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SMR Deployment and Economics: *Viability of Business Case for SMRs*

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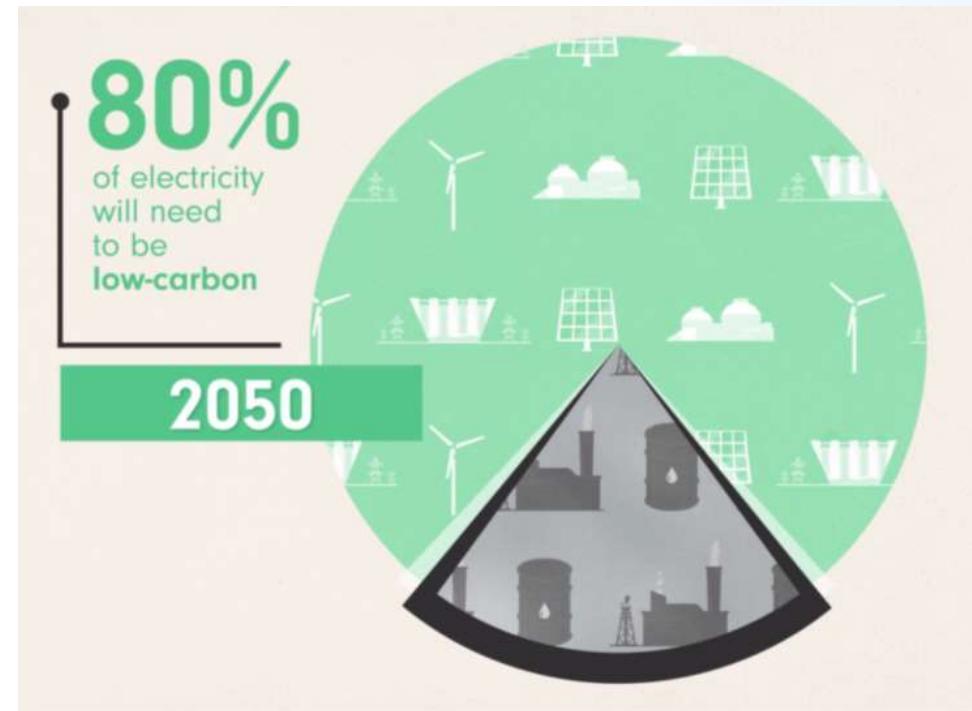
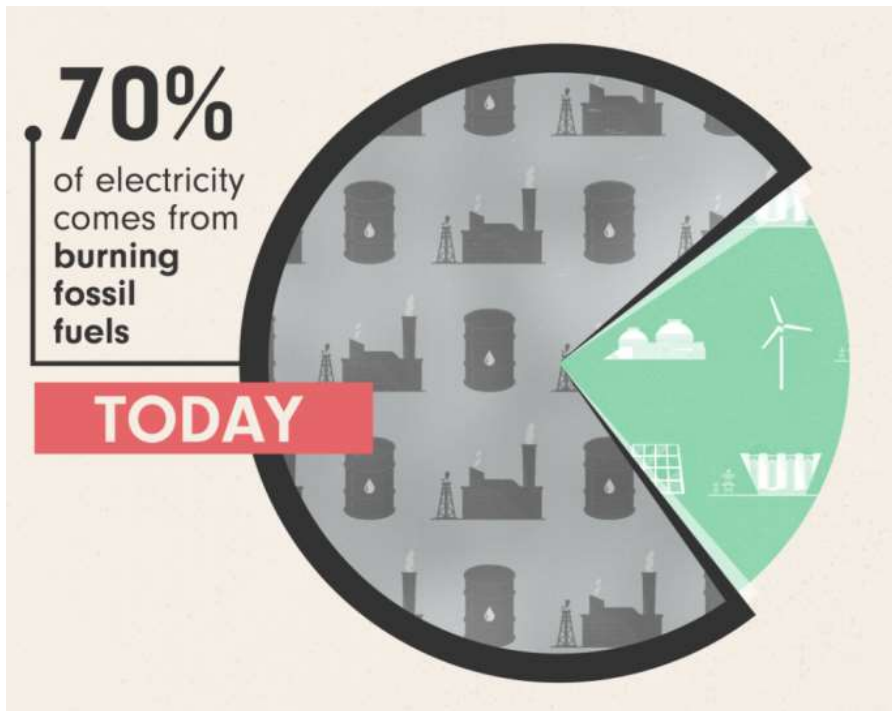
**First Meeting, Technical Working Group for SMR
VIC, 23 April 2018**

