Ontario Electricity Supply Pathways

Prepared for Environmental Defence

June 2026

Contents

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Background and Overview of Report

- Ontario's electricity grid is expected to undergo significant change over the next 25 years
- After more than a decade of flat or declining demand, electricity demand is expected to grow by 65% in 2050 – largely driven by the combination of economic development and decarbonization policies
- At the same time that demand is expected to increase materially, the province – in part driven by policies from the federal government – wants to limit supply from carbon emitting resources such as gas-fired generation over the long-term
- As a result, the province and the IESO are both supporting a significant buildout of Ontario's fleet of nuclear reactors, as well as launching a series of procurements to develop other resources, including new wind, solar, storage and gas-fired generation
- Environmental Defence (ED) retained Power Advisory to undertake an analysis on the following:
    - An overview and commentary on the supply and demand assumptions from the IESO and the province to meet future demand growth
    - The potential commodity costs of the current plan to meet future supply needs
    - An alternative scenario to meet future supply needs
    - A comparison of the cost outcomes of the expected path and the alternative scenario

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Executive Summary of Findings

- Power Advisory modelled two different future supply scenarios and different forecast demand assumptions
- One supply scenario incorporates a substantial buildout of nuclear facilities, as laid out in the province's energy policies and the IESO's Annual Planning Outlook (APO)
- The alternative scenario includes the ongoing operation of existing nuclear facilities and the Small Modular Reactors (SMRs) at Darlington, but no new nuclear facilities and a faster renewable resource buildout

Scenarios Modelled

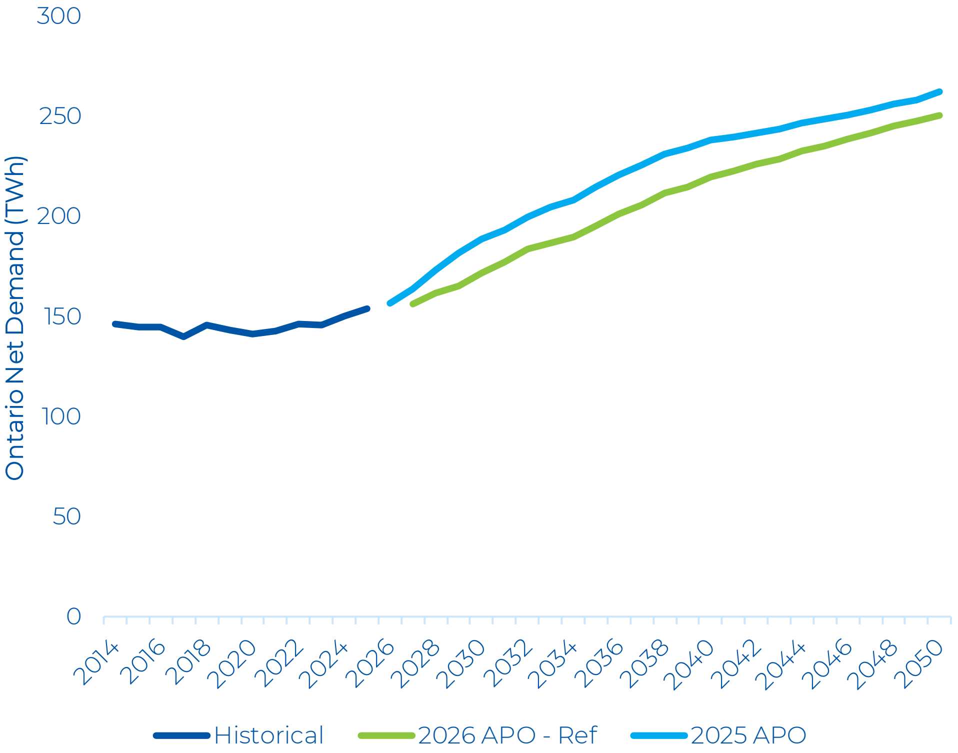
	2026 APO Reference Demand Growth	2026 APO Low Demand Growth
High Nuclear Expansion	Scenario 1: High Nuclear/Reference Demand	Scenario 2: High Nuclear/Low Demand
Low Nuclear Expansion	Scenario 3: Low Nuclear/Reference Demand	Scenario 4: Low Nuclear/Low Demand

