
Jordan's Path to Regulatory Readiness to Deploy SMRs: Overcoming Licensing Challenges for SMRs and Coupling with Desalination

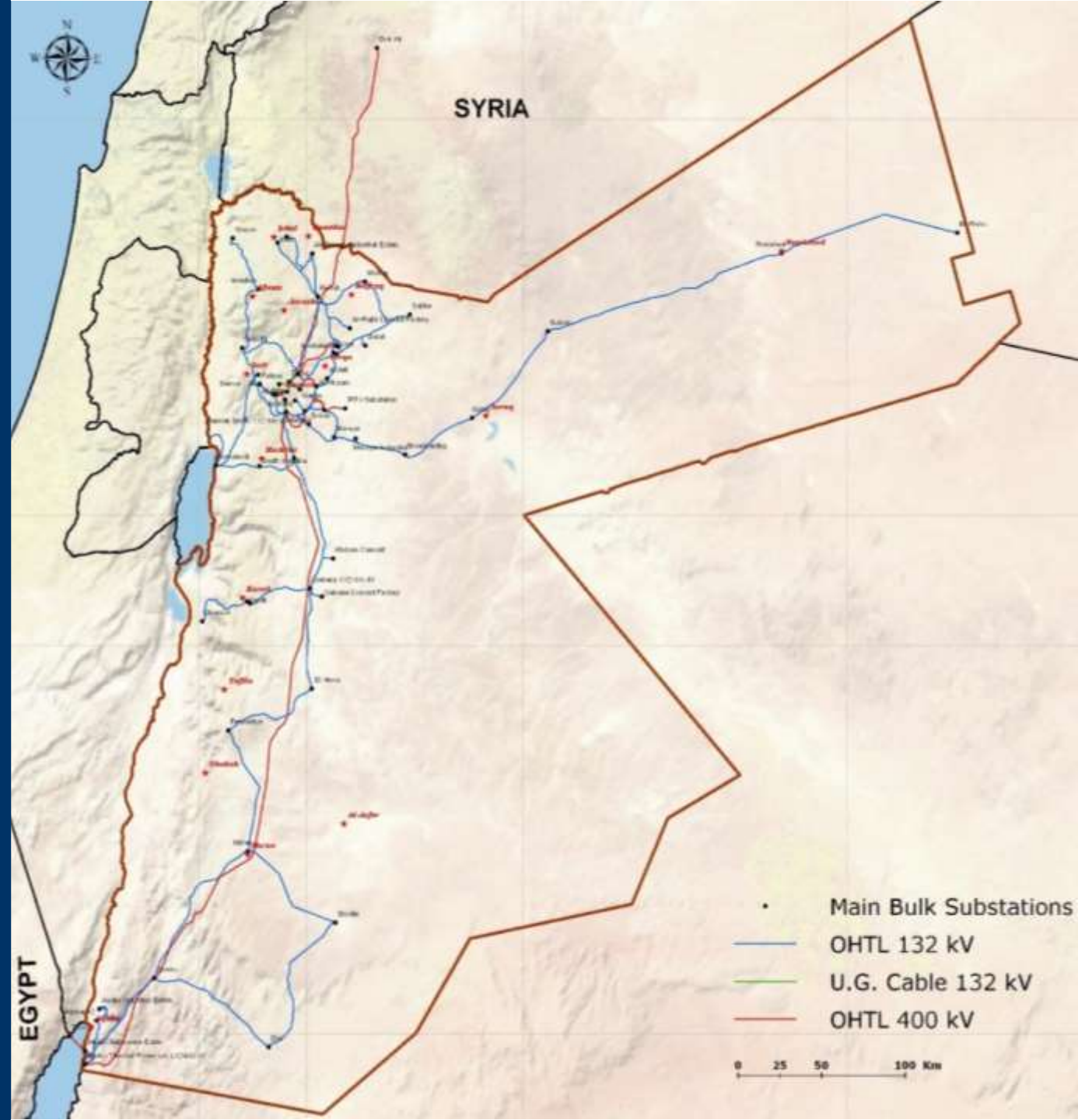
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ASEEL ABU-AL-JADAYEL
Jordan Atomic Energy Commission



