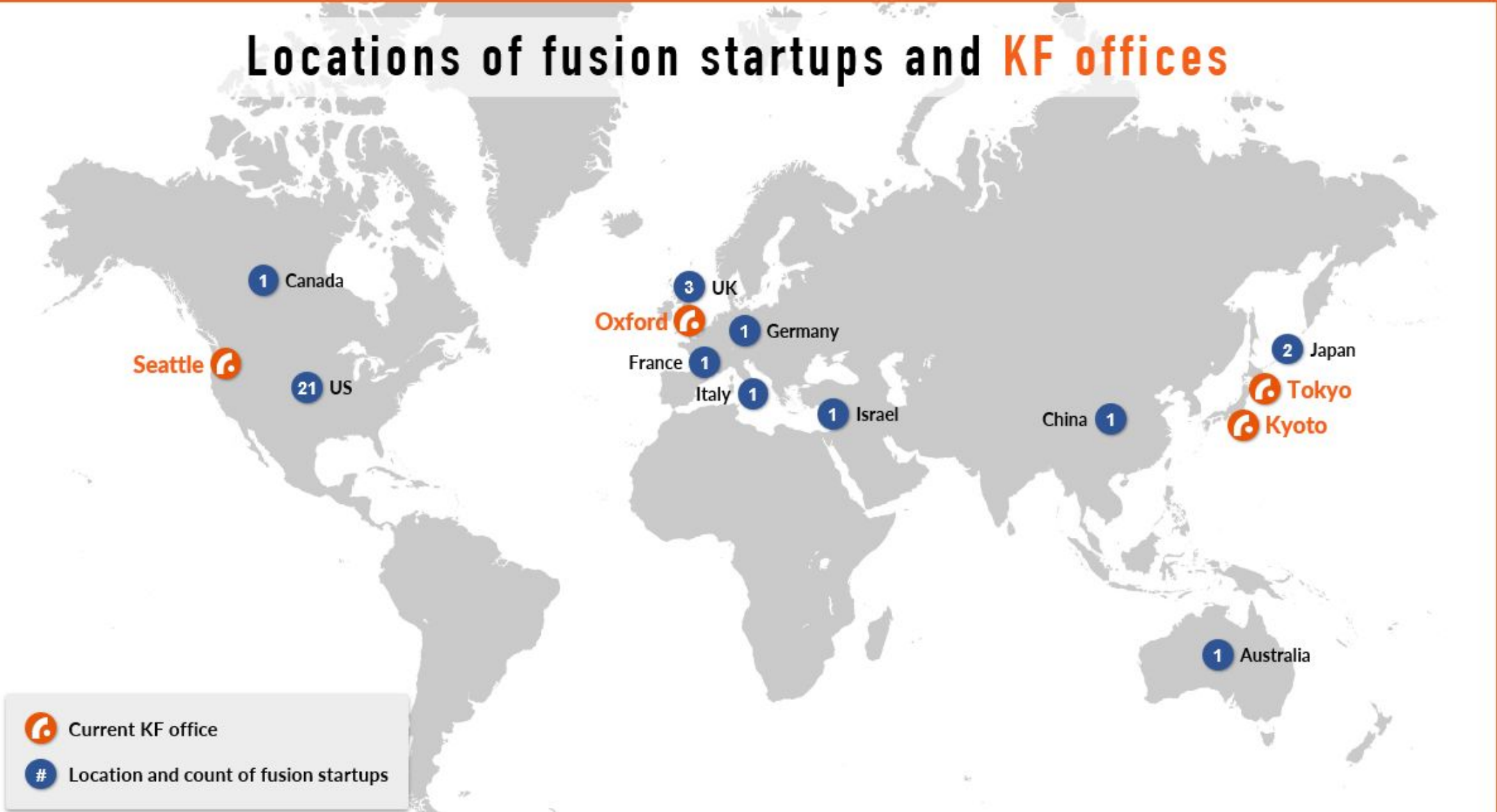




Country	#
United States	34
Japan	25
Russia	13
China	11
United Kingdo..	9
France	5
Germany	4
Italy	4
Pakistan	4
Brazil	3
India	3
Iran	3
Republic of K..	3
Canada	2
Costa Rica	2
Czech Republic	2
Spain	2
Switzerland	2
Ukraine	2
Australia	1
Denmark	1
Egypt	1
European Uni..	1
Kazakhstan	1
Libya	1
Portugal	1
Sweden	1
Thailand	1

Operating	Under construction	Planned	Public	Private	Public-Private
97	14	31	110	31	1

