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Guggenheim's Perspective on Financing the Advanced Reactor Sector

Overview

A global, zero-carbon electric grid is unachievable without the deployment of carbon-free, baseload generation

Nuclear is the only technology that provides reliable, clean, baseload energy at the required scale for governments, utilities, and corporations to reach their decarbonization goals

While potentially not the least expensive form of power available, it is price competitive and provides ancillary services and benefits that conventional generation cannot

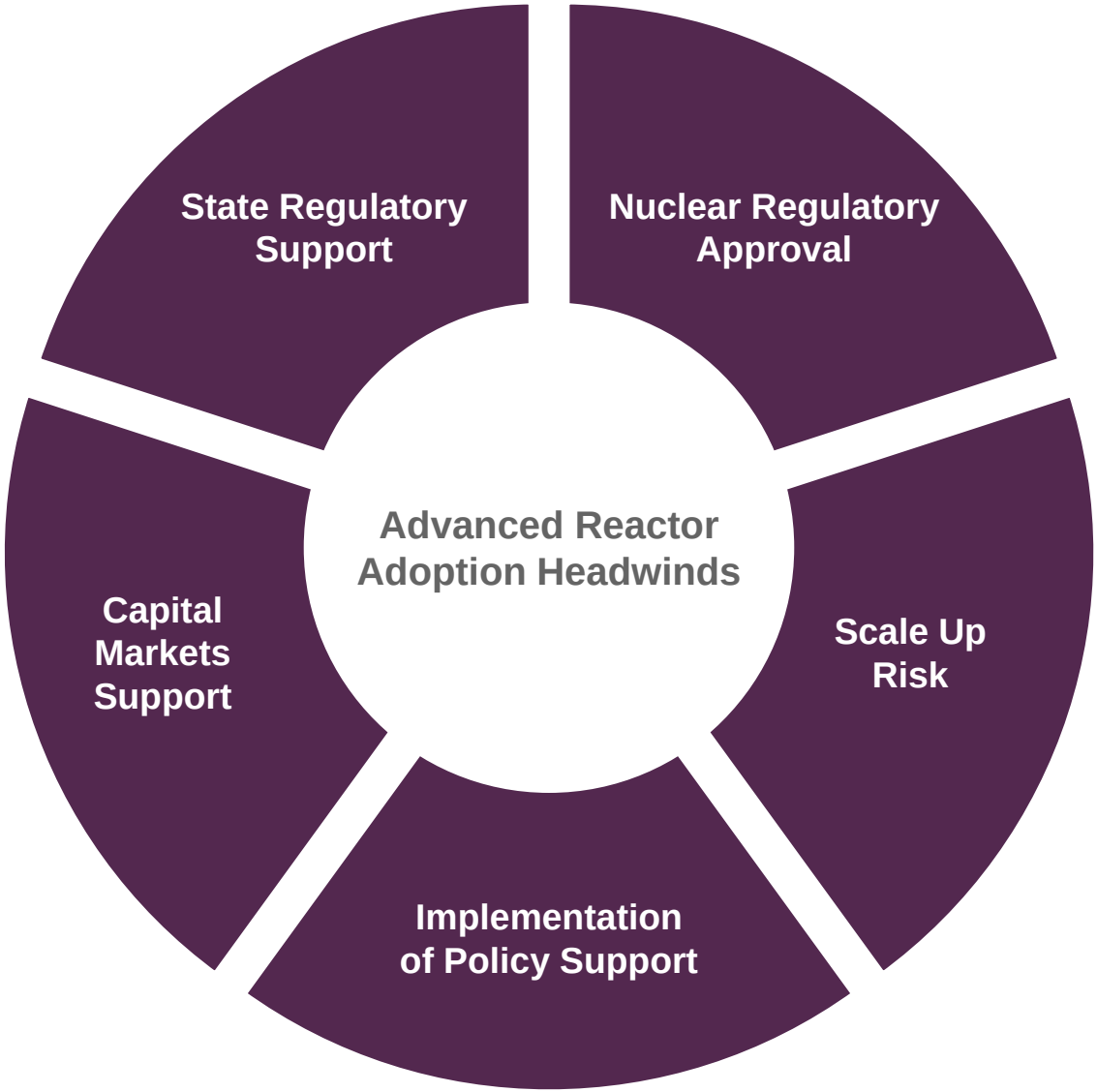
Advanced nuclear companies are announcing numerous customer orders demonstrating real interests from both private and public sectors

