

Grant PSC-23-16 Michigan Nuclear Feasibility Study



January 9, 2024

Agenda

- Welcome and Introductions
- Overview of Goals for Stakeholder Meeting
- Review of Study Sections
 - Executive Summary
 - Intro – Advantages/Disadvantages (Section 1)
 - Michigan Resources/Expertise (Section 2 & Appendix)
 - Economic Impacts Assessment (Section 2 & Appendix)
 - Nuclear Technologies Evaluation (Section 3)
- Stakeholder Feedback/Q&A - Break
 - New Nuclear Technology & Siting (Section 4)
 - Nuclear Project Schedule Assessment (Section 5)
 - Coordination with Other Technologies (Section 6)
- Stakeholder Feedback/Q&A - Break
 - Policy Assessment (Section 7)
 - Supporting Studies Summary (Section 8)
 - Discussion of Economic and Power System Modeling (Appendix)
- Closing Remarks



AGENDA

Overview of the Goals for Stakeholder Meeting

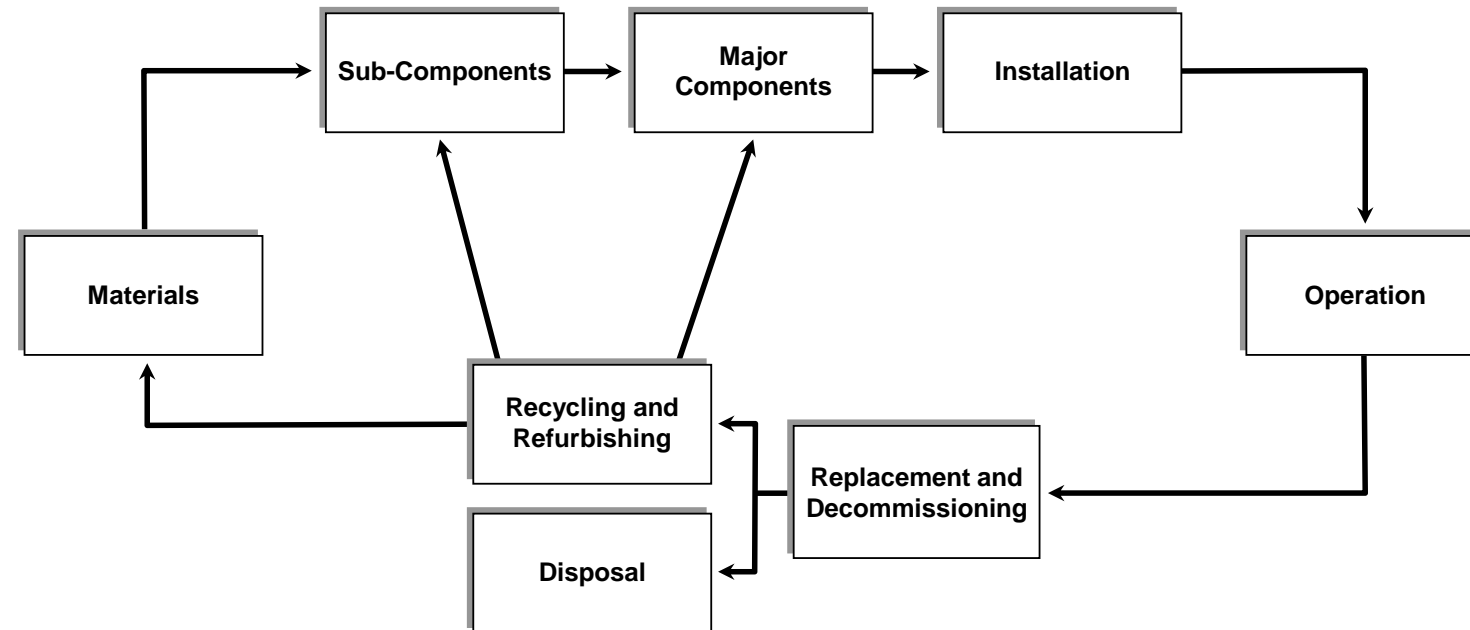
- Provide Summary Information on Draft Study
 - Summarize High-Level Findings
 - Solicit Feedback from the Public
 - Consider the Public Feedback w/ PSC input
 - Incorporate Feedback Items within the Scope of the Report into the Final version



