

Overview: Manufacturing and supply chain

Shutaro TAKEDA

Associate Professor

Fusion Energy Division

Urban Institute, Kyushu University



Urban Institute

Founded 2015

Urban Institute was established as a leading economic, engineering, law, and medical research institute within Kyushu University. The main focus of the Institute is to conduct empirical and theoretical research on complex urban and sustainable development challenges in order to provide effective policy recommendations.

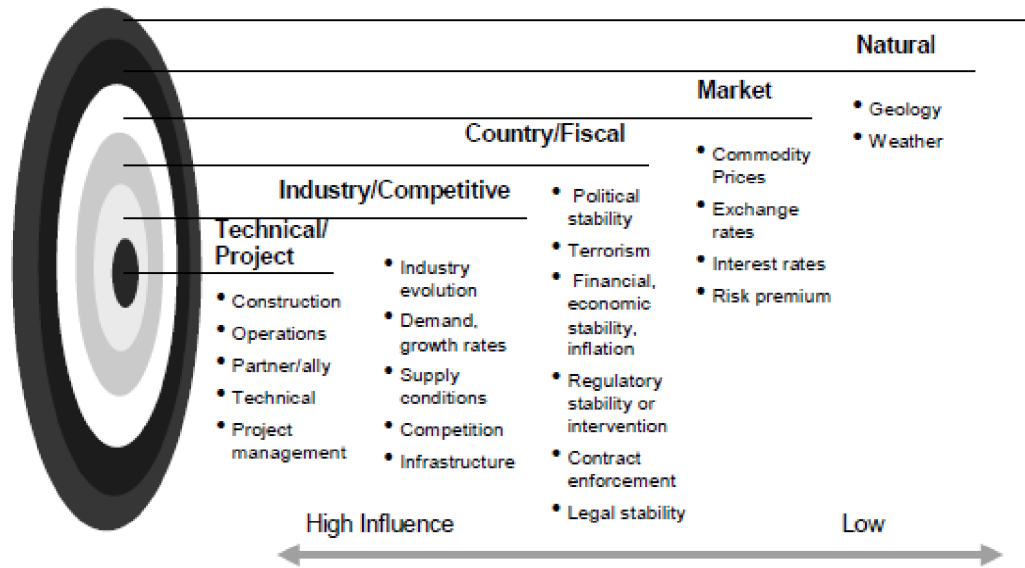


Founded 1903

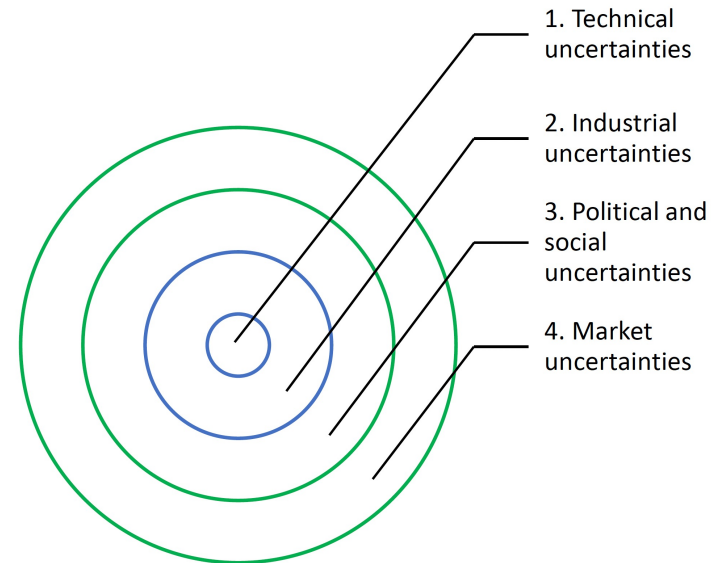


In 2022, Urban Institute launched its latest division – **Fusion Energy Division**, exemplifying the momentum toward the commercialization of fusion energy in Japan.