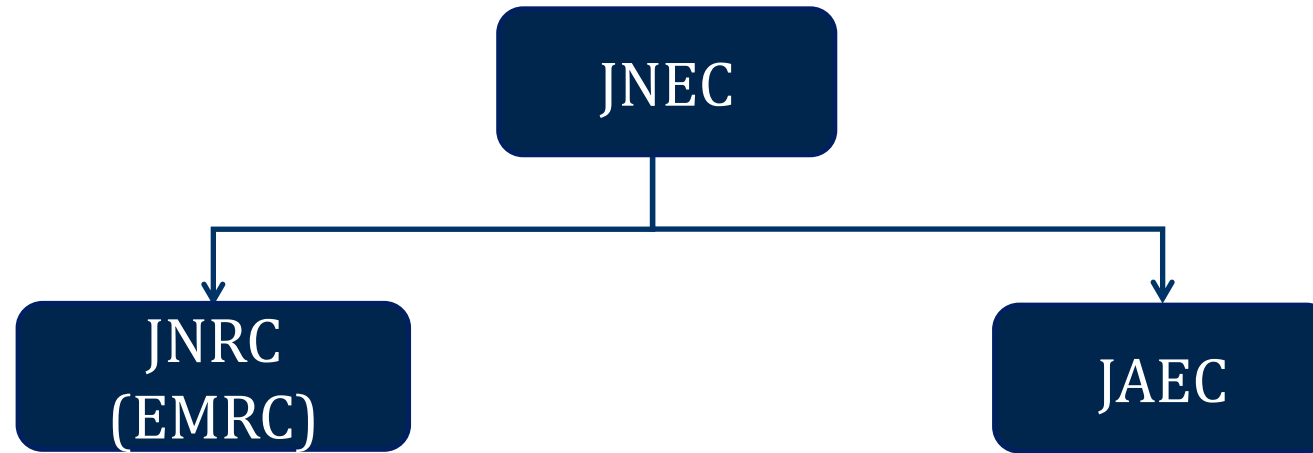
Jordan's National Context: Energy & Water

- Area: 89,342 km²
- Population: + 10.2 million.
- Electrification rate: 99.9%
- The economy is services-driven.
- Lacks of indigenous natural resources (especially oil and gas).
- Only one seaport.
- One of the lowest water availability per capita globally (~60 m³/capita/year).
- Significant supply-demand deficit.
- Solution: Large-scale seawater desalination is a national priority.



The National Nuclear Landscape: Key Institutions

- The Nuclear Law was modified in 2007 resulting in splitting the Jordan Nuclear Energy Commission (JNEC) into two independent commissions:



- The independent regulator for nuclear safety, security, and licensing.
- EMRC established in 2014, successor to the JNRC.

- Development and promotion of nuclear projects.
- Acts as the licensee.

➤ Ministry of Environment (MoEnv):

- Oversees environmental protection and approves the non-radiological part of the Environmental Impact Assessment (EIA).

➤ International Coordination:

- Ongoing collaboration with the IAEA and international partners.



Jordan's Nuclear Project

Human Resources Development

- Jordan Research and Training Reactor (JRTR)
- Nuclear Engineering Department at Jordan University of Science and Technology (JUST)
- Jordan Sub-critical Assembly
- Synchrotron-light for Experimental Science and Applications in the Middle East (SESAME)

Uranium Project

- Exploration
- Mining
- Production

Nuclear Power Plant Project

- Electricity Production
- Water Desalination



Two Parallel Paths since 2017

Large Reactor

- Currently, and due to market demand dynamics, the potential for a large reactor has been postponed. Exploring potential of large reactors and technologies post 2030.

SMR

- Continue technical & economic assessment to down-select to the most viable SMR options.
- Issue a BIS/RFP for a binding proposal from technology vendors.