The war in Europe has increased focus on advanced nuclear as a solution to both decarbonization and energy security

For the world to reach its net-zero goals and for the industry to meet its demand, real and durable support must be committed by regulatory bodies

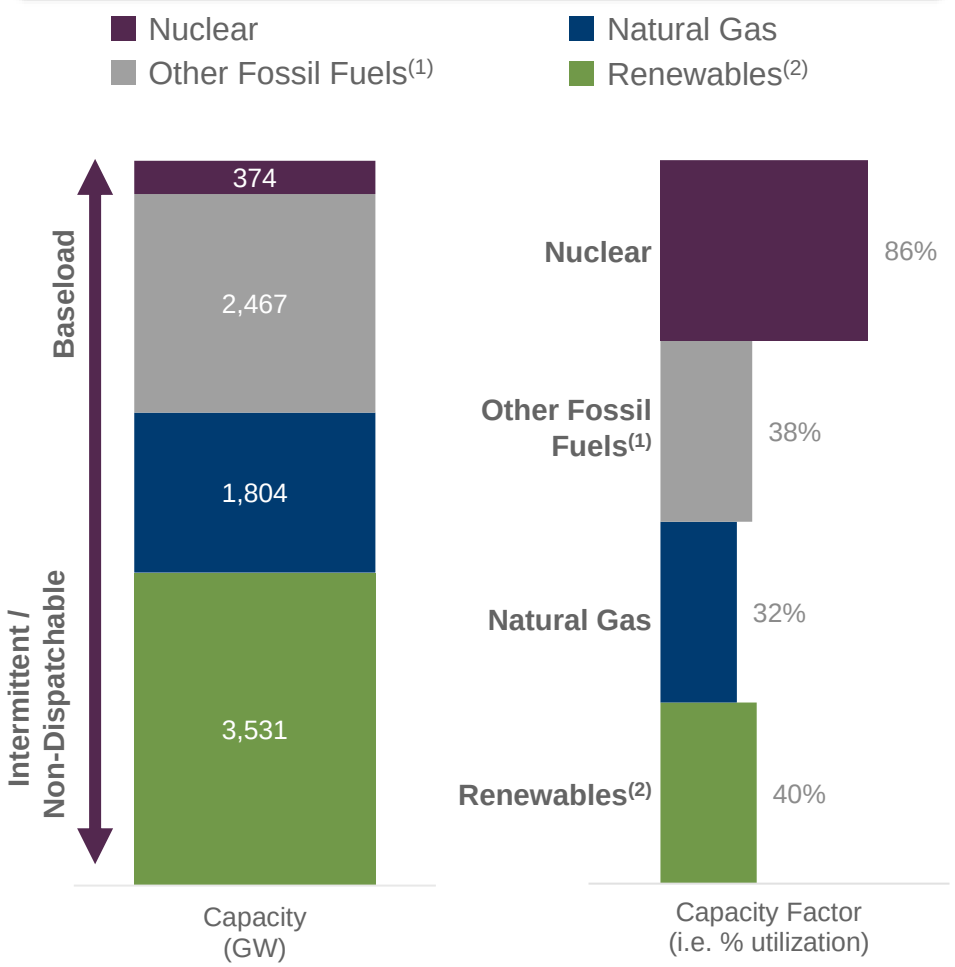
Key Challenges for Advanced Reactors

Advanced reactors are facing multiple challenges that are delaying their wide-spread adoption



The Energy Transition Requires Zero-Emission Baseload Generation to Meet Growing Energy Demand…

2022 Global Generation by Resource Type



Key Observations

- **Nuclear is the only existing baseload (i.e. reliable, non-intermittent and dispatchable) technology that is clean**
  - Highly efficient and capable of capacity factors nearing 100%
- Power grids **cannot** rely on **intermittent renewables** alone for power
  - Baseload generation is required for grid stability, continuity of power during adverse weather events, and provision of ancillary services, among other benefits
- As the world accelerates toward a zero-carbon power grid, significant carbon-based generation will need to be replaced
  - 4,271 GW of current global power capacity is carbon-intensive (coal, oil, natural gas) and will largely be replaced with zero-emission generation over time
  - 7,176 GW of capacity globally is expected to retire by 2050(3)
    - 2,523 GW coal and oil, 2,451 GW natural gas and 97 GW nuclear make up the majority of retirements
  - ***In total, including consumption growth, more than 30,000 GW of clean generation is forecast to be built globally through 2050***

Source: BloombergNEF New Energy Outlook 2022 Data Viewer.
Note: Excludes energy storage capacity (i.e. pumped hydro and battery storage) and "Other" generation resources figures.
(1) Other Fossil Fuels includes coal and oil.
(2) Renewables includes hydro, geothermal, biomass, onshore and offshore wind, PV solar, and thermal solar.
(3) Represents forecast of total gross retirements from 2023-2050.