Agenda



- Global Challenges and Nuclear Pathways
- SMR Deployment and Economics
 - Prospects & Impediments
 - Economics and Competitiveness
- Infrastructure Distinctions for SMRs
- Summary

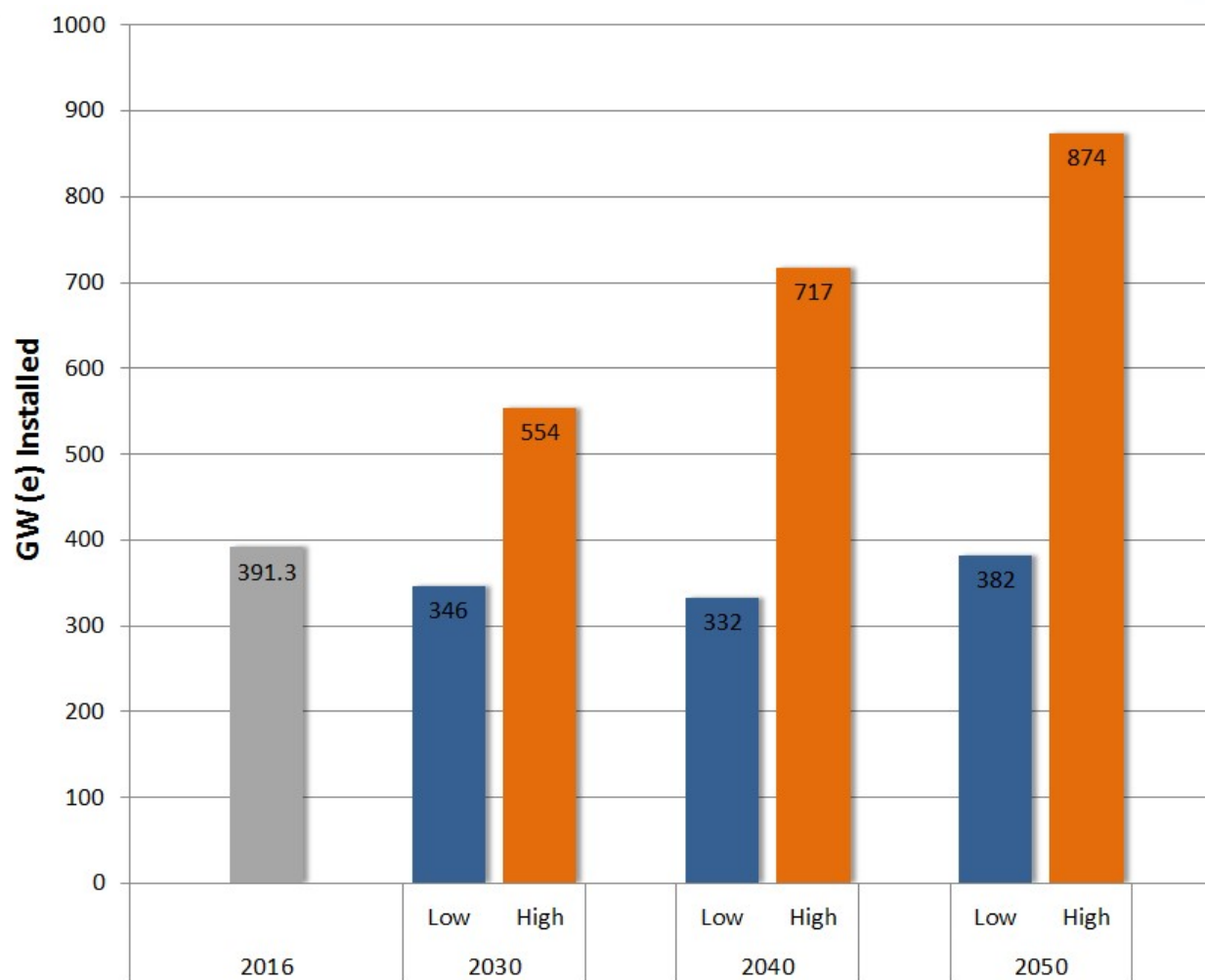
Immense challenge



Nuclear Energy Projections



Capacity more than doubles by 2050 when countries invest in nuclear energy to protect against climate change



Drivers

- Paris Agreement, NDC targets
- Sustainable Development Goal #7
- Disruptive technologies
- Growth of variable renewable capacity
- Nuclear Retirements
- New global nuclear markets

Can SMRs Capture New Markets?

- As a low-C alternative to fossil fuels
- Replace aging coal plants
- Meet growing demands for potable water
- Use modularity to better fit growing markets (incl. load following)