Focus on SMRs

Aligned with IAG Key Recommendations (2016):

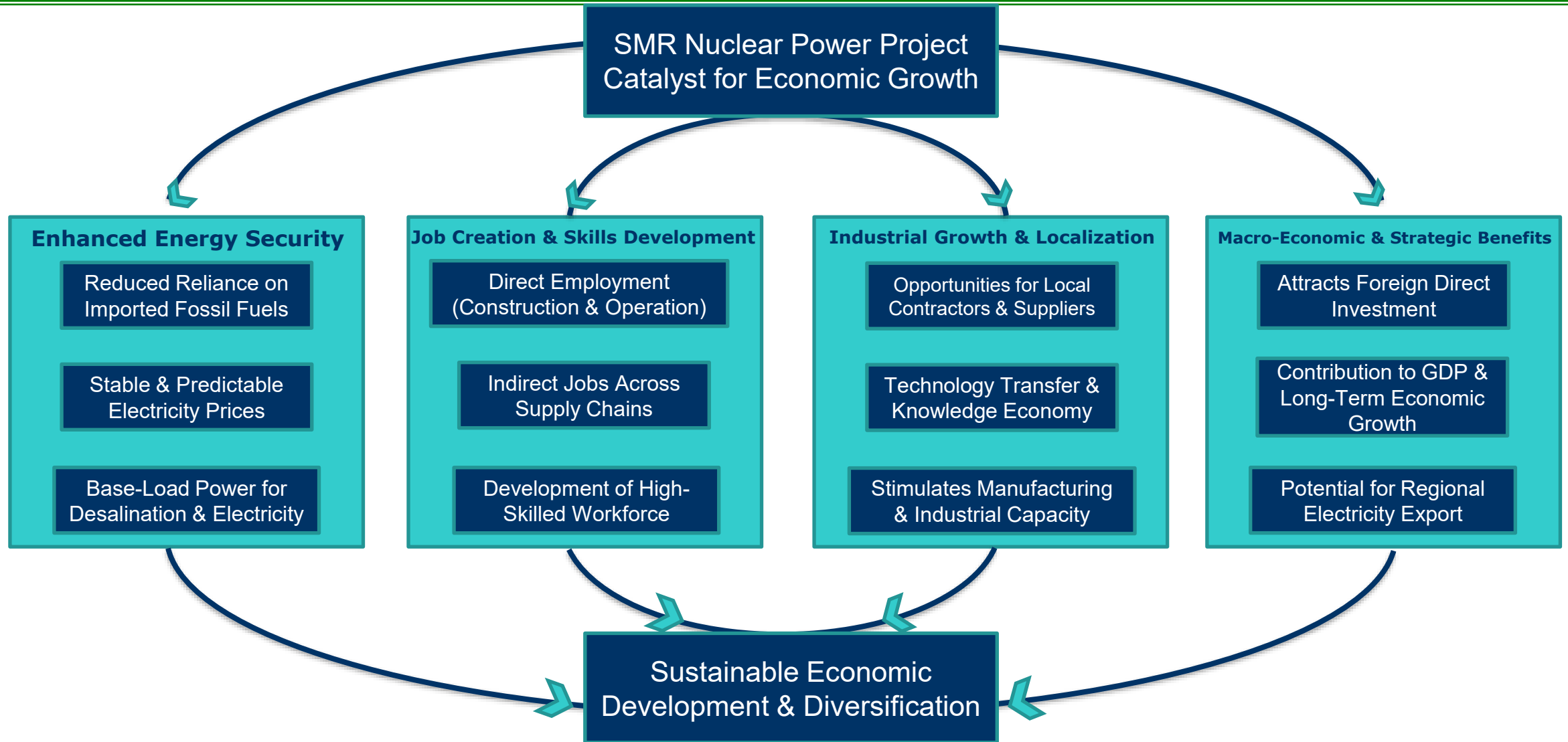
- The Integrated Advisory Group (IAG) for Jordan recommended developing a parallel track on SMRs to ensure timely and secure electricity supply consistent with national demand projections.
- SMRs offer a scalable and flexible option to meet Jordan's growing electricity needs while addressing grid limitations and water scarcity challenges associated with large-scale reactors.

Why SMRs for Jordan?

- Suitability: Lower upfront capital investment; scalability aligns with grid size.
- Applications: Potential for electricity generation and non-electric applications (e.g. desalination).
- Safety: Enhanced passive safety features.
- Global Trend: Over 80 designs under development; global deployment expected in the 2030s.
- Jordan's first NPP is now envisioned to be an SMR.