…And Advanced Nuclear is the Only Viable Zero-Emission Baseload Technology

	Traditional Baseload	Renewables	Fission (Advanced Reactors)	Fusion
Baseload Capable	✓	✗	✓	✓
Zero-Emission / Clean	✗	✓	✓	✓
Cost-Effective	✓	✓	✓	✓
Material Efficiency	✓	✗	✓	✓
Land Use Efficiency	✓	✗	✓	✓
Fuel Supply	✓	✓	~	✓
Fuel Waste	✓	✓	~	✓
Weaponization / Non-Proliferation	✓	✓	~	✓
Commercialization	✓	✓	~	✗

Once commercialization is proven, advanced nuclear will be the clear and only path to advancing decarbonization of power globally

SMRs Solve Conventional Nuclear's Shortcomings…

	Small Modular Reactors (Gen III & Gen IV)[1]	Large-Scale Conventional (Gen II)
Size	<300 MWe	>700 MWe
Upfront Plant Capex[2]	$3.3bn for 924 MWe (12 reactors)	$9.0+bn for 2.2 GWe
Construction Time	3 - 5 years	6+ years
Resource Planning	Modular and truly load-following capable (+/- 15 minutes)	Large step change in capacity (1+ GW) and requires 12+ hours to power up/down
Diversity of Business Cases	On-site industrial heat and power; off-grid; microreactors; hydrogen production; desalination	Large centralized utility planning
Advanced Capabilities and Ancillary Services[3]	e.g., blackstart, island mode, load following	
Refueling Period	2 - 30 years	1 - 2 years
Passive Safety Mechanisms[3]	"Walk-away safe"	

Source: U.S. Energy Information Administration Annual Energy Outlook 2021 (February 2021), *U.S. Nuclear Outages Remained Low in Summer and Moderate in September* (October 2019), management estimates, IEA, NIA.

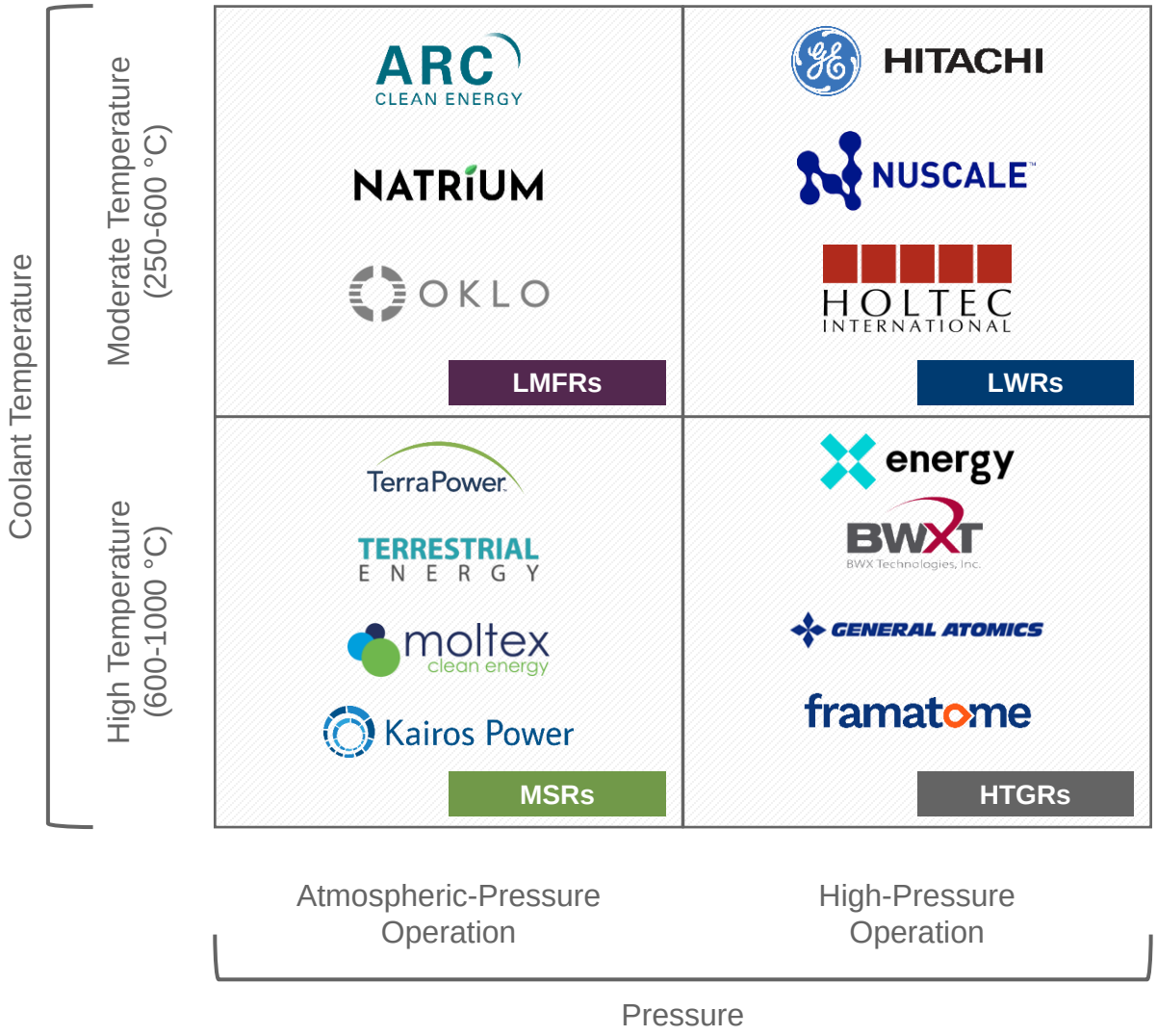
(1) Typical or illustrative industry average characteristics

