# Nuclear Nation Building

## Policies and pathways for scaling new reactors across Canada

**SEPTEMBER 2025** | **Brendan Frank**

With energy-economy modelling from Navius Research and public polling from Léger

# About Clean Prosperity

Clean Prosperity is a Canadian climate policy organization that advocates for pragmatic solutions to grow the low-carbon economy. Learn more at CleanProsperity.ca.

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# Abbreviations

| | | |
|---|---|---|
| BWR | Boiling water reactor | |
| CANDU | Canada deuterium uranium | |
| CCGT | Combined cycle gas turbine | |
| CCNG | Combined cycle natural gas | |
| CNSC | Canadian Nuclear Safety Commission | |
| CCS | Carbon capture and storage | |
| FOAK | First-of-a-kind | |
| HALEU | High-assay low-enriched uranium | |
| IESO | Independent Electricity System Operator | |
| IAAC | Impact Assessment Agency of Canada | |
| ITC | Investment tax credit | |
| LCOE | Levelized cost of electricity | |
| LCOF | Levelized cost of firming | |
| LTPS | License to prepare the site | |
| LEU | Low-enriched uranium | |
| NOAK | nth-of-a-kind | |
| NPV | Net present value | |
| SMR | Small modular reactor | |
| W | Watt | 1 W = 1 joule per second |
| kW | Kilowatt | (1,000 watts) |
| MW | Megawatt | (1,000,000 watts) |
| GW | Gigawatt | (1,000,000,000 watts) |
| TW | Terawatt | (1,000,000,000,000 watts) |
| Wh | Watt-hour | 1 Wh = 3600 joules |
| kWh | Kilowatt-hour | (1,000 watt-hours) |
| MWh | Megawatt-hour | (1,000,000 watt-hours) |
| GWh | Gigawatt-hour | (1,000,000,000 watt-hours) |
| TWh | Terawatt-hour | (1,000,000,000,000 watt-hours) |

# Executive summary

**Nuclear energy expansion could be a driver of Canadian prosperity, competitiveness, and climate progress for decades to come — in short, a nation-building endeavor among federal and provincial governments, Indigenous peoples, and local communities.** But building new nuclear reactors only makes sense if provinces commit to deep electrification of their economies.

Electrifying Canada's economy can advance economic, security, and climate goals. New reactors, large or small, can help. But to meet short-term electricity demand growth, provinces must build new generating capacity, and build it quickly. Nuclear expansion will operate on a slower timeline. In the long run, this expansion can offer large amounts of clean electricity and valuable hedges against future constraints on the grid.

This paper uses energy-economy modelling from Navius Research, in-house financial modelling, and public polling to assess enabling conditions for scaling nuclear power in Canada. Across our energy-economy modelling, we find that a best-case scenario for nuclear energy requires a combination of deep electrification, capital cost reductions for new reactors, and efficient industry execution of reactor construction. In this scenario, nuclear power becomes not just a far more cost-competitive option, but an undertaking of national scale.

High upfront costs remain a significant barrier to deploying nuclear power. Our public polling shows that while a majority of Canadian voters hold favourable views of nuclear power, a majority would also not support building a nuclear power station in their province if it increased the price of electricity. Upfront capital support, such as investment tax credits, and steep cost declines are required to create the cost reductions necessary for scaling.

Our modelling shows that Canada could increase its nuclear generating capacity from 13 gigawatts today to 41 gigawatts in 2050, more than tripling the capacity of its current fleet. Building at this scale would entail adding over 1.5 gigawatts of nuclear capacity every year from 2035 to 2050. But to get there, Canada will need to get three things right.

Electrifying Canada's economy can advance economic, security, and climate goals. New reactors, large or small, can help. In the long run, nuclear expansion can offer valuable hedges against future constraints on the grid.

## Recommendations

**Recommendation #1: Electrify everything.** Electrification is a strategic lever that can support Canadian competitiveness and energy security. Accelerated electrification on its own can unlock billions worth of investment, savings for consumers and taxpayers, and positive spillover effects across the economy. It also aids the case for nuclear expansion.

To further support provinces that want to build new nuclear reactors, we recommend that the federal government pass the Clean Electricity Investment Tax Credit as soon as possible. In parallel, we recommend provinces direct energy system regulators to align their mandates and capital planning with deep electrification. Current regulator mandates are too narrow and are creating misalignments between electrification goals and capital planning.

Provinces should also strengthen their carbon markets to level the playing field for low-carbon electricity sources like nuclear power. Any resulting costs to consumers should be offset with direct $-per-kWh rebates.

**Recommendation #2: Use fleet-based planning.** Fleet-based approaches to nuclear expansion are optimized around single reactor designs. Repeat builds of the same reactor design offer the most plausible pathway to cost reductions. Provinces and the federal government should pursue, coordinate, and standardize a single design choice for each reactor size category: large, small, and micro.

Provinces should also prioritize the expansion of existing nuclear sites zoned for electricity generation over greenfield development to shorten project timelines, and to enable cost sharing and economies of scale in construction and operations (e.g. refueling, security, shielding, shared infrastructure).

**Recommendation #3: Be transparent about costs and develop off-ramps to contain them.** We recommend that Ontario, in partnership with the federal government, publish project-level cost data for the BWRX-300 project at Darlington. This is the first new nuclear build in Canada in over four decades. Sufficient transparency over the life of the project will facilitate the development of learning curves, cost curves, and shared labour and capital across provinces.

We also recommend the Ontario government consider developing off-ramps for the Darlington BWRX-300 project, should cost curves fail to materialize, and establish checkpoints that clearly define when to take those off-ramps.

# Introduction: fast and slow electricity projects

As provinces anticipate significant demand growth on their grids, nuclear reactors offer a distinct and valuable package of attributes: long-lived, large-scale, high-capacity, zero-carbon baseload generating assets with low land-use requirements and manageable risks related to safety, waste, and security. Provinces are considering new reactors of various sizes — large, small, and micro. The economic case for all requires a long time horizon. In the short term, governments, system planners, and utilities will meet growing electricity demand with a mix of energy-efficiency measures[1] and significant net-new generating capacity. Electricity projects that are widely deployable by 2030 include wind, solar, natural gas generation, utility-scale storage, and transmission, but not nuclear power.

Reactors are long-term, geoeconomic infrastructure. Most projects will take a decade or more to complete. But with refurbishment, reactors constructed in the 2030s could conceivably operate into the next century.

This paper assesses the enabling conditions for scaling nuclear power in Canada. The paper analyzes the costs, benefits, and tradeoffs of expanding Canada's fleet of commercial reactors. We use:

1. Energy-economy modelling from Navius Research to identify drivers of nuclear buildout to 2050.
2. Levelized cost of electricity (LCOE) analysis for the Darlington New Nuclear Project.
3. Public opinion polling from Léger, which identifies cost containment and low electricity prices as necessary for broad public support of nuclear expansion.

[1] We use efficiency to describe actions that reduce consumption, ranging from avoided generation (e.g. virtual power plants, distributed energy resources) to improved efficiency of "energy services," to mobilization of private capital (e.g. local distribution reforms).

# State of play: action on new nuclear builds in Canada

Five provinces are considering new nuclear reactors — large, small, and micro — as part of their future grids. Ontario, New Brunswick, Saskatchewan, and Alberta are all signatories to the 2022 joint Strategic Plan for the Deployment of Small Modular Reactors.

**Ontario** is the core of Canada's nuclear industry and home to the overwhelming majority of the nuclear supply chain, which has been revived and primed by the ongoing refurbishment of 16 CANDU reactors across the Bruce, Pickering, and Darlington Nuclear Generating Stations.[2] These refurbishments have to date been on budget and either on or ahead of schedule, cutting against the nuclear sector's recent history (see Box 1).

The Darlington B New Nuclear Site is licensed for up to 4,800 MW of new nuclear capacity. In December 2022, Ontario Power Generation (OPG) broke ground on the first of four BWRX-300 small modular reactors (SMRs) at Darlington. These four reactors, once completed, would have a total generating capacity of 1,200 MW. OPG is also considering three strategic sites, formerly fossil fuel-based generating stations, for new reactors. The most viable is the Wesleyville Station in Port Hope.[3] A proposed 4,800 megawatt (MW) expansion at Bruce would make it the world's biggest nuclear station.

**New Brunswick** is interested in expanding the Point Lepreau Nuclear Generating Station. The provincial government recently included a second reactor at Point Lepreau as part of its nation-building pitch to the federal government.

**Saskatchewan** is considering the BWRX-300 for its first nuclear project, anticipates a final construction decision in 2029, and has narrowed its search to the Estevan region. In 2023, the Government of Saskatchewan also invested $80 million via the Saskatchewan Research Council (SRC) to demonstrate a first-of-a-kind eVinci 5 MW microreactor.

**Alberta** remains in early exploratory stages for its first commercial reactor and in July 2025 signed a

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[2] Previously 18; Pickering 1 and Pickering 4 were decommissioned in 2025.