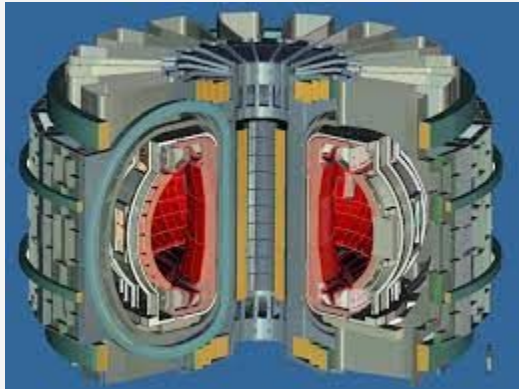
Source: IAEA

Locations of fusion startups and KF offices

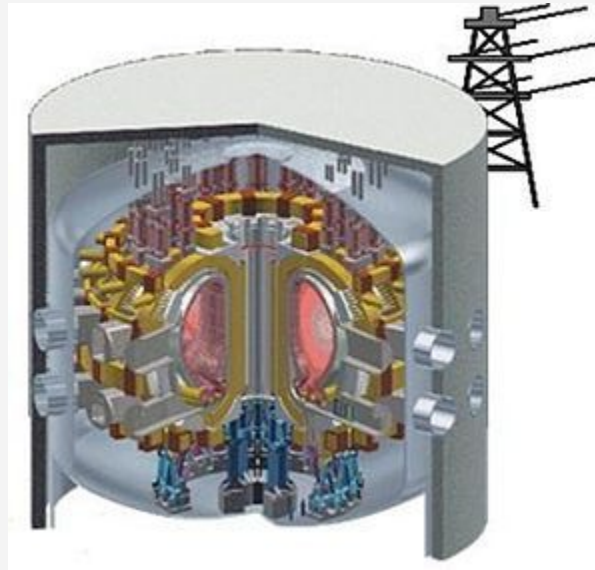


 Current KF office
 Location and count of fusion startups

Experimental Plant



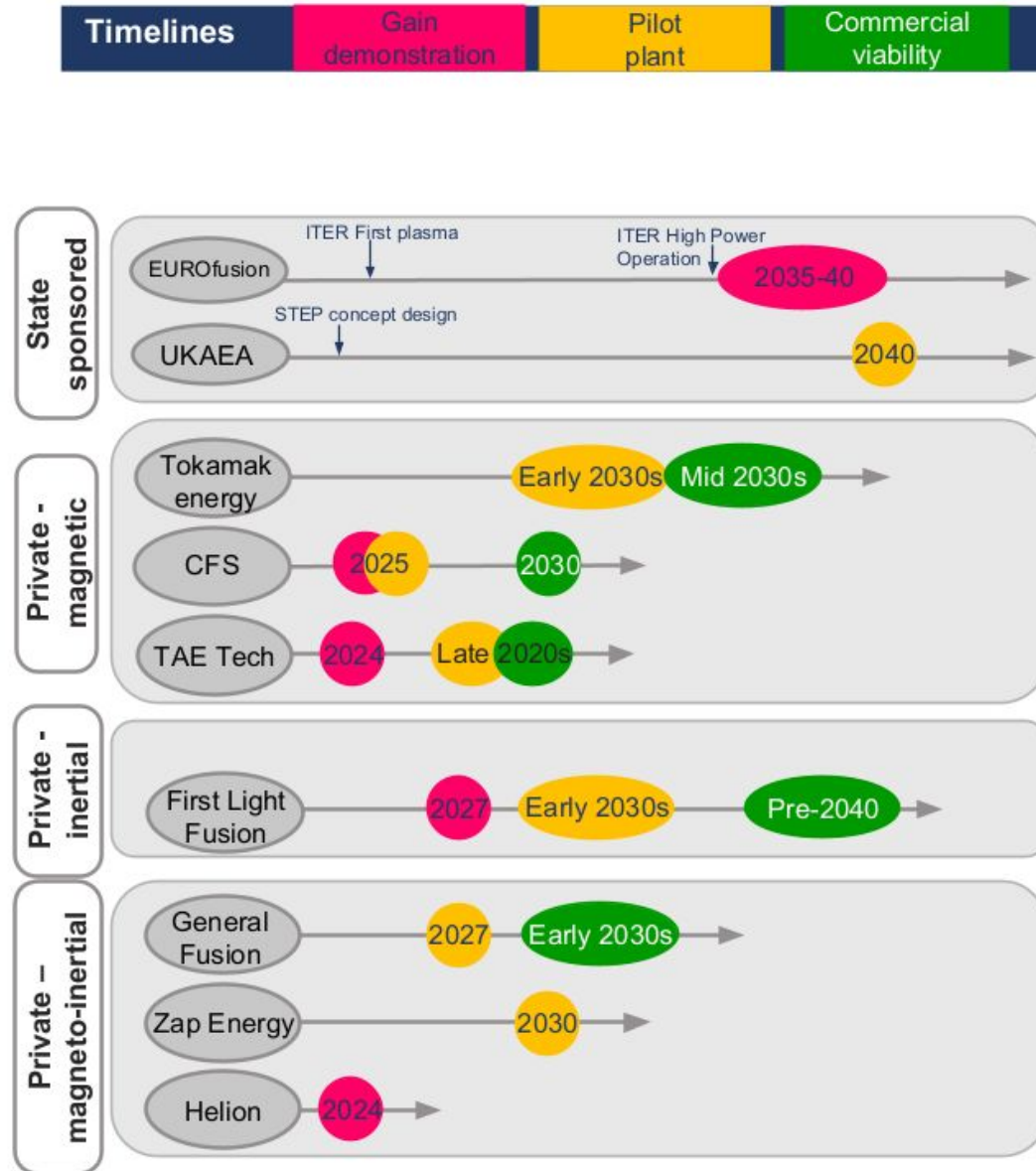
DEMOstration Plant



Commercial Plant



Path to Commercialisation



Source: UK Government Office for Science (UK)

- Fusion [advisory panel by the cabinet office](#) with several key people from public and private fusion efforts
 - Purpose: Promoting innovation (イノベーション政策強化推進のための有識者会議「核融合戦略」の開催について)
