



**Hamm Institute
for American Energy**

OKLAHOMA STATE UNIVERSITY

Regulatory Harmonization for Small Modular Reactors: Direct and Opportunity Cost Implications

*Evidence from U.S. Developers and
Cross-Jurisdictional Benchmarks*

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Regulatory Harmonization for SMRs: Direct and Opportunity Cost Implications

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This assessment estimates whether cross-country regulatory harmonization lowers the direct regulatory costs of small modular and microreactors, and how those effects compare with the value of time saved. Results are anonymized and presented by product segment rather than firm. Figures reflect public material and interviews with executives across vendors, utilities, regulators, and advisors. Where sources differ, we present ranges and state assumptions so the numbers remain useful as of 2025.

Scope and Method

We examine three segments: We examine three segments: utility-scale light-water reactors (LWRs) in small modular reactor (SMR) configurations (multi-module stations of ~300–1,000+ MWe), advanced non-LWR SMRs (high-temperature gas, molten salt, or sodium designs of ~20–350 MWe), and transportable/behind-the-meter microreactors (~1–20 MWe).

Direct regulatory cost is decomposed into (a) regulator fees and (b) applicant/third-party licensing and qualification work (engineering analyses, safety case development, testing, quality). Opportunity cost of delay is estimated as:

Forgone Revenue

$$= \text{Capacity (MWe)} \times \text{Capacity Factor (0.9)} \times \text{Price (\$/MWh)} \\ \times \text{Hours per Year (8,760)} \times \text{Years Delayed}$$

We normalize to 2025 dollars, assume typical nuclear capacity factors (~90% unless technology evidence suggests otherwise), and run price bands for grid wholesale and premium behind-the-meter markets.

An independent energy-finance advisory compiled an anonymized, cross-vendor benchmark indicating direct regulatory outlays of ~\$20–40 million per reactor and opportunity costs of roughly ~\$1 billion for a 2–3-year delay per ~750 MWe, as of 2025. We use this as an industry-wide calibration point rather than a vendor-specific projection.

Findings

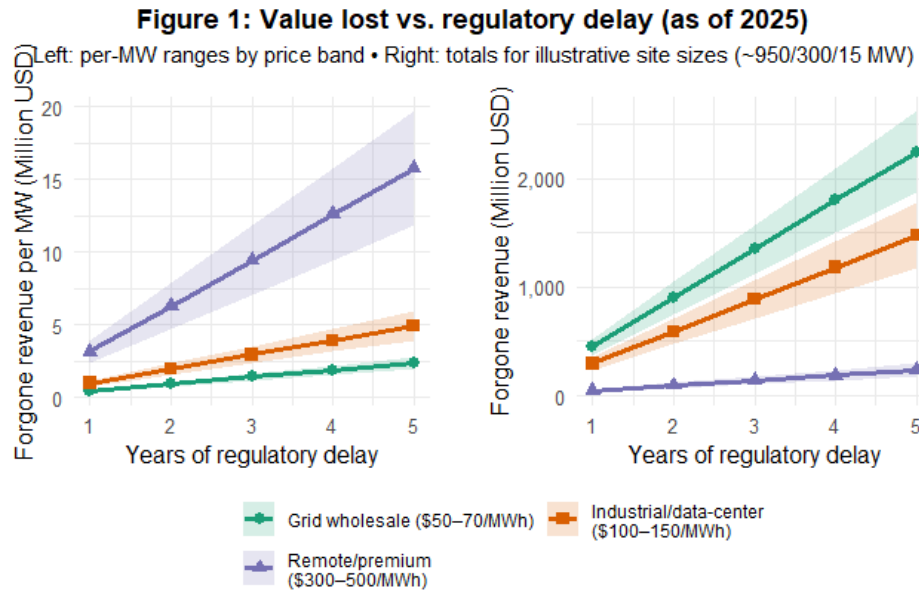
Cross-country regulatory harmonization materially improves project economics primarily through schedule compression. Shorter reviews and reduced duplication bring revenue

forward and lower financing carry, increasing project value even when statutory fee lines are unchanged. As of 2025, a two-year acceleration typically preserves approximately \$0.5–1.0 million per MWe, conditional on capacity factor and realized prices. Earlier approvals also reduce interest during construction and pre-revenue overhead, improving net present value.

Component of direct regulatory cost	Typical share (illustrative)	What harmonization can affect
Regulator fees	~30–40%	Limited change (statutory/fee-schedule bound)
Applicant & third-party analyses/tests/QA	~60–70%	Material reuse via mutual reliance/acceptance

With respect to direct regulatory cash outlays, we do not observe consistent, material reductions in regulator fee schedules across jurisdictions. Limited direct savings arise on the applicant/third-party side when prior analyses, tests, and safety evaluations are formally accepted under mutual-reliance arrangements. These savings are real but uneven and not yet quantifiable with confidence across countries; hence, our emphasis on the schedule benefit.

Indicative magnitudes remain as follows (all approximately, as of 2025). Direct regulatory costs: utility-scale LWR SMRs ~\$20–50 million per reactor (follow-ons nearer ~\$20–40 million where certified designs and prior evaluations are referenced); advanced non-LWR first-of-a-kind (FOAK) program licensing/qualification in the hundreds of millions, in some cases ~\$0.6–1.2 billion across the FOAK envelope; microreactors ~\$5–40 million per unit, noting a proportionally heavier burden at very small outputs under current pathways. Illustrative opportunity costs for a two- to three-year delay: ~\$1.2–2.4 billion for a ~900–1,000 MWe multi-module LWR SMR site; ~\$0.3–0.6 billion for an advanced non-LWR SMR of ~300–350 MWe; and ~\$16–20 million for a ~15 MWe microreactor at grid-like wholesale prices, rising to ~\$50–150 million where premium behind-the-meter tariffs apply (defense, remote industry, data centers).