[3] OPG started engagement with municipalities and local Indigenous communities in 2024 to explore new generation opportunities at its three strategic sites. For the Wesleyville site, following expressions of interest from the Municipality of Port Hope and the Williams Treaties First Nations in January 2025, OPG is considering new nuclear energy generation at the site. Wesleyville is located near existing transmission, road, and railway infrastructure, already zoned for new electricity generation, and therefore well-suited to support a large new nuclear site. OPG's early assessments indicate the site could host up to 10 GW of new nuclear generation.

memorandum of understanding with Ontario on “sharing of technologies and expertise in small-modular and large-scale reactors to support new nuclear facilities.”

Hydro-**Québec** is interested in reviving the Gentilly Nuclear Generating Station, decommissioned in 2012. This undertaking faces strong opposition from the National Assembly of Quebec.

There are many barriers to building new reactors. Cost, policy uncertainty, and supply chain issues remain critical challenges (see Box 1).

| | **AB** | **SK** | **ON** | **QC** | **NB** |
|---|---|---|---|---|---|
| Interest from policymakers | | | | | |
| Access to federal ITCs | | | | | |
| Workable regulatory frameworks | | | | | |
| Preliminary siting decisions | | | | | |
| Fuel and component supply chains | | | | | |
| Workforce with construction experience | | | | | |
| Workforce with operations experience | | | | | |
| Order book for new reactors | | | | | |
| National long-term waste framework | | | | | |
| **Size of current active fleet** | **0** | **0** | **18** | **0** | **1** |

Fully in place    Partially in place    Not initiated

Of the federal government’s five major investment tax credits (ITCs), three are relevant across the nuclear supply chain. The 15% technology-neutral Clean Electricity ITC is the only ITC for non-taxable entities, such as Crown corporations and Indigenous communities, and therefore the only ITC accessible to nuclear proponents such as OPG and SaskPower. As of this writing, the Clean Electricity ITC is not finalized.

Certain aspects of nuclear projects can also access a 30% Clean Technology Manufacturing ITC for fuel reprocessing and heavy water recycling and a 30% Clean Technology ITC that covers zero-emissions electricity technologies, including SMRs.

## Box 1: The problem of cost

Reactors are distinguished by generation (Gen) and size. The 439 reactors operating globally are mostly large, ranging from 700 to 1,750 MW of capacity; medium reactors are in the 500 to 700 MW range. They are a mix of Gen II reactors from the 1970s and 1980s and Gen III reactors from the 1990s onward. Gen III+ and IV are "advanced reactors" and make greater use of safety features like passive cooling. Gen IV reactors also use exotic coolants to achieve higher thermal efficiencies.

Gen II and III nuclear reactors encountered more frequent and severe timeline and cost overruns than other types of large infrastructure projects. This arose from factors like project complexity, capital requirements, long timelines, and workforce inexperience. Cost overruns are not universal. India, South Korea, Japan, and China build large reactors for under $5 million per MW by repeating builds of single reactor designs on a limited number of sites and with minimal greenfield development. The U.S. just built its first reactors in 40 years for closer to $24 million per MW. Even with high costs, many governments have been willing to stomach the premium in exchange for nuclear's long lifespan and distinct energy and economic profile.

Though few have been built to date, SMRs (Gen III+ and Gen IV reactors under 500 MW) and microreactors (under 20 MW) have lower capital requirements and therefore promise less financial risk. The tradeoff is thermodynamic and economic efficiency, which are worse relative to large reactors.

A standardized construction process for the same reactor is projected to reduce costs from one project to the next. BNEF and CIBC Capital Markets estimate 50% cost reductions from first-of-a-kind (FOAK) to nth-of-a-kind (NOAK) for SMRs. The Canada Energy Regulator more conservatively estimated 10% to 30% reductions from FOAK to NOAK by 2050 in Canada. Colterjohn et al. (2024) estimated advanced reactors could experience 5% to 10% cost reductions for every doubling of global capacity.

Cost curves are possible for large reactors, with best-in-class 25-30% reductions for successive reactors on a single site following FOAK completions. The U.S. Department of Energy Liftoff Report for Advanced Reactors estimates that over 80% of possible cost reductions will be driven by consistent application of best practices and learning by doing across the workforce.

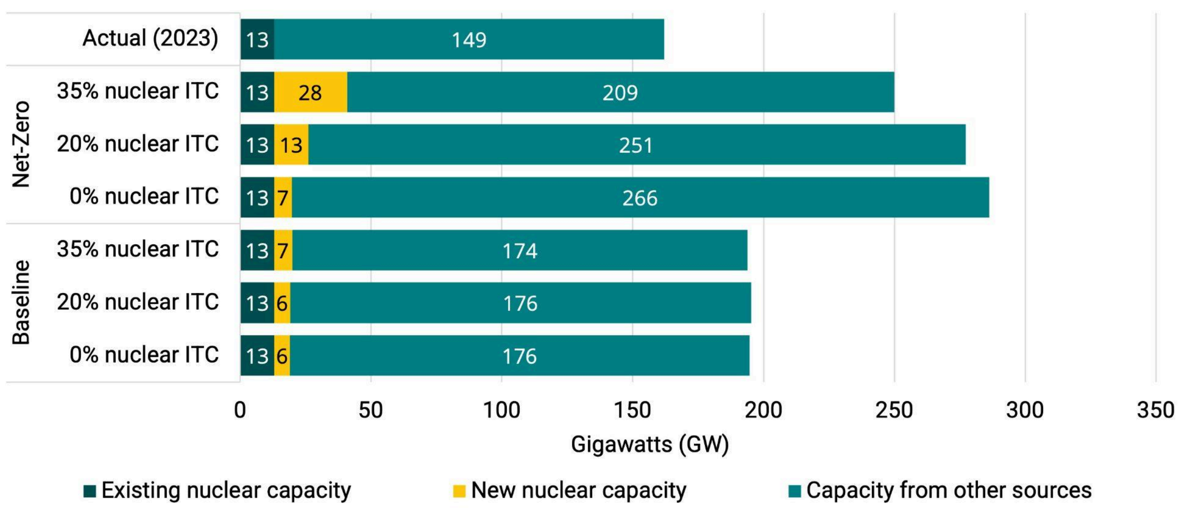
## Enabling conditions for nuclear expansion: What drives deployment?

To identify the economic and policy drivers that allow large-scale, non-emitting electricity sources like nuclear power to scale in Canada, we used Navius's gTech-IESD model to develop two broad scenarios for Canada's future energy economy.

1. **Baseline:** includes legislated climate policies but omits those that are uncertain or not fully implemented, such as the oil and gas emissions cap and the Clean Electricity Regulations.
2. **Net-zero:** where Canada achieves net-zero emissions by 2050.

We identify two key drivers of nuclear adoption: deep electrification across the economy and capital cost reductions. We simulate cost reductions as investment tax credits in our modelling, but these lower capital requirements could also serve as a proxy for cost declines, construction experience, and workforce expertise that lowers capital requirements for successive builds.

**Figure 1: Modelled electricity generation capacity in Canada by 2050 (gigawatts)[4]**




We then added different policies to our scenarios to test their influence on provincial electricity generation mixes through 2050. This includes nuclear ITCs of various levels and, in our net-zero scenarios, constraints on deployment of wind, solar, and carbon capture and storage (CCS) attached to combined cycle natural gas (CCNG) generation.

[4] 2023 actual figures taken from Statistics Canada's Electricity Year in Review (2024).

### Necessary conditions: High electrification and capital cost reductions

Our modelling identifies two crucial conditions to enable nuclear expansion over the next 25 years: strong confidence in faster rates of electrification across the Canadian economy, and ITCs or an equivalent mechanism that reduces capital costs for new projects.[5] As Figure 1 shows, neither condition is sufficient on its own; both are necessary. We note that greater demand for emerging and disruptive technologies could boost electricity demand beyond what is shown in our forecasts.[6]

**In our net-zero scenario with low-cost nuclear, Canada adds the equivalent of one large reactor a year, every year, between 2025 and 2050.** Nuclear's density and high capacity factors reduce the need for buildout of capacity elsewhere on the grid. The more reactors, the higher the utilization rate (i.e. capacity factor) across provincial grids. In scenarios with higher renewables deployment, average capacity factors run around 35% (meaning that electricity is being generated about 35% of the time). In scenarios with higher nuclear deployment, average capacity factors edge up towards 45%. This is the outcome of gigawatt-scale buildout enabled by significant capital cost reductions (approximated here by an enhanced ITC.)[7]

