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**Assessing Different SMR plans
Deployment to Comply with Energy
Requirement of Middle-east Arid Countries
considering a Multi- purpose cogeneration Approach**

By:
Ebrahim Abedi

Introduction

- It's obvious each country must select the own roadmap on the SMR development and deployment strategy, however contributing and sharing the experiences and used procedures could be constructive.
- The roadmap must be designed and specified base on the **country needs** in the energy providing section and **challenges associated** with any SMR technology
- Here we proceed to do an evaluation about the middle-east countries potentials and common needs in energy section.(with a case study on IRAN)
- One of the common properties among middle-east countries is pretty much arid climate and the direct outcome of this is **water scarcity**.
- So it seems **cogeneration and Desalination** are key points of Deployment of SMRs in such countries.

Middle-east countries general specifications in energy related field

Hot and arid climate

- Water scarcity
- DS needs

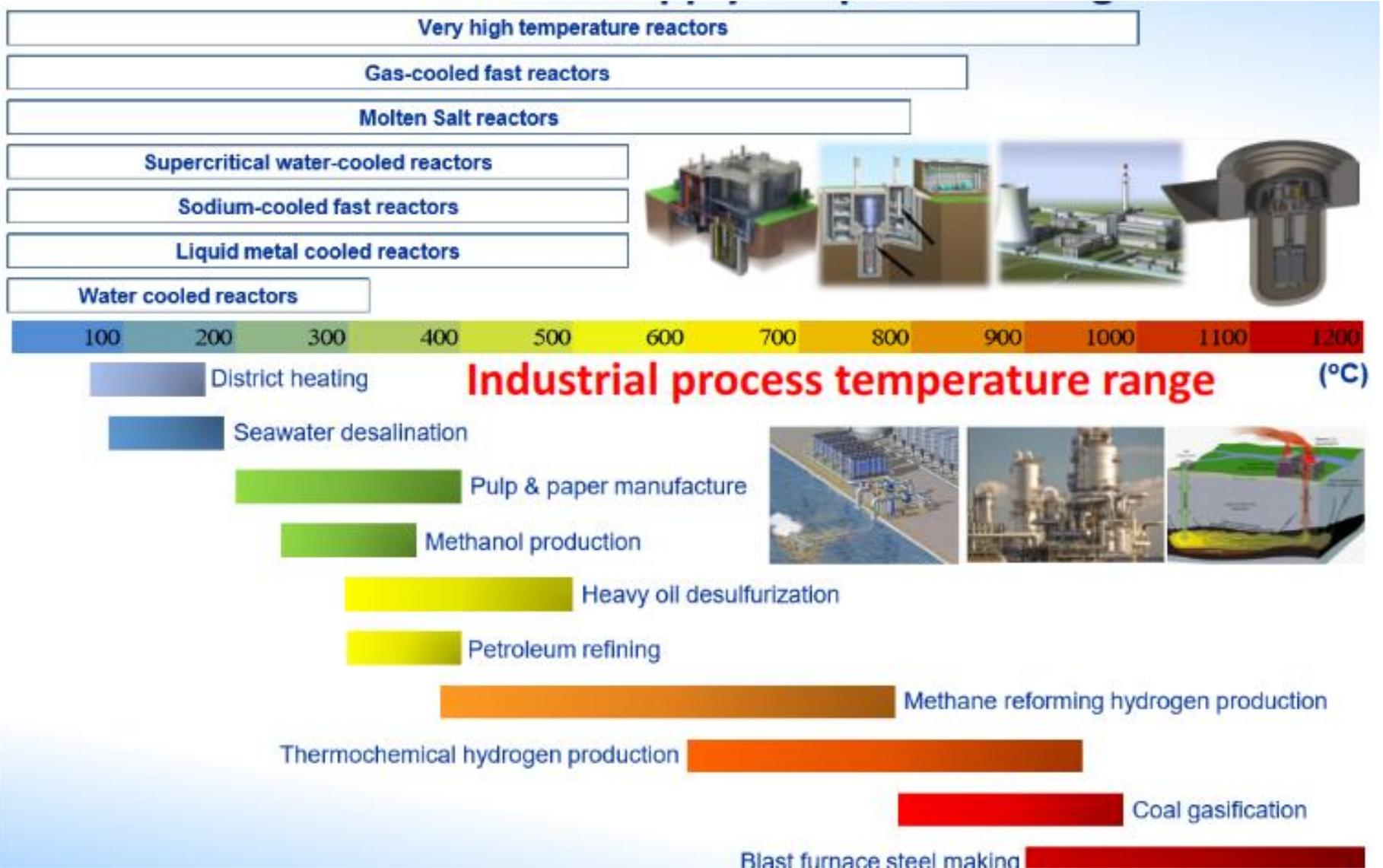
Oil & petrochemical industries owner

- Huge energy consumer

Oil & petrochemical exports

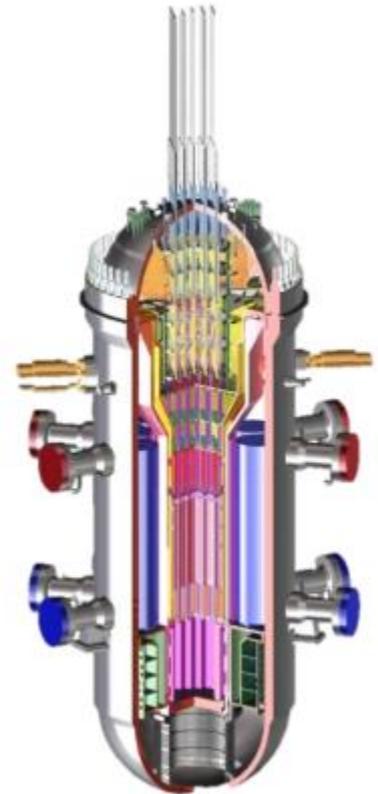
- Governmental massive Investment and finance capability

Temperature needs for various types of industrial



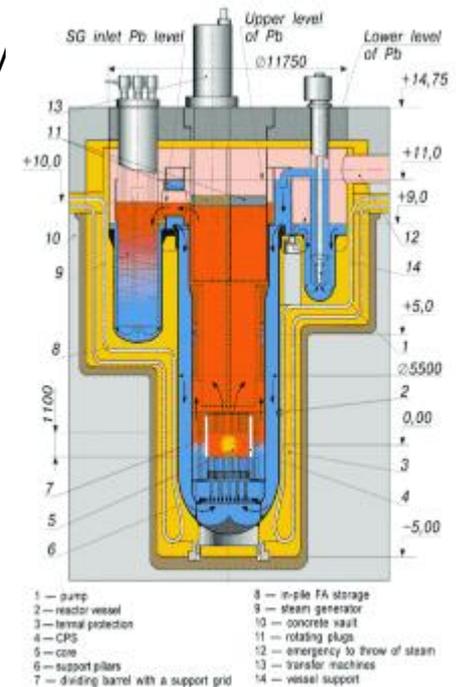
SMRs Technologies: 1-PWRs