- Impetus for the Study
 - Public Act 166 of 2022
 - Public Act 218 of 2022
- Roadmap of the Report – Highlighting which sections contain what information
- Summaries of Economic Impacts and Emissions Reduction Potential

- Brief History of Nuclear Power in Michigan
- Detailed mapping of the study parameters from Public Act 218 of 2022 – Description of Stakeholder Input to Study
- Brief History of Nuclear Power, generally
- Advantages of Nuclear Power
 - High Capacity Factors, Small Footprint (High Power Density), GHG-free Operation, Air Pollutant-free Operation, Resilience, Low Fuel Cost, Waste Storage Accountability, Local Economic Benefits
- Disadvantages of Nuclear Power
 - High Capital Cost & Long Timelines, Waste Final Disposition, Lack of Flexible Dispatchability, Radiation Concerns, Proliferation Concerns

- Use of Michigan Workers
- Workforce Education, Training, and Development
- Use of Michigan Products
- Supply Chain Development
 - Timeline and Outlays
 - Manufacturing
 - Employment



Nuclear Energy Plant Lifecycle Supply Chain

The economic impacts of constructing and operating a new small modular reactor in Michigan include the following:

- Economic Impact to the People of Michigan
 - Jobs during every phase from construction, operation, to decommissioning
- Economic Impact to Michigan Businesses
 - Total economic impacts of ~\$3.6-3.7 billion in direct, indirect, and induced effects
- Economic Impact to Michigan State Government
 - Total State Tax Impacts of >\$200M from construction and >\$250M from lifetime of operation for either modeled location



Evaluation of Current Nuclear Technology and Designs

- Design characteristics, including existing and potential modifications
- Environmental, ecological, health, and climate impacts
- Engineering and cost related criteria, including, but not limited to:
 - Extension of current NRC licenses
 - D.C. Cook Units 1 & 2
 - DTE – Fermi Unit 2
- Environmental Records of the existing plants
- Overview of License Renewal Process