### High electrification and lower costs enable gigawatt-scale buildout

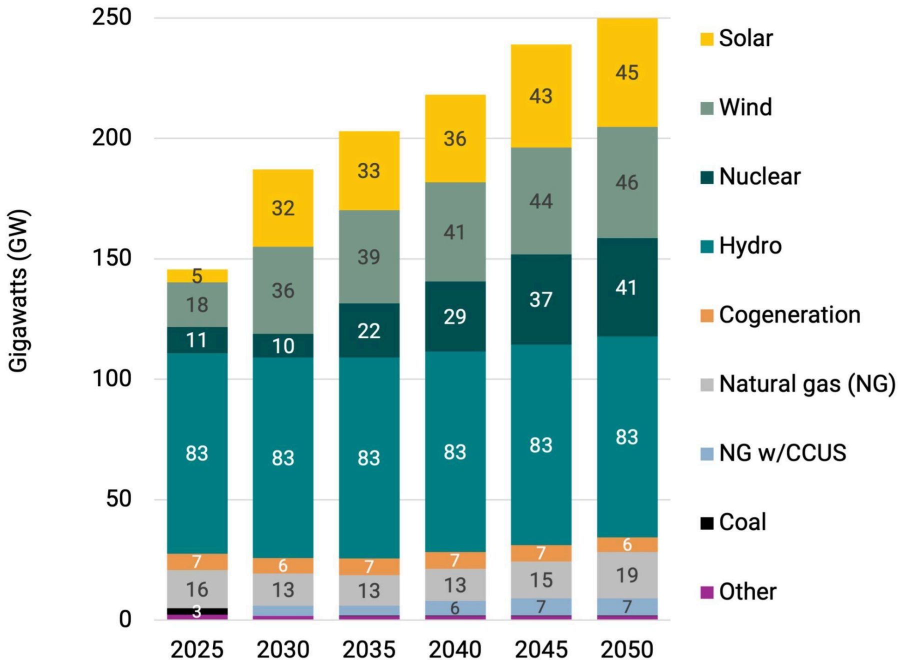
In our most optimistic scenario for nuclear (net-zero, 35% ITC), the nuclear sector becomes national in scope. Canada's fleet more than triples from 13 GW of refurbished CANDUs in Ontario and New Brunswick to a 41 GW fleet (Figure 2) that spans Ontario, Atlantic Canada, and Western Canada (Figure 3) by 2050.

[5] Other considerations could affect the feasibility and competitiveness of new reactors but are out of scope of our modelling, including trade instability, fuel supply, labour supply, and other supply chain chokepoints.

[6] To test the implications of new demand sources, we include the Ontario IESO's estimates for data centre growth by 2030. This 14 TWh of additional demand would require an approximate 10% increase in generation across Ontario.

[7] We use an "enhanced" 35% ITC to simulate either a larger public subsidy, more significant cost reductions consistent with an optimistic cost curve for successive construction projects, or some combination thereof. All are plausible pathways to lower costs. A reactor cost curve that reduced capital requirements by 35% from first-of-kind to nth-of-kind is approximated by our enhanced ITC. This is separate from the Clean Electricity and Clean Technology ITCs, which phase out in 2034. Crown corporations like OPG can only access the 15% Clean Electricity ITC. OPG's partners, Aecon, AtkinsRéalis, and GE Hitachi can access the Clean Technology and Clean Technology Manufacturing ITCs, both worth 30%, for parts of the project. We use a blended 20% rate for our modelling to approximate this ITC mix.

**Figure 2: Optimistic scenario, 29 GW of nuclear capacity by 2040, 41 GW by 2050 (total capacity)**[8]



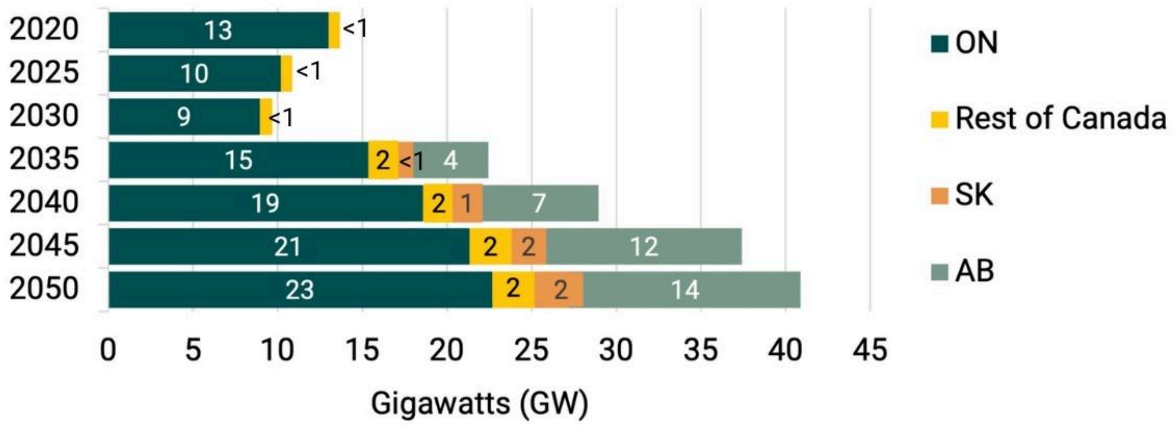

A combination of deep electrification, capital cost reductions, and efficient industry execution is nuclear power's best-case scenario.[9]

Under our optimistic scenario, nuclear power makes up 16% of Canada's 2050 generating capacity without constraints on wind, solar, and battery deployment. If electricity demand rises faster than expected, or renewables face barriers to scaling, the role for nuclear or other forms of high-capacity baseload power could grow significantly.

[8] 2025-2030 declines in nuclear capacity are a result of scheduled refurbishments. Navius's model assumes that a mix of electricity imports and additional generation from other sources is the most cost-effective way to bridge the gap in Ontario while its reactors are offline.

[9] Standard energy-economy models generally don't deploy nuclear power without assumptions that improve project economics, e.g. low LCOE, ITCs, concessional financing, or cost curves. Navius and Clean Prosperity derived an LCOE estimate from a range of sources, using the lower end of most ranges to illustrate scenarios that approach best-case. The model also does not model challenges like cost overruns or delays unless instructed, and so implicitly assumes efficient industry execution. See Appendix A for more detail.

**Figure 3: Total nuclear capacity by region in net-zero, 35% ITC scenario**




As with most energy-economy modelling, these outcomes assume industry is 100% confident in existing policies, responds rationally to incentives, successfully secures community buy-in and Indigenous consent, executes projects on time and on budget, and can successfully navigate licensing and regulatory processes with the Impact Assessment Agency of Canada (IAAC) and the Canadian Nuclear Safety Commission (CNSC).[10]

[10] The regulatory duplication introduced by the IAAC is an impediment to nuclear buildout. For example, the CNSC already guarantees a two-year timeline for a license to prepare the site (LTPS). Under the 2012 Canadian Environmental Assessment Act, a two-year environmental impact assessment could take place in parallel with the LTPS. IAAC has different rules that could extend this process beyond two years. SaskPower, for example, is estimating four years.

# Building fast: wind, solar, and storage by 2030

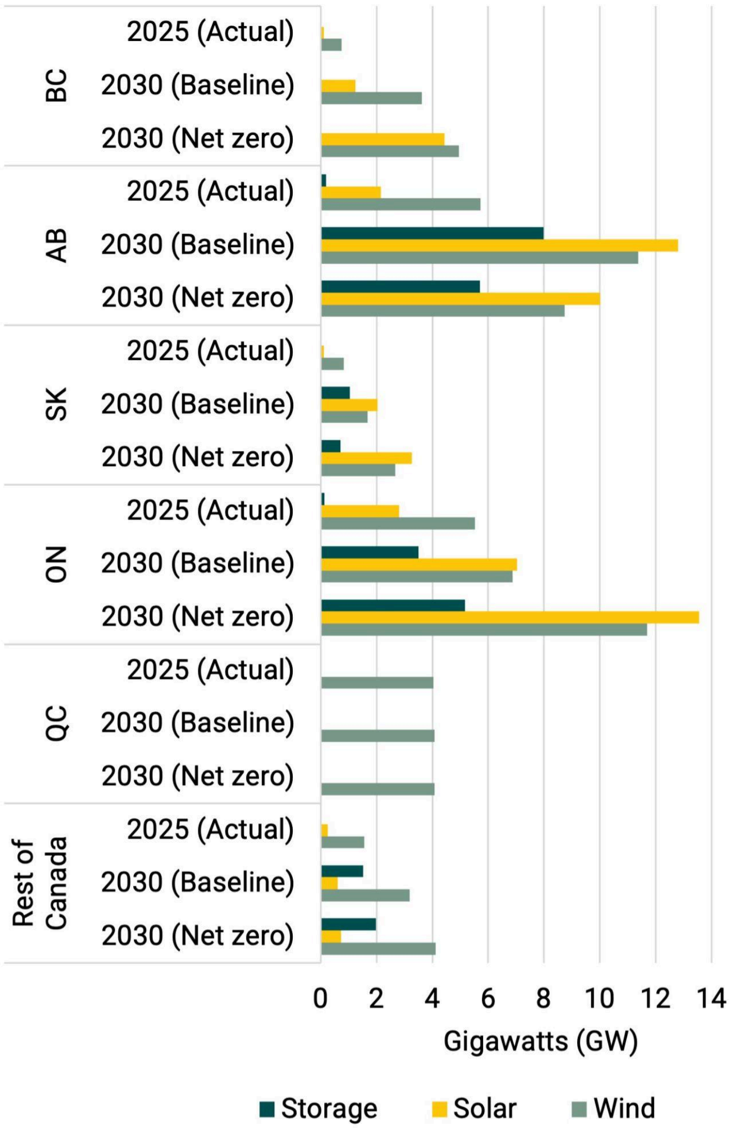
### Building fast is required in all scenarios

Across both our baseline and net-zero scenarios, provinces need a lot of new electricity generation over the next 10 years. Wind, solar, and storage continue to decline in cost[11] and we observe a significant ramp-up of capacity from these sources to meet fast-growing near-term demand (Figure 4). These buildout scenarios would require a significant acceleration of current buildout rates.