- Conventional light water reactors Base (i.e. PWR, BWR, iPWR, ...)
- Expected Output temp. : 300-320°C
- Advantages:
 - Expected to be constructed and tested in near future
 - As it runs in the conventional reactor process conditions
Less technical and material issues.
- Disadvantages:
 - As the output temp. is the same conventional reactors it doesn't Contain new or more application than them.
Non-proven Safety features in iPWR



SMRs Technologies: 2-LMFR

- Expected output Temp. : 500-550°C
- Advantages:
 - Higher output temperatures could be exploited more application especially in process heating.
 - Using closed fuel cycle, so more fuel exploitation efficiency
- Disadvantages:
 - Technical and material issues.
 - Safety concerns.



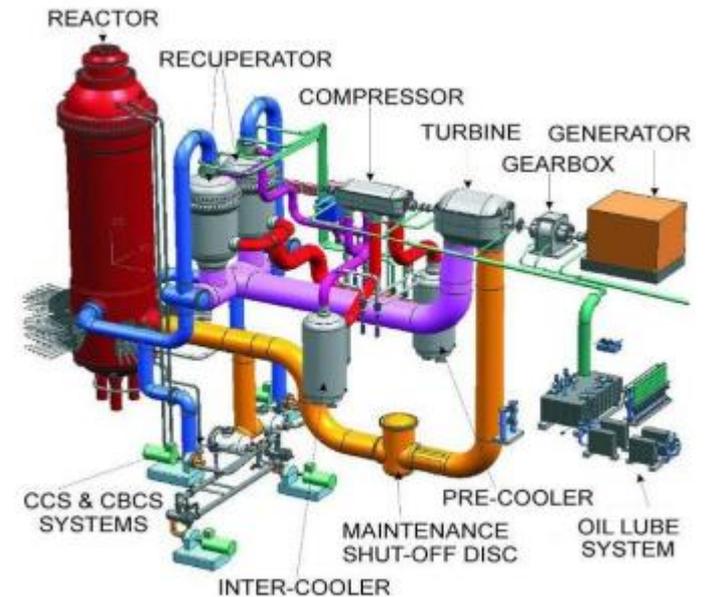
BREST-300 reactor. Vertical section

SMRs Technologies: 3-MSR

- Expected output temp. : 700-800°C
- **Advantages:**
 - Higher output temperatures could be exploited more application i.e. oil upgrading or refinery process.
- **Disadvantages:**
 - Technical and material issues.
 - Safety concerns.

SMRs Technologies: 4-HTGR

- Expected output temp. : 750-900°C
- **Advantages:**
 - The highest output temperature between all nuclear reactor technologies means it covers most expected applications certainly Hydrogen production.
 - More safe than others because of its inherent safety.
- **Disadvantages:**
 - Technical issues via high operating temperatures and also gas fluid.



SMR Applications priority Ranking (IRAN C.S.)