- Layered framework (De Weck, Eckert, & Clarkson, 2007; Marechal, 2019) would prove useful in identifying the uncertainties for fusion.



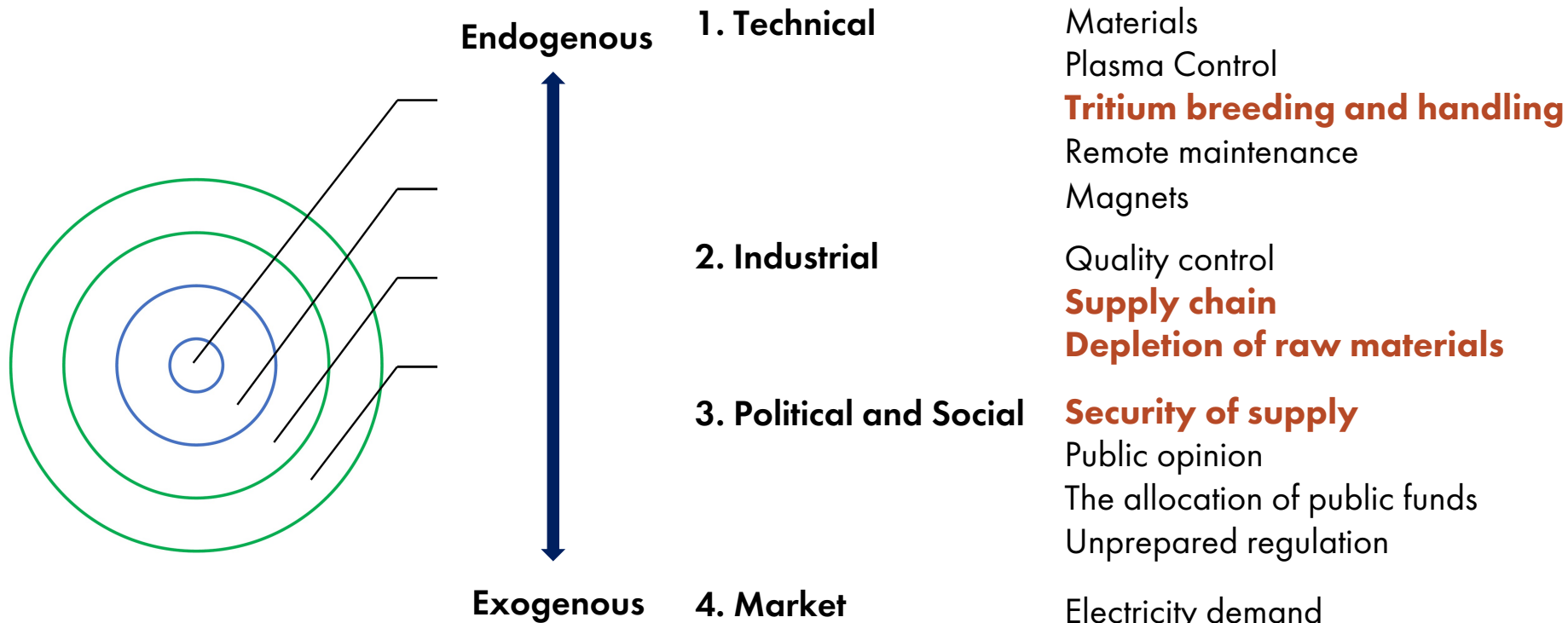
(De Weck, Eckert, & Clarkson, 2007)



(Marechal, 2019)