Between 2025 and 2030, our baseline scenario shows national wind capacity doubling, solar quadrupling, and storage capacity reaching over 14 GW by 2030.[12] To offer a sense of scale, in 2024, Ontario announced 2.2 GW of new storage and expanded its long-term competitive electricity procurement from 5 to 7.5 GW. Our modelling suggests Ontario must deliver this full pipeline of wind, solar, and storage projects by 2030 to stay on track.

[11] Wind and solar decline in cost by an average of 23% and 20% with every doubling of global capacity, respectively. These technologies have followed Wright's Law, where each doubling of installed capacity reduces costs at a more or less constant rate. Utility-scale storage is on a similar trajectory and our modelling shows similarly significant uptake.
[12] Storage capacity is mostly utility-scale lithium batteries and some hydrogen. The 14 GW of storage that appears in our model is equivalent to 56 Oneida Energy Storage projects, currently the largest grid-scale battery storage facility in Canada and among the five largest in the world.

**Figure 4: Anticipated storage, solar, and wind capacity needs by 2030**[13 14 15]




With the exception of Darlington, nuclear capacity additions before 2035 are unlikely. Even when factoring in additional transmission requirements, the cost competitiveness of wind, solar, and storage drive significant uptake of these technologies in the modelling.

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[13] Charge capacity (GW) shown for storage. Charge capacity is how much energy can be added to storage in an hour. A hydro dam is a helpful analogy; charge capacity is the size of the “door” that lets the water in. Storage capacity, not shown, is the total amount of energy in (MWh or GWh) that batteries can store and discharge before requiring recharge.
[14] Actual figures taken from CanREA estimates of renewable capacity as of December 31, 2024.
[15] In our baseline scenario, Alberta shows higher wind and solar deployment due to offset credit generation in its TIER carbon market. No other provincial carbon market uses this mechanism. Our net-zero scenario simulates a more stringent market than TIER but does use wind and solar crediting. This change results in less deployment by 2030 relative to the baseline.

# Building slow: nuclear fleets by 2040s

### Nuclear can be a hedge in a constrained world

Wind, solar, and storage could scale quickly and cost-effectively in the near term. But if their deployment cannot sustain momentum, energy-dense and high-capacity projects like nuclear are a valuable hedge. The ultimate cost of the hedge depends on how fast the economy electrifies, project financing structures, the size of the tax and ratepayer base, the number of projects, and the frequency of delays and cost overruns.

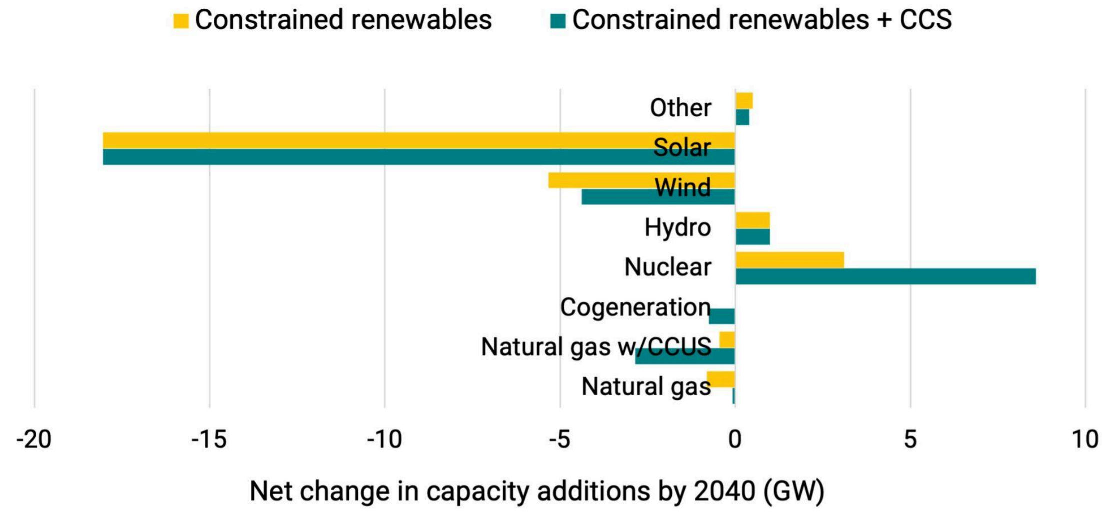
In our net-zero scenarios, nuclear trades off with two competitors: renewables with battery storage and combined cycle gas turbines (CCGT) with CCS.

In scenarios where we constrain renewables, nuclear capacity fills the gap if it is lower cost. The pace of renewables construction could be slowed by a number of factors, including unstable or targeted policy, community backlash, grid stability, or geographic constraints, such as congestion and transmission expansion costs.[16] If these factors make it impossible for provinces to add solar and

[16] Intra-provincially, investments for transmission and distribution in the model are determined by peak demand times and transmission and distribution cost estimates ($/kW) that vary by region and sector. Grid connection costs for new wind capacity depends on the distance of the site to existing transmission lines, using a set of wind site archetypes to reflect higher costs for remote and inaccessible sites. The model does not explicitly represent congestion but does represent the declining marginal value of renewables, of which regional congestion and hourly oversupply are two real-world factors leading to this declining marginal value.

wind faster than their current pace, for example, our net-zero, low-cost nuclear scenario shows Canada would need 4 GW of equivalent nuclear capacity by 2040. If renewables face constraints and CCS fails to scale for electricity,[17] additional nuclear capacity requirements more than double; Canada would require an additional 9 GW of equivalent nuclear capacity by 2040 (Figure 5).

**Figure 5: Effects of constrained deployment of renewables and CCS (relative to unconstrained net-zero scenario with 35% nuclear ITC)**




### For the hedge to work, Ontario needs short-term capital support and steep cost curves

For new reactors to be a worthwhile hedge, construction costs must fall over time. Standard levelized cost of electricity (LCOE) calculations show that without cost declines, nuclear power will likely remain behind its competitors on cost in the coming years (Figure 6). Because of its high capital costs, nuclear's LCOE is more sensitive to ITCs than its competitors.

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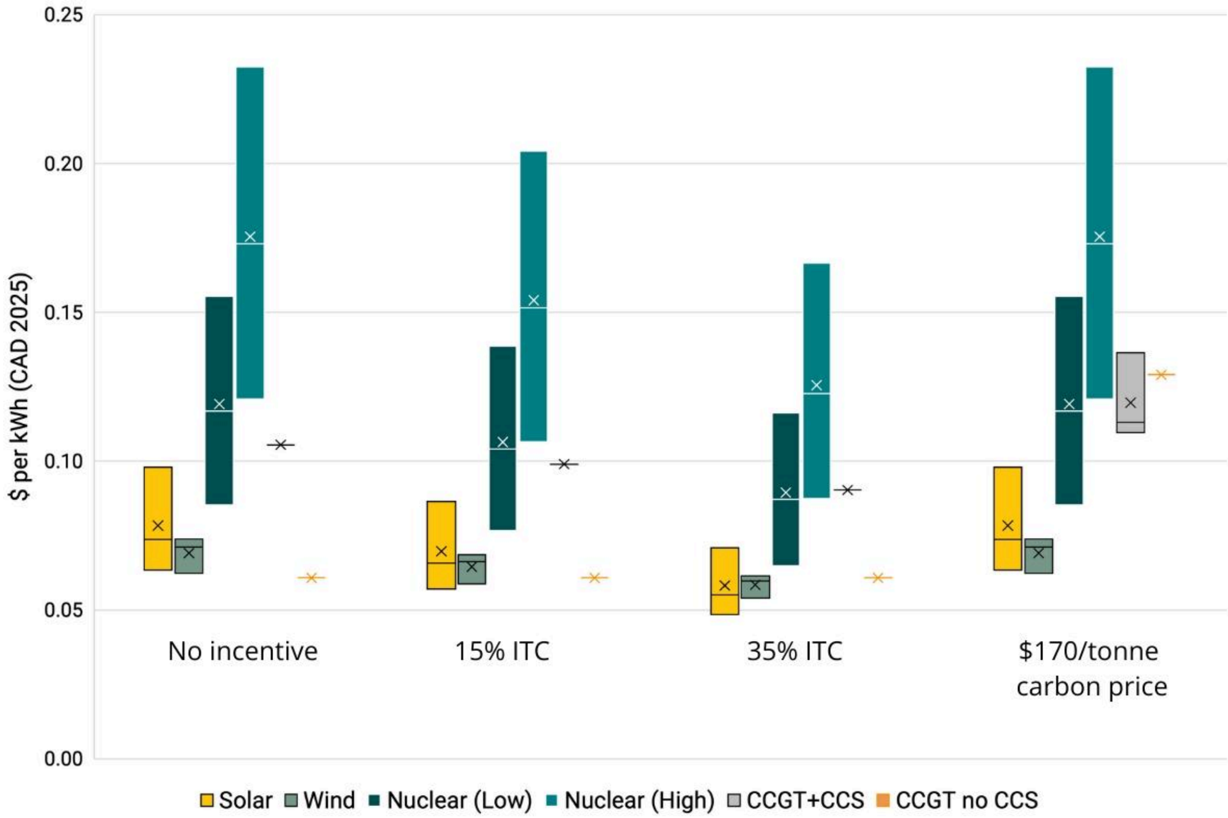
[17] Failure to scale could come from technological failure (e.g. inability to achieve sufficiently high capture and storage rates) or policy factors (e.g. insufficient price signal in carbon markets). We assume 90% capture rate for successful CCS, 60% for lower capture costs and 95% for higher capture costs.