- Prof Konishi from Kyoto Fusionneering is a member
- Key questions for us
 - What is the way forward in terms of funding
 - Which roles play private companies
 - National vs international
 - Grid rollout
- For us it's important to create an ecosystem that will support JP startups over the long term



Source: [Nikkei](#)

Today: Government to move forward with DEMO reactor, "fusion power generation" to be specified in national strategy.

- Acknowledgement of the need to fund startups (all 3 mentioned)

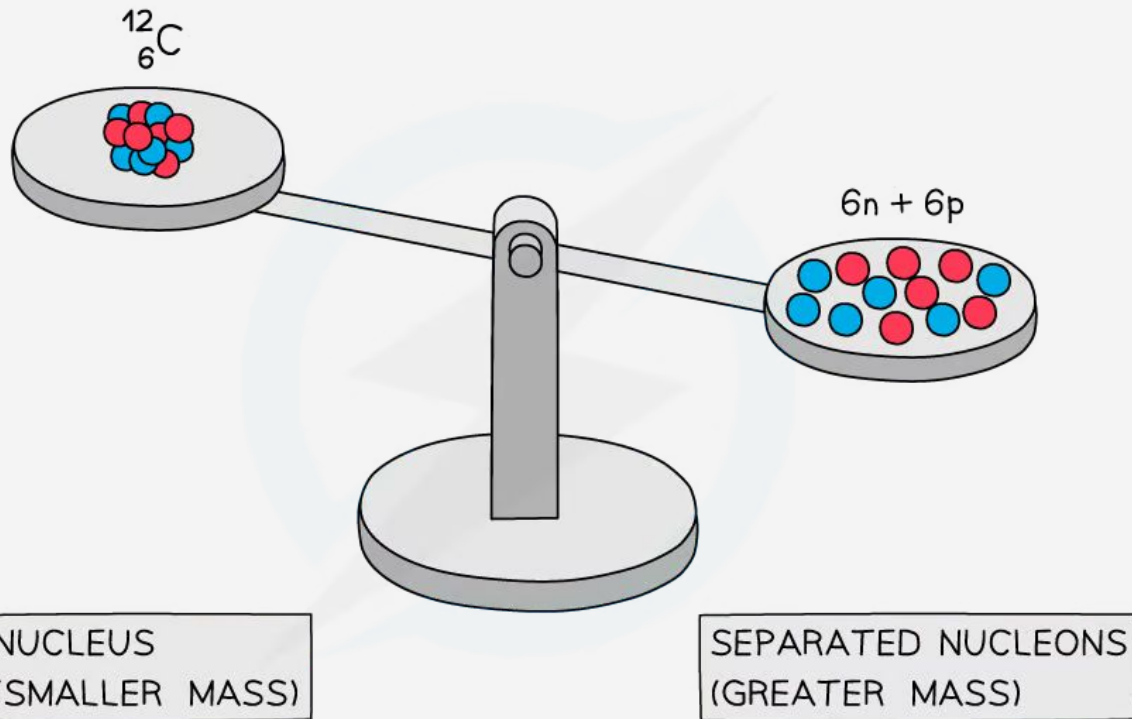
Source: [Nikkan](#)