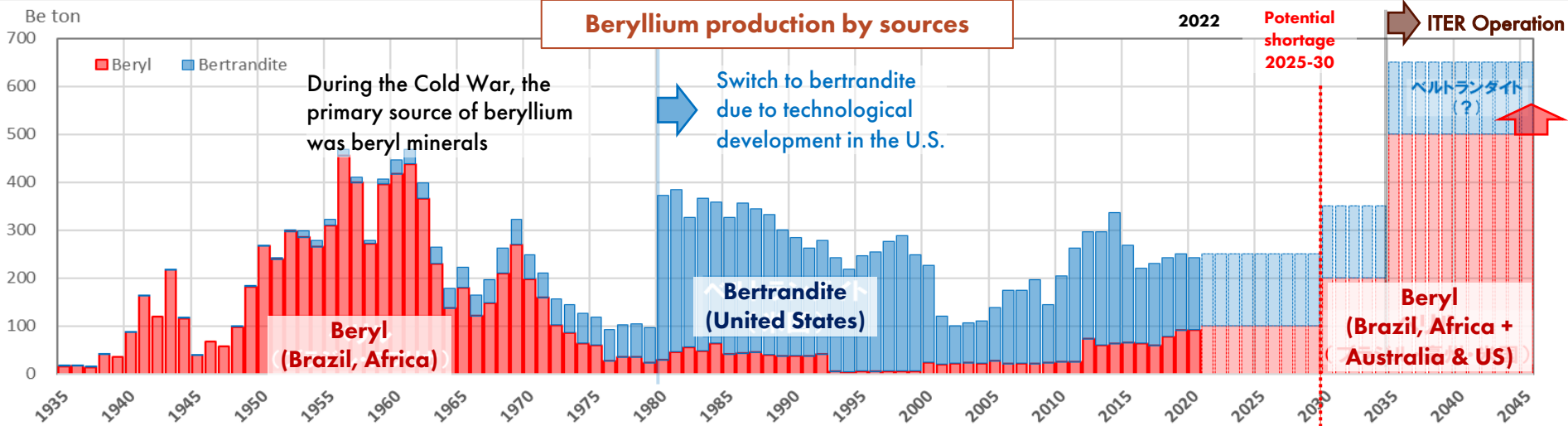
Major Uncertainties for fusion (modified from Marechal, 2019)



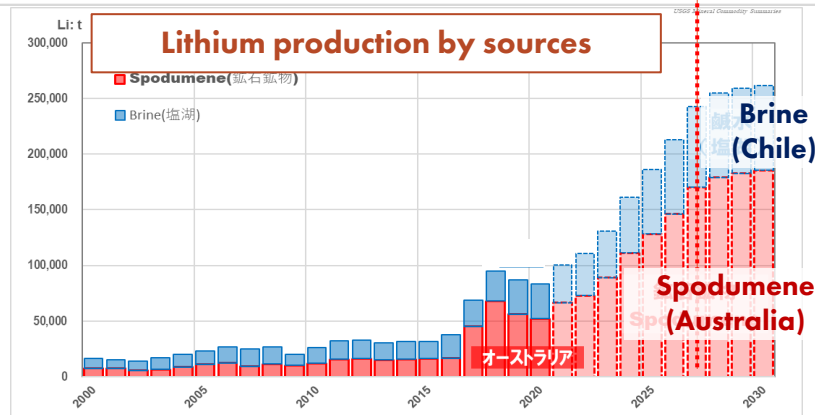
Manufacturing and supply chain are major uncertainty for fusion commercialization on Technical, Industrial, and Socio-political layers



Case in point: Beryllium and Lithium (Fuji, 2022)



- Beryllium and Lithium have been strategic materials for decades.
 - This clearly demonstrates that the supply chain is technical, industrial, and political matter.
 - With the increased geo-political instability, increased demand for electric vehicles (Li) and ITER (Be), **supply chain could be an Achilles' heel for fusion.**





- Bestwick, Riley, & Moscrop (2000) identified that:

More than 75% of...

- production and reserves of niobium is located in **Brazil**;
- the total helium and beryllium is supplied from **the US**;
- the total tungsten is produced in **China**;
- lithium reserves is found in **Bolivia and Chile**;
- chromium reserves is found in **South Africa and Zimbabwe**.