**Figure 6: Estimated levelized costs of electricity (LCOE) under different scenarios, 2035**[18][19][20][21]




Bars represent the range of estimates. X denotes the mean estimate; horizontal line denotes the median estimate.

Metrics like LCOE and net present value (NPV) are useful but insufficient for evaluating nuclear energy costs. Standard discount rates are unfavourable to nuclear projects given their timelines. The difference between a discount rate that achieves a positive NPV or reasonable LCOE for a nuclear project and the discount rate that would be required for most electricity projects can be substantial. The delta, which can be closed through subsidies, ITCs or concessional financing, represents

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[18] All Figure 6 calculations based on estimates conducted with Navius Research (adjusted to 2025 Canadian dollars). We forecast costs for 2035 as this is the earliest conceivable timeframe that new reactors would come online in Canada, after Darlington. A 7% discount rate and 30-year lifespan are used in LCOE calculations. ITCs are applied equally to all eligible technologies in each scenario.

[19] Wind and solar LCOE estimates shown for Ontario. We do not factor the levelized cost of firming (LCOF) required to make renewables non-intermittent. We omit LCOF to show the maximum possible cost differential between renewables and nuclear. Lazard's most recent LCOE+ analysis estimates that firming onshore wind adds at least 20% to LCOE, and 30% for solar. High LCOF estimates can more than double the cost of firming for wind and solar, but we expect market forces to favour projects that offer the lowest possible LCOF.

[20] Lower nuclear cost estimate taken from the Canadian SMR Roadmap, higher estimate from National Renewable Energy Laboratory (NREL). Nuclear cost estimates are for SMRs, but we would expect most large reactors to fall within the range shown.

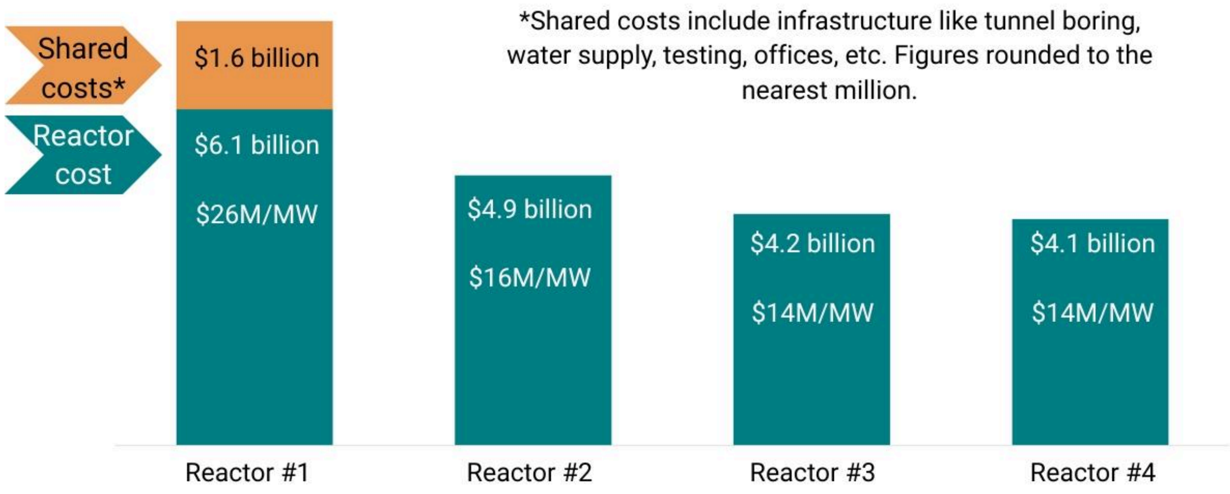
[21] The $170/tonne carbon price scenario applies full pricing (i.e. zero benchmarks) to generation from CCGT and CCGT+CCS. Our median natural gas fuel cost estimate is $4.50/GJ. We find that LCOE is quite sensitive to fuel prices; a 50% increase in natural gas prices would increase LCOE for natural gas by approximately 20%, with or without CCS.

unrealized positive externalities of nuclear generation (high-capacity, zero-carbon, energy-dense, low-land use, etc.).

We use millions ($M) per megawatt to offer an additional lens on cost. Efficient countries like China can construct large reactors for below $5M per MW. The most expensive reactors — at the Vogtle Electric Generating Plant in Georgia, U.S., and the Hinkley Point C nuclear power station in the U.K. — run well above $20M/MW. At gigawatt-scale, the difference between $5M/MW and $20M/MW is $15 billion.

We previously estimated that a cost of $10M/MW at Darlington could facilitate rapid uptake of the BWRX-300. OPG's recent estimate for four BWRX-300 reactors is $17.4M per MW, for a total of $20.9 billion and a cost reduction from FOAK to fourth-of-kind of 33% (Figure 7). It will finance the project through funds on hand, operational cash flow, loans and green bonds, rate recovery, and ITCs.[22] Best practices can further reduce reactor capital requirements over time. This includes centralizing reactors on a more limited number of sites, leveraging existing grid infrastructure, and developing the workforce and supply chains required to drive efficiencies and economies of scale (e.g. construction, procurement, security, refuelling).

**Figure 7: OPG cost estimate for BWRX-300 reactors at the Darlington Station, inclusive of federal investment tax credits**




[22] Because OPG is primarily financing the BWRX-300 construction with cash, its discount rate should reflect the opportunity cost of those cash flows reinvested in capital, equivalent to the overall weighted average cost of capital. The cash flow model limits borrowing costs and is worth considering in other jurisdictions as an option to reduce overall project costs.

OPG's estimate exceeds the Ontario Independent Electricity System Operator's (IESO) generic $13.8 million per MW estimate for SMRs.[23] It is also 20% higher than the IESO's installed capacity estimate for large nuclear ($11.5M/MW) and multiples higher than its estimates for wind ($1.8M/MW), utility-scale solar ($1.9M/MW), utility-scale batteries ($2.5M/MW), CCNG ($1.6M/MW) and biomass ($6.5M/MW).[24] However, the cost curve is promising, well above recent and more conservative cost reduction estimates (10-30%) from FOAK to NOAK.

OPG's cost estimate is inclusive of federal ITCs[25] that are available to nuclear projects, including the yet-to-be-legislated 15% Clean Electricity ITC and the 30% Clean Technology ITC and Clean Technology Manufacturing ITC.[26] As a Crown corporation, OPG's capital expenditures would only be eligible for the Clean Electricity ITC, while those of its partners, Aecon, GE-Hitachi, and AtkinsRéalis, could be eligible for the 30% ITCs.

ITCs will help advance the Darlington project and any other nuclear project in a position for capital spend by 2034. Given the $26M/MW price tag for the first BWRX-300, delays or cost overruns at Darlington could give other jurisdictions pause. The Tennessee Valley Authority applied for a BWRX-300 construction permit and Poland and Estonia have also embraced the design. For the BWRX-300 to emerge a winner in its size category, 30% cost reductions from FOAK to third of kind, as projected, is essential. OPG and its partners must execute and the cost curve must sustain itself for the next project — be it in Europe, Saskatchewan, or Tennessee.

## Low discount rates significantly strengthen the value of nuclear projects

Of more immediate concern than fifth-of-kind costs for the BWRX-300 will be the final cost of electricity produced at Darlington. Our LCOE estimates show a large range for nuclear LCOE given its unique sensitivity to discounting and uncertainty around timelines, cost declines, and scalability.

Because project timelines and asset lifespans are so much longer for nuclear power, discount rates are far more influential on the final LCOE. Separate from the Navius modelling, we use in-house LCOE modelling to illustrate this sensitivity. Final LCOE could feasibly range from 10 to 37 cents per kWh (Figure 8). The question of what is an appropriate discount rate for public investments and climate economics is contested (see Box 2).