Impact of SMR and Nuclear Project on Jordan's Economy



Jordan's Nuclear Project Background

Pre 2017

- Site suitability report
- ToR for EIA
- Infrastructure studies (grid, electricity market, localization,...)
- Project structure

SMRs considered as
new direction

**BIS document
prepared**

Discussions with
potential vendors

Post 2024

- BIS release, technology assessment and selection
- Full site characterization, EIA, site permit



Consideration of Siting Possibilities and Grid Capacity



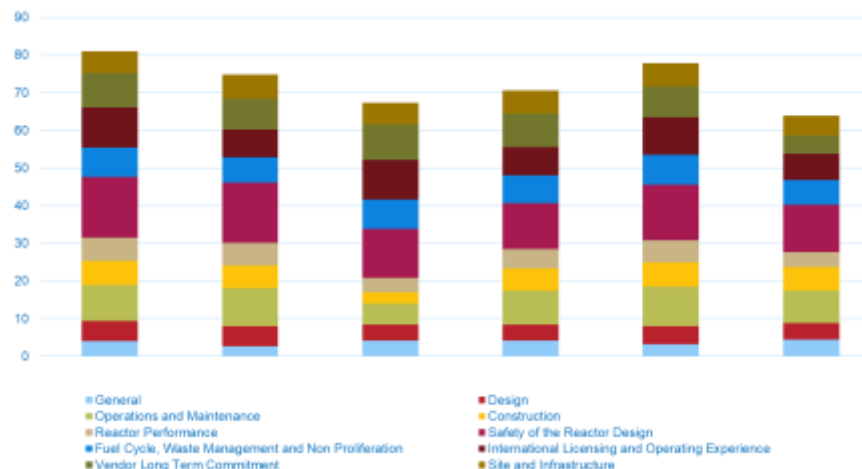
Preferred sites for the NPP

Several **viable regions** for NPP development in Jordan were identified through a Countrywide Survey (CWS), using stringent IAEA-compliant criteria.

A grid study by Tractebel Engineering (Oct 2016) assessed **Jordan's electrical system**, ensured NPP compatibility, and recommended grid adaptations and interface requirements.

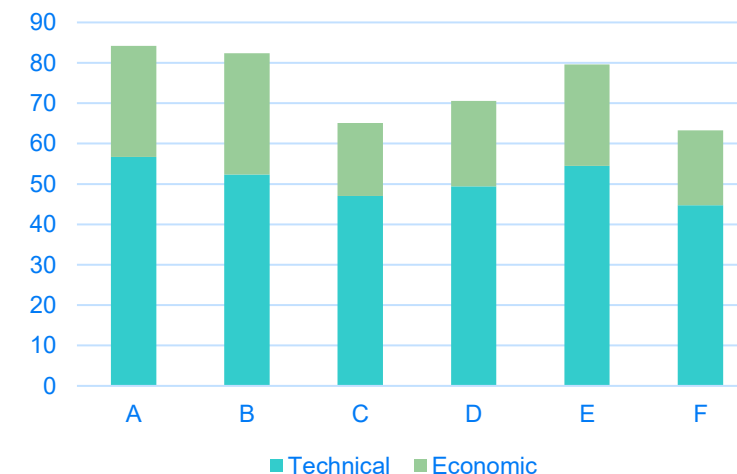
Preliminary Technology Assessment

Provides a clear, repeatable framework to align business objectives with technology choices, justify selections, and manage associated risks.

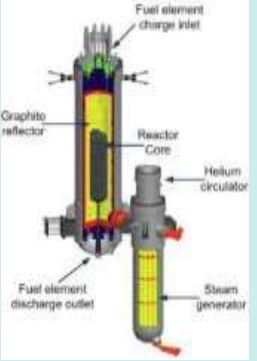


Integrated Evaluation Results of the shortlisted SMRs Technologies

Evaluation Methodology				
Evaluation Matrix (%)	81	78	75	71
Key Factors (%)	83	85	83	81
Best In Class (%)	81	80	73	66
Average (%)	82	81	77	73
Ranking	1	2	3	4
LCOE (\$/MWh)	98	107	90	128
Investment Cost (\$/kWe)	6240	9257	4500	9640

