Role of Nuclear Energy
In our Clean Energy Future

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Today’s Agenda

- Overview of Nuclear Power and role in the portfolio
- Management of Spent Nuclear Fuel
- Nuclear Policy Updates
- Advanced Nuclear
- Resource Planning

State of the Nuclear Industry in the US

93 operating reactors at 54 plants across the country

19% of US electricity production in 2022

45.5% of emission-free electricity generation in 2022

92.6% capacity factor

$30.18 MWh industry average generating cost

New Vogtle Unit 4 online in 2nd qtr 2024

History of Nuclear Power at Xcel Energy

PLANT	TIME	TYPE	MWe	LOCATION	NOTES
Pathfinder	1966-67	BWR (Boiling Water Reactor)	59	Sioux Falls, South Dakota	Test Reactor used to gain knowledge Site - Angus Anson Plant
Fort St. Vrain	1979-89	HTGR (High Temp Gas Reactor)	330	Platteville, Colorado	• Converted to Natural Gas in 1996 • Only Nuclear Plant in CO • One of two HGTRs in country • Uranium / Thorium Fuel
Monticello	1971 - Current	BWR (Boiling Water Reactor)	671	Monticello, Minnesota	Applied for second 20-year license extension to operate 80 years until 2050
Prairie Island	1973/74 - Current	PWR (Pressurized Water Reactor)	1,100	Red Wing, Minnesota	Plan to apply for second 20-year license extension to operate 80 years until 2053/54

- Costs are industry-leading despite the small size of the reactors in our fleet.
- Operational Excellence is part of the culture of Xcel Energy Nuclear.

Xcel Energy Nuclear Generating Fleet

Over five decades of carbon free power

Prairie Island Nuclear Plant

- 2 Pressurized water reactors
- Unit 1 (1973); Unit 2(1974)
- Licensed through 2033/2034
- 1,100 MW
- 800 Employees; 1,000 more during refueling

Monticello Nuclear Plant

- 1 Boiling water reactor (1971)
- Licensed through 2030
- 671 MW
- 650 employees; 800 more during refueling

Benefits of Nuclear Power

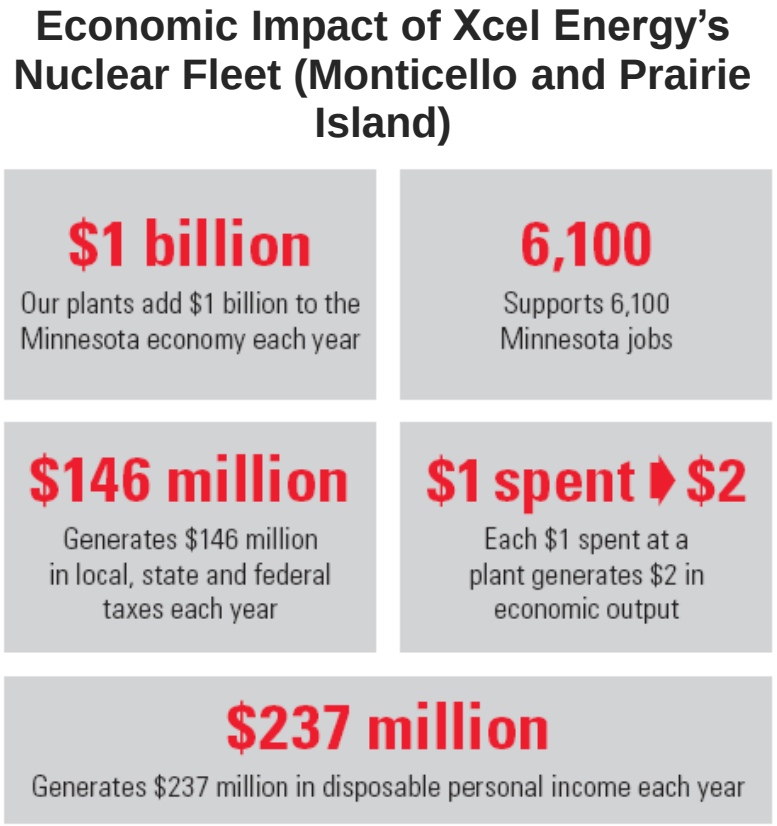
Clean	**Nuclear provides more than 1,700 MW of clean energy**
Economic	**Nuclear provides $1B to the local economy**
Reliable	**Nuclear is always on 24/7 - regardless of the weather. Can flexibly operate – better integration with renewables**
Safe	**Nuclear is highly regulated and secured**

