645 – Computational Economics
Tyler Linnebur
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Project Proposal

Research Question

How much value does permitting reform create for new nuclear projects by reducing delays and uncertainty, and through which channels (IDC, WACC/risk premium, soft costs, abandonment risk) does that value materialize?

Nuclear power is a key component of decarbonization because it provides reliable, low-carbon baseload electricity. Yet new projects remain among the most capital-intensive and risky energy investments, with high upfront costs, long timelines, and frequent delays. These challenges raise financing burdens through higher interest during construction (IDC), increased weighted average cost of capital (WACC), inflated soft costs from regulatory requirements, and greater abandonment risk (Portugal-Pereira et al., 2018; Eash-Gates, 2020). Permitting reform has been proposed to reduce these uncertainties by shortening reviews and improving predictability (Jacobs et al., 2024; Bowen et al., 2024). This project develops a quantitative model to estimate the economic value of such reforms and identify the channels through which benefits materialize.

Overview of Recent Research

Research highlights two themes: how regulatory delays shape project risk and how delays and overruns affect nuclear economics. Lengthy and unpredictable licensing processes consistently raise financing costs and weaken nuclear competitiveness (Portugal-Pereira et al., 2018; Guaita et al., 2025).

Work on regulatory processes shows that statutory timelines, generic environmental reviews, and restructured NRC fees can reduce soft costs (Jacobs et al., 2024). Studies of National Environmental Policy Act reforms demonstrate that page and time limits and expanded use of Environmental Assessments improve predictability, lowering IDC and WACC (Bowen et al., 2024). Broader reform proposals emphasize more efficient NRC decision-making to reduce abandonment risk (Nuclear Innovation Alliance, 2024).

Empirical evidence quantifies the financial impact of delays. Cross-national studies find costs increase by roughly 20 percent on average due to extended financing periods (Portugal-Pereira et al., 2018). Case studies link regulatory uncertainty and design complexity to overruns, raising soft costs and abandonment risk (Eash-Gates, 2020). Econometric comparisons show U.S. projects face much higher overruns than those in Europe and Asia, particularly after Three Mile Island when regulations tightened (Guaita et al., 2025). Together, these findings suggest permitting reform could unlock value by reducing IDC, WACC, soft costs, and abandonment risk. While each mechanism is documented, their combined effect has not been systematically quantified. This project addresses that gap using a structured investment model.

Proposed Modeling Approach and Anticipated Hurdles

The project uses a two-stage stochastic investment model. In stage one, an investor decides whether to build a plant, represented by a binary decision variable weighing expected revenues against risks. In stage two, delays and cost overruns are drawn from probability distributions, influencing financing costs, the start of operations, and overall project cost. Once operating, revenues from electricity sales are compared with lifetime costs.

Permitting reform is modeled as a shift in delay years, cost multipliers, and risk premiums. In the baseline, permitting is lengthy and uncertain, with wide outcome spreads. Under reform, delays are shorter and variance smaller, reducing costly extremes. These changes operate through four channels: shorter delays lower IDC, reduced uncertainty lowers WACC, streamlined reviews cut soft costs, and predictable processes reduce abandonment risk.

Model outputs will include changes in net present value (ΔNPV), levelized cost of electricity (ΔLCOE), and a "support equivalent," defined as the reduction in carbon price or subsidy needed for viability after reform. These outputs make the value of permitting reform measurable and policy relevant.

Key hurdles include calibration, since reforms like "shorter reviews" must be expressed as quantitative inputs; data scarcity, as detailed permitting timelines and escalation data remain limited; and balancing realism with tractability for a classroom project. Stylized scenarios calibrated to literature ranges will be used rather than a full dataset.

Data Availability

The model will draw on four categories of data: (1) delay and cost overrun distributions to define scenarios (Portugal-Pereira et al., 2018; Guaita et al., 2025), (2) permitting timelines and fees to capture impacts on soft costs and uncertainty (Jacobs et al., 2024; Bowen et al., 2024), (3) financing assumptions for WACC, IDC, and capital structures, adjusted for risk (Eash-Gates, 2020), and (4) licensing practices and policy supports to reflect realistic investment conditions (Nuclear Innovation Alliance, 2024).

Contribution

Most studies analyze permitting reform qualitatively or focus on single cost drivers. Few quantify its overall financial value. This project contributes by linking reform to measurable economic outcomes in a stochastic investment framework. By capturing the combined effects of IDC, WACC, soft costs, and abandonment risk, the model produces a systematic estimate of reform's value. The results aim to provide insights that are academically rigorous and useful for policymakers seeking to make nuclear power more viable in a decarbonized system.

References

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