- We are supported by METI and Kyoto Prefectural grants (Thank you!)
- New opportunities by [MEXT](#) (70B JPY for space program, disaster prevention and *fusion!*)
- However up to now there were no fusion specific grants (for private organisations) we could tap into in Japan
- In the UK we are granted FIP ([Fusion Industry Programme](#)) grant, several others exist (EEF, ANR, FNEF)
- In the US several possibilities exist for public-private partnerships: Innovation Network for Fusion Energy (INFUSE), ARPA-E and recently Funding Opportunity Announcement for Pilot Plant development together with national labs

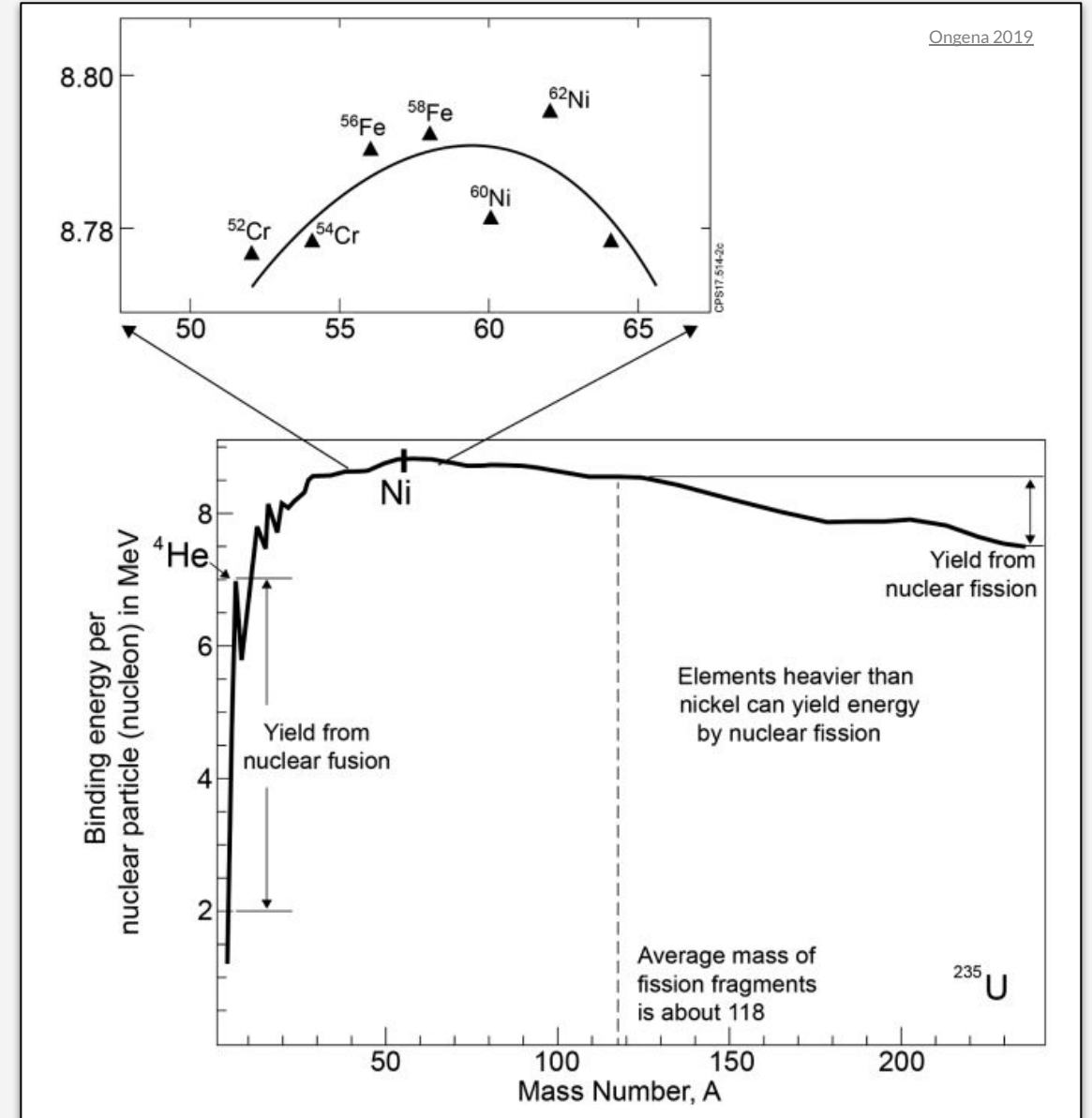


Role Model for successful public-private partnerships

Fusion energy

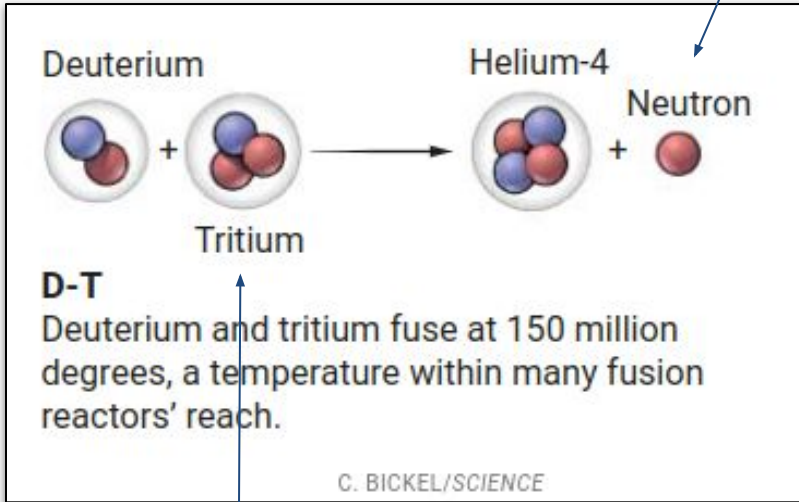


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The Fuel

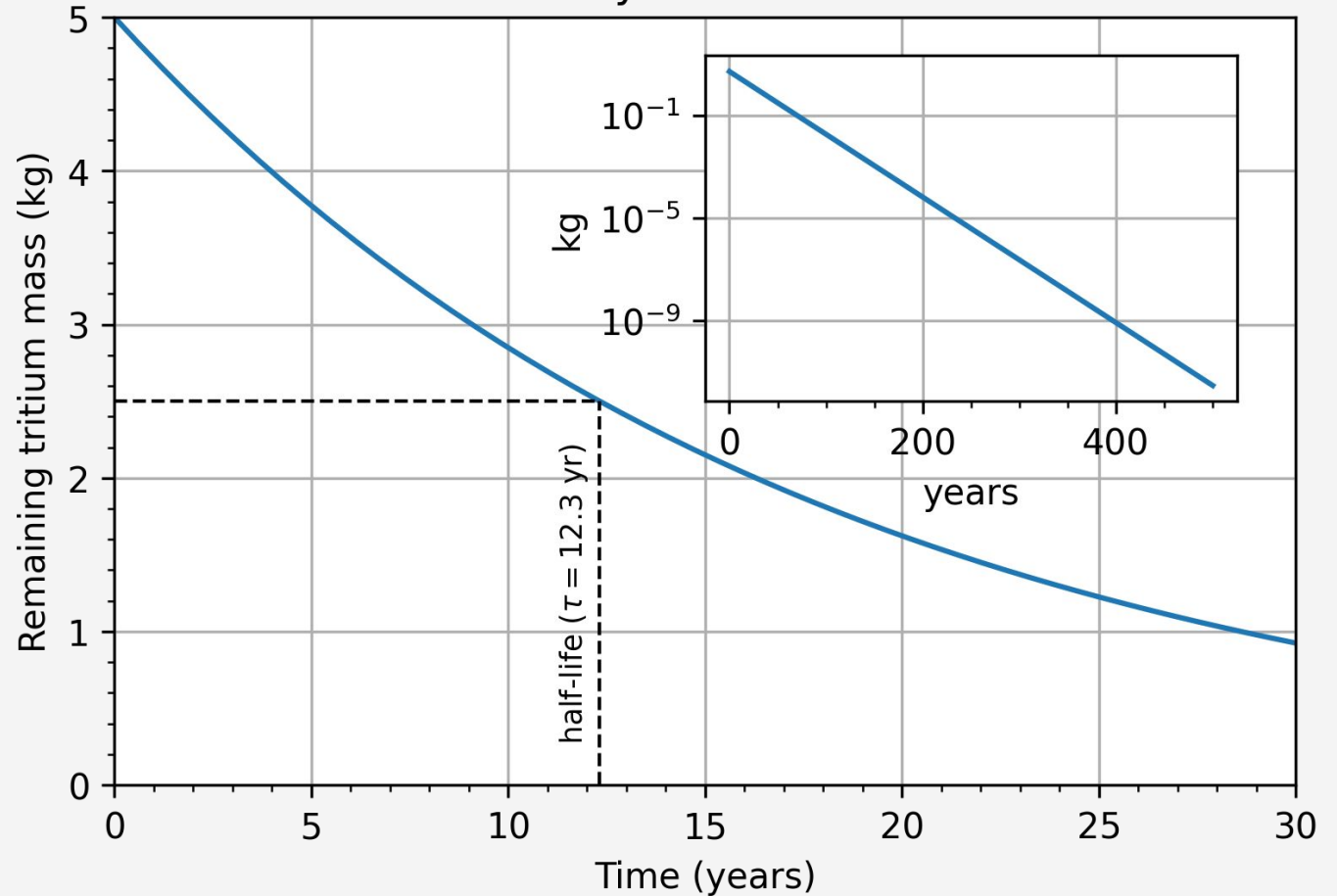
14.1 MeV



Tritium is heavy hydrogen with 2 extra neutrons



Tritium decay for a fusion reactor



Quite a radioactive material
1g = $\sim 4 \times 10^{14}$ Bq
But no penetration, stopped by a paper