Xcel Energy Nuclear Fleet

- Nuclear plants > 50% existing carbon-free generation and 1/3 total generation in Upper Midwest
- Nuclear fleet adds important diversity to our generation portfolio
- Critical piece of our reliability requirement > 90% capacity factors
- As of 2022, our fleet achieved its fourth year of production costs below $30/MWh, which represents greater than 35% decline from 2013

Community Involvement

- The nuclear fleet supports over 1400 jobs directly and more during refueling outages. Statewide the nuclear fleet supports 6100 jobs.
- Our plants pay significant local taxes, and generates a billion dollars in local economic activity/yr
- Monticello and Prairie Island are the largest sources of carbon-free energy in Minnesota
- Nuclear employees contribute significantly to the local United Way, and are personally involved in the local host communities



The Power of Nuclear Fuel

One fuel pellet contains as much energy as…

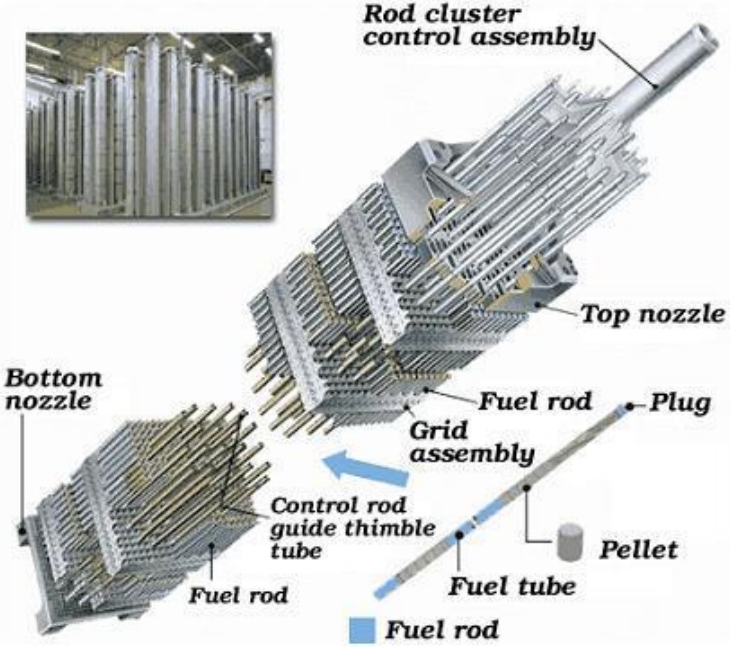
…and each reactor contains millions of pellets.