Comparative Insights

Economics differ by what is being displaced. Microreactors compete against diesel logistics and the cost of waiting for grid upgrades; utility-scale LWR SMRs monetize firm capacity and process heat at scale with modular revenue starts; advanced non-LWR SMRs create value where high-grade heat matters for hydrogen, ammonia, fuels, and materials.

Harmonization works through reliance, not rebates. Where regulators accept prior safety evaluations, technology-specific review tracks, right-sized emergency planning zones, validated code acceptance, and coordinated export/fuel approvals, the schedule compresses. We do not observe uniform reductions in fee lines across borders. Any direct-cost relief is mostly the avoided re-work in applicant/third-party effort, which varies by design maturity, documentation quality, and the depth of reliance between authorities.

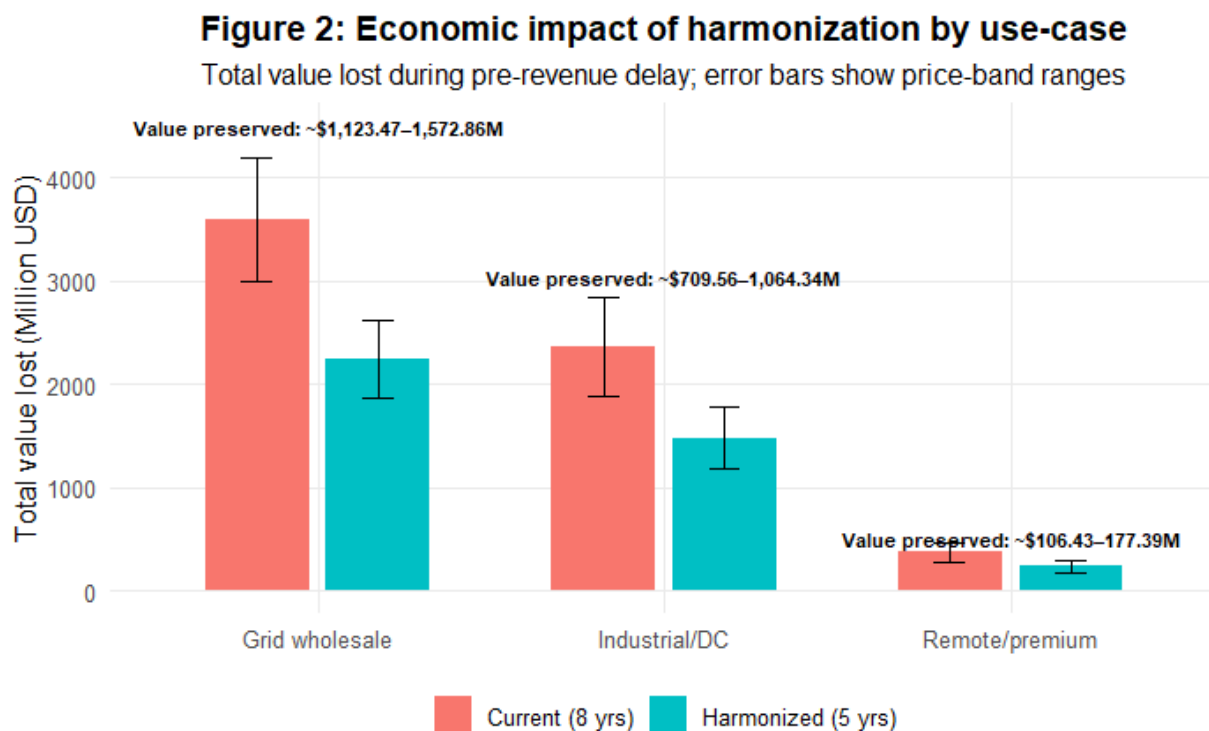
Policy Implications

Harmonization should be managed and funded as a schedule program. Success ought to be measured in months saved from application to first revenue and in the share of prior analyses formally accepted by relying authorities. Regulators should publish these metrics regularly so that reliance is visible and auditable.

Technology-specific pathways for non-LWR SMRs and microreactors should be codified with right-sized scope, including clear criteria for accepting model-based evidence (for example,

digital twins and validated severe-accident codes). Resourcing then becomes pivotal: without additional reviewers and technical staff, reliance agreements do not translate into throughput. Emergency planning zones should be right-sized where safety cases justify it, and export and fuel approvals should be sequenced in parallel to avoid serial bottlenecks.

Because direct regulatory cash outlays rarely fall in a uniform way across countries, the policy emphasis should remain on schedule compression and on the applicant/third-party savings that come from reusing prior work. Applicants should report engineering hours and third-party test spend avoided through reliance; regulators should report the percentage of prior evaluations they accept. Developer-led build-own-operate or build-own-transfer structures that bundle behind-the-meter anchors with grid offtake can further pull forward learning curves and spread first-of-a-kind risk across borders.



Conclusion

Cross-country harmonization increases project value chiefly by compressing the schedule, not by cutting regulator fee lines. Saving two to three years reliably preserves hundreds of millions to billions per project; direct regulatory spend is comparatively small. The fastest

route to scale is mutual reliance, technology-specific pathways, right-sized emergency planning zones (EPZs), parallel fuel/export approvals, and sufficient regulator staffing.