LOCA scenarios “Acc1” and “Acc2”: large circles the risk framework matrix

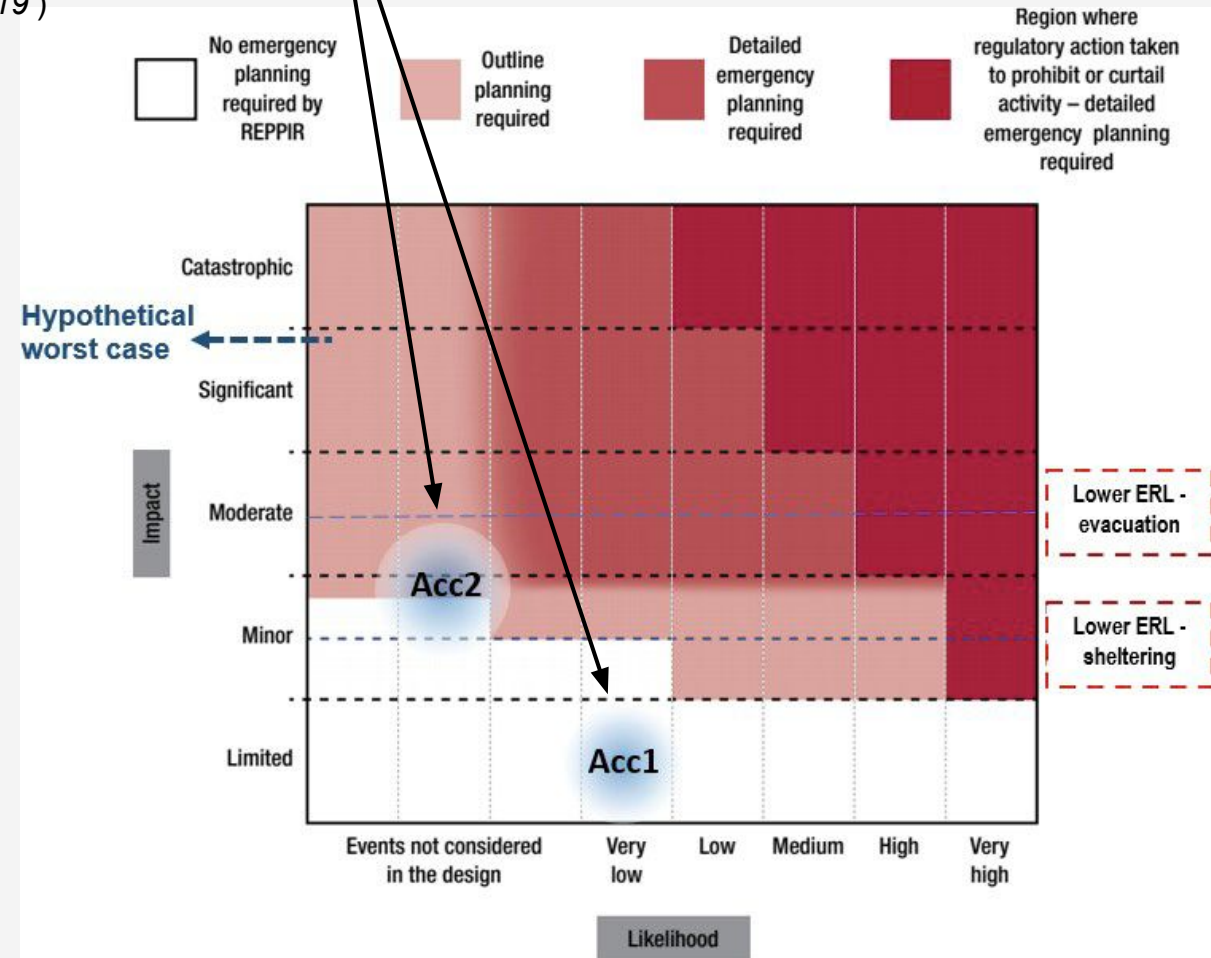
Circles represent the uncertainties that remain in the technology and recognising safety analyses contain various assumptions

(ONR, ‘The radiation (emergency preparedness and public information) regulations 2019’)

Nature of uncertainties and assumptions:

- Hydrogen generation
- Temperature transients
- Mobilisation source terms

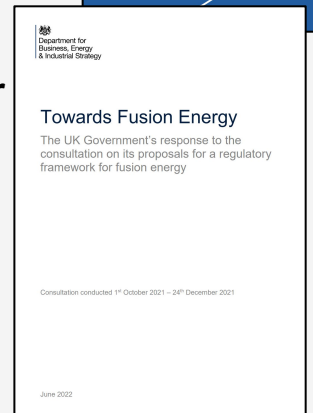
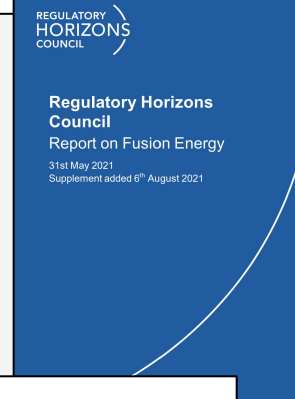
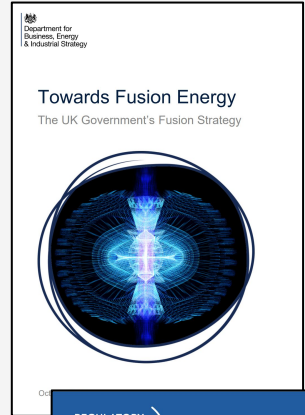
KF will present soon on this topic at the meeting of Atomic Energy Society of Japan (AESJ)



- UK has one of the most advanced strategies (for USA see Bob's presentation)
- Main question:
 - Do we regulate it as a nuclear site such as a fission reactor (10 CFR part 5X) or a lightly controlled area such as materials licensing (10 CFR part 30)?
 - Several more detailed discussions about material codes and standards
- Current decisions
 - UK's DEMO plant STEP will likely not be regulated as nuclear fission site (next slide)
 - Commissioner from the US NRC has [voted in favour](#) of using 10 CFR part 30
 - Japan does not yet have a clear strategy
- KF is advising J-DEMO taskforce led by QST
- KF is part of ASME special group for fusion materials