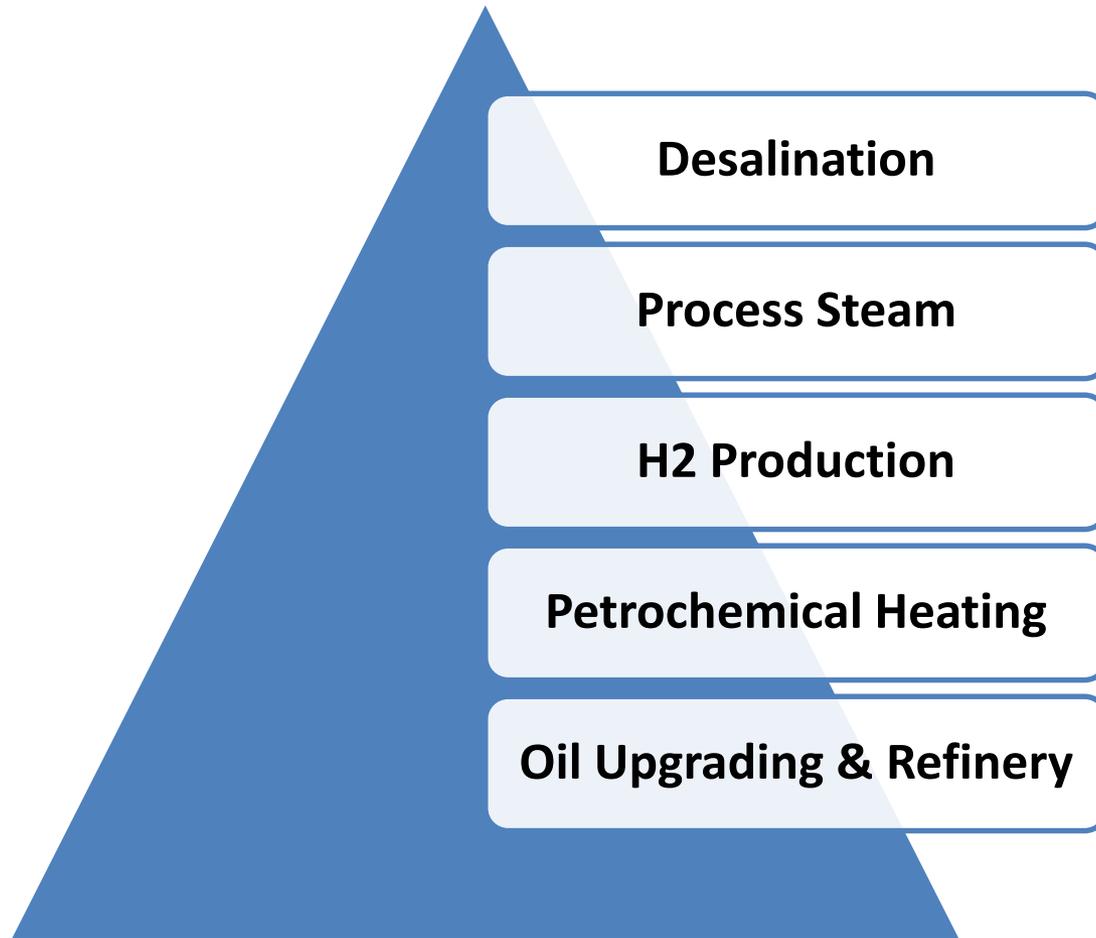


Table 1- various SMR technologies vs. weighted various applications (IRAN C.S.)

capability	weight	PWR	LMFR	MSFR	HTGR
Desalination	5	5	4.4	4.8	5
Process Steam	2.8	1.4	2.5	2.7	2.8
H2 Production	2.5	N/A	1	1	2.5
Petrochemical Heating	2	N/A	1.3	1.5	2
Oil Upgrading & Refinery	1.0	N/A	0.7	0.8	1.0
Total Point		6.4	9.9	10.8	13.3

SMR challenges Ranking

Economically Affordable

- Higher Efficiencies or lower required investment

Cogeneration Capability

- More widen Applications

Safety & Reliability

- Proven technologies
- Getting commercialize in developer countries

Carbon footprint

- Worldwide

Public Acceptance

Table 2- various SMR technologies vs. weighted various challenges and advantages (IRAN C.S.)

challenge	weight	PWR	LMFR	MSFR	HTGR
Affordability	5	2.8	3	3.7	5
Safety & Reliability	3	2.4	1.2	1.7	3
Technical issues	2.5	2.5	0.5	0.8	1.5
Carbon footprint	1.5	1.5	1.5	1.5	1.5
Public acceptance	1	1.0	0.5	0.5	0.9
Total Point		10.2	6.7	8.2	11.9

Conclusion

✓ Each country must compose and complete its own selecting technology tables base on its demands.

✓ For the **IRAN** case, our investigation shows proper **SMR technologies** are respectively:

1- HTGR

2-PWR

3-MSR

4-LMFR

✓ This rating could be completed in more detail and more SMR technologies.

Thank you