

Considerations in Development and Deployment of SMRs in Pakistan



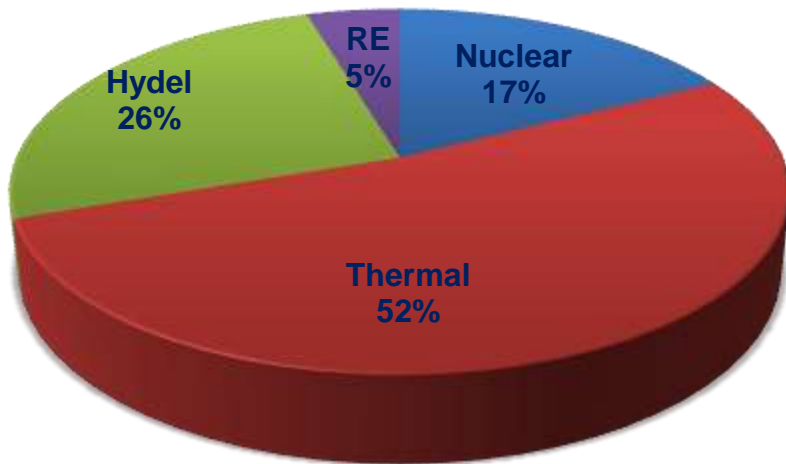
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Nuclear Power in Pakistan

- Mix of Hydro, Thermal, Renewable and Nuclear power units
- Nuclear power units are owned and operated by PAEC
- **52 years** of successful nuclear power generation through small & medium sized reactors
- Excellent records of NPP operation and maintenance
- Strong infrastructure of Human Resource and R&D facilities
- Increased indigenous manufacturing of NPP structures, equipment and components of NPPs
- Involvement in design of NPP systems and conduct of design modifications
- Achieved 100% handling of Refueling outage independently

Electricity Generation (FY 2022-23)



NPPs in Pakistan		
Operational	Retired	Under-construction
06 units	01 unit	01 unit
PWRs (04 CNP300, 02 Hualong-I)	PHWR (CANDU)	PWR (Hualong-I)
3575 MW _e	137 MW _e	1200 MW _e

Source: NEPRA State of Industry Report 2023

Activities on SMRs in Pakistan

Interest in SMRs

- **Nuclear infrastructure supports development & deployment of SMRs**
- Needs for quick clean and economic energy resources
- Presence of small and localized grid areas with specific energy needs
- Ongoing research work on cogeneration applications, particularly desalination and H₂ production

Technology Development

- Conduct of technical feasibility assessment
- R&D activities, e.g. Systems thermal hydraulics test facility
- Educational activities, e.g. courses on SMRs at PIEAS

Liaison with IAEA

- Member of IAEA Technical Working Group on SMRs
- Placement of Cost Free Experts at IAEA (07 on SMRs & innovative reactors)
- Hosting of IAEA Technical Meetings (03) in Pakistan
- PIEAS as designated regional collaboration centre of IAEA

Other Activities

- International and national workshops on SMR related topics
- Inclusion of SMRs in International Nathiagali Summer College
- Capacity building of human resource

Challenges in SMR Development & Deployment

Demonstration of technology	<ul style="list-style-type: none">• Demonstration or Prototype SMR NPPs need to be developed• Comprehensive testing and qualification requirements
Complex engineering	<ul style="list-style-type: none">• Contain “First-of-a-kind” engineering systems and components• Updating of codes and standards• Long-term reliability a major technological and material challenge• Interfacing with cogeneration and non-electric applications
Economic viability	<ul style="list-style-type: none">• Challenges in entering established energy markets• Financing of NPPs in developing countries• Large initial orders required for economy of factory fabrication• Economic competitiveness is not proven yet
Licensing & regulatory framework	<ul style="list-style-type: none">• Updating of regulatory framework for SMRs• Legal & institutional framework, particularly for transportable SMRs• Development of pathways to licensing• Long lead-time for regulatory review
Public acceptance	<ul style="list-style-type: none">• Overall nuclear business is linked with public acceptance• Public advocacy and lobbying are required for SMRs
Concepts of operations	<ul style="list-style-type: none">• Control room’s designs for multi-module SMRs• Design of human-system interfaces• I&C requirements and interfaces