

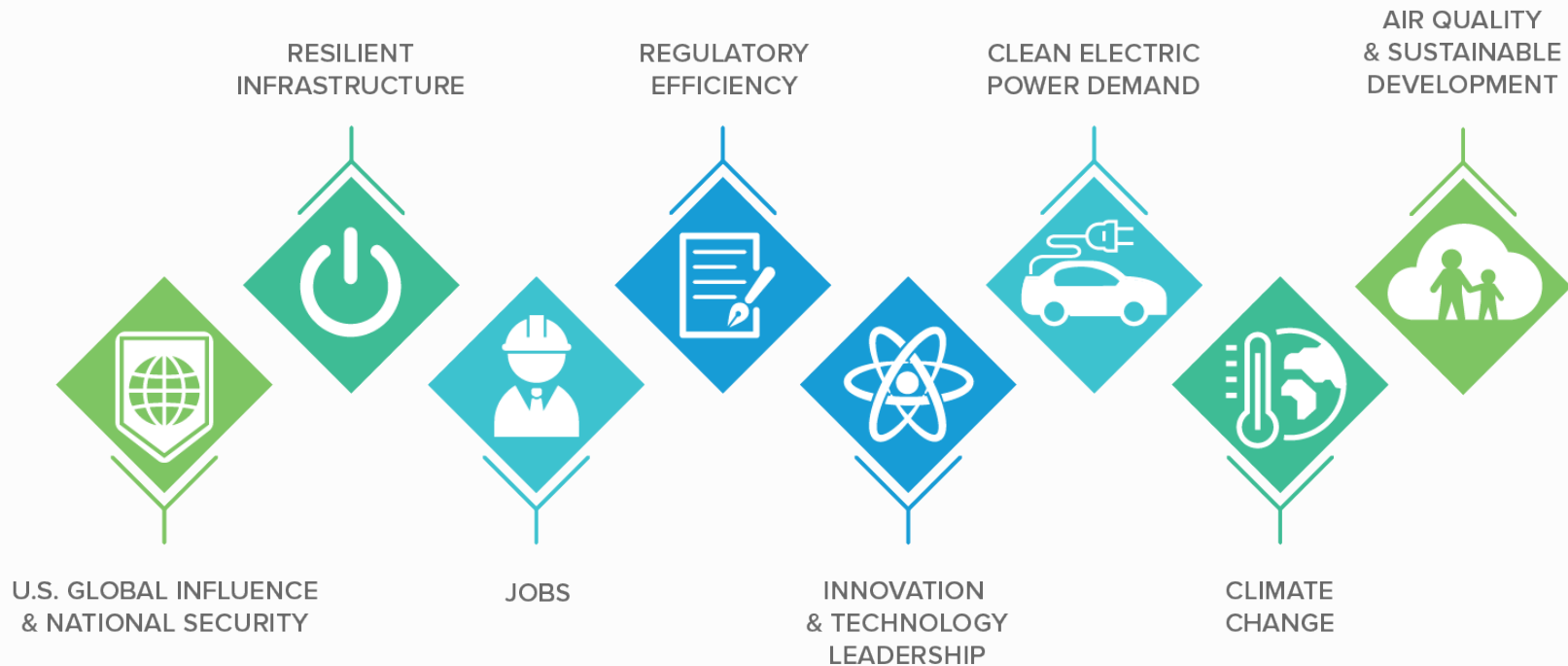
Advanced Reactors

Marc Nichol
Senior Director, New Reactors

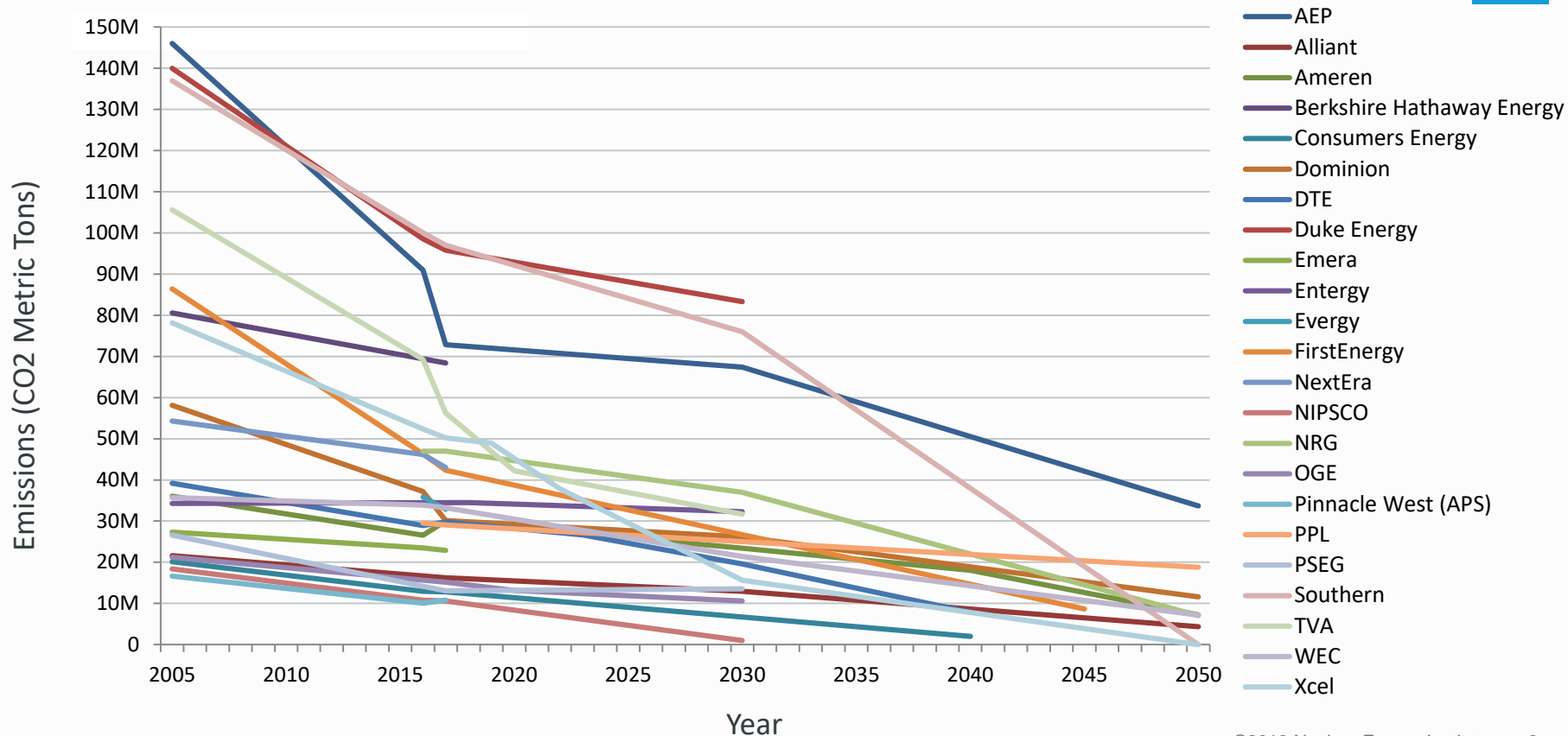
March 3, 2020



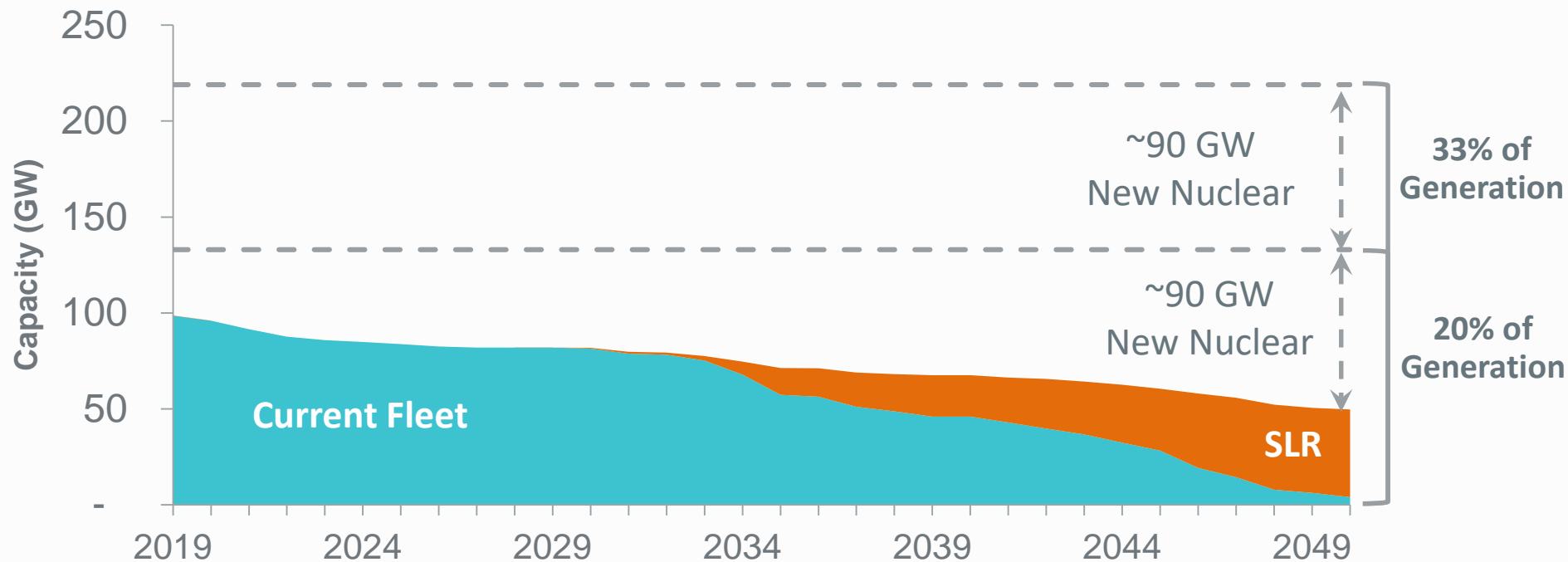
Imperatives



Decarbonization Trajectory of U.S. Utilities



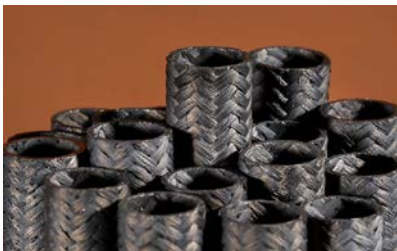
Nuclear's Role in a Low Carbon Electricity Future



Does not account for decarbonization of other sectors

Continuum of Innovation