17,000 cubic feet of natural gas

149 gallons of oil

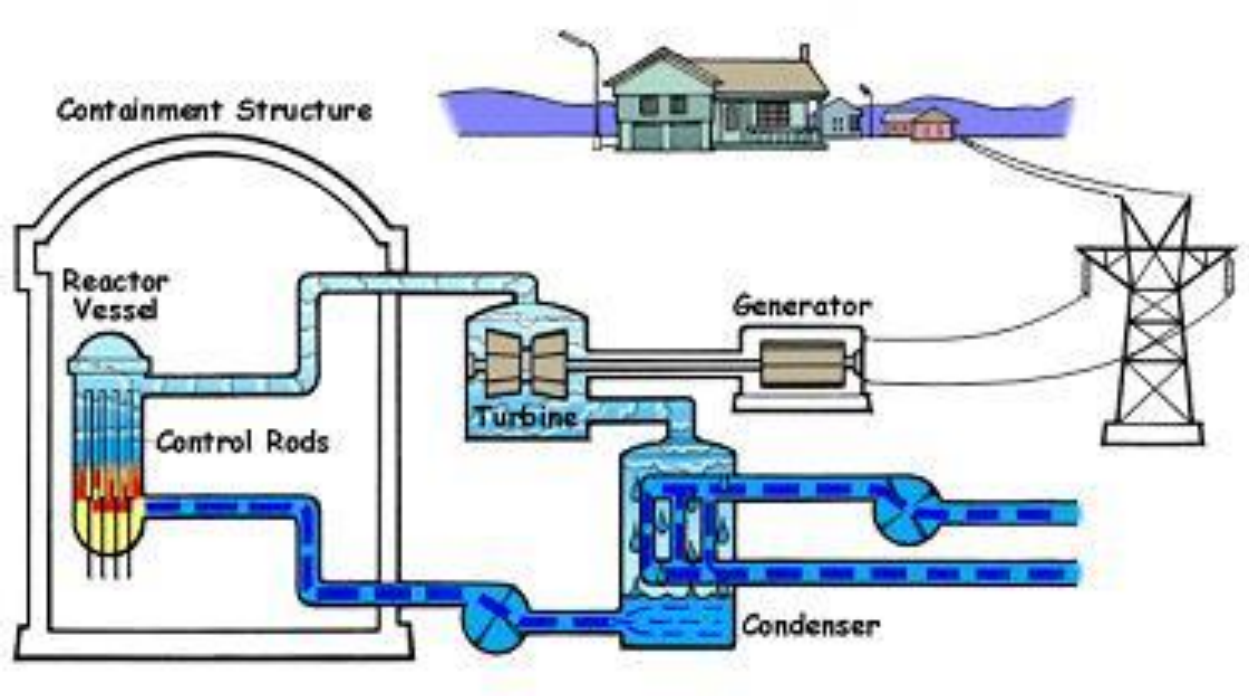
One ton of coal

Nuclear Fuel Assembly



- **Pellets are stacked and sealed in a Zircaloy tube (fuel tube) to form a fuel rod**
- **Fuel rods are placed in a matrix to form a fuel assembly**

Monticello Nuclear Generating Plant



Management of Spent Nuclear Fuel

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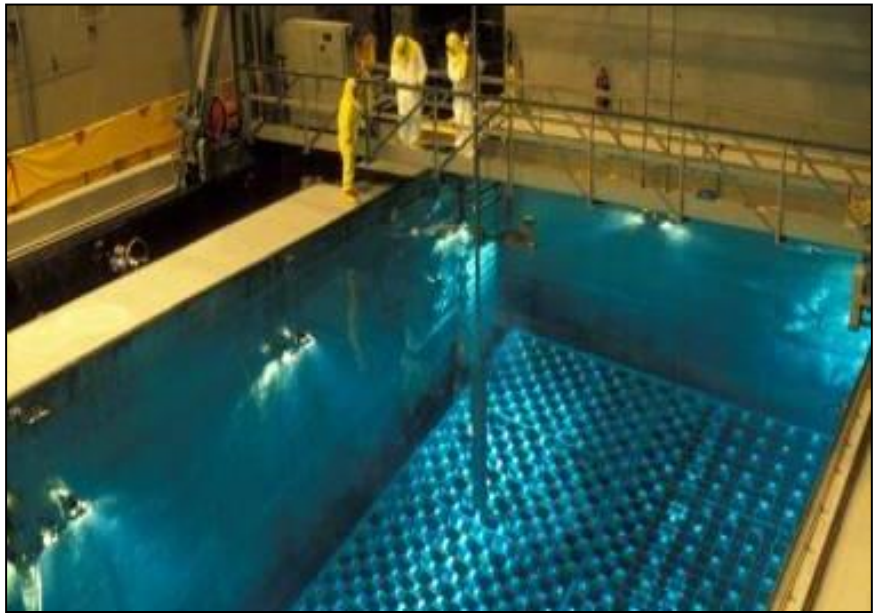
Spent Fuel Pools

After producing electricity for 5– 6 years, spent fuel assemblies stored in pools inside the plants. Once cooled sufficiently it is moved to dry storage systems.

Pools have 3-6 feet of concrete with stainless-steel liners.

Pools contain a leakage detection and collection system.