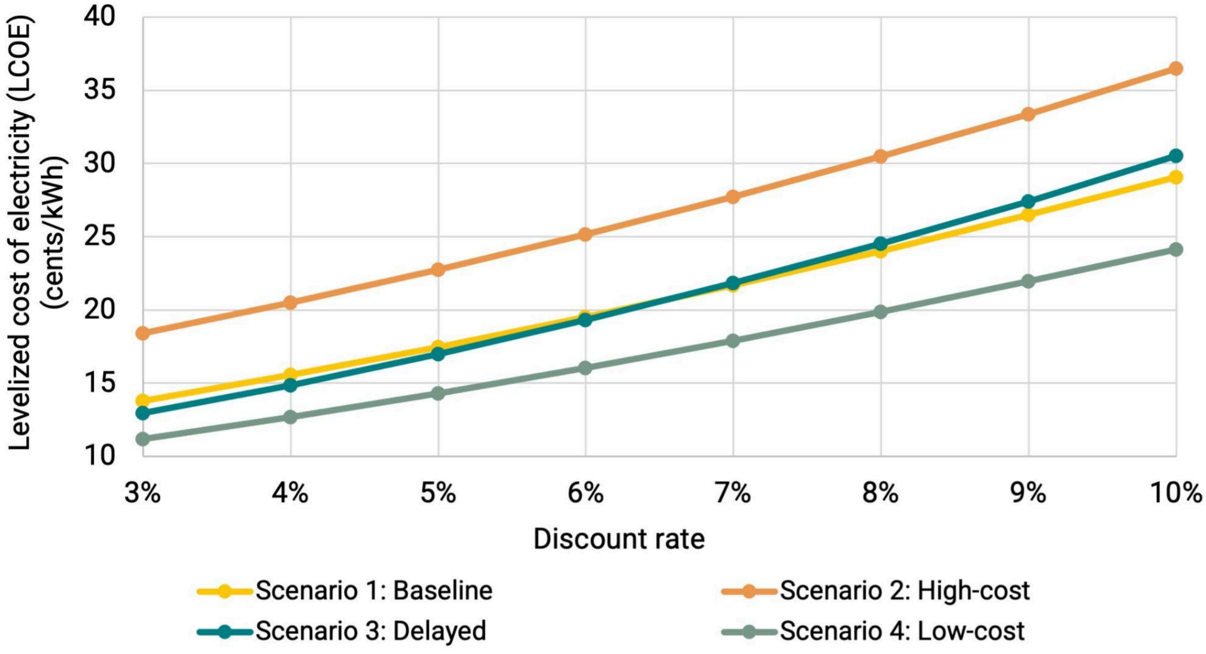
[23] IESO 2024 Annual Planning Outlook: Resource Costs and Trends, Table 1.

[24] We note the key shortcoming of the $/MW metric: it does not adjust for capacity factors of different assets. We also note the IESO's estimates do not factor in financing costs.

[25] The federal government has also reduced taxes for zero-emission technology manufacturers, including nuclear equipment manufacturing, fuel processing/recycling, and heavy water production.

[26] The Clean Technology Manufacturing ITC covers fuel reprocessing and heavy water recycling but not the original production of uranium or heavy water. This ITC will reduce supply chain and operating costs but is unlikely to materially affect capital requirements for the Darlington SMRs.

**Figure 8: The value of the Darlington project remains to be seen**




**Scenario descriptions**[27]

- **Scenario 1: Baseline.** Reactors online in 2030, 2032, 2034, and 2036; 40-year lifespans, ITC set at 20% to represent a blending of the federal Clean Electricity ITC (15%) and Clean Tech and Clean Tech Manufacturing ITCs (30%).

- **Scenario 2: High-cost.** Reactors come online in 2030, 2032, 2034, and 2036 with two drivers leading to higher costs: a shortened 30-year lifespan and no ITCs.

- **Scenario 3: Delayed**. Reactors come online two years later than scheduled in 2032, 2034, 2036, and 2038, 50-year lifespan, 20% ITC.

- **Scenario 4: Low-cost**. Reactors come online in 2030, 2032, 2034, and 2036 with two drivers leading to lower costs: a 50-year lifespan and an enhanced 35% ITC.

[27] Key assumptions across all scenarios: 75/25 debt-to-equity ratio; interest rate 5%; cost of equity 10%; conservative assumptions for fixed ($200/kW/year), variable operation ($5/MWh), and maintenance costs and fuel costs ($10/MWh). Reactors operate at a 90% capacity factor.

**Box 2: Discount rates in climate economics**

Discount rates are a subject of ongoing debate in climate economics. Using lower discount rates for projects or public investments places greater value on future benefits, while higher discount rates favour short-term gains. The Stern Review argues that social discount rates (1-2%) are justified given the tail risks of failing to act on climate change, arguing future generations should be valued nearly as much as current generations. Nordhaus supports 3-5% discounting to reflect the opportunity cost of capital and argues 1-2% is inconsistent with how societies actually value time and risk.

More recent literature attempts to reconcile these views. Arrow et al. (2013) and Goulder & Williams (2012) argue for declining discount rates over time, reflecting uncertainty in future growth and intergenerational timelines. For public investment decisions such as climate mitigation and energy infrastructure, many economists recommend 2-3% for intergenerational analyses and 5-7% for private investment. This difference could be critical to the economics of nuclear expansion (see Figure 8). Instruments like ITCs and concessional financing are, in effect, instruments to lower the required discount rate for nuclear projects. Because nuclear projects are capital-intensive and provide electricity for upwards of 40 or 50 years, their relative competitiveness improves significantly at lower discount rates — especially when compared to shorter-lived grid assets.

## Cost overruns can put upward pressure on electricity prices

Absent material cost overruns, significant upward pressure on electricity prices in Ontario is unlikely given the size of Darlington SMR project (1.2 GW) relative to the rest of Ontario's nuclear fleet (13 GW) and overall generating fleet (38 GW and growing). Under our Baseline Scenario in Figure 8, discount rates of 4% or lower are required to keep the LCOE for the Darlington SMRs below the IESO's reported $0.15 per kWh estimate. This $0.15 estimate is a helpful benchmark, as it is comparable to the current $0.158 per kWh on-peak rate in Ontario.

Without measures to insulate ratepayers from cost overruns, a hypothetical worst-case scenario for new reactors could show up on electricity bills. Consider the most recent reactors to come online in North America: Vogtle 3 and 4 in Georgia. Georgia's grid has 38 GW of capacity, so it is of similar size to Ontario's. The project, two new 1,117 MW AP1000 reactors, severely overshot its $27 billion budget ($12M/MW).[28] The final cost of $53 billion ($24M/MW) resulted in a 5% increase in Georgia's electricity prices before the reactors entered service.

[28] Figures converted from 2023 USD to 2025 CAD (1=1.43887).

Recent U.S. Department of Energy analysis estimated that with successful application of lessons learned from Vogtle, building three to four additional AP1000 reactors could achieve cost reductions of 30% (or even 50%, if the U.S. can replicate the Chinese learning curve; China has already built a pair of AP1000 reactors for under $5M/MW).

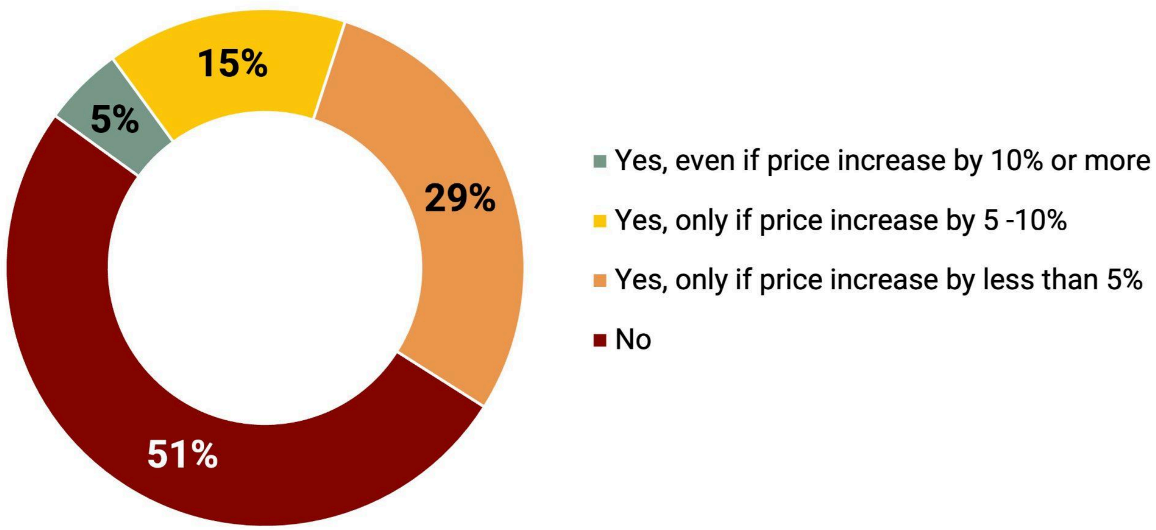
Even with its significant cost overruns, the U.S. Department of Energy's Liftoff Report (2024) notes that construction of Vogtle Unit 4 was approximately 30% more efficient and 20% cheaper than Unit 3. The Liftoff Report points to five efficiencies that led to this outcome:

- Key testing milestones were completed approximately 38-76% faster;
- Engineering service requests dropped by about 50%;
- Project sequencing was modified to accommodate work packages, staffing, and scheduling;
- Learning by doing via modular construction methods, material management plans, and electrical quality inspections; and
- Vendor and supply chain efficiencies.