(2) SMR value represents NuScale's disclosed illustrative Nth-of-a-kind ("NOAK") costs excluding escalation, contingencies and fees. Large scale nuclear estimate per Table 11.1, U.S. Energy Information Administration Capital Cost and Performance Characteristic Estimates for Utility Scale Electric Power Generating Technologies (February 2020).

(3) Comparisons are on a generalized, industry accepted, basis.

…Through Different Variants of Advanced Reactor Design

Coolant Temperature and Pressure Analysis



Note: Placement within quadrant is not indicative of temp. or pressure.

Coolant Overviews

Light Water Reactors (LWRs)

Most Extensive Commercial Track Record

- Lowest deployment risk; LWR technology has a proven track record of over 60 years
- Advanced designs include smaller scale reactors and passive safety features

Liquid Metal Fuel Reactors (LMFRs)

Moderate Commercial Track Record

- Technology has been demonstrated but hasn't seen widespread use
- The coolants' higher boiling points allow them to stay at atmospheric pressure, simplifying design and reducing safety costs

High Temperature Gas Reactors (HTGRs)

Moderate Commercial Track Record

- Technology has been demonstrated but hasn't seen widespread use
- Operating at high temperatures allows for greater thermodynamic efficiency and potential industrial heat applications (desalination, producing hydrogen, etc.)

Molten Salt Reactors (MSRs)

Lack of Commercial Track Record

- Least mature technology and no commercial proof
- Operating at high temperatures with low pressure allows for industrial heat applications and thermodynamic efficiencies with a simple design
- In addition to the industrial heat applications of HTGRs, MSRs can also breed medical isotopes due to their higher temperature range

Market Momentum for Nuclear is Accelerating…

United States

$2.5B

Funding to the DOE's Advanced Reactor Demonstration Program ("ARDP") as part of the Bipartisan Infrastructure Bill

$700M

Programs supporting domestic HALEU[1] research, development and commercial production as part of the Inflation Reduction Act

Nuclear Power is the Best Climate-Change Solution by Far

WSJ

WSJ, 11/4/2021

Suddenly, **the nuclear alternative for power generation enters the arena**. Enough safety measures have been developed to reduce fears about its dangers, and **the viability of nuclear power is widely acknowledged**.

Blackstone

Blackstone's Top 10 Surprises of 2022

Climate Worries Galvanize a Pro-Nuclear Movement in the U.S.