Magnets

Cooling, Multiplication

Divertor

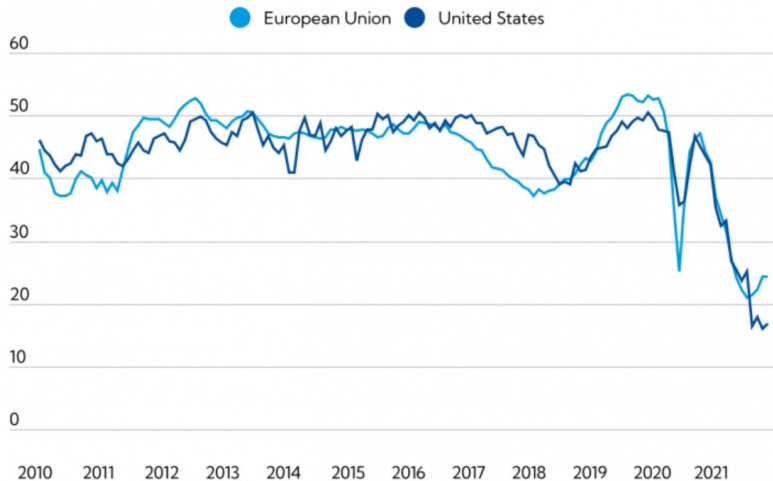
Fuel, Breeding

Structural material

**Fusion may be free from geopolitics in terms of fuel,
but not so in terms of supply chain of materials.**

Backlogs and bottlenecks: supply chain turmoil

Suppliers' delivery times in the US and EU have slowed considerably – a lower index reflects longer delivery times. (Manufacturing PMI, suppliers' delivery times)

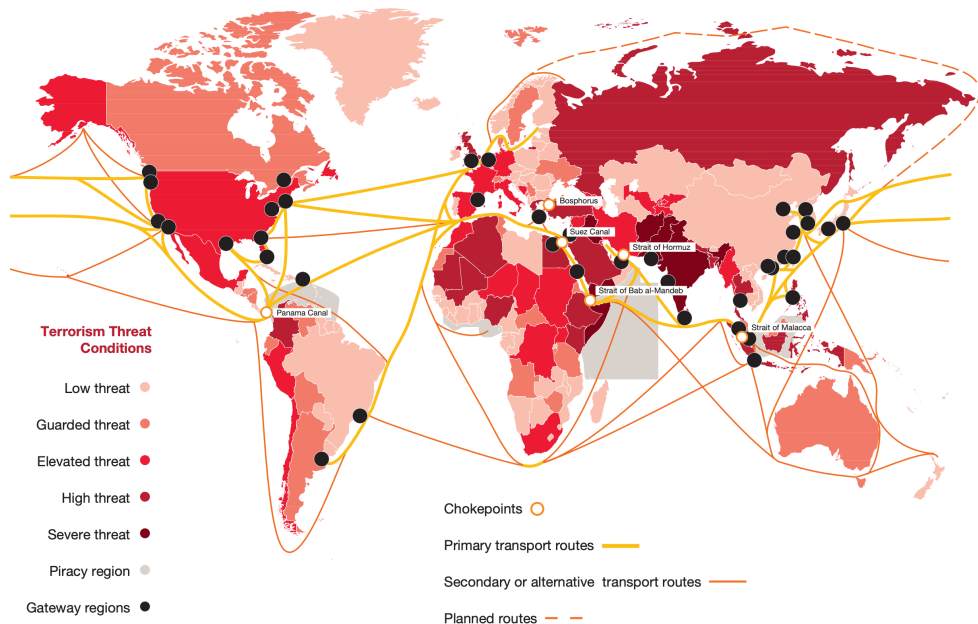


Sources: IHS Markit.
 Note: PMI=Purchasing Managers' Index. Readings above 50 indicate faster delivery times, readings at 50 signal no change, and readings below 50 indicate slower.