## Higher costs severely undermine public acceptability of nuclear power

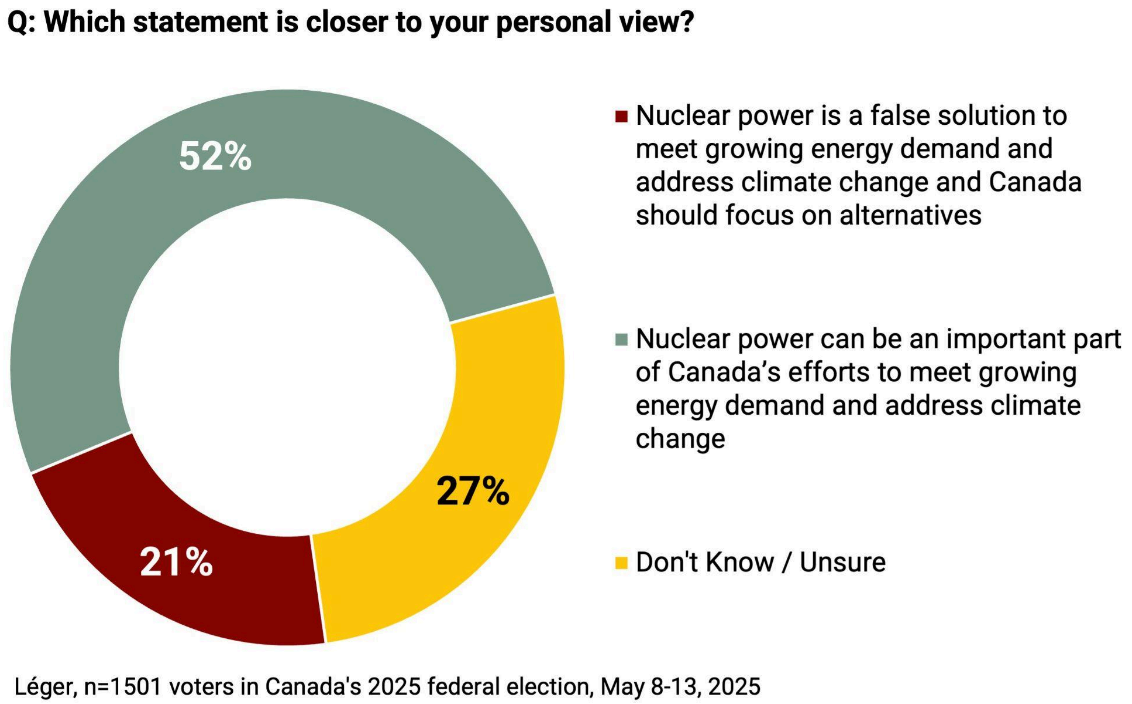
New public polling, commissioned by Clean Prosperity and conducted by Léger, shows that containing project costs is key to maintaining public support for new nuclear power projects. Over half of Canadian voters say they would not support a nuclear power station in their province if it meant higher electricity prices. Only 5% say they would tolerate a price increase of 10% or more.

**Q: Would you support building a nuclear power station in your province to reduce greenhouse gas emissions, even if it led to an increase in the price of electricity?**




Léger, n=1501 voters in Canada's 2025 federal election, May 8-13, 2025

Our polling further shows that a majority of Canadian voters hold favourable views of nuclear power and many more are persuadable. Coupled with the data above, this suggests that proving nuclear energy can be affordable is crucial for social acceptability. Executing projects on time and on budget is of course vital. Measures that leverage existing supply chains and make optimal use of existing infrastructure, such as fleet-based planning and minimal greenfield development, can help keep a lid on costs.




Informed debate about the benefits, tradeoffs, and safety features of commercial nuclear power can help to build public confidence in and support for future nuclear development.[29] The participation of communities, stakeholders, and Indigenous rightsholders in decision-making processes is vital to the success of future nuclear projects, particularly on siting and lifecycle management.

[29] Kim et al., 2014.

# Conclusion and recommendations

To meet short-term growth in demand for electricity and maximize the long-term benefits of electrification, provinces must build and plan fast. Our modelling identifies conditions that make nuclear a viable and significant part of this expansion, starting in 2035. A combination of deep electrification, capital cost reductions, and industry execution is a best-case scenario. This trifecta could yield a tripling of nuclear capacity across Canada by 2050 — equivalent to adding over 1,800 MW of capacity annually from 2035 until 2050.

Public support for nuclear expansion hinges on affordability. Over half of Canadian voters say they would not support a new reactor in their province if it led to any increase in electricity prices. Recent nuclear projects like Vogtle show how cost overruns for a single nuclear project can impact electricity prices overnight. We can extrapolate this finding to electrification writ large; electrification must produce visible and material affordability benefits to maintain public support and avoid backlash.

To make new nuclear power a successful part of Canada's nation-building efforts, early projects must deliver reliable electricity without material increases in electricity prices. This will enable scaling beyond Ontario. If costs balloon or ratepayers come to associate new reactors with higher costs, the case for additional reactors weakens.

*To make new nuclear power a successful part of Canada's nation-building efforts, early projects must deliver reliable electricity without material increases in electricity prices.*

**We make the following recommendations to policymakers:**

## Recommendation #1: Electrify everything

Electrification is a strategic lever that can support Canadian competitiveness and energy security. Accelerated electrification on its own can unlock billions worth of investment, savings, and spillover effects across the economy. It also aids the case for nuclear expansion. We find nuclear power much less competitive in scenarios with slower electrification and in policy environments that do not properly value its attributes. To enhance Canadian competitiveness and energy security while building the case for expansion, all orders of government can work to accelerate deep electrification.

**We recommend that the federal government:**

- **Pass the Clean Electricity ITC** in Parliament as soon as possible. Broad access to low-emissions, low-cost electricity is a competitive advantage for Canada, and faster electrification of Canada's economy could accelerate progress across multiple national interest projects.[30] Every province will benefit from this ITC but many require additional policy support to accelerate industrial and household electrification.

**We recommend to all provinces:**

- **Direct energy system regulators to align mandates and capital planning for deep electrification.** Depending on the province, this may require both legislative changes and regulatory directives.[31] Most provincial regulator mandates still prioritize short-term rate stability over long-term system adequacy, creating a misalignment between electrification goals and capital planning. Meeting growing electricity demand will require coordinated investment in generation, transmission, and distribution at scales unseen in decades, while making space for emerging technologies like utility-scale storage.

- **Strengthen provincial carbon markets to attract investments in low-carbon electricity.** Provincial carbon markets treat different electricity sources unequally by using different emissions-intensity performance benchmarks for non-emitting electricity, gas, and coal. Setting all of these benchmarks to zero (fully exposing the sector to the price signal) would fix this issue and level the playing field for nuclear reactors in the process.

  Costs passed through to ratepayers resulting from this change could be fully offset through a $/kWh rebate, which utilities could return via a line item on consumer bills. At the current $95 per tonne headline carbon price, grids with higher emissions intensities like Alberta's and Saskatchewan's (about 400 to 600 grams of $CO_2$e/ kWh) would see an extra four to five cents per kWh in costs. Assuming average household electricity consumption of about 1,000 kWh per month would mean up to $50 of carbon costs on monthly household bills, offset by a rebate. While the net financial effect for households is neutral, zero benchmarks would both influence hourly dispatch choices and steer system planners to larger-scale, low-carbon generation projects.

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[30] https://financialpost.com/news/economy/carney-nation-building-projects-list-focus-5-areas

[31] Amendments to the relevant governing legislation will be required in most cases (e.g. Alberta Utilities Commission Act, Saskatchewan Power Corporation Act, Ontario Energy Board Act, New Brunswick Energy and Utilities Board Act). However, most provinces afford significant ministerial discretion for directives (e.g. the Ontario Minister of Energy has strong powers to direct the Ontario Energy Board and the IESO under the Electricity Act; Saskatchewan's cabinet holds direct authority over SaskPower's planning. The Saskatchewan Minister responsible for Crown utilities can set the scope of reviews but cabinet must approve any changes.).

## Recommendation #2: Use fleet-based planning

Fleet-based approaches, optimized around single reactor designs, are the most plausible pathway to cost reductions. Economies of scale and learning curves are critical. Canada may ultimately need a small portfolio of reactor models, including one large, one small, and one micro reactor, ideally capable of generating both electricity and industrial-grade heat.

The large reactor category has two primary candidates within Canada: next-generation CANDUs (e.g. the Monark) and the AP1000, produced by Westinghouse Electric Company, which is jointly owned by Cameco and Brookfield Asset Management. The AP1000 has already been deployed commercially at Vogtle and at multiple sites in China. Like the BWRX-300, it requires low enriched uranium (LEU), which would be a first for a nuclear reactor in Canada. Next-generation CANDU reactors remain in the design phase, including the 1 GW Monark and the 300 MW SMR. Unlike the AP1000, CANDUs would not require LEU and could instead use unenriched uranium for fuel.