Q & A

Executive Summary, Sections 1-3 & Appendix



Evaluation of New Nuclear Technology and Designs

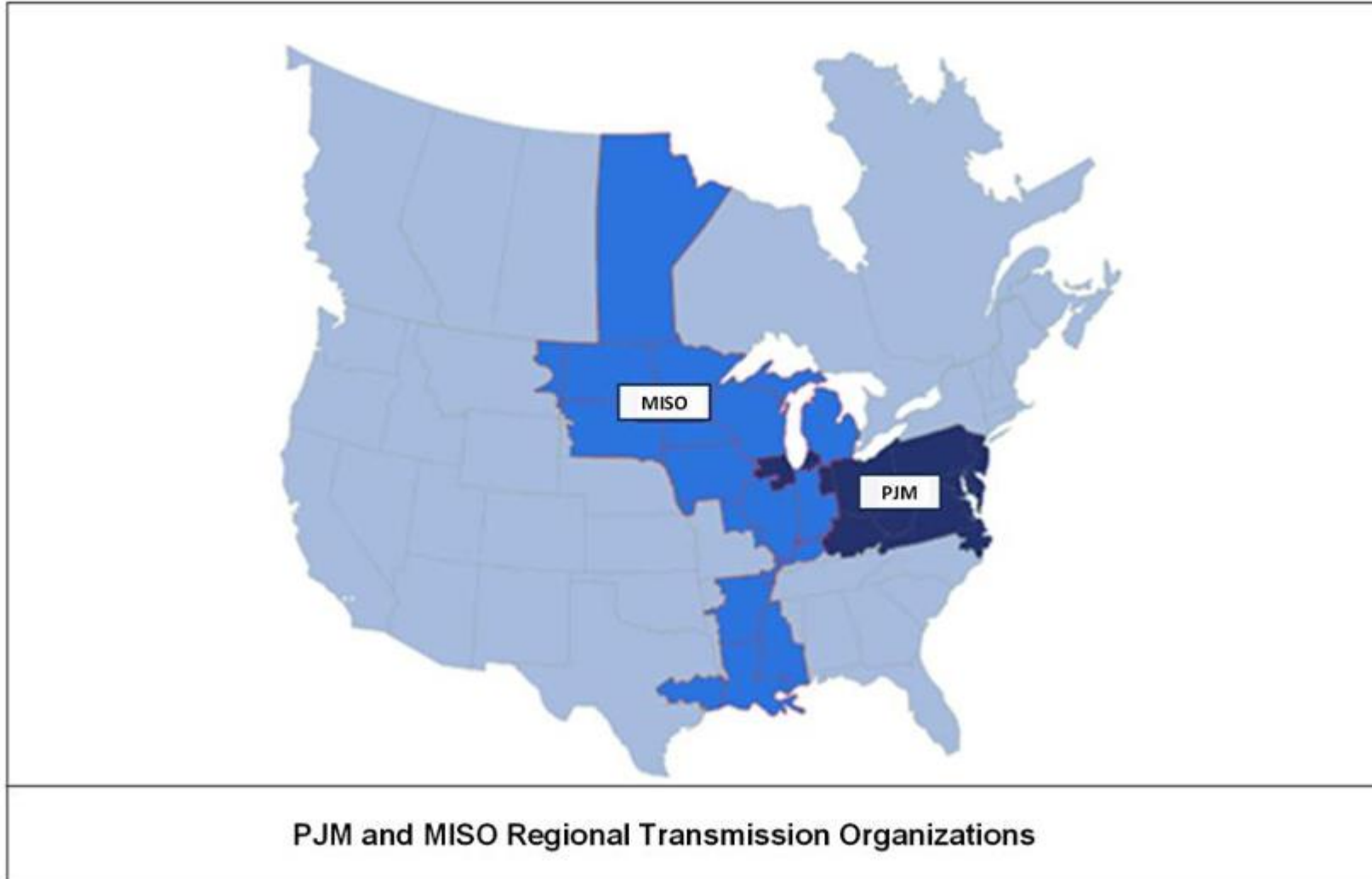
- Discussions of “Advanced” Nuclear, SMRs, and Microreactors
- Design characteristics, including but not limited to reactor types, sizes, and fuel
 - Sourced from EPRI, NEA, and NIA reports along with others
- Environmental, ecological, health, and climate impacts
 - NRC processes relating to these reviews; No CO2 emissions from operation
- Land and siting criteria
- Safety and on-site security criteria
 - Potential for reduced EPZ sizes & versatility for siting
- Engineering and readily available cost-related criteria
 - FOAK vs. NOAK unit cost, w/ learning curves
- Small-scale nuclear reactor capability
 - Comparable capacity factors expected; Some designs have improved efficiency and flexibility beyond electricity