Status of On-Site Storage

30 loaded canisters stored on site

- Supports operations to 2030
- Mid-1980's shipped 33 casks containing ~1,000 assemblies to General Electric facility in Morris, IL

50 loaded casks stored on site

- 64 approved to support 2033/2034

Nuclear Policy Updates

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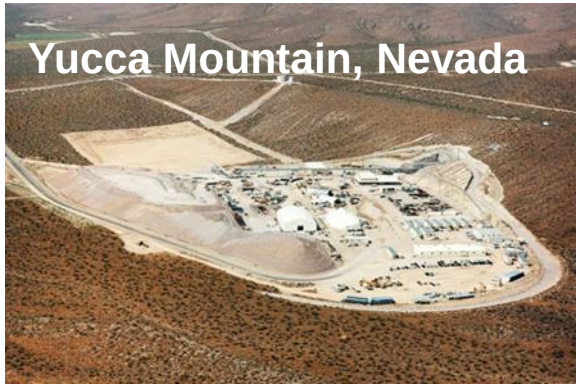
Extending Xcel Energy Nuclear Fleet

- **Monticello Nuclear Generating Plant**
  - Current operating license expires 2030
  - State Certificate of Need (CON) for 10-year extension approved August 2023
  - Federal license application to extend submitted to NRC January 2023
    - Decision expected end of 2025
- **Integrated Resource Plan**
  - Filed Feb 2024
  - Preferred plan would extend Monticello by 10 years, Prairie Island by 20 years
- **Prairie Island Nuclear Generating Plant**
  - Current operating license expires 2033/2034
  - State CON for 20-year extension filed Feb 2024
  - Federal license application to extend will be filed with NRC after CON decision final in 2026

Managing Spent Nuclear Fuel

Department of Energy responsible for permanent disposal (by law)



- Yucca Mountain not viable (politically)
- DOE Consent Based Siting Program for interim storage
    - Increased grant program to $26M as a result of the Consolidated Appropriations Act, 2023
    - 13 grantees awarded ~$2 Million each
    - Goal is to increase stakeholder capacity, dialogue, and education to assist the DOE to develop a community-focused consent-based approach

Consolidated Interim Storage

Holtec *Hobbs, New Mexico*

Integrated Storage Partners

Andrews, Texas

- Private Initiative
- Received NRC licenses but legal and state challenges remain

Advanced Nuclear

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Nuclear interface with the grid

Existing vs. advanced

Traditional nuclear power generation is large capacity base load.

1. Commercial light water reactors take longer to respond to power transients

2. Traditional role has generally been steady state base load

3. Current operating commercial reactors are of large MW size to capitalize on relatively stable O&M costs

Advanced nuclear power generation will fill a different role on the grid (or in other ways, i.e. process heat, district heat, etc.)

1. SMRs and other advanced reactor technology much more responsive to generation demand changes, with ramp rates similar to coal plants.

2. Almost all advanced reactor technologies have been designed to partner with renewables, both in opportunities to quickly change power levels, and possible complementary technologies (shared molten salt coolant/heat sink/enthalpy trap.)

3. Many advanced techs reduce LCOE via engineered cost reduction and building inherent safety into systems instead of relying on people