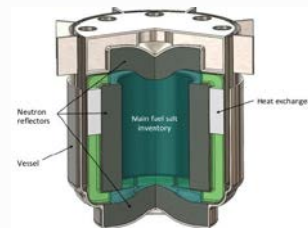
Advanced Fuels



Micro-Reactors



Advanced Non-LWRs



TerraPower

2020

2025

2030

2035

Large Light Water



Vogtle 3 & 4

Oklo Aurora

Small Modular Reactor



NuScale

- Hi-temp gas
- Liquid metal
- Molten salt

Innovation is Key

Advanced Technology



Advanced Fuel



Reactor Designs



Manufacturing



Digital Technology



Automation

Better Performance



Reduced costs and
time to market



Enhanced safety



Flexibility

Potential Markets



**U.S. Grid
Electricity**



**Non-Grid
Electricity**



Process Heat



Hydrogen



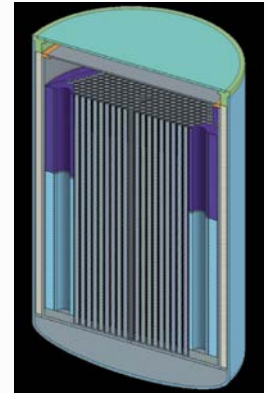
**International
Market**

Used Fuel

- Characteristics
 - Radiation and heat
 - Solid and compact
 - Potential source of future fuel
 - Demonstrated safety
- Management
 - On-site storage
 - Off-site storage options being created
 - Contracts with DOE for final disposal