The BWRX-300 is the North American frontrunner in the small reactor category. The projected 33% cost drop from FOAK to fourth-of-a-kind at Darlington is both promising and necessary for fleet-based deployment. Capital costs must continue to fall past $14M/MW and success must extend beyond Ontario. Driving further cost reductions will require repeat success abroad by others — including the Tennessee Valley Authority, Poland, and Estonia. Cost reductions of 50% from FOAK to NOAK, as projected by more optimistic estimates, would push NOAK costs closer to $10M/MW, our initial estimate for a cost-competitive SMR.

Microreactors (below 20 MW) and advanced reactors for industrial heat face higher barriers to deployment, but would benefit from fleet-based deployment should they become viable at scale. Many microreactors, including the eVinci microreactor, require high-assay low-enriched uranium (HALEU).[32] Enriching uranium-235 to the required levels for HALEU, 5-20%, is a capability that only China and Russia possess.[33]

[32] Westinghouse and Urenco signed a long-term fuel enrichment agreement in March 2025, under which Urenco will provide enrichment of HALEU to Westinghouse for five years of deployment for the eVinci microreactor.

[33] Forthcoming research from Clean Prosperity will examine the implications of different fuel types and enrichment requirements for different reactors in more depth.

**We recommend that the federal government:**

- **Coordinate with the provinces to standardize single designs for a large reactor, a small reactor, and a micro reactor.** Our most ambitious modelling scenario shows a future where the provinces collaborate to build over 1,500 megawatts of new nuclear capacity per year, every year, from 2035 to 2050. If Canada is to build at this scale, all new reactors in each size category should look alike to optimize cost-effectiveness and affordability.

- **Consider incentives, such as enhanced federal ITCs, to persuade provinces to embrace and opt into a fleet-based approach to deployment.** Offer this enhanced ITC (e.g. 20-25%) only to provinces that sign a memorandum of understanding on fleet-based planning. Fleet eligibility could include: one design per size class; commitment to a minimum order book (e.g., one large unit or three or more SMRs) with staggered starts to ensure workforce availability; prioritization of brownfield nuclear sites to maximize shared infrastructure savings; and open-book cost reporting (e.g. schedule, change orders, and realized learning).

**We recommend that the government of Ontario:**

- **Prioritize expansion and use of existing sites zoned for electricity generation over greenfield development**, including expansion of existing nuclear sites. Optimization and centralization around fewer sites will shorten project timelines, maximize workforce learning by doing during construction, and enable cost sharing and economies of scale in operations (e.g. refueling, security, shielding, shared infrastructure).

**We recommend that other provincial governments:**

- **Coordinate closely with Ontario and optimize around a single reactor design for each size class** so as to enable a fleet-based approach, solidify an order book, and add certainty across the supply chain.

## Recommendation #3: Be transparent about costs and develop off-ramps to contain them

Upfront capital costs account for up to 80% of lifetime expenditures for most nuclear projects. No financing model is risk-free. Cost declines may come over time, but government support is required in the early going to absorb risk and attract private investment for FOAK and early deployment.

Government support should be targeted, temporary, and transparent. With significant government support, ideally including the Clean Electricity ITC, the nuclear sector should step up to deliver and lay the groundwork for expansion. It must do so with as much transparency as possible to ensure optimal fleet-based planning.

**We recommend that Ontario, in partnership with the federal government:**

- **Publish project-level cost data** for the BWRX-300 project at Darlington. Cost transparency will facilitate the development of learning curves, cost curves, and shared labour and capital across provinces. It will also offer early indicators if costs are as low as expected, or are not falling as expected. This cost data should include a full accounting of public finance, including the federal ITCs and other forms of concessional financing.

- **Consider off-ramps for the BWRX-300 project if cost curves do not develop at Darlington.** Using fleet-based planning increases the probability that Canadian nuclear projects will achieve the needed cost reductions. But it does not guarantee cost reductions. Hedges and contingencies should be in play across Canada's entire portfolio of proposed nuclear projects.

If the BWRX-300 has cost overruns, for example, it will be crucial to determine if they are one-off FOAK challenges that can be overcome through subsequent builds. Full transparency can help policymakers assess whether overruns are indeed one-offs, or if they are inherent to SMR construction. If promised cost reductions appear unlikely, multiple off-ramps merit consideration. The first off-ramp is a pivot to a large reactor. Our analysis shows that even expensive large reactors compare favourably to SMRs on a $/MW basis. This is corroborated by IESO estimates. Alternative SMR models offer a second off-ramp.

# Appendix: Modelling approach, assumptions and scenarios

We use a mix of assumptions in our modelling and explore cost sensitivities and other assumptions to understand under what conditions nuclear can appear in gTech-IESD on its own.

Clean Prosperity contracted Navius Research to explore conditions under which nuclear electricity generation can compete with other generation types. We developed several scenarios.[34] Modelling nuclear power with energy-economy models requires that new nuclear projects either be “forced” into the model (i.e. pick a quantity and let the system solve for cost) or they can be made cost-competitive enough to appear on their own (i.e. pick a cost and let the model solve for quantity).

**Scenario description**

The simulated scenarios explore the impact of a few key variables (increased subsidization of nuclear generation, constraints on renewable generation, increased costs for CCS, and increased electrification and policy stringency) on the competitiveness of nuclear generation relative to other generation options.

The impacts of these variables are explored under two different possible futures: 1) a business-as-usual **baseline scenario**, which represents the current climate policy framework in Canada; and 2) a **net-zero policy scenario**, which represents a future with high electrification and a high carbon price.

**Baseline scenario**

The baseline scenario includes currently legislated key policies, with the changes outlined below. For the initial baseline analysis we also added refurbished nuclear as a technology option in the model and aligned nuclear refurbishment with a schedule, provided by Clean Prosperity, for Ontario and New Brunswick. In addition, we calibrated the model to align more closely with planned renewable energy procurement in Ontario.

[34] Note: this paper does not review results from all of the modelling runs.

Clean Prosperity requested the changes below in order to create a policy package that only includes policies which we viewed as politically stable as of December 2024:

- Removed the (now-cancelled) federal fuel charge. Quebec's cap-and-trade system remains in place as currently legislated. The B.C. carbon tax also remains in place but is kept constant (in nominal terms) after reaching $95 per tonne.
- Removed the Clean Fuel Regulations (removed after 2025).
- Maintained Canada's Electric Vehicle Availability Standard.
- Added the federal 75% methane reduction requirement.
- Added Clean Electricity, Clean Technology, Clean Technology Manufacturing, carbon capture, and hydrogen ITCs.

Navius then layered the following scenarios onto the baseline scenario:

- **Baseline + nuclear ITC (20% and 35%)**
  Baseline scenario with a 35% investment tax credit on nuclear electricity generation, available until 2050, and baseline scenario with a 20% ITC, available until 2040.
- **Baseline + nuclear ITC (20% and 35%) + renewable constraint**
  Baseline scenario with a 20% or 35% investment tax credit on nuclear electricity generation and constraints on wind and solar electricity generation, using constraints provided by Clean Prosperity based on a province's best construction year to date.
- **Baseline + nuclear ITC (20% and 35%) + inflation adjustment**
  Baseline scenario with a 20% or 35% investment tax credit on nuclear electricity generation, an inflation adjustment to the $170 per tonne carbon price and, where needed, performance standard benchmark adjustments to ensure that the carbon price is binding.
- **Baseline + nuclear ITC (20% and 35%) + renewable constraints + inflation adjustment**
  Baseline scenario with a 20% or 35% investment tax credit on nuclear electricity generation, constraints on wind and solar electricity generation, and inflation adjustments on the $170 per tonne carbon price.

**Net-zero scenario**

In this scenario, Canada achieves its 2030 target and net-zero emissions by 2050. This is simulated through a national emissions cap that achieves the 2030 target, assuming 30 Mt of offsets attributable to land use, land use change, and forestry (LULUCF) in 2030, based on the estimated amount of 2030 LULUCF in the federal Emissions Reduction Plan, and then linearly declines to 50 Mt $CO_2e$ by 2050. The underlying assumption is that 50 Mt would be offset through LULUCF or other forms of offsets in 2050 to achieve net zero on the national level.

Navius layered the following scenarios onto the net zero scenario:

- **Net zero + nuclear ITC (20% and 35%)**
  Net zero scenario with a 35% investment tax credit on nuclear electricity generation, available until 2050, and net zero scenario with a 20% ITC, available until 2040.

- **Net zero + nuclear ITC (20% and 35%) + renewable constraint**
  Net zero scenario with a 20% or 35% investment tax credit on nuclear electricity generation and constraints on wind and solar electricity generation, using constraints provided by Clean Prosperity, indexed to each province's best years of construction.

- **Net zero + nuclear ITC (20% and 35%) + renewable constraint + high CCS cost**
  Net zero scenario with a 20% or 35% investment tax credit on nuclear electricity generation, constraints on wind and solar electricity generation, and a high carbon capture and storage cost rate of 75%

- **Net zero + 35% nuclear ITC + low storage costs**
  Net zero scenario with a 35% investment tax credit on nuclear electricity generation and low storage costs. Note that low storage costs mean low lithium battery and hydrogen fuel cell costs, which also results in increased vehicle electrification.

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