Advanced Nuclear Reactors Vary in Size

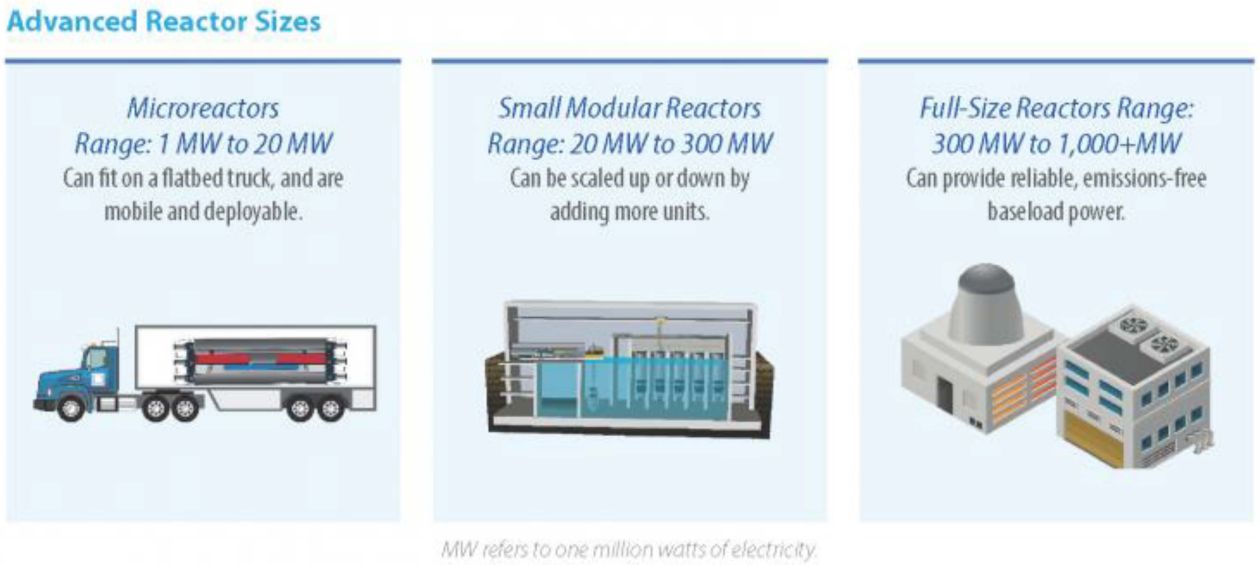

Image from U.S. Department of Energy Office of Nuclear Energy – Advanced Reactor Technology Development Fact Sheet: https://www.energy.gov/ne/articles/advanced-reactor-technology-development-fact-sheet

DOE Advanced Reactor Demonstrations

- **Reactor demonstrations** expected to result in a fully functional advanced nuclear reactor within 7 years of the award. Timeline is a challenge.

Two designs funded by DOE
Moving into next phases

Aoril 2024 - TerraPower Submits Construction Permit application to the NRC

TerraPower Natrium

- Sodium cooled fast reactor, combined with thermal storage
- Pilot location in Kemmerer, Wyoming. It is coal plant conversion
- Laboratory testing and analysis phase next
- Construction permit application submitted to NRC in 2024
- Early construction activities will begin 2024

X-Energy Xe-100

- Four, 80 MWe High temperature gas reactors
- Working with Dow on Pilot
- Ontario Power Generation and X-energy pursue deployment in Canada
- MOU with Saskatchewan company SIMSA for supply chain
- Announced selection of constructors

Advanced Nuclear Tech Overview

Small Modular Nuclear Reactors (SMRs)
Zero-Carbon Dispatchable Base Load

- SMRs: Modular fission reactors generally 50 to 300 MW
- Strong federal support: DOE >$5B over 7 years
- GE BWRX-300 under construction in Canada
- NuScale, TerraPower, and X-Energy in varying stages of pilot projects
- Project development, licensing and construction timeline estimated at 10-14 years
- Micro Reactors: Factory-built, 1-20 MW, very small footprint

Considerations:
- Fuel, supply chain, licensing

Gen III+

Strong Safety Case

Substantial Operating Experience

Design and Licensing Maturity

Conventional Fuel

Gen IV

Gas and molten salt/metal coolant

Includes: “fast” reactors

TRISO/HALEU fuel

2030

Technology Readiness

2040+

HITACHI III+
TerraPower IV
Westinghouse III+
energy IV III+
NUSCALE
TERRESTRIAL ENERGY IV
moltex clean energy IV
Flibe ENERGY IV
Kairos Power IV
OKLO IV
ULTRA SAFE NUCLEAR IV

30 + companies

Micro Reactors
(< 20MW)