Light Water SMR



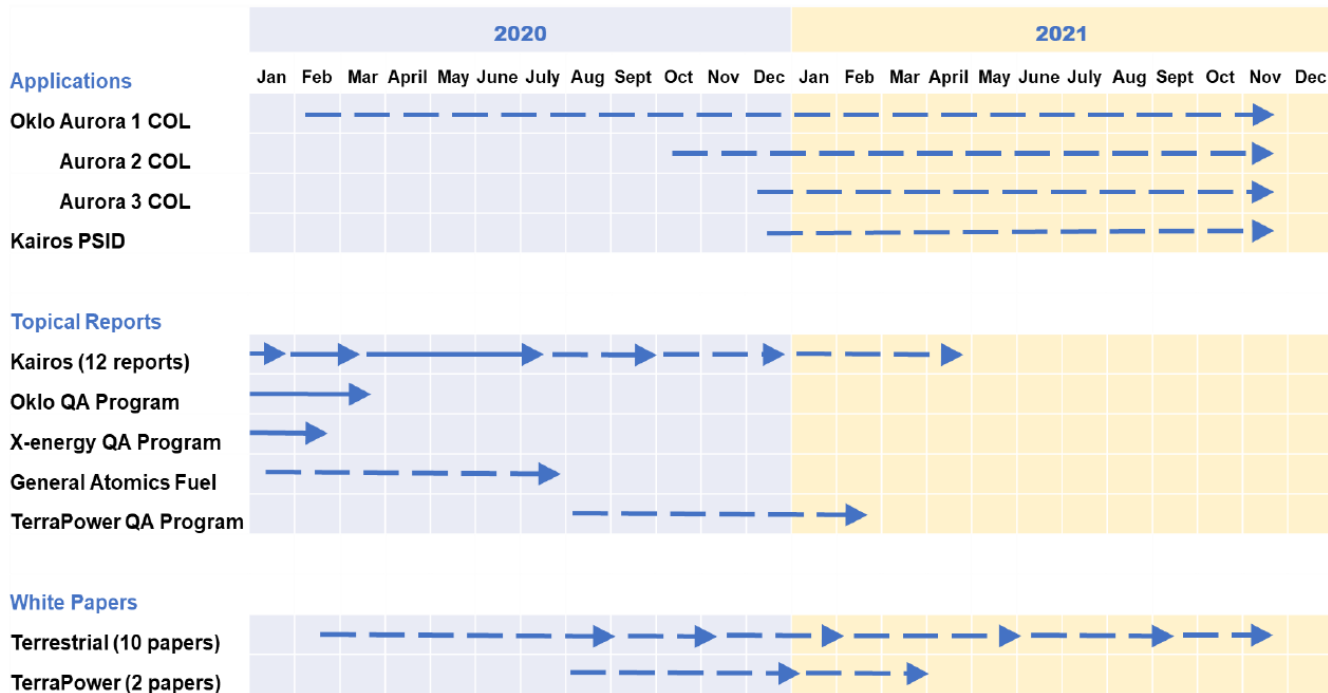
Oklo Aurora

Licensing

SMR Reviews

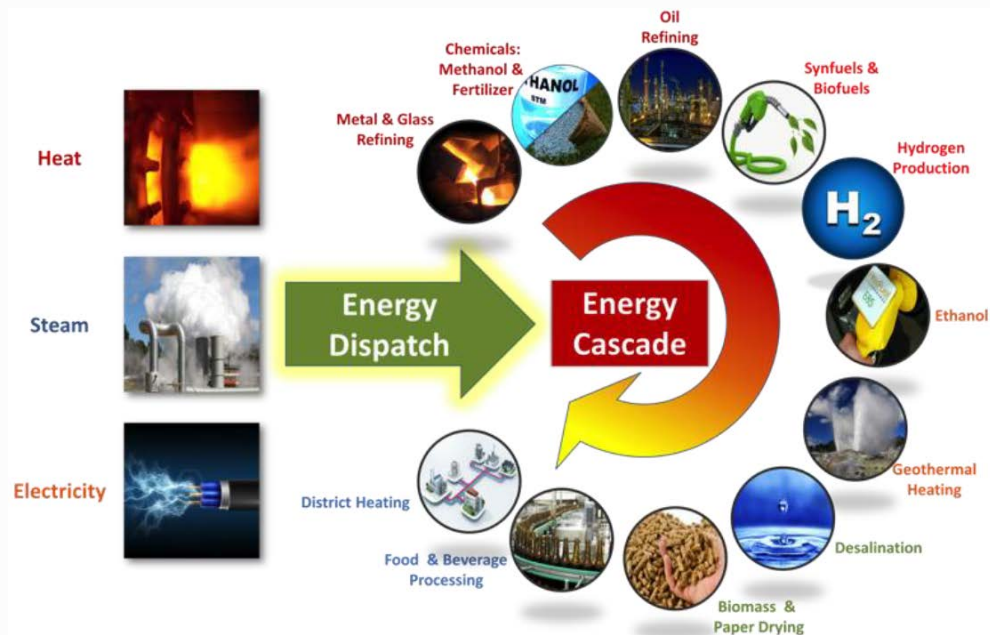
- NuScale design certification expected Fall 2020
- UAMPS application expected 2021
- GEH BWR-X300 topical reports in 2020

Current and Anticipated Work



Demonstrations

- DOE Joint use modular program
 - UAMPS/NuScale/INL
- DOE demonstration program
 - Two reactors in 5 to 7 years
 - Two to five longer term