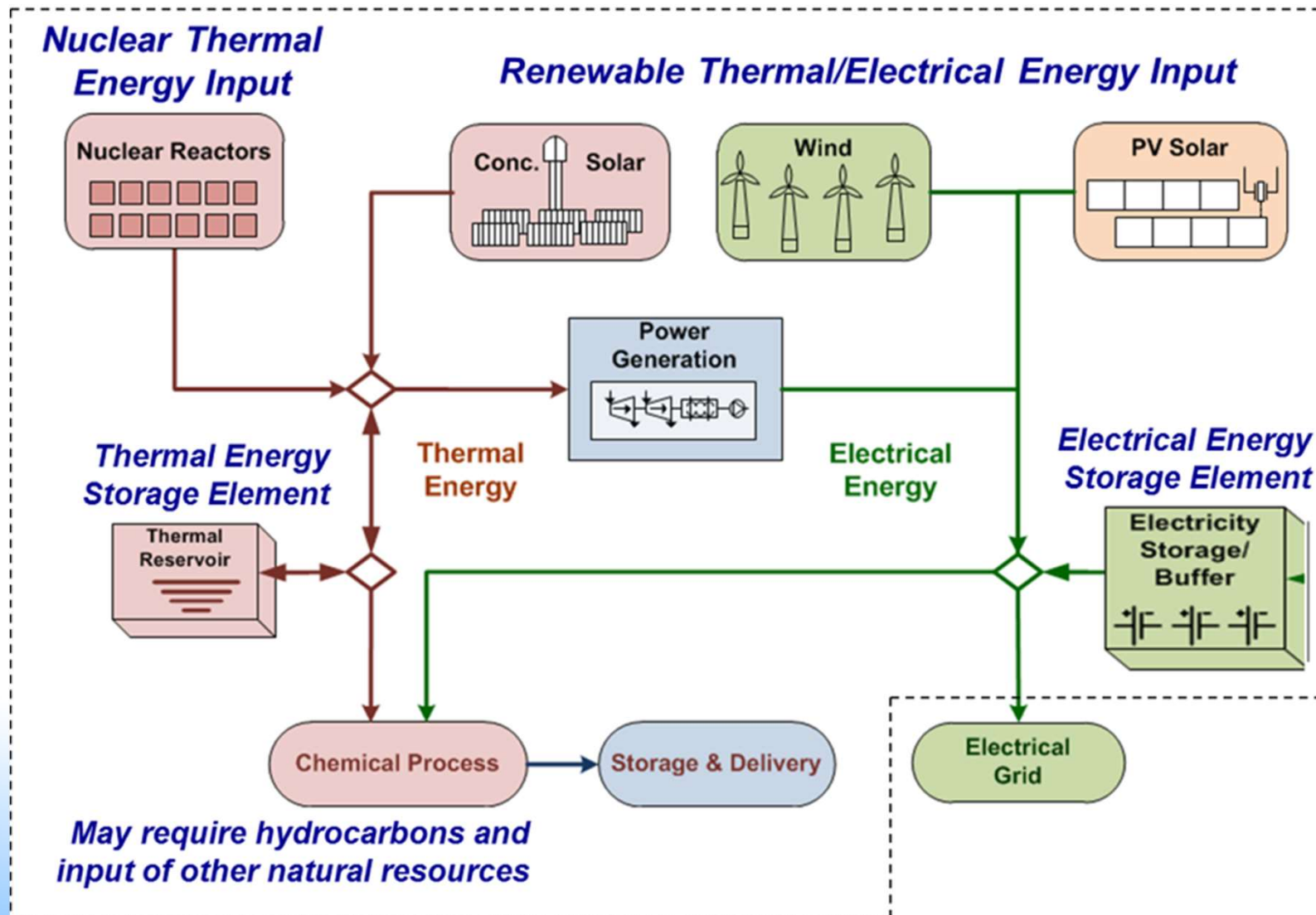
SMR Deployment Opportunities



- Remote and niche applications
- Limited-time energy demands (mining)
- Build for Export Markets
- Cogenerate electricity and heat for municipal and industrial applications (Hybrid Systems)

Hybrid System Example

System Boundary



Key indicators for deploying SMRs



National Energy Demand	SMR Energy Demand	Financial/Economic Sufficiency	Physical Infrastructure Sufficiency	Climate Change Motivation	Energy Security Motivation
Growth of Economic Activity (GDP GWTH)	Dispersed Energy (RURAL)	Ability to Support New Investments (GDP/PC-GDP)	Electric Grid Capacity (GRID)	Reduce CO ₂ Emissions per Capita (CO2)	Reduce Energy Imports (ENG IMP)
Growth Rate of Primary Energy Consumption (GRPEC)	Co-Generation (DESAL/DH)	Openness to International Trade (FDI/TRADE)	Infrastructure Conditions (INFRA)	Reduce Fossil Fuel-Energy Consumption (FOSSFUEL/OGC)	Use Domestic Uranium Resources (URAN)
Per Capita Energy Consumption (PC-EC)	Energy Intensive Industries (EII)	Fitness for Investment (CREDIT)	Land Availability (LAND)	Achieve NDC Carbon Reduction Goals (NDC)	Balance Intermittent Renewables (RES)

Impediments

- Large NPPs are more economical for desalination/district heating at large scale.
- Multi-module SMR need demonstration of both design and economy-of-production.
- Potential siting issues when placing reactor in proximity to industrial complex.

Prospects

- Right size - to industrial applications
- Where flexibility is needed
- Places lacking other energy resources
- Small grid capacity
- Transportability
- Energy security

Economic Competitiveness



In OECD Countries:

Reduced competitiveness - more energy choices and trading opportunities, subsidized renewables, but less so for nuclear.

Increased competitiveness: - existing nuclear infrastructure (regulators, etc.), SMR exports scale production and reduce costs, provides low-carbon means to meet NDC goals.

Economic Competitiveness

In Developing/Newcomer Countries:

Reduced competitiveness – High initial cost hurdle, domestic energy needs more quickly met by domestic fossil energy.

Increased competitiveness: - Modular capacity additions could support fast energy growth, SMRs provide competitive alternative to imported energy while providing energy security.

Infrastructure Simplifications

- Fuel supply and take back could simplify waste disposition requirements
- Plug and play reactors limit need for domestic supply chain
- SMRs could avoid need for grid upgrades and help reduce infrastructure needed to support renewables

Summary

- A business case for SMRs can be made, but requires a focus on:
 1. Adapting to a changing energy market;
 2. Finding and satisfying new customers.



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Thank you!

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