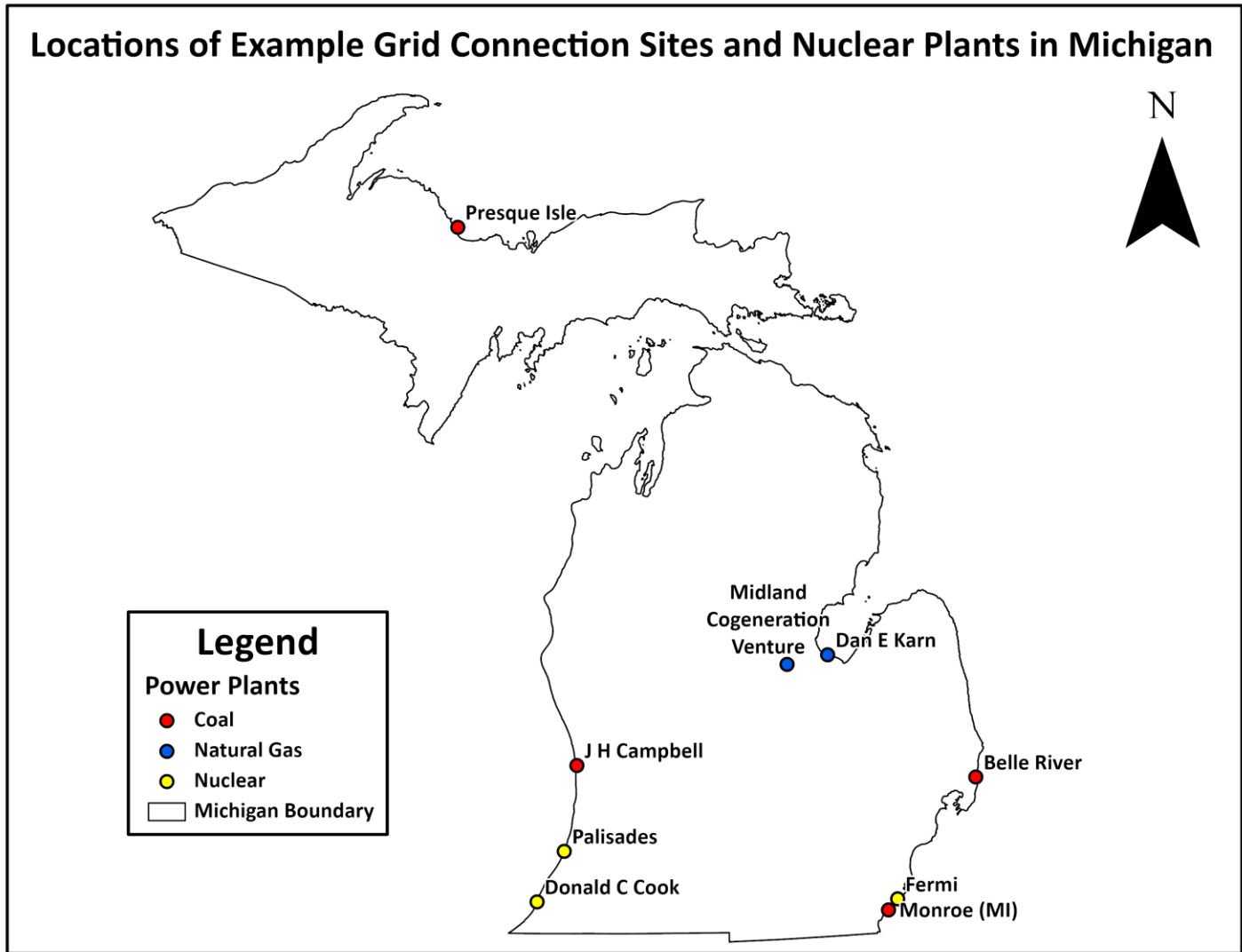


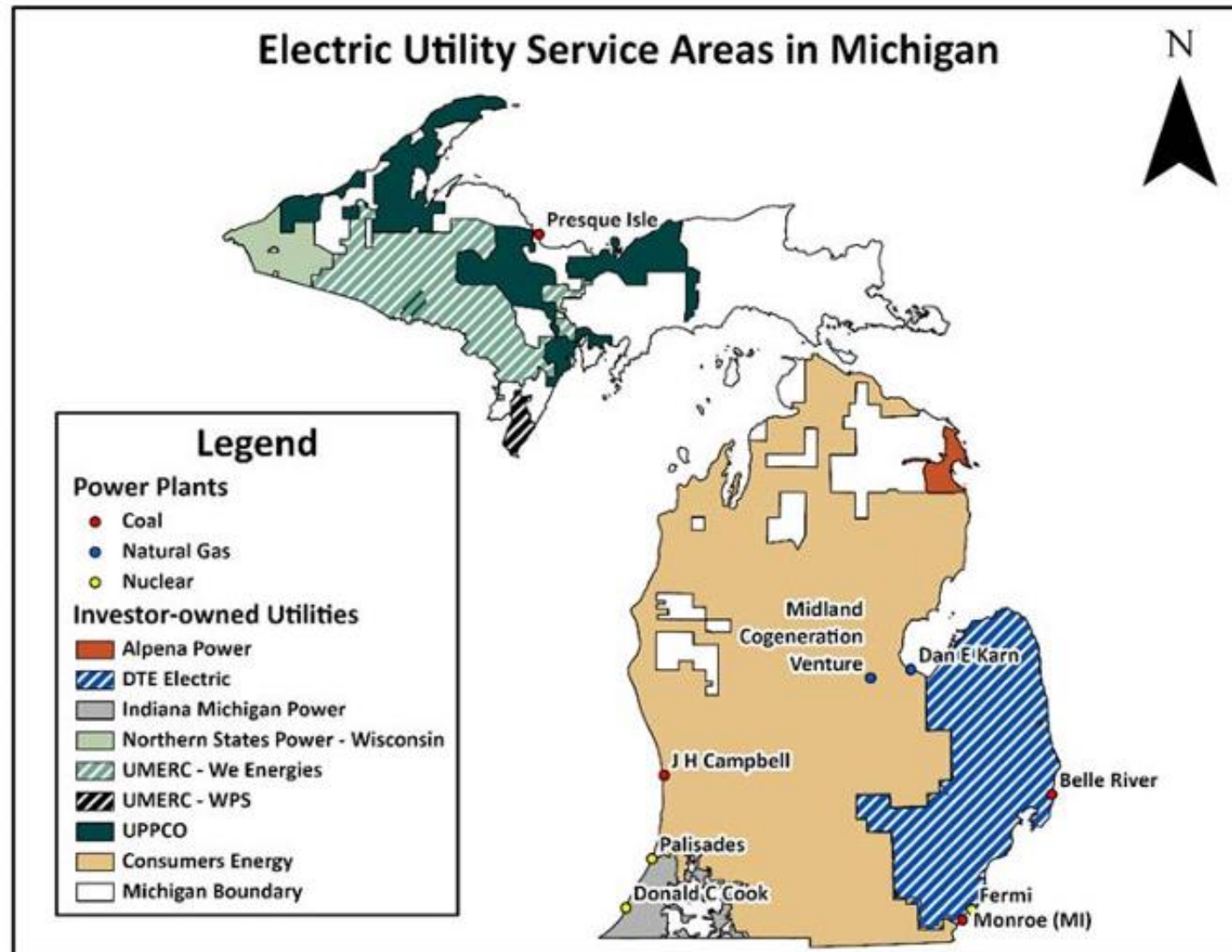
Process of Hypothetical Location Selection (Appendix)