- Department of Defense
 - Mobile micro-reactor by 2024
 - Installation pilot by 2027
- Private demonstrations



Source: Idaho National Laboratory

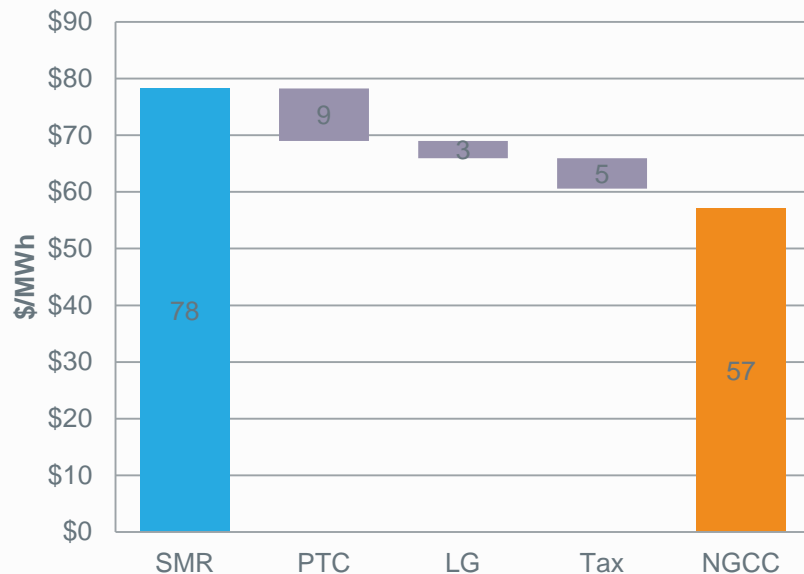
Financing Options

- Private financing
 - Municipal utilities
 - Developer or third party capital
- Federal support
 - Production tax credits
 - Loan guarantees
 - Power purchase agreements
- State support
 - Tax incentives
 - Construction work in progress