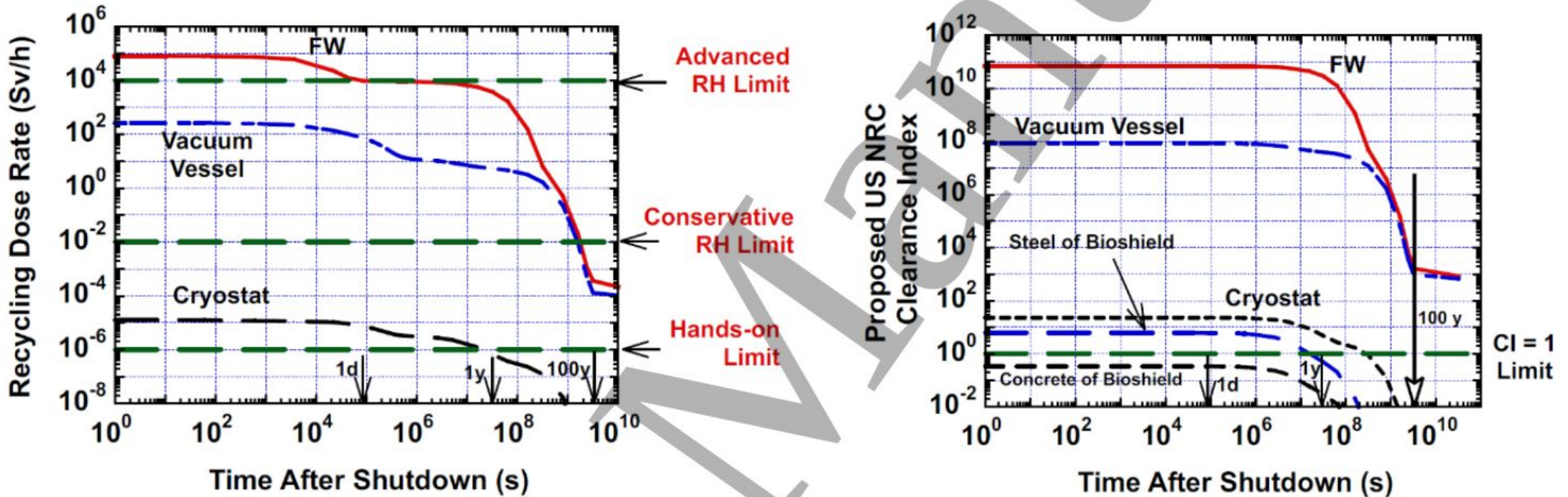
The UK Government's Approach

- 1. Towards Fusion Energy: The UK Government's Fusion Strategy (Oct 2021)**
 - *"Proportionate and effective regulation is a key 'enabler' of the UK's Fusion Strategy."*
 - *"...the regulatory framework for fusion needs to enable the safe and rapid deployment of fusion energy power plants, promoting innovation while maintaining human and environmental protections at all times."*
- 2. Regulatory Horizons Council: Report on Fusion Energy (Aug 2021)**
 - Considered the following options:
 - A – Evolution and continuation of current regulatory approach with HSE regulating safety and EA environment
 - B – Adaptation to ONR regulating safety and EA environment
 - C – A new fusion-specific regulatory approach by a new regulator
 - *"The RHC recommends that the UK champions the way for a non-fission approach, by setting out and consulting on a bold, forward-looking vision of how HSE and EA could lead and evolve the regulatory approach for STEP."*
- 3. Towards Fusion Energy: The UK Government's response to the consultation on its proposals for a regulatory framework for fusion energy (Jun 2022)**
 - *"...future fusion energy facilities will be regulated under the legal framework already in place for fusion."*
 - *"While the hazard and complexity of fusion energy facilities will be greater than current research facilities, we remain confident that existing regulations in the UK will be able to uphold safety standards in a proportionate way."*
 - *"...the fundamental differences between nuclear fission and fusion mean that it would be disproportionate and unnecessary to incorporate fusion energy facilities into nuclear regulations."*



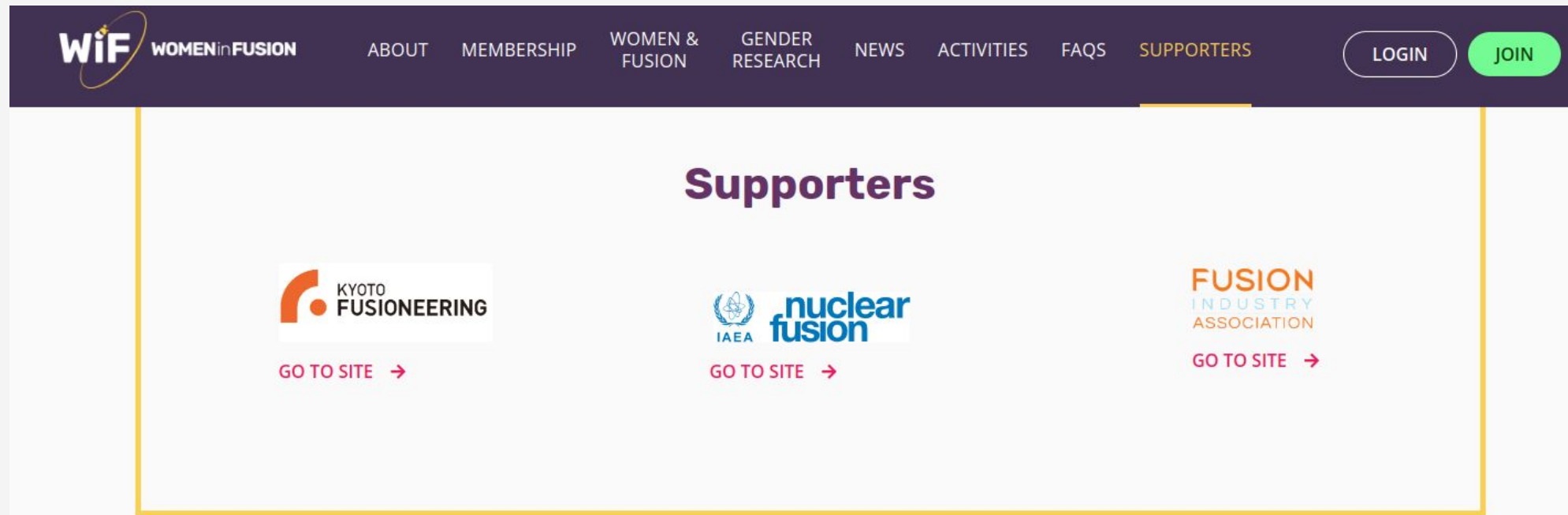
How to Regulate Nuclear Waste

- Fusion is not waste-free. At best it's HLW-free
- ITER design policy (within 100 years everything has to be classifiable as LLW)
- This policy does neither exist for private nor for current public DEMO projects!
- Fusion waste is very different from fission waste
- Large quantities of LLW



Policy related topics that we cannot discuss today

- Non-existent diversity in fusion
- Diversity, Equity, & Inclusion
- Non-proliferation



ありがとうございます

(Thank You !)

Web: www.kyotofusioneering.com

Contact: c.baus+grips@kyotofusioneering.com

Twitter: [@kyotofusioneer](https://twitter.com/kyotofusioneer)

LinkedIn: [linkedin.com/company/kyoto-fusioneering/](https://www.linkedin.com/company/kyoto-fusioneering/)