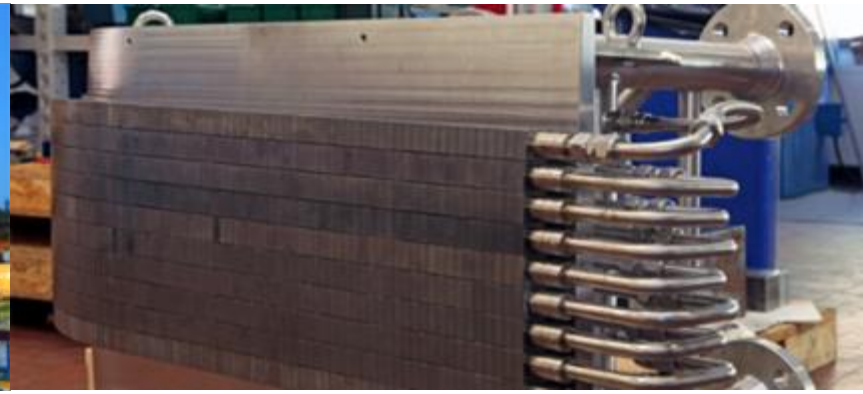
SMR DEPLOYMENT THROUGH EUROPE: WHICH CHALLENGES FOR THE SUPPLY CHAIN?





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WHAT'S NEW WITH SMRs?

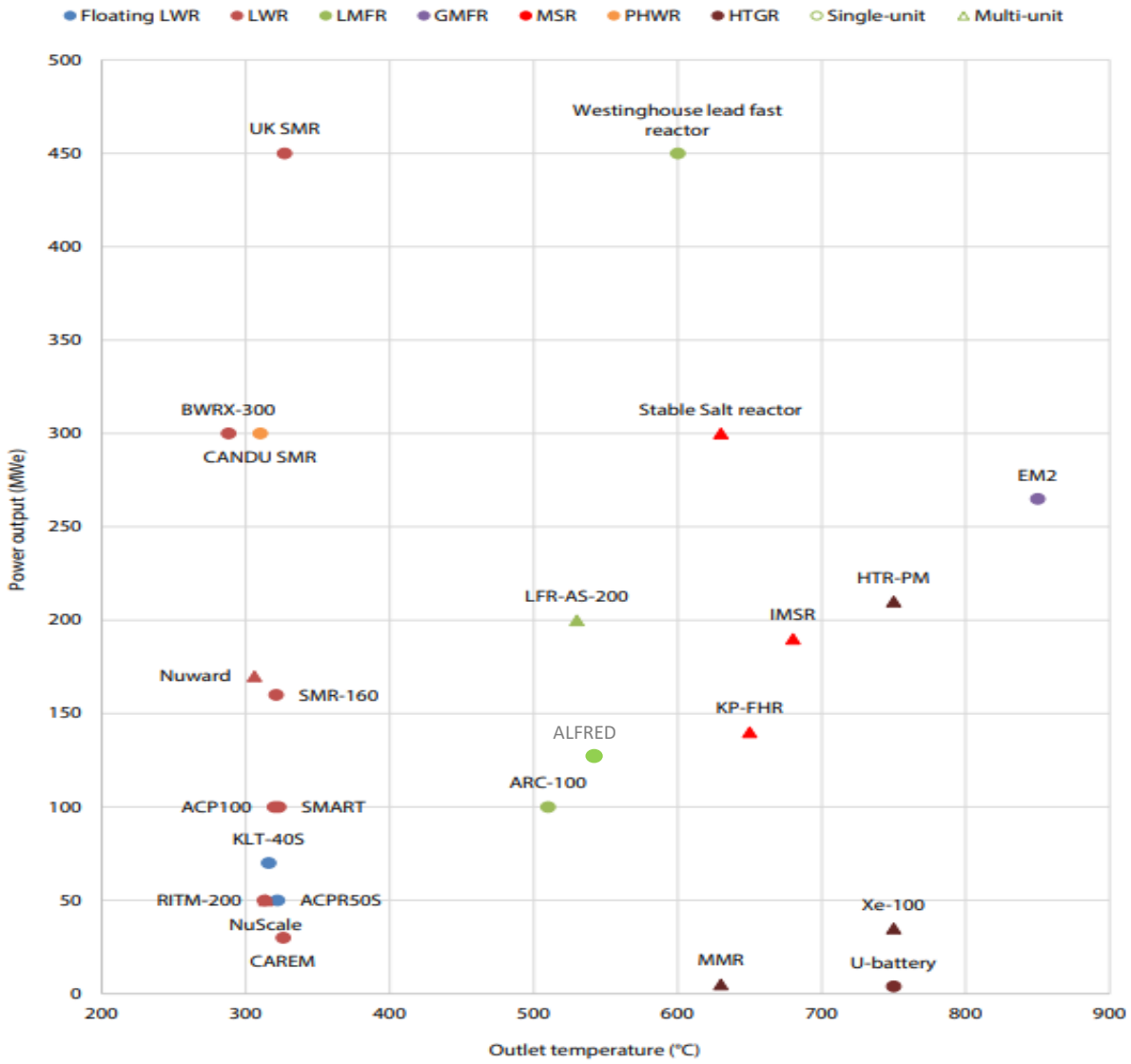
- IAEA is currently listing more than 70 SMR
- The common characteristic among all of them is *neither the technology* (GENIII and GEN IV models), *nor the safety innovative features* (active and passive designs)
- *Not even the size*: «small» can vary from tens of MW to 300 (IAEA definition) and even 450MW