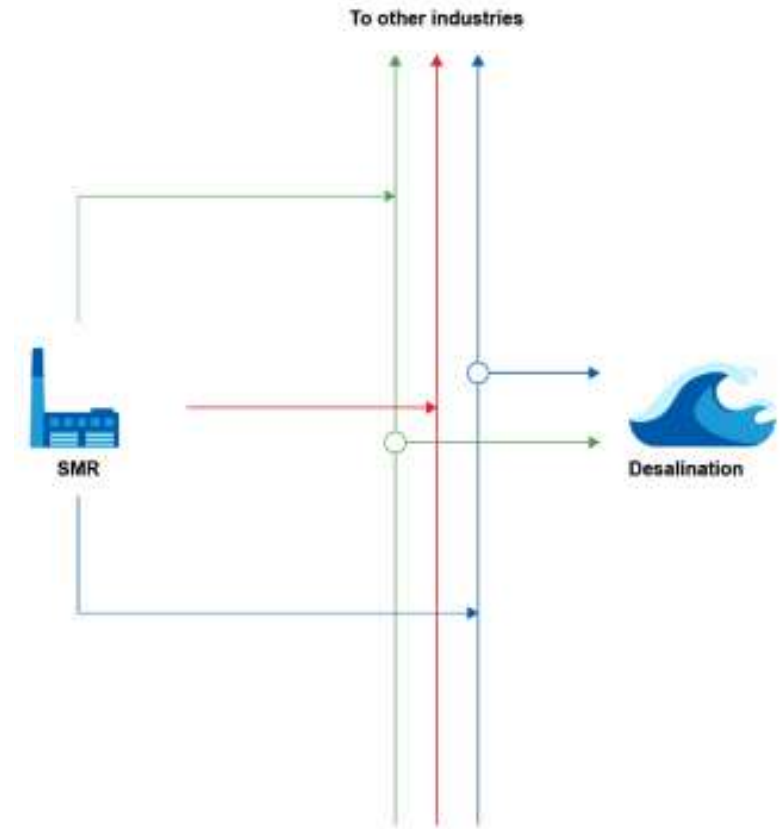


SMRs under Consideration

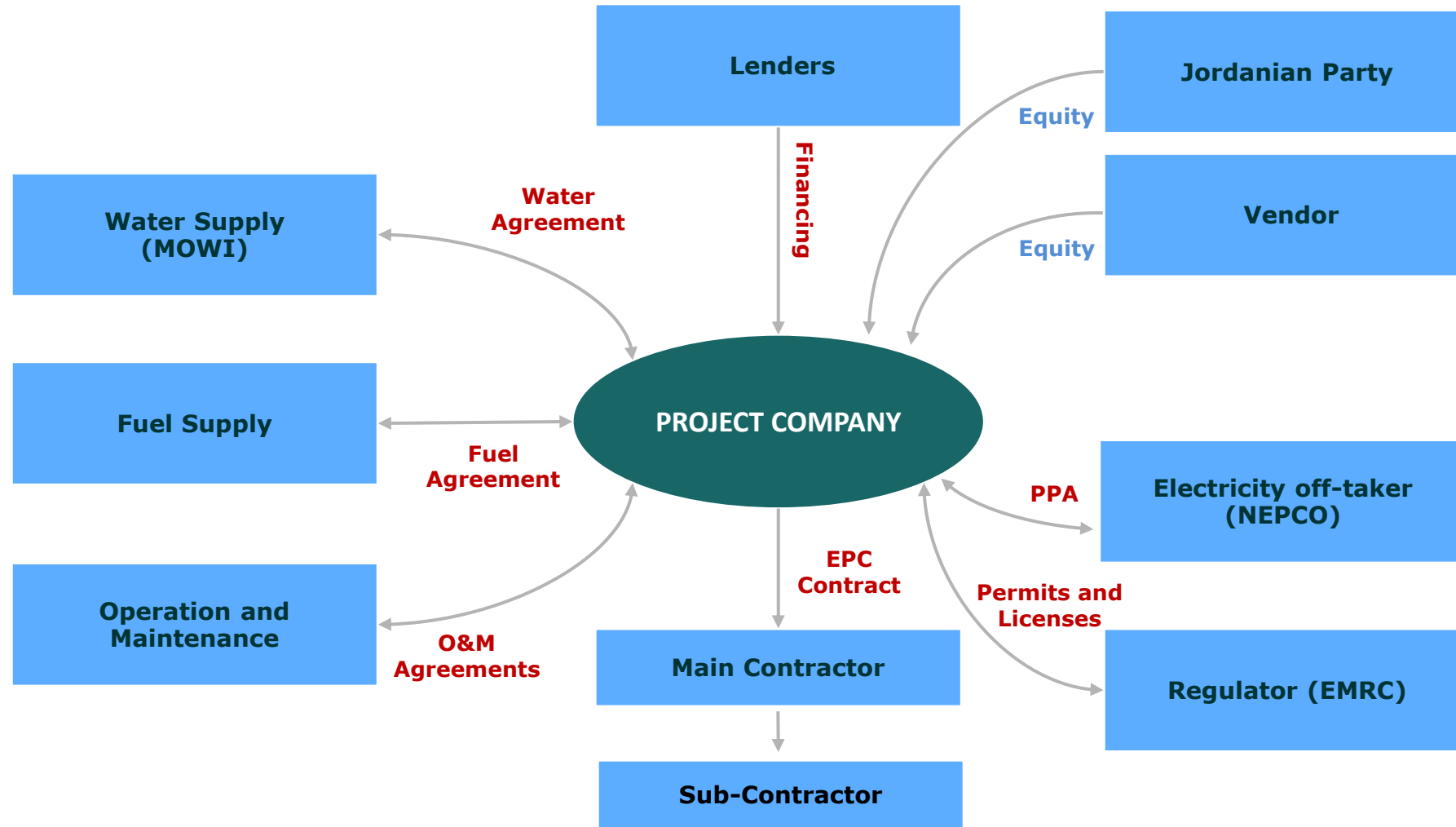
Rolls-Royce	HTR-PM	ACP-100	NuScale	Xe-100	RITM-200
					