- Both of the supply scenarios (High Nuclear and Low Nuclear) are compared against a reference and low demand outlook from the 2026 APO
- The total commodity cost of the different scenarios are compared to one another by incorporating publicly available forecasts for the cost of new supply
- The High Nuclear, Low Demand scenario results in the highest commodity cost in 2050, while the commodity cost from the more aggressive renewable buildout are lowest in both the reference and low demand scenario
- None of the estimates incorporate broader socio-economic impacts of different resource options or the cost of new transmission, which may be required to integrate a large amount of supply from renewable resources that would likely be sited far from major load centres and existing transmission lines

1. IESO’s Annual Planning Outlook (APO) of Future Supply Needs

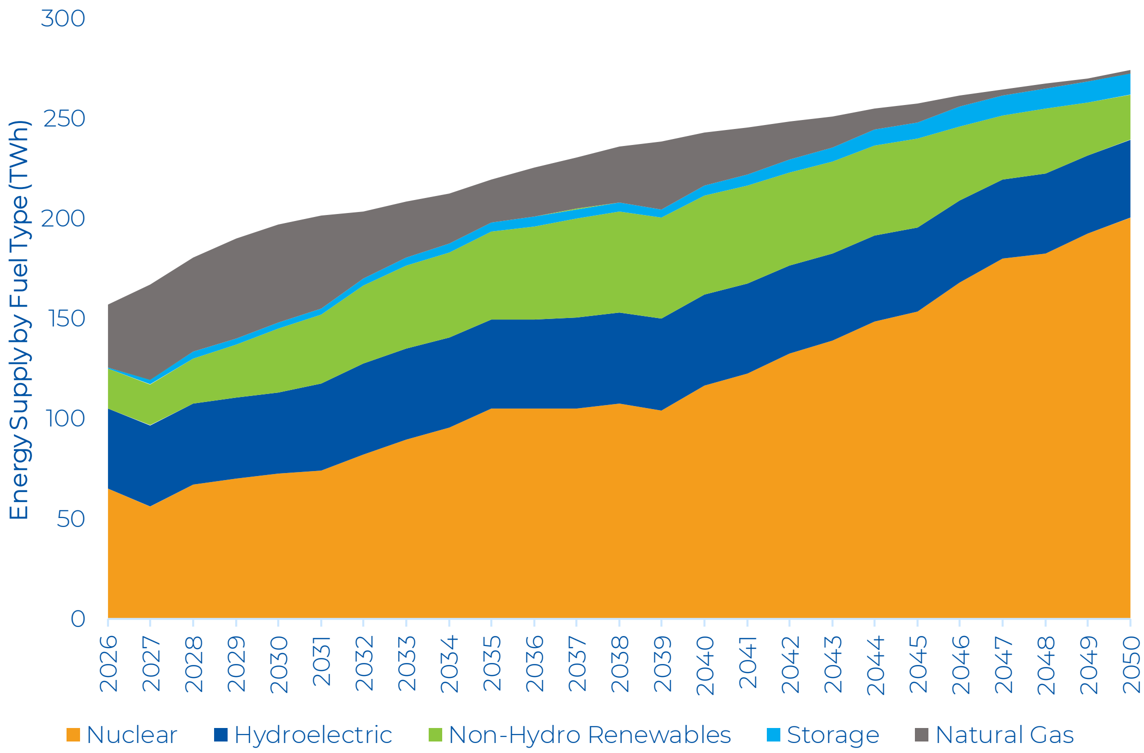
Overview of the APO Forecasted Demand Growth

- The Annual Planning Outlook (APO) is the IESO's long-term forecast for electricity demand in Ontario
- The APO includes forecasts on capacity and energy needs and how they province will serve future demand growth
- In recent years, the APO has marked a significant change from previous forecasts and is now forecasting material demand growth
- This comes after Ontario experienced more than a decade of relatively flat or declining electricity demand (with moderate growth in both 2024 and 2025 supporting recent demand forecasts from the IESO)
- The demand growth forecast will occur while the province will try to minimize supply from gas-fired generation in order to meet the standards included in the Clean Electricity Regulations (CER)