SMR are mostly about

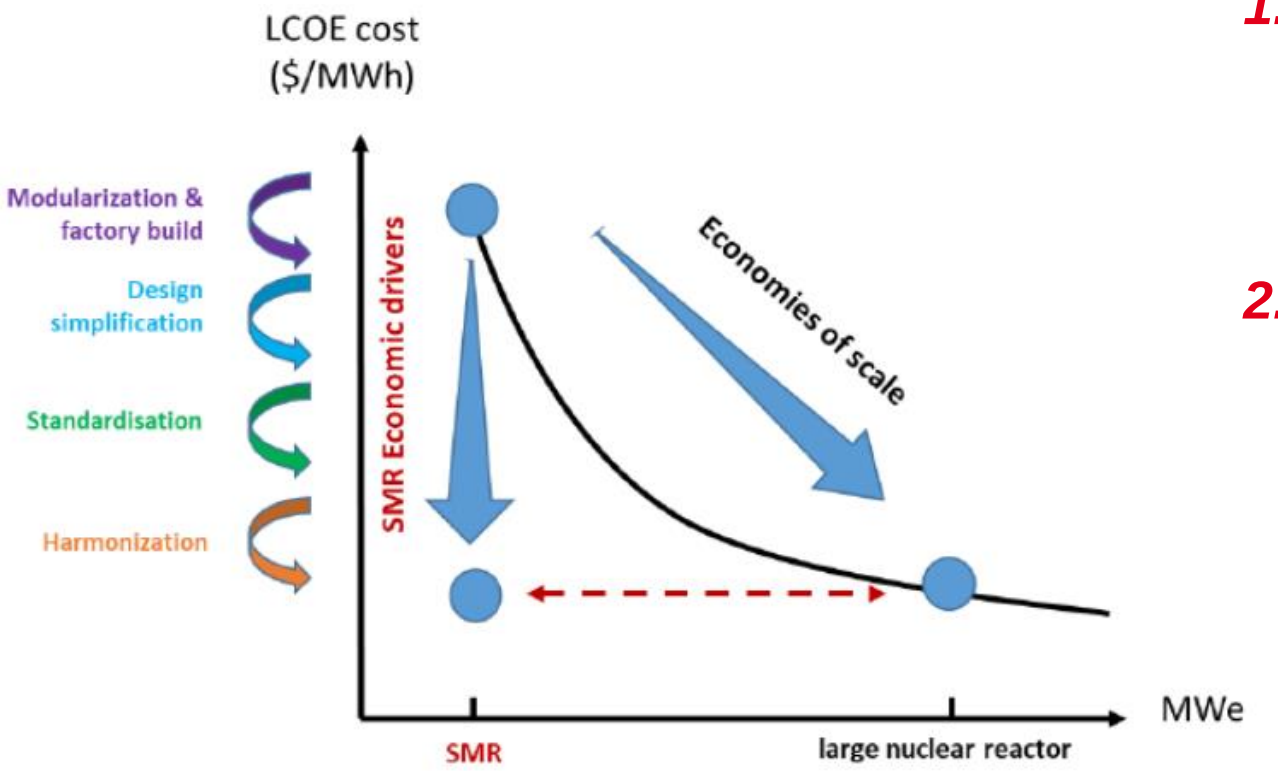
economic competitiveness

in a quite different market

- In the Energy Transition, nuclear will need to attract public &private stakeholders by means of
  - shorter time to build
  - stability of costs
  - investment size



THE SMR BUSINESS MODEL



Against the economies of scale, SMRs leverage on mainly two cost reduction mechanisms:

1. ***Reduction of construction time and risk***
   - Site construction delays generate high extracosts: factory building is less sensitive
   - IDC represent 50% and more of capital costs
2. ***Learning curve effects***
   - The smaller size allows to reach NOAK costs at a lower overall installed power (and with a lower initial investment)
   - Stabilization of the costs is instrumental to reduce the perceived financial risk and then the financial burden
   - Quicker amortization of manufacturing investments would facilitate new suppliers to embark in the nuclear sector