British Compact PWR	Chinese HTR	Chinese iPWR	American iPWR	American HTR	Russian iPWR
•470 MWe / module •> 0.3 g seismicity •Passive (backed-up by active) safety trains •18-24 months refueling cycle	•110.5 MWe (Gross) / module •103 MWe (net) / module •0.3 g seismicity •2 Passive safety trains •Online refueling	•125 MWe (Gross) / module •112.5 MWe (net) / module •0.3 g seismicity •2 passive safety trains •24 months refueling cycle	•77 MWe (Gross) / module •74 MWe (net)/ module •0.5 g seismicity •2 passive safety trains (backed up by active systems) •24 months refueling cycle	•81.5 MWe (Gross) / module •75 MWe (net) / module •0.3 g seismicity •2 passive (inherent) safety trains •Online refueling	•57 MWe (Gross) / module •52.5 MWe (net)/ module •0.3 g seismicity •4 safety trains (2 active and 2 passive) •48-72 months refueling cycle

A Key Application: Coupling SMRs with Water Desalination

- The Nexus: Addressing Jordan's two most critical challenges simultaneously (Electricity Generation & Desalination)
- The Problem: Traditional desalination is energy-intensive and relies on fossil fuels, creating CO₂ emissions.
- The Aqaba–Amman Water Desalination & Conveyance Project is a national strategic project requiring ~**330 MW** of reliable base-load power
- The SMR Solution:
 - Provides a low-carbon, source of electricity and process heat.
 - Key opportunity to supply sustainable, base-load energy source for water desalination and pumping operations.
 - Offers a reliable and scalable energy source for large-scale water projects.



Generic Project Structure



Jordan's Participation in INPRO

- Jordan is a participant of INPRO since 2011.
- Since 2011, Jordan was represented in steering committee meetings and contributed to discussions on INPRO development vision and INPRO action plans.
- In 2019, JAEC invited the IAEA to organize a 4-day training course on SimPacts, focusing on developing capabilities to enhance the process of making energy choices for Jordan.
- In 2022, Jordan joined the ASENES-SMR project and conducted a case study using KIND-ET and ROADMAPS tools. The case study will be published in a TECDOC next year.
- A follow-up project is intended to be commenced after the finalization of ASENES-SMR, and JAEC is considering the participation in this project.



Take Away Points

- SMRs present unique licensing challenges; their smaller size does not mean a simpler regulatory process.
- Jordan's regulator is open to collaboration with vendors and their countries to create a tailored licensing framework.
- Key selection factors in Jordan include a proven design certificate and licensability in the country of origin.
- Coupling SMRs with desalination addresses national energy and water needs but introduces additional licensing complexity.
- Jordan is proactively addressing licensing challenges through international cooperation, IAEA engagement, and regulatory strengthening.



Thank you