- Look at current grid regions/system operator territories
 - MISO and PJM both operate “the grid” in portions of Michigan
 - Consider existing transmission infrastructure
- Note existing electric utilities within Michigan
- Selected 2 hypothetical sites for new nuclear generation for modeling purposes (economic and power system)









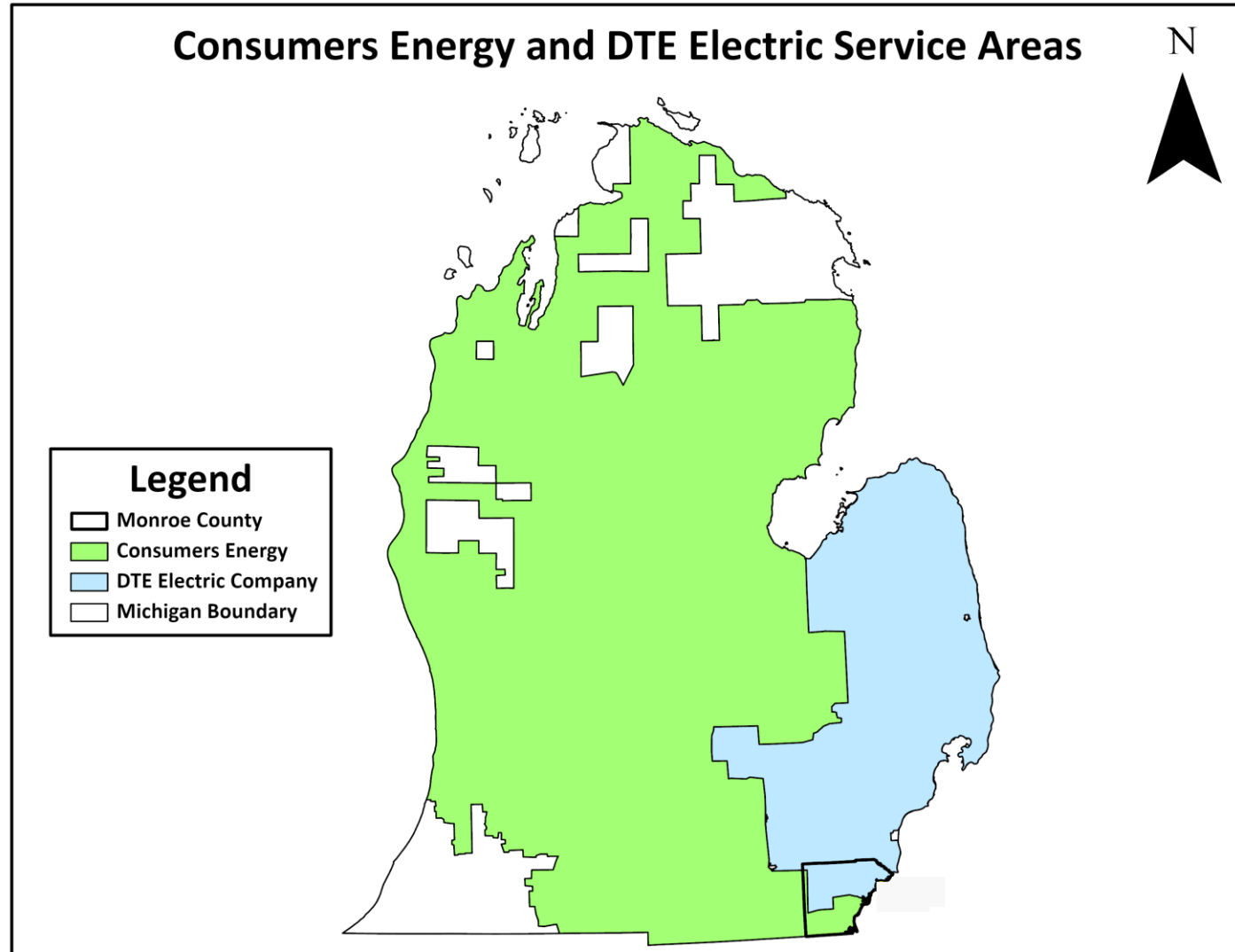


Table 5.3
Air Emission Reductions with Operating a Hypothetical Nuclear Plant (Tons)

Service Territory	Emission	Annual Reduction in 2036
DTE Electric	Carbon dioxide (CO ₂)	365.2K
	Sulfur dioxide (SO ₂)	62.4
	Nitrogen oxide (NO _x)	140.5
Consumers Energy	Carbon dioxide (CO ₂)	1.2M
	Sulfur dioxide (SO ₂)	6.2
	Nitrogen oxide (NO _x)	197.2

Determine the timeline for development of nuclear energy generation facilities within the State of Michigan

- DOE Liftoff Report Timeline →
- Potentially improved Timeline

Table 7 Best case scenario for completion of a nuclear power plant in the U.S. [52, 199].

Year	Y-1	Y-2	Y-3	Y-4	Y-5	Y+6	Y+7	Y+8	Y+9
Feasibility Study & Project Plan	Detailed Site Survey & Impact Assessment		Project Planning						
License		Apply for Permit	Permit Review	Construction Permit Issued		If part 50, apply for QL	Review by Reg.	Operating License Issued	
Design & Procurement	Procurement		Engineering Design (site specific)						
Construction	Contract with EPC	Site Preparation		Excavation	Construction			Commissioning / Start up	

Table 6 Illustrative major steps for building a nuclear power plant adapted from DOE [52].

Year	Y-1	Y-2	Y-3	Y-4	Y-5	Y+6	Y+7	Y+8	Y+9	Y+10	Y+11
Feasibility Study & Project Plan	Detailed Site Survey & Impact Assessment		Project Planning								
License		Apply for Permit	Permit Review	Construction Permit Issued				If part 50, apply for QL	Review by Reg.	Operating License Issued	
Design & Procurement	Procurement		Engineering Design (site specific)								
Construction		Contract with EPC	Site Preparation	Excavation	Construction					Commissioning / Start up	



Coordination with Other Technologies (Section 6)

Address gains made by coordinating new gen with retired nuclear, coal, gas, or other plants.

Address efficiencies by coordinating with other advanced, clean technologies, including:

- Re-Purposing Power Plant Sites
- Energy Potential Beyond Electricity
- Hydrogen Production
- District Heating
- Desalination (Not needed in Michigan)
- Direct air capture of carbon dioxide
- Energy storage
- Chemical/Petroleum Applications