REDUCTION OF CONSTRUCTION TIME AND RISK

Some drawbacks for the Supply Chain

- **Modularization** is the most common approach followed by SMR proponents to limit site activities
- The extent could be quite different:
  - only mechanical / structural modules as well
  - Auxiliaries and BOP / Inside Containment
- Experience in modular construction already exist in the nuclear industry (eg AP1000, Japan BWR…)
- Module design could result in further burden to certify the quality of several subsystems: standardization of modules to be considered
- Most SMR designs also aiming to integrate the NSSS (eg in vessel components) and so to grant **factory fabrication** of high quality components
- The need for such compact design implies consideration of modern manufacturing processes (eg additive manufacturing, electron beam welding etc)

HOW TO ACHIEVE THE LEARNING CURVE EFFECTS

Some drawbacks for the Supply Chain

- **Standardization** is the key condition:

  in the nuclear industry even limited deviations, either in the design or in the manufacturing process, would require time and money to implement

- The extent of the standardization only partially depends from the Vendor/designer: **customers** have a relevant role to play, by defining **common requirements** and then a common market

- For the supply chain, this would mainly reflect in standardised procurement specs, including reference codes/standards which remain stable for a

  «**limited series production**»

  (vs project specific specs)

HOW TO ACHIEVE THE LEARNING CURVE EFFECTS – cont'd

Some drawbacks for the Supply Chain

- SMR can hardly afford to segment the international market: **harmonization** of nuclear requirements through the European Union would boost the learning curve effect and then make SMR *more competitive in a shorter time frame*

- This would likely implies need for **reconciliation of different codes/standars** currently used in various European countries

- For the supply chain, this would reflect in wider geographical markets to be served, and in **increased flexibility** built in their products (for easier reconciliation)

TYPICAL SMR CHALLENGES TO THE SUPPLY CHAIN

- Serving a Power Demand through SMR (vs large size nuclear units) will result in a **larger number of components** to be manufactured (likely smaller, not necessarily simpler): a more robust supply chain should then be envisaged, possibly looking to new players coming from other industry sectors

- Reduction in construction time on one side, standardisation on the other side will result in transforming the supplier's organization from project oriented to **series production**: consideration to be given to inventory management (vs «just in time»)

- However, to achieve standardisation, national supply chains should properly adapt to an **harmonised european market**, mainly in terms of flexibility built in their products

- Special attention should be given to the **fuel supply chain**, mainly for advanced

THE EU PRE-PARTNERSHIP : SUPPLY CHAIN ADAPTATION

Workstream #4

The objectives:

1. Identify specific needs for SMR manufacturing
2. Identify supply chains in Europe and their adequacy to the needs
3. Standardisation: how, and how far, to promote it
4. Modularity, Quality insurance & Reliability: possible synergies with other industrial sectors
5. How to maximise new tools and methods in SMR manufacturing
6. Possible use of non-nuclear,high quality components
7. Robustness of the future supply chain

VENDOR'S QUESTIONNAIRE

- A questionnaire has beeen distributed to those SMR Vendors which are actively pursuing initiatives in European countries

- The goal is to collect their vision about the supply chain criticalities to succesfully deploy their models in Europe

- Questions are related to:
  - Learning curve expected benefits
  - Innovative components in their design and adequacy of the existing supply chain
  - Need for series manufacturing (dedicated factories etc)
  - Extent of modular construction
  - Standardization

SUPPLY CHAIN OVERVIEW

- National nuclear associations associated to Foratom are requested to collect inputs from their members and provide info on three main areas:
  - **Current status** of national supply chains (company list, product range etc)
  - **Capability** to cope with SMR expected needs
    - ✓ Experience with different reactor designs
    - ✓ Experience with different codes/standards
    - ✓ Internal engineering skills
    - ✓ Foreseen upgradings of the production processes (digitalization, mew technologies)
  - **Capacity** growth potential
    - ✓ Currently available capacity not used for nuclear
    - ✓ Bottlenecks for further investment decisions related to the nuclear market
    - ✓ Bottlenecks coming from the subsupplying (eg raw materials)

CONCLUSIONS

Our contribution, as Workstream 4, to the EU PrePartnership initiative will aim to the following goals:

- Identify the key features of an SMR supply Chain (vs. current practice)
- Analyze the existing gaps and the main hurdles to overcome
- Identify which ones are largely technology-independent and define roadmaps to address them upfront
- Identify recommendations to sistematically address technology-dependent hurdles from various partnerships

Thanks for your attention