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SMALL MODULAR REACTOR TECHNOLOGY AND ITS IMPACT FOR INDIANA

Indiana invests in a diverse energy supply including natural gas, coal, wind, and solar. Currently, no nuclear power plants exist in the state with the benefit of producing zero carbon emissions. In view of this, Purdue University, in partnership with a team of experts, was selected by the Indiana Office of Energy Development (IOED) to perform a comprehensive study that analyzes small modular reactor (SMR) technology applications and their impacts for the state of Indiana.

STUDY CONCLUSION

SMRs present a viable opportunity for Indiana to transition to a cleaner, resilient and diversified energy future. Successful deployment of SMR technology requires a careful balance of economic, regulatory and social considerations along with development of the technology.

KEY RECOMMENDATIONS

The state of Indiana, as well as Indiana energy stakeholders, should proceed with feasibility studies, build partnerships for SMR development and prioritize stakeholder engagement to ensure SMRs are integrated smoothly and beneficially into the state's energy portfolio. More specific recommendations include:

- Develop educational resources for differing audiences to build on publicly understood benefits of nuclear energy while educating on perceived safety and environmental concerns.
- Review existing state requirements, investigate incentives and lead in technology standardization with a goal of de-risking SMR construction within the state, especially at existing or retired coal plants.
- Take advantage of existing supply chain resources within the state to ensure Indiana's economy benefits from SMR construction anywhere in the nation.

CHALLENGES:

- **HIGH FIRST-OF-A-KIND (FOAK) CONSTRUCTION COSTS.** Subsequent "nth-of-a-kind" (NOAK) units are expected to be significantly cheaper as experience and efficiencies improve.
- **SUPPLY CHAIN STABILITY.** High-cost components like reactor vessels require reliable supply networks.
- **NAVIGATING FEDERAL AND STATE REGULATORY FRAMEWORKS.** Careful planning will be required to meet stringent safety and environmental standards.

OPPORTUNITIES:

- **LEADERSHIP ROLE IN SUPPLY CHAIN AND MANUFACTURING ECOSYSTEMS.** Early adopters might craft workforce development and supply chain programs to incentivize new, high-value business opportunities to locate in Indiana, including the manufacturing of key components.
- **LOCAL EXPENDITURES.** Many SMR construction categories of expenditures are sourced locally, including materials for structures and labor for sitework and field supervision.
- **COAL-TO-NUCLEAR TRANSITION.** Existing or retired coal plant sites and their workforce could be repurposed to support nuclear energy.

OPPORTUNITIES FOR INDIANA

- Coal-to-nuclear transition
- 24/7 dispatchable source of carbon free electricity with capacity factor of more than 92%
- Creation of high-paying jobs during construction and operation
- Increase of the tax base
- Increase employment by supply chain providers

TECHNOLOGY, DEMAND AND SITING

Electricity generation in Indiana has fallen by 26% over the past two decades while electricity consumption has only decreased by 3% over the same time period.

The first Department of Energy (DOE) Coal-to-Nuclear (C2N) report published in 2022 found that Indiana has 8 to 10 coal plants suitable for the development of nuclear plants. Only Texas has more suitable coal power plant sites.

Key benefits cited by the DOE for C2N included the following:

- Mitigate the economic challenges of closing a coal plant, turning it into an opportunity instead.
- Need for carbon-free baseload power throughout the country.
- Existing site, minimizing environmental impacts of new site.
- Existing workforce with some relevant skill sets.
- Existing infrastructure: roads, water, grid interconnection equipment and ancillary site improvements such as office buildings, fencing and security.
- Possible reuse of plant components such as the heat sink and the electric plant equipment.

Additionally, when a coal plant is replaced with nuclear, it is replacing a baseload power resource directly and can serve the same load as the coal plant served previously. Key site selection considerations include seismic and geological stability, proximity to existing infrastructure and environmental impact considerations, all of which are essential to meeting regulatory requirements and supporting safe, efficient operations.

ECONOMIC IMPACT AND COST

The DOE Liftoff Report examined ways to limit First-of-a-Kind (FOAK) construction costs. Their report suggests a cost of $6,200/kW is possible, which is 60% of the cost of the most recently constructed U.S. nuclear plant. Additionally, it was reported that there could be significant opportunities for savings between the FOAK and the NOAK that could reduce costs by another 40%. Further, repurposing coal sites could reduce SMR project costs by 7-26% due to existing infrastructure. Upon completion of construction, the costs of operating a nuclear power plant tend to be about half of the operating costs of a gas turbine plant or coal plant of the same size.

ECONOMIC BENEFITS OF 500MWe SMR

- Four year construction phase could create approximately **2,000 direct jobs** and inject **$500M+ annually** into the state's economy
- Operational phase could employ **140 full-time workers** earning 18% more on average than those in coal plants with an estimated economic impact of **$352M annually**, double that of a similarly sized coal plant

WORKFORCE NEEDS

It is essential to develop a skilled workforce to support nuclear energy as SMR technology demands a broad base of expertise in nuclear engineering, safety protocols, reactor operations and more. Additionally, workers trained in various fossil-fuel fields will require reskilling and retraining to adapt to the new employment environment. An evaluation of existing educational programs is required to identify relevant opportunities for workforce development. By creating synergy between and within Ivy Tech Community College, Purdue Polytechnic Institute, and Purdue Nuclear Engineering as well as other related disciplines, comprehensive nuclear training can be delivered for Indiana's workforce across all levels.

COMMUNITY SURVEY RESPONSES

46% of respondents (465 out of 1,012) either **favor or strongly favor** the idea of using SMR technology to produce electricity in the U.S.

ARGUMENTS FOR

- Low cost of electricity, **48.1%**
- Energy independence, **40.7%**
- Reduction of greenhouse gases, **38.2%**

CONCERNS WITH

- Risk of accident, **63.4%**
- Production of radioactive water, **55.7%**

SAFETY CONSIDERATIONS

SMRs have small emergency planning zones (EPZs) and have advanced safety characteristics including inherent safety features, advanced control systems, modularity, redundancy, and resilience.

COMMUNITY ENGAGEMENT

Focus groups—made up of local officials, economic developers, utility representatives and emergency managers—and surveys that targeted Indiana residents conducted over the course of the study found that public acceptance of nuclear technology hinges on transparent communication about the benefits and safety measures associated with SMRs. Education is needed on both real and perceived risks associated with SMRs as many residents are unfamiliar with advanced nuclear technologies.

82.7% OF SURVEY RESPONDENTS *reported that they thought scientists were the most trustworthy source of information on nuclear technology.*