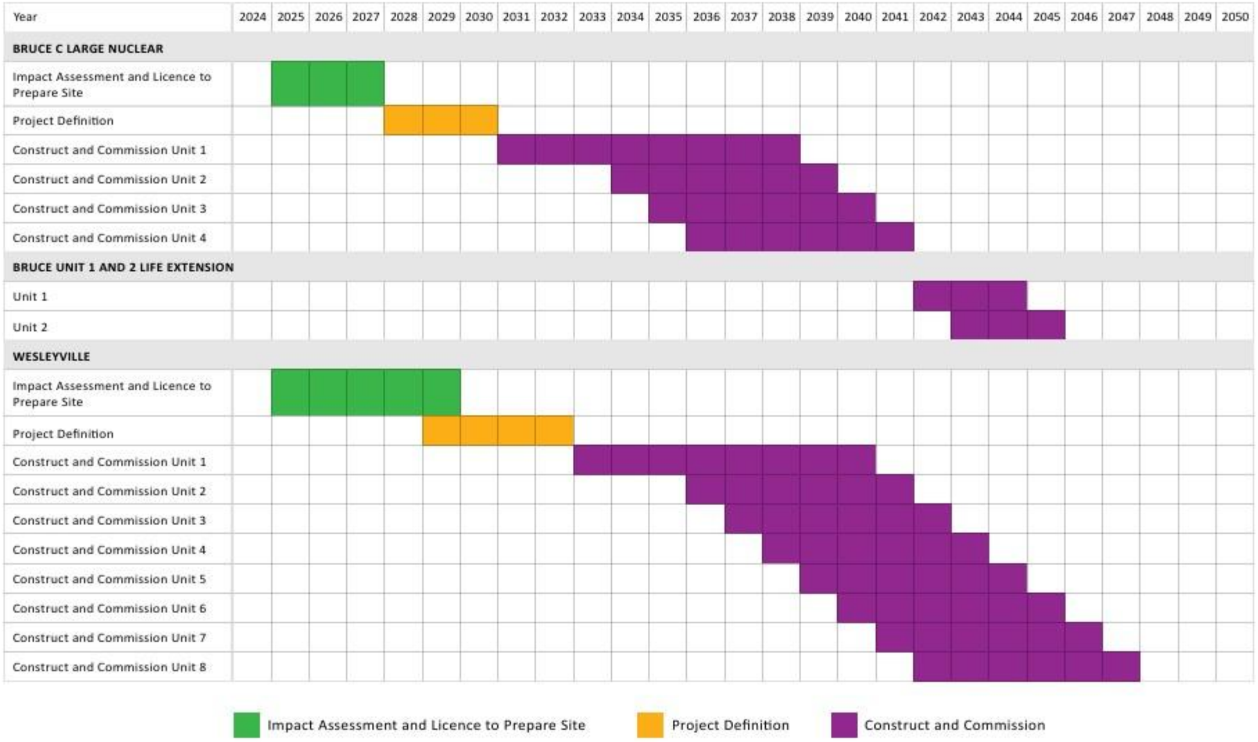
APO's Base Supply Path to Meet Demand Needs

- The 2025 APO also includes a forecast for potential resources to serve future demand growth
- Some of the resources are included in the IESO's multiple procurement paths, while other resources – particularly nuclear power and large-scale hydro – more broadly reflect the province's policy for new supply from nuclear reactors, including Small Modular Reactors (SMRs) at Darlington and large-scale reactors at both Wesleyville and Bruce
- Overall, the IESO's potential supply path includes a significant amount of supply – more than 200 TWh per year – coming from nuclear power