The Washington Post

The Washington Post, 5/24/2022

Advanced reactors will completely change the way we engineer, build, and operate nuclear reactors…These awards support technical and regulatory strides necessary for commercializing new carbon-free nuclear technologies **poised to help our nation reach net-zero emissions by 2050**

Dr. Kathryn Huff, Assistant Secretary for Nuclear Energy (Nominated)

Majority of U.S. states pursue nuclear power for emissions cuts

AP

AP News, 1/18/2022

International

$531M

U.K. Government funding to accelerate developing nuclear technologies to be operating by the 2030s

€500B

Investment in nuclear power needed to achieve the EU's goal of carbon neutrality in 2050

We see [high-temperature gas-cooled reactors] to be extremely promising and we would like a research reactor to be built in Poland in an international cooperation and we still see a high temperature reactor also as part of the solution to hydrogen production

Michal Kurtyka, Climate Minister, Poland

Canada's electricity supply is among the cleanest in the world, thanks in large part to the dominance of hydro power and the **important role of nuclear**

iea

Dr. Fatih Birol, Executive Director, IEA

(1) High-Assay Low-Enriched Uranium "HALEU" is the fuel used by Gen IV nuclear reactors. The concentration of U-235 is 5% – 20%, compared to less than 5% in LEU used by traditional and Gen III reactors.

…Bolstered by Ongoing Bipartisan Support Across Administrations…

Political support has continued to expand, with record-breaking policy proposed by the Biden administration

Biden Administration

- The *American Jobs Plan* called for $15 billion investment in demonstration projects for climate R&D priorities, including utility-scale energy storage, carbon capture and storage, hydrogen, advanced nuclear and others
- Pending Inflation Reduction Act allocates $700 million for domestic HALEU research, development and commercial production with funds available through September, 2026
- House Energy and Commerce Republicans are leading on legislation that seeks to establish a uranium reserve and speed up nuclear permitting

Trump Administration

- Department of Energy approved $1.4bn for small-scale nuclear reactor project
- In February 2020, the DOE awarded NuScale a $700mm cost share program, agreeing to bear 50% of NuScale's costs to commercialization over the next five years

Obama Administration

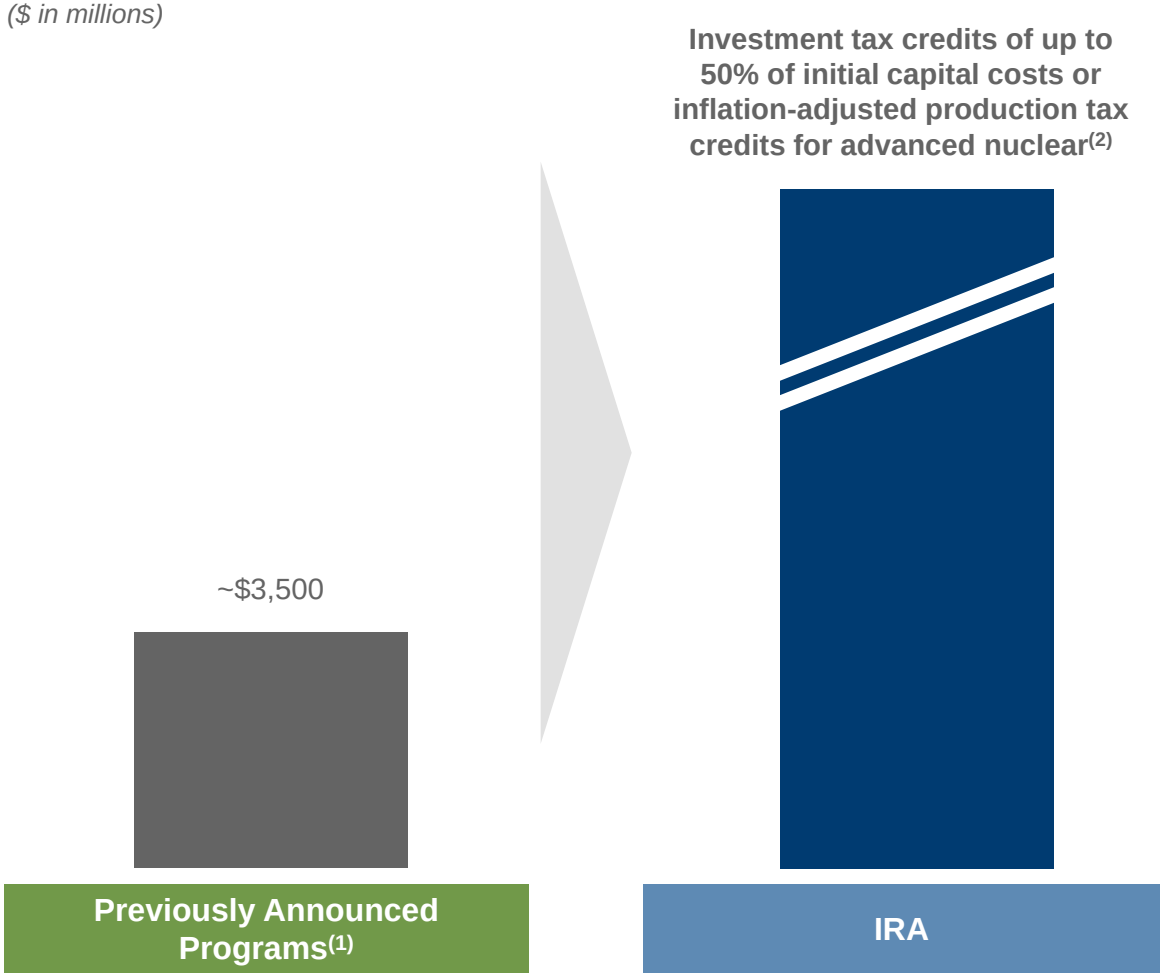
- DOE granted $450mm to support up to two SMR designs
- "Through the funding for small modular nuclear reactors announced today, the Energy Department and private industry are working to position America as the leader in advanced nuclear energy technology and manufacturing" *– Obama Administration, March 22, 2012*