Oklo (shown)
Approximately a dozen in development

LWR SMRs
<300MW

NuScale (shown)
GEH X-300
Holtec SMR-160

Resource Planning and Maintaining a Diverse Portfolio

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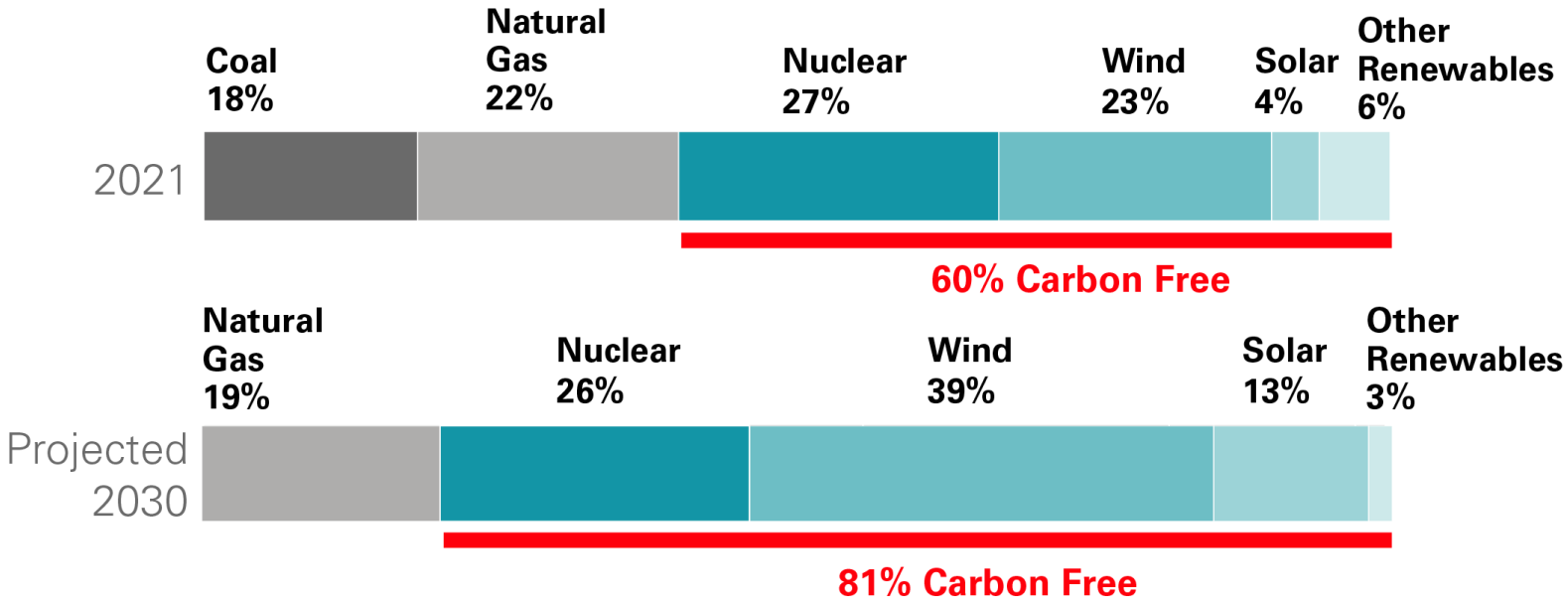
Cleaner Energy Mix

