INDEPENDENT NUCLEAR ECONOMIC MODELING

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OVERVIEW

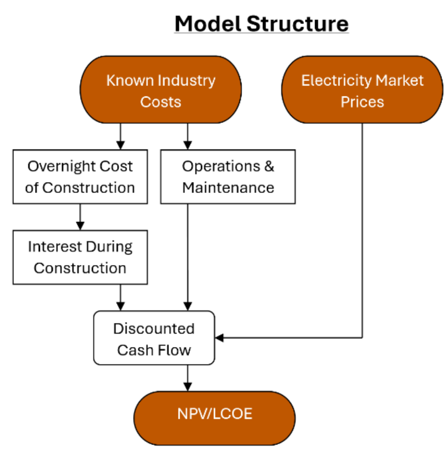
This paper examines the financial and economic viability of nuclear energy in a de-regulated market by analyzing current and proposed energy market conditions within the State of Texas. The goal of this analysis was to investigate the relationship between the input costs of nuclear energy projects and the output metrics used to both judge their financial viability and inform policy creation. An in-depth sensitivity analysis was used to identify which of those metrics had the most significant impact and how they could be modified to further increase a nuclear energy project's probability of success. The paper includes a set of ranked recommendations based on those findings, indicating where policy changes would have the most outsized effect.

METHODOLOGY

The model employs a discounted cash flow analysis (figure 1.1), incorporating data from regional electricity markets, coal-to-nuclear studies, and various industry sources to estimate the potential value of new nuclear power generation projects. The analysis considers multiple scenarios, accounting for varying project size, changes in technology learning rates, and the impact of the Inflation Reduction Act (2022) energy tax credits.

A sensitivity analysis was conducted to better understand the relationship between each of the cost inputs and how both together, and individually, they affect the primary output value metrics. Those output metrics being NPV, LCOE, and payback period.

1.1 discounted cash flow model structure



RESULTS

Results indicate that new nuclear projects would be financially viable under current and proposed Texas energy market conditions and further enhanced with certain policy changes. Figure 1.2 displays low, mid, and high-cost scenarios and results utilizing the IRA Investment Tax Credit (ITC). The "Medium" or most-likely scenario yields an LCOE of $61 /MWh which falls far below the more traditional LCOE range of $100-115 /MWh. The project value in this scenario is approximately $582 million with a payback period of 7 years, indicating that this project would be a good financial investment.

1.2 financial model results

LCOE & NPV using IRA Investment Tax Credits - BOAK			
Large & SMR	Low	Medium	High
Overnight Cost of Capital	$3,434 /kW	$5,160 /kW	$6,968 /kW
Operating Costs	$19 /MWh	$20 /MWh	$22 /MWh
LCOE	$48 /MWh	$61 /MWh	$77 /MWh
NPV	$1.57B	$0.58B	-$0.15B

- Interest rate: 8%
- Learning rate: 10%
- Construction time: 5 years
- Payback period: 5, 7, 10 (years)
- Electricity price date range: 2014-2023

The sensitivity analysis improved upon the initial model results by providing a larger set of outcomes with higher resolution. From this new set of results, it became possible to identify specific cost inputs that, when changed, would lead to outsized positive changes to the NPV and LCOE and an overall increase in project viability. Figure 1.3 shows five parameters that provide the best "bang-for-your-buck" along with a set of potential State policy actions and "Results" for each. The cost inputs are ranked according to the size of their result, how the perceived level of difficulty associated with implementing those policy changes. Example: while the coal-to-nuclear scenario increases project NPV by ~ $169 million, it would require the cooperation of government officials at both the State and local (city, county, etc.) levels, which would add a higher degree of difficulty. Comparatively, an energy firm's Weighted Average Cost of Capital (WACC) can be decreased by reducing perceived risk associated with new projects. Commitments by the State to support new nuclear projects would excite and reassure potential investors and energy firms.

1.3 ranking of sensitivity analysis cost inputs

Cost Input Ranking - Best "Bang-for-your-Buck" Policy Changes		
Name	**State Action**	**Result**
1. WACC	Long term commitments to nuclear and regulatory improvments by the State will help reduce percieved risk.	Reducing the WACC from 10% to 8.8% results in a positive NPV change of aprox. $292 million. LCOE drops by ~ $4 /MWh.
2. Interest Rates	Facilitate low interest loans.	Reducing the interest rate on loans from 7.3% to 3.3% results in a positive NPV change of aprox. $143 million. LCOE decreases by ~ $2 /MWh. The lower rate also encourages investment and lowers perceived risk.
3. Construction Time	Streamline permiting and regulatory processes. Reduce the amount of time it takes to build a plant and generate	Reducing build time from 5 years to 3 years results in a positive NPV change of aprox. $60 million. LCOE decreases by ~ $2 /MWh.
4. Coal-to-Nuclear	Facilitate the utiliziation of retired coal power plant sites as new nuclear plants to reduce construction costs and time.	There are 14 potential coal-to-nuclear sites in Texas. Estimated construction cost savings are 17-26%. Utilizing these sites and assets increases the NPV by 29% or aprox. $169 million. LCOE decreases by ~ $3 /MWh.
5. Electricity Price Floor	Set a minimum market electricity price over a given time period.	Guarunteeing a minimum price levels (in early project years) will improve nuclear power plant profitability/viability and can reduce future dependence on state assistance. Such assurances will also encourage investment and lower perceived risk.

Note: many of these inputs are interconnected and an incremental change to one often positively affects the rest.

CONCLUSIONS

The goal of this research was to find high-value policy changes that could further enhance the economics of implementing nuclear energy at scale. Crucially, a series of adaptable recommendations was developed to assist policy and decision makers regardless of reactor technology preferences or market size. These ranked recommendations and findings were presented to the Public Utility Commission of Texas Advanced Nuclear Working Group and used to inform upcoming state-level energy policy creation.

REFERENCES

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