…Including the Inflation Reduction Act ("IRA")

The IRA provides significant support for SMRs

U.S. Government Funding for Advanced Nuclear

($ in millions)



IRA Highlights

- ✓ Inflation Reduction Act's Investment Tax Credit and Production Tax Credit represent a meaningful increase in government support for advanced nuclear. Investment tax credits can equal up to **50% of initial capital cost**
- ✓ **$700mm** has been slated in appropriations to support the availability of HALEU nuclear fuel for research, development and demonstration
- ✓ The IRA has increased the DOE's loan guarantee program to **$250bn**, which could be applicable to certain advanced nuclear projects

Case Study: Solar Industry Demonstrates Tax Credit Impact

Since the solar Investment Tax Credit was enacted in 2006, the U.S. solar industry has grown by more than 200x(3)

1) *Includes Research Funding (i.e., average annual research funding for advanced nuclear since 2009 according to DOE) of $66mm, Project Pele of $40mm, HALEU Demonstration program of $170mm and ARDP of $3.2bn*
2) *Inflation Reduction Act includes $700mm to support HALEU and also provides our customers the option of electing either the Investment Tax Credit or the Production Tax Credit (see next page for additional detail)*
3) *Source: Solar Energy Industries Association – Solar Investment Tax Credit (August 2022)*

SMR Investment Appeals to Various Groups, But State Regulatory Support Can Be Extraordinarily Impactful In Accelerating Adoption

	Utilities	End-Users	Financial Investors
Goals	• Serve customer load within service territory • Provide clean, baseload power alongside renewables in integrated resource mix	• Ensure stable, reliable electricity source for industrial / manufacturing processes • Reduce emissions footprint • Reduce energy price volatility	• Generate financial returns for fund investors • Balance risk / reward to ensure attractive opportunities relative to downside potential
Constituents	• Ratepayers (several classes including: residential, commercial, and industrial users) • State regulators • State lawmakers • Shareholders / investors	• Customers • Shareholders and investors	• Fund investors
Return Targets	• High single to low double digit equity returns	• Varies widely • Need to balance alternative sources of energy with importance of having stable, reliable power	• Equity investors: low double digits to 20%+ • Debt investors: high single to high teen returns
Sources of Funding	• Internally generated cash flow • Capital markets (equity and debt)	• Internally generated cash flow • Capital markets (equity and debt)	• High net worth individuals • Family offices • Pension plans • Insurance companies
Illustrative Universe	Ontario Power Generation, Georgia Power, Duke Energy, FPL, NorthWestern Energy	KGHM Polska Miedź, Newmont, Suncor Energy, Dow, ConocoPhillips, ArcelorMittal	Brookfield, EQT, Fifth Wall, BlackRock, Bardin Hill, Congruent Ventures, nuveen, Fidelity Investments

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