Upper Midwest electricity sources

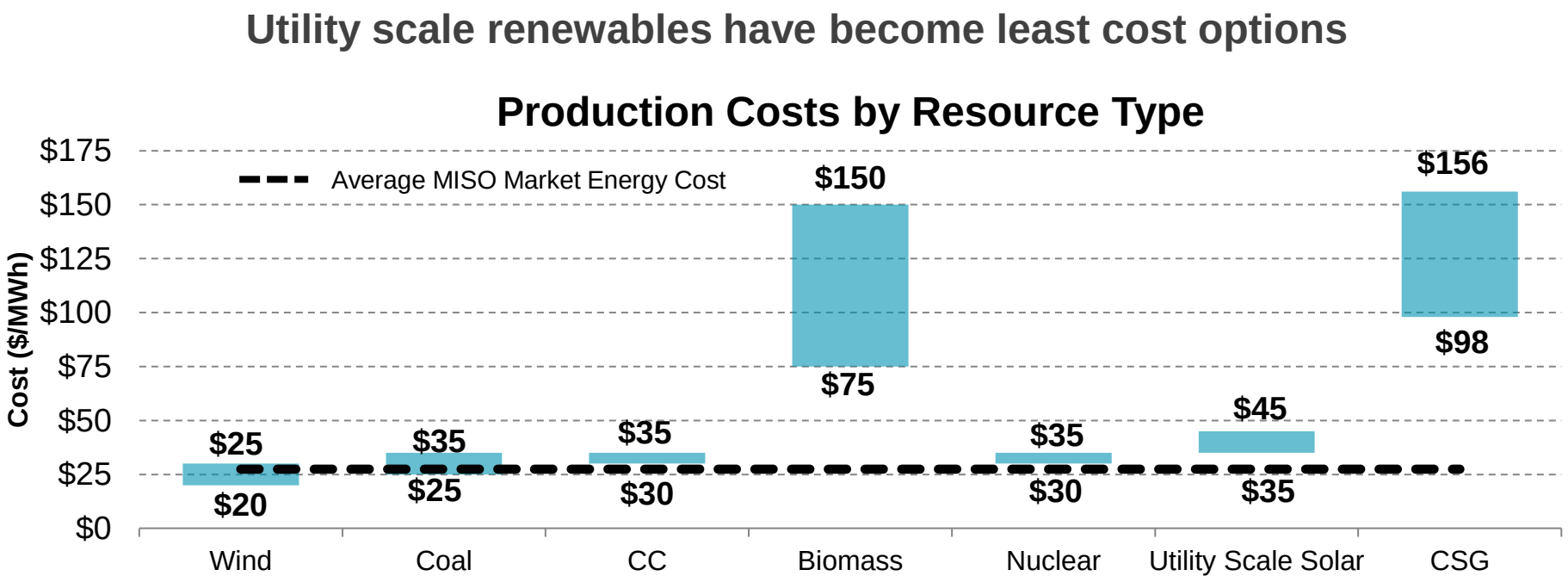


Upper Midwest Integrated Resource Planning (IRP) process

IRP is a roadmap for the generation resources we will use to serve customers in the future

- Assesses **size, type, timing** of least-cost resource sets that appropriately **balance four core planning objectives**
  - **All objectives must be balanced!**
- Looks **15 years** into the future; charts a path to our 2030 goals and beyond
- Models on a **"fixed resource adequacy basis"**
  - Ensures summer peak demand + reserve margin is covered with owned or contracted accredited capacity
- **Complex economic modeling** supports plan development

Current Generation Resource Economics



Production Cost = Fuel plus Operating & Maintenance Costs, CSG = Community Solar Gardens, CC = Natural Gas Combined Cycle
Wind & Solar Costs represent current estimated range for power purchase agreements (non-owned resources)
Sources: SNL Financial Power Plant Benchmarking Report 2018 values, Internal Xcel Energy Information

Long Term Resource Planning Considerations

- Industry is under-going tremendous change with the generation fleet turning over at an accelerating pace
- Average age of coal/natural gas plants is approaching 50 years
- There will be an on-going need for dispatchable and ‘spinning mass’ generation to maintain Transmission power quality/stability and meet customer demand
- Currently there are limited dispatchable generation options available long term, Long Duration Battery Storage, Natural Gas w/clean fuels or carbon capture, Advanced Nuclear, Geothermal+
- Utilities and their PUCs need to start working on long lead resource options – we need to start now to be successful and on pace with the retirements of the generation fleet
- Advanced nuclear is gaining national support
  - Multiple utilities are identifying it as a long-term resource option
  - DOE is developing programmatic support to catalyze development

In Summary

Xcel Energy's nuclear fleet is important to our customers, employees and the communities we serve

- Nuclear provides around the clock grid stability, voltage support and overall reliability
- Cost competitiveness is important, and we have reduced costs over 35% since 2013
- Strong Community partner

Nuclear is a key component of our company's future

- Plan to extend Monticello and Prairie Island part of our integrated resource plan
- Advanced nuclear could have a role in the future and we plan to stay engaged with nuclear developers

Finding a solution for spent nuclear fuel is a priority – especially for Xcel Energy

- We continue to provide industry leadership on all initiatives
- Intend to work with the Department of Energy to establish an interim siting program and continue to engage with federal and state policy makers on long-term storage
- Support the Consolidated Interim Storage applicants

Q & A