Provincial Policy Supports Nuclear Build-out

- As noted, the supply path included in the APO reflects provincial policy that supports nuclear generation
- Ontario Power Generation (OPG) is moving forward with a number of potential new nuclear projects, including 4 Small Modular Reactors (SMRs), and the refurbishment of the Pickering B nuclear site, which would amount to 2,000 MW of nuclear capacity
- In its recent Integrated Energy Plan (IEP), the province highlighted the potential for more than 17,000 MW of new nuclear by 2050, including new units at Bruce and a new facility at Wesleyville



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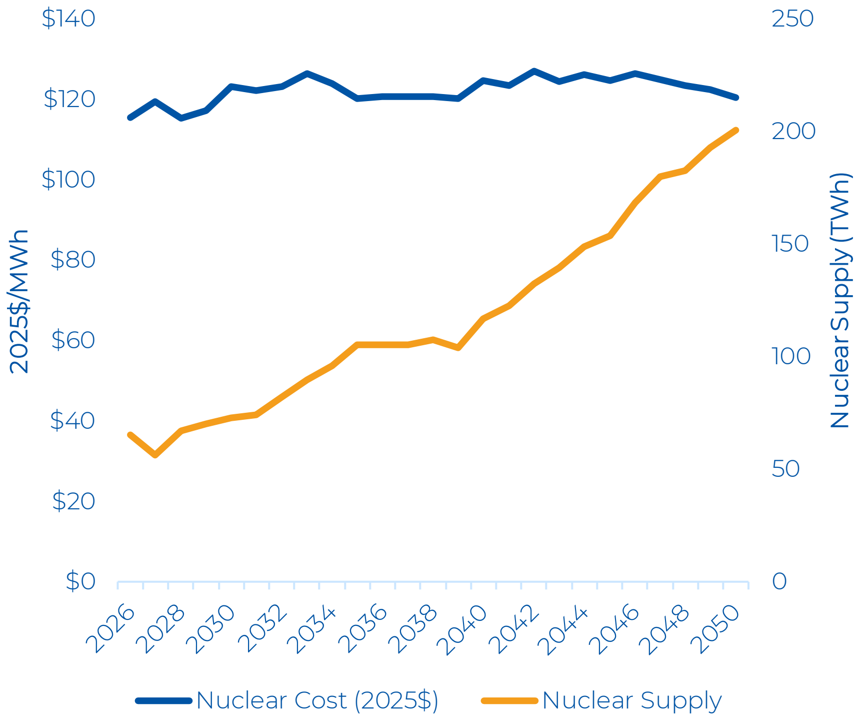
IESO Procurements of Other Resource Types

Procurement Mechanism	Procurement Type	Resource Target	Capacity Target (MW)	Term Start	Term Length
Long Term 2 (LT2) Window 1	Competitive	Energy and Capacity	3 TWh (Energy) 600 MW (Capacity)	2029/30	20 years
LT2 Window 2	Competitive	Energy and Capacity	1-3 TWh (Energy) 400 MW (Capacity)	2030/31	20 years
LT2 Window 3	Competitive	Energy and Capacity	2-4 TWh (Energy) 300 MW (Capacity)	2031/32	20 years
LT2 Window 4	Competitive	Energy and Capacity	2-4 TWh (Energy) 300 MW (Capacity)	2032/33	20 years
Long Lead Time	Competitive	Energy and Capacity (*Limitations on eligible storage technologies)*	600-800 MW and 1 TWh	Mid-2030s	40 years
Local Generation Program Window 1	Competitive	Energy and Capacity (*Locally sited, distribution-connected generation)*	TBD Provincial target with regional targets based on needs	2027	5 years *(recontracting stream)* 20 years *(new build)*

- The IESO is also moving forward with procurements of other resources through its Long-Term 2 procurement, but these amounts are more modest compared to the plans for nuclear supply – with the procurements for supply from renewable energy totaling between 8 and 14 TWh of new supply between now and 2035

Nuclear Supply Costs Assumed in 2025 APO

- The APO includes an estimate on the total cost of supply from different resource types, including nuclear power
- In “real” dollars – and an assumption that inflation will total 2% annually over the next 25 years – the cost of nuclear power is expected to remain around $120/MWh
    - The value is calculated by dividing the Long-term Forecast of Generation Costs by Resource Type included in the APO by the IESO’s Annual Energy Production values for nuclear supply over the next 25 years
    - The per unit cost is then converted to “real” 2025$
- This value is significantly below the more than $200/MWh that OPG has proposed in its 2027-2031 rate application before the Ontario Energy Board (OEB)



2: Capacity Expansion Options for 2050 and Forecasted Commodity Costs

Methodology For Environmental Defence Study

- Power Advisory provided Environmental Defence with a number of different scenarios to explore the potential cost and emissions profile of future supply in Ontario
- The scenarios include:
  - A 2035 Reference Scenario
  - 2050, High Nuclear, Low Demand
  - 2050, High Nuclear, Reference Demand
  - 2050, Low Nuclear, Low Demand, Aggressive Renewable Buildout
  - 2050, Low Nuclear, Reference Demand, Aggressive Renewable Buildout
- The scenarios are intended to provide a range of costs and emissions profiles between the nuclear buildout that is currently being proposed by the province and an alternative path that more aggressively pursues renewable resources such as wind and solar
- All the scenarios for 2050 have also been designed to align with the Clean Electricity Regulations (CER)

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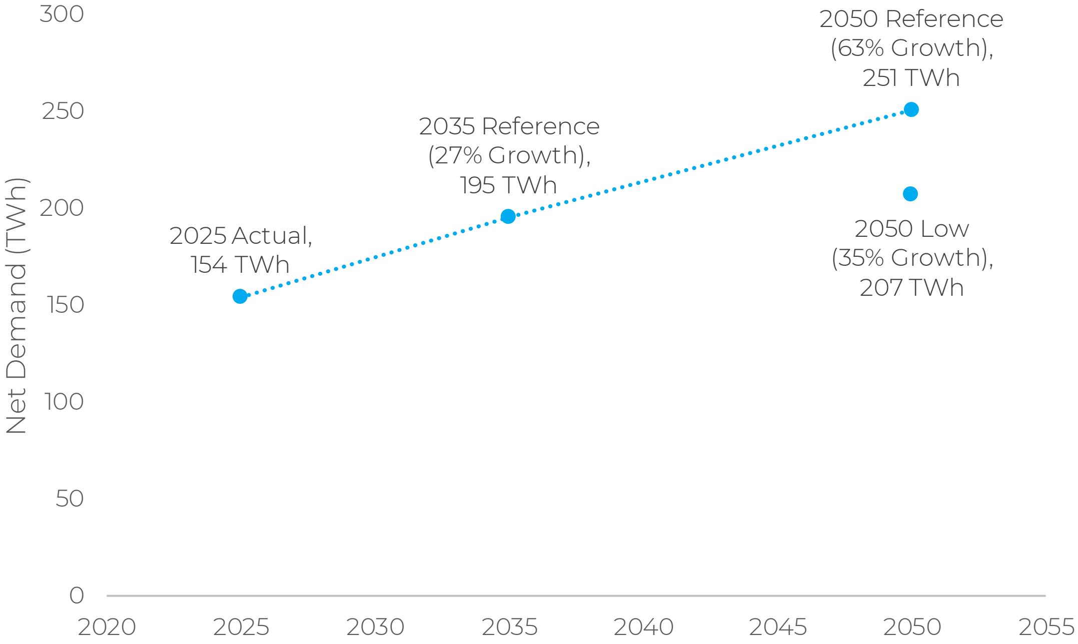
Demand Scenarios

- One of the key assumptions in the different scenarios is the underlying demand forecast
- Reference and Low demand scenarios are aligned with the peak and energy forecasts in the IESO's 2026 APO
- In the Reference demand scenario, Ontario demand increases from around 154 TWh in 2025 to 195 TWh in 2035 and more than 250 TWh by 2050
- In the Low demand scenario, Ontario demand reaches just 207 TWh in 2050



Supply Scenarios

- Supply assumptions were compiled using data from the IESO's 2025 APO, information from completed and planned IESO procurements, and the Government of Ontario's June 2025 Energy for Generations plan
- The 2035 supply scenario includes ongoing projects: Bruce refurbishment, Pickering refurbishment, and 1.2 GW of small modular reactors (SMR) at Darlington, and a reasonable potential outcome of the ongoing Long-Term 2 (LT2) procurement program
- The 2050 High Nuclear scenario also includes new nuclear at Wesleyville, the 4.8 GW Bruce C facility, and life extension of Bruce A (Units 1 and 2)
  - The 2050 Low Nuclear scenario excludes these three projects
- For the 2050 scenarios, a capacity expansion model is used to find the least-cost mix of wind, solar, demand response, and storage capacity that satisfies resource adequacy requirements and the Clean Electricity Regulations

Nuclear Installed Capacity Assumptions (GW)

Facility	2035	2050 High Nuclear	2050 Low Nuclear
Bruce A	3.3	3.3	1.6
Bruce B	3.3	3.3	3.3
Bruce C	-	4.8	-
Darlington	3.5	3.5	3.5
Darlington SMRs	1.2	1.2	1.2
Pickering	2.2	2.2	2.2
Wesleyville	-	8.0	-
Total	13.5	26.3	11.8

Cost Assumptions

- Cost assumptions for existing resources that are expected to continue operating through 2050 were set using the RPP Price Report, October 2025[1] .
    - Costs for demand response were based on the December 2025 Capacity Auction results[2]
- Cost assumptions for planned and candidate resources (CAPEX, OPEX, and fuel costs) were gathered from several recent sources outlined on the following slide
    - A future cost factor is defined to reflect forecasted cost decreases for some resources compared to current levels
        - Future for resources anticipated from the LT2 procurement were set using the average of forecasted costs for 2030 to 2035. Future costs for post-LT2 wind, solar, and storage were set using the average of forecasted costs from 2035 to 2049 (i.e. assuming a steady growth rate)
    - Power Advisory assumed new wind, solar, and battery storage will be eligible for the Clean Technology Investment Tax Credit (ITC) until December 31, 2034 and OPG's Darlington SMRs and Pickering refurbishment will be eligible for the Clean Electricity ITC
    - Power Advisory used conservative assumptions for wind, solar, and storage, including using the average of learning rates from a Moderate and High scenario and benchmarking Ontario wind and solar costs to higher-cost regions of the U.S. (e.g. New York) rather than relying on national averages
    - Capital costs were levelized using a 5% real cost of capital with 20-year life for storage, 30-year life for wind, solar, and gas, and 60-year life for nuclear

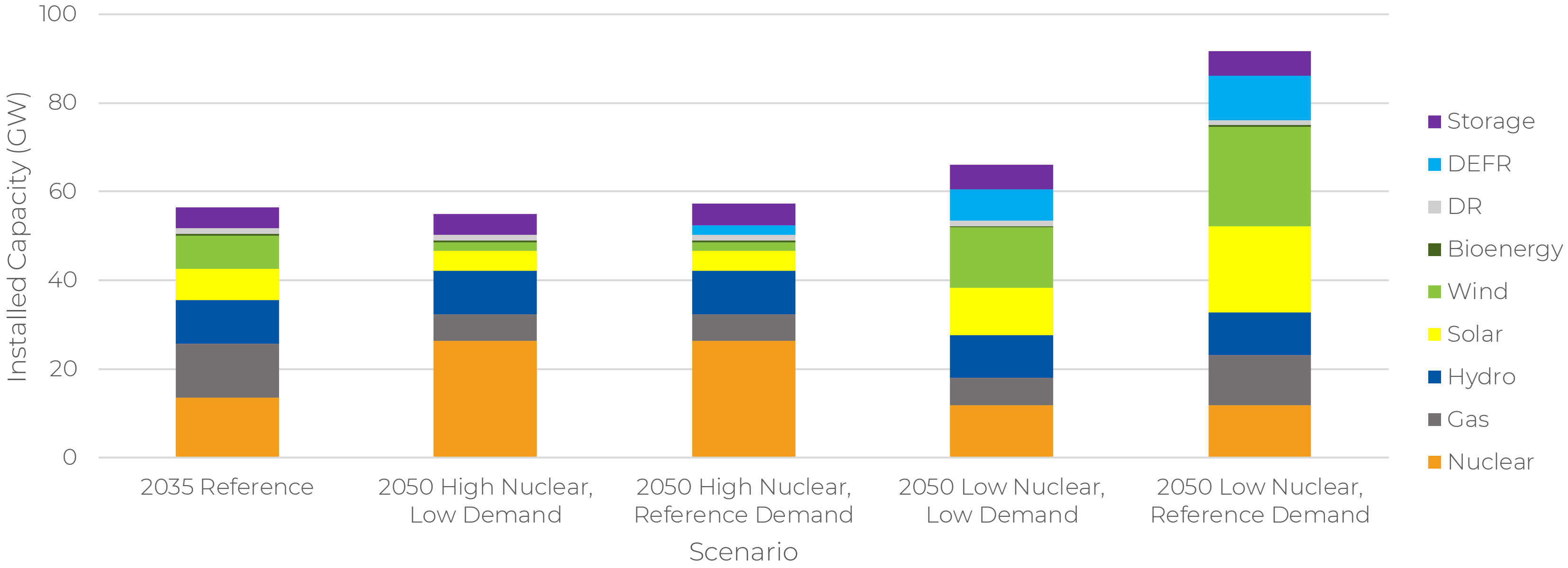
1. https://oeb.ca/sites/default/files/rpp-price-report-20251017.pdf
2. https://reports-public.ieso.ca/public/CA-PostAuction/PUB_CA-PostAuction_2026.xml

Cost Assumptions (continued)

Fuel Type	Base Year Unsubsidized CAPEX (2025 CAD/kW)	Base Year OPEX (2025 CAD/kW-year)	Base Year Fuel Cost ($/MWh)	Source for Base Year Costs	2050 Future Cost Factor	Source for Future Cost Factor	Low and High Range for Costs
Wind[1]	3,255	45	n/a	CAPEX: LBNL 2025 Wind Report[2] OPEX: Lazard 2025 LCOE+[3]	0.85	NREL 2024 ATB[4], average of Moderate and Conservative case for 2030 to 2050 compared to 2024 Base Year	+/- 15%, and double transmission cost for High range
Solar	2,754	17	n/a	CAPEX: LBNL 2025 Solar Report[5] OPEX: Lazard 2025 LCOE+	0.65		+/- 15%
Combustion Turbine (Natural Gas)	2,070	37	80 to 140	NYSERDA 0x40[6]	n/a	n/a	Low and High from NYSERDA 0x40 report
Combustion Turbine (Renewable Natural Gas)	2,070	37	380		n/a	n/a	
Nuclear - Large	14,980	281	20	NYSERDA 0x40	n/a	n/a	Low and High from NYSERDA 0x40 report
Nuclear - SMR	21,176	217	26		n/a		
4-hour Battery Storage[7]	1,347	77	n/a	NREL 2025 Battery Cost Projections[8]	0.83	NREL 2025 Battery Cost Projections	+/- 45%

1. An additional transmission cost for wind is included based on estimates in the IESO's Hybrid Resource Portfolio Equivalency Assessment https://ieso.ca/-/media/Files/IESO/Document-Library/Technical-papers/Hybrid-Resource-Equivalency-Assessment-Appendices.xlsx
2. Data for NYISO reported in LBNL Land-Based Wind Energy Technology Update 2025, for NYISO https://eta-publications.lbl.gov/sites/default/files/2025-08/data_file_land-based_wind_energy_technology_update_2025_edition.xlsx
3. Lazard 2025 LCOE+ https://www.lazard.com/media/5tlbhyla/lazards-lcoeplus-june-2025-_vf.pdf
4. NREL 2024 Annual Technology Baseline (ATB) v3 https://data.openei.org/files/6006/2024_v3_Workbook.xlsx
5. Average of 2024 CAPEX reported for NYISO, MISO, and PJM in LBNL U.S. Utility-Scale Solar, 2025 Data Update https://emp.lbl.gov/sites/default/files/2025-10/2025%20Utility-Scale%20Solar%20Data%20Update.xlsx
6. NYSERDA Zero by 40 Technoeconomic Assessment https://www.nyserda.ny.gov/-/media/Project/Nyserda/Files/Publications/Energy-Analysis/Zero-x-40-Technoeconomic-Assessment.pdf
7. 8-hour storage is modelled using a 76% cost premium on 4-hour storage, based on forecasts from the NREL 2024 ATB
8. NREL Cost Projections for Utility-Scale Battery Storage: 2025 Update https://docs.nrel.gov/docs/fy25osti/93281.pdf

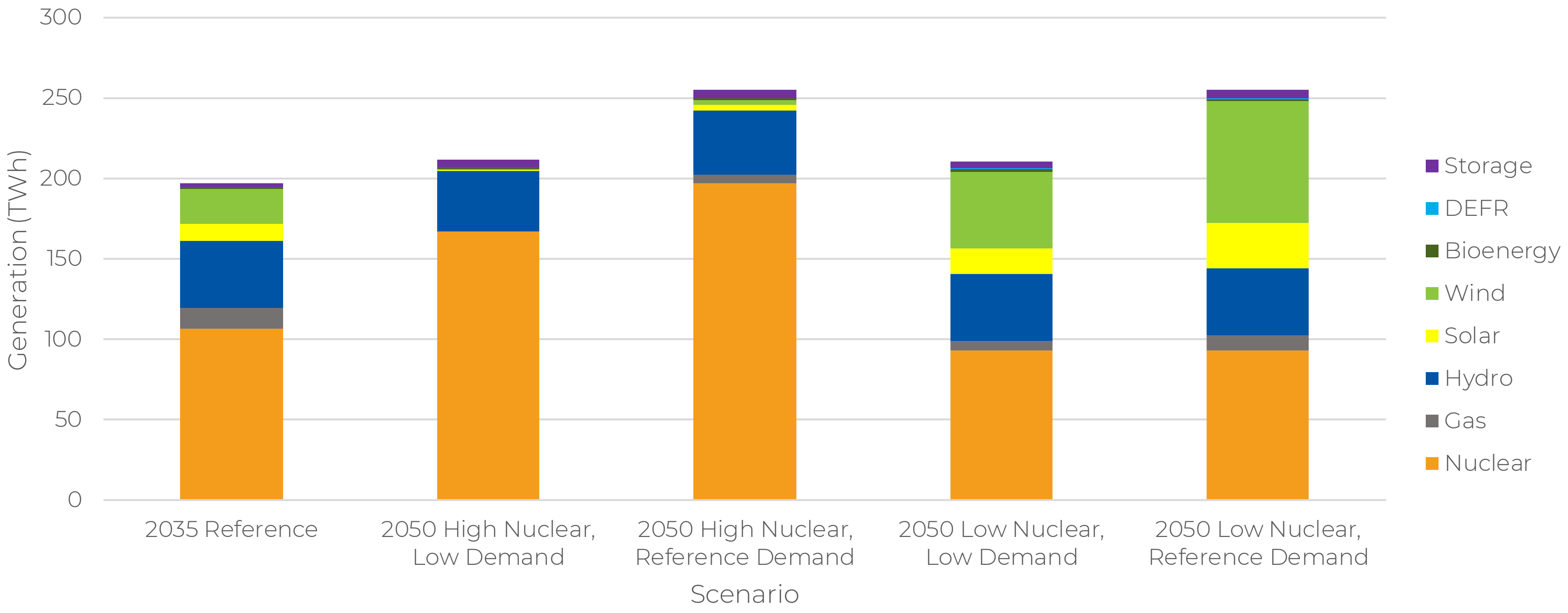
Installed Capacity (GW by Fuel Type)



- The different scenarios result in significant differences in the capacity buildout by resource type
- The Low Nuclear scenarios require more solar and wind to provide non-emitting energy, as well as more storage and dispatchable emissions free resources (DEFRs)* to provide non-emitting capacity