Q & A

Sections 4-6 & Power System Modeling



- Nuclear Energy Innovation and Modernization Act (2019)
 - Requires NRC to develop a risk-informed performance-based evaluation technique for review of reactor design applications by 2027
 - Stakeholder recently provided significant comments on the NRC's proposed 10CFR53 rulemaking
 - In parallel with proposed rulemaking, a number of advanced reactor vendors in coordination with the Department of Energy and one existing nuclear utility developed the Licensing Modernization Program (LMP) that provides risk-based techniques for evaluating the hazards to be considered in advanced reactors
 - The NRC Commissioners concluded that the methodology in LMP is a reasonable approach for the design of advanced reactors
 - Many of the reactor designs are currently utilizing the LMP methodology
 - Delays in the final issuance of the 10CFR53 rule making is not expected to impact many of the advanced reactors currently being designed



- Infrastructure Investment and Jobs Act (2021)
 - Civil Nuclear Credit Program provides up to \$6 Billion incentives to preserve current US nuclear fleet
 - Financial incentive available for other nuclear plants that can demonstrate at risk of closure for economic reasons
- Inflation Reduction Act (2022)
 - Production tax credit of up to \$15/MWH available for operating nuclear plants from 2024 through 2032 (labor and wage requirements)
 - Production tax credits or investment tax credits available for deployment of advanced reactors designs (additional incentives for siting nuclear plants near existing coal facilities)
 - Provides financial support for domestic supply of Highly Assay Low-Enriched Uranium (HALEU)



- ADVANCE Act (Proposed Federal Legislation – S.1111)
 - Proposed legislation passed in bipartisan manner by the US Senate in July 2023
 - Develop and Deploy New Nuclear Technologies
 - Reduce regulatory costs associated with new reactor designs
 - Create incentives to deploy the next generation of nuclear reactors
 - Require NRC to develop pathway to review licensing of nuclear facilities at brownfield locations
 - Improve NRC efficiency
 - Provide tools to hire and retain staff
 - Require the NRC to schedule performance metric metrics for review of applications
 - Strengthen US nuclear fuel cycle and supply chain infrastructure
- Removed from National Defense Authorization Act negotiations in late-November 2023



- Other Proposed Regulatory Changes
 - Advanced Nuclear Reactor Generic Environmental Impact Statement (GEIS) – 2025
 - Generic environmental impacts will reduce effort for each site specific environmental assessment
- Recent State Policies
 - Michigan
 - Provided \$150 Million to support restart of Palisades
 - Michigan Clean Energy Future Bill – 100% carbon free generation by 2040
 - Nuclear power credited as carbon free source
 - Tennessee
 - Developed \$50 Million nuclear fund to supporting businesses in the nuclear industry that grow or relocate to Tennessee
 - Virginia
 - Nuclear Innovation Fund and Nuclear Education Grant Fund
 - California – state support for Diablo Canyon remaining open



- In Summary, Bipartisan federal support for nuclear
 - Reduce carbon emissions
 - Regain U.S. strategic position worldwide in nuclear technology
 - Russia and China aggressively marketing their nuclear technology around the world
- Expect additional federal policy changes to support the nuclear industry
- Recommended Policy Actions for Michigan
 - Policies that support first mover nuclear deployments
 - Utilities and power project developers continue to be concerned with the potentially high cost of the initial reactor deployments
 - Policies that support work force and supply chain development
 - Coordination with other states interested in nuclear may be advisable.





- Perform Literature Review
 - Complete analysis of national and international studies where development of nuclear energy is supported
 - Describe recent US nuclear generation studies
- The report currently has over 200 total references, including summaries of studies from DOE (particularly recent “Liftoff” reports for Advanced Nuclear and for Clean Hydrogen), The Union of Concerned Scientists, the Electric Power Research Institute (EPRI), TerraPraxis, Nuclear Energy Assembly (2 volume SMR dashboard), and the Nuclear Innovation Alliance (Advanced Reactor Primer)

- Today, the site remains in the early stage of the decommissioning process
- In March 2023, site owner Holtec filed an application for federal loan funding through the U.S. Department of Energy's Loan Programs Office to support the repowering.
- In August 2023, Governor Whitmer signed into law the Fiscal Year 2024 budget, which includes \$150 million for restart
- Holtec is in the process of developing a small modular reactor design (SMR-300) & has announced Palisades as their preferred location for the first installation, with 2 SMR-300 Units to be constructed following Palisades re-start



Q & A

Sections 7-9 & Appendix & Palisades



Closing Remarks, Next Steps for Final Report

- Final Report Due to Legislature by mid-April 2024
 - MPSC staff and ENERCON working towards that delivery