Estimated Costs of First SMR

Comparison of Costs of First SMR and
Natural Gas Combined Cycle
Example 2 - Municipal Utility

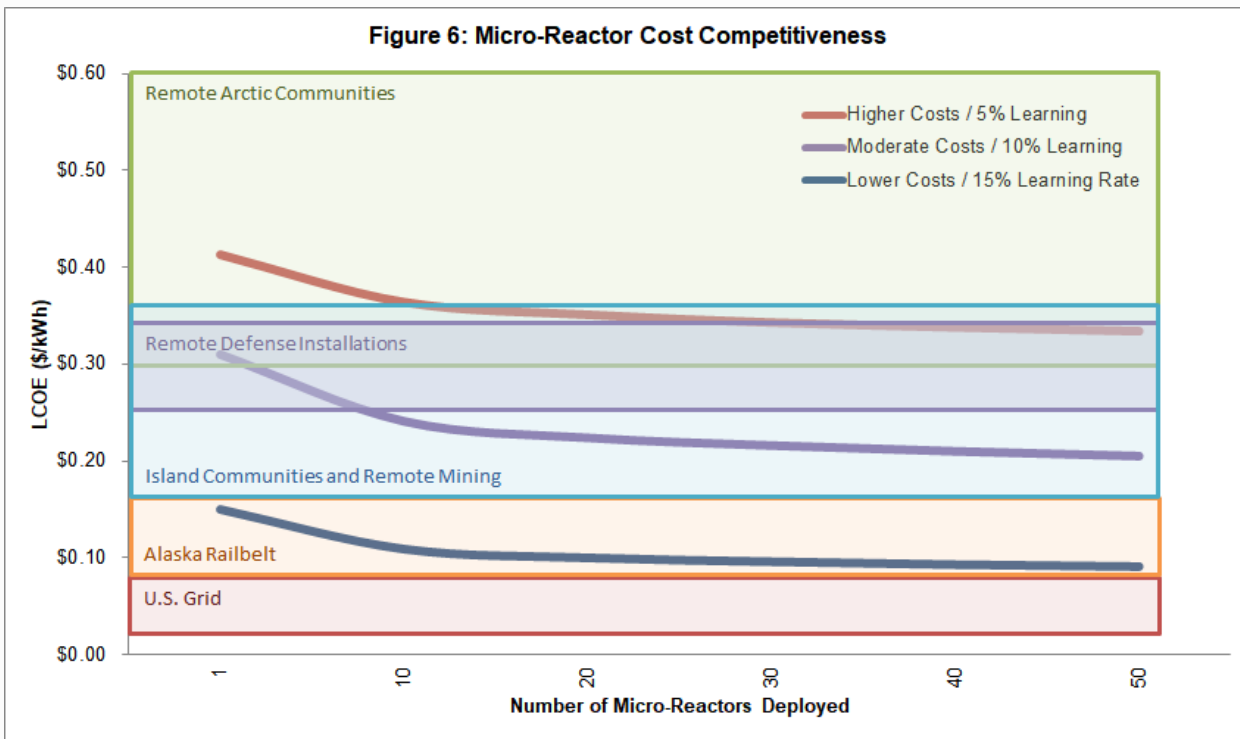


- First of a Kind Costs (400 MWe)
 - \$2 billion capital cost
 - \$27/MWh operating cost
 - 36 month construction
- Nth of a Kind Efficiencies
 - 10% to 20% lower cost

SMR Start: *The Economics of Small Modular Reactors*, September 2017

Micro-Reactor Cost Competitiveness

Figure 6: Micro-Reactor Cost Competitiveness



Reference Micro-Reactor

- First of a kind
- 10 MWe

Moderate Costs

- \$150 million capital cost
- \$5/kWh operating cost
- < 24 month construction

QUESTIONS?