IMF

- ... on top of more inherent risks of transport systems, including terrorism. (PWC, 2022)

- Recent events highlighted the vulnerability of global supply chains to geopolitical disruptions, pandemics, and worker shortages.



Key resources/materials in this presentation:

1. Tritium
2. Lithium-6
3. Beryllium
4. RAFM steels

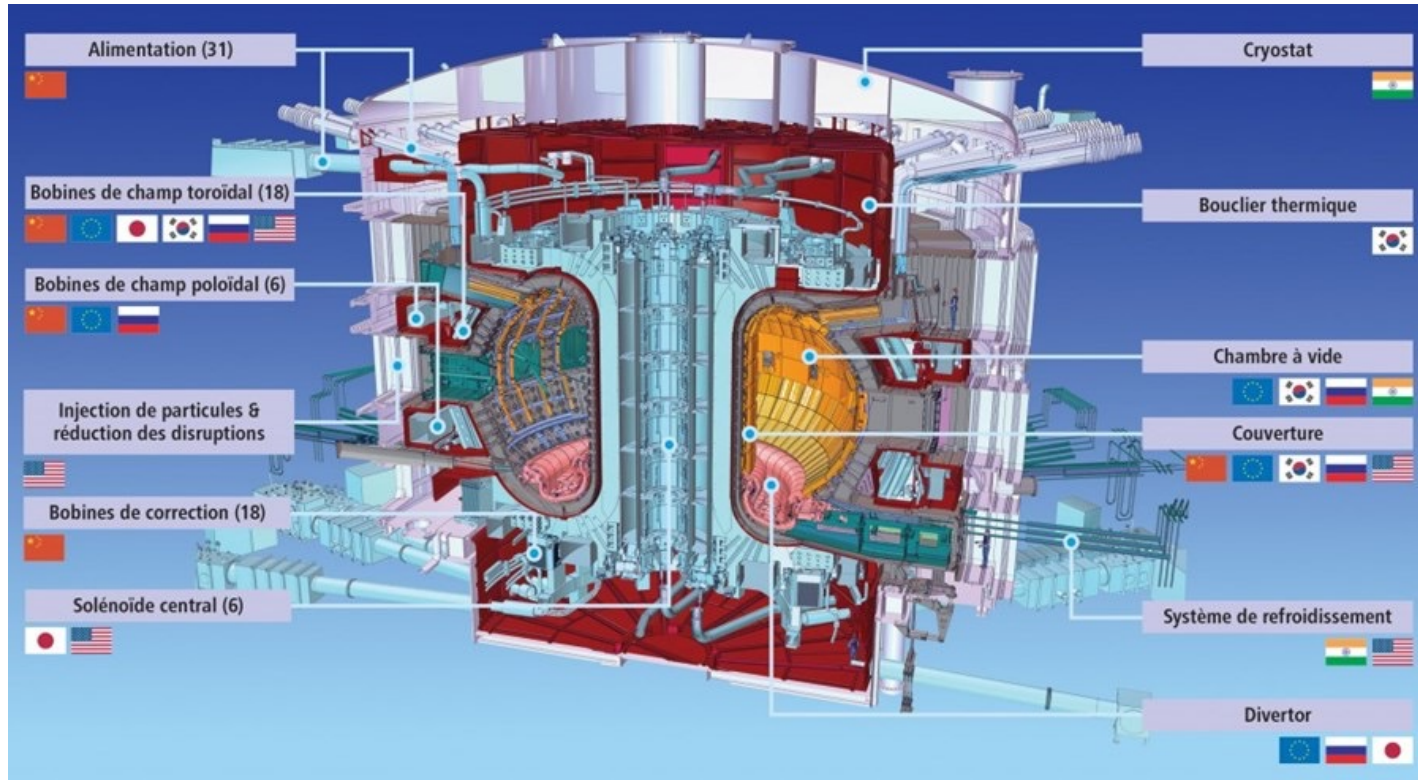
Note: availability and supply of these resources in particular

Dr. Pearson's upcoming presentation:

**ON THE AVAILABILITY, SUPPLY AND USE OF CRITICAL NATURAL
RESOURCE FOR THE REALISATION OF THE FUSION INDUSTRY**

tokamaks.
challenges.

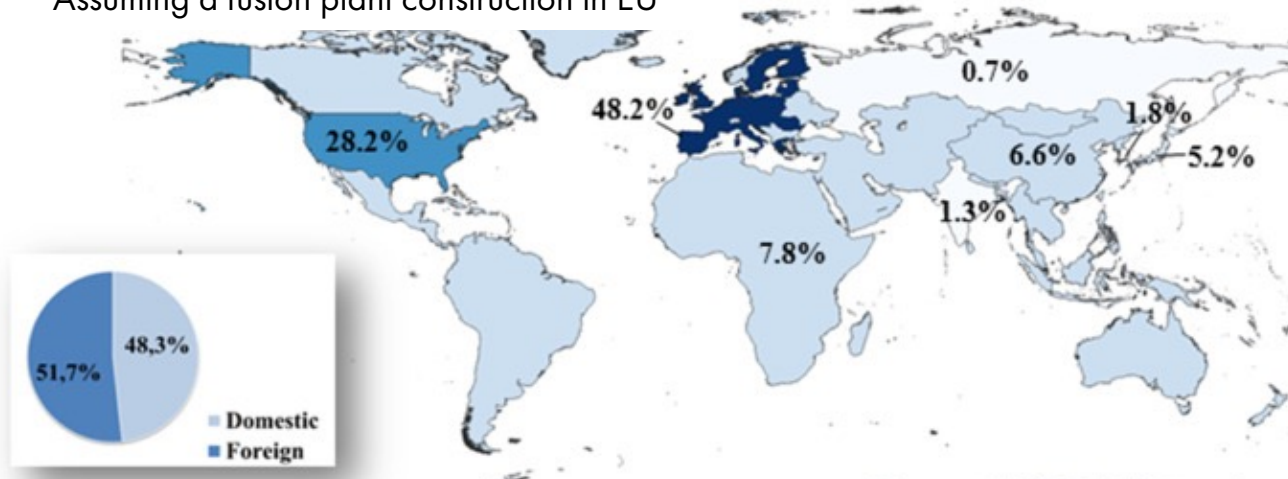
- Fusion energy rely on international supply chain for manufacturing**, more so than other energy sources.



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Distribution of Value Added ($\hat{=}$ Profit)

Assuming a fusion plant construction in EU



A 2020 study estimated that majority of economic effect of a fusion power plant construction will take place overseas.

(Banacloche et al., 2020)

Buiding a robust supply chain by diversifying the manufacturing capability is critical for fusion.

Fusion may be free from geopolitics in terms of fuel, but not so in terms of manufacturing.

**Dr. Hu Jiansheng's upcoming presentation:
RESEARCH PROGRESS AND CHALLENGES FOR CFETR FUSION REATOR**

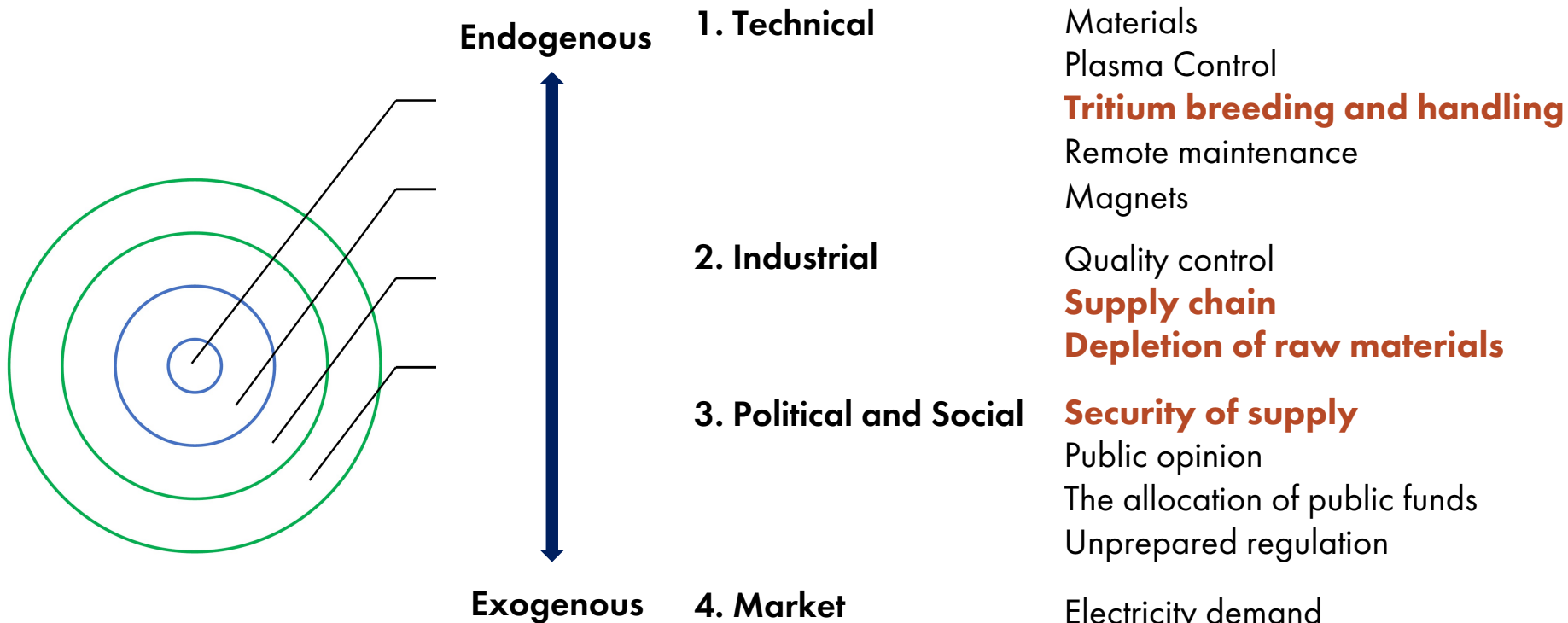
aborations

**Fusion + Fission field
Inst. + University**





Major Uncertainties for fusion (modified from Marechal, 2019)



Manufacturing and supply chain are major uncertainty for fusion commercialization on Technical, Industrial, and Socio-political layers



- Manufacturing and supply chain are major uncertainty for fusion commercialization on technical, industrial, and political layers.
- Fusion may be free from geopolitics in terms of fuel, but not so in terms of both supply chain and manufacturing.
- US White House, *Parallel Processing the Path to Commercialization of Fusion Energy* (June 3)

“These days we are all acutely aware of the vulnerability of supply chains to geopolitical disruptions, pandemics, and worker shortages.

“As fusion technology develops, we must also concurrently identify the supply chain vulnerabilities and bottlenecks, build a resilient fusion supply chain, build a robust U.S. fusion manufacturing base, and build international partnerships to diversify production of critical materials and components.”

- **Building a robust global supply chain by diversifying the manufacturing capability is critical for fusion.**



- In this session, we will hear from two experts:
 - Dr. Hu Jiansheng (ASIPP), *RESEARCH PROGRESS AND CHALLENGES FOR CFETR FUSION REATOR*
 - Dr. Pearson (Kyoto Fusioneering), *ON THE AVAILABLITY, SUPPLY AND USE OF CRITICAL NATURAL RESOURCE FOR THE REALISATION OF THE FUSION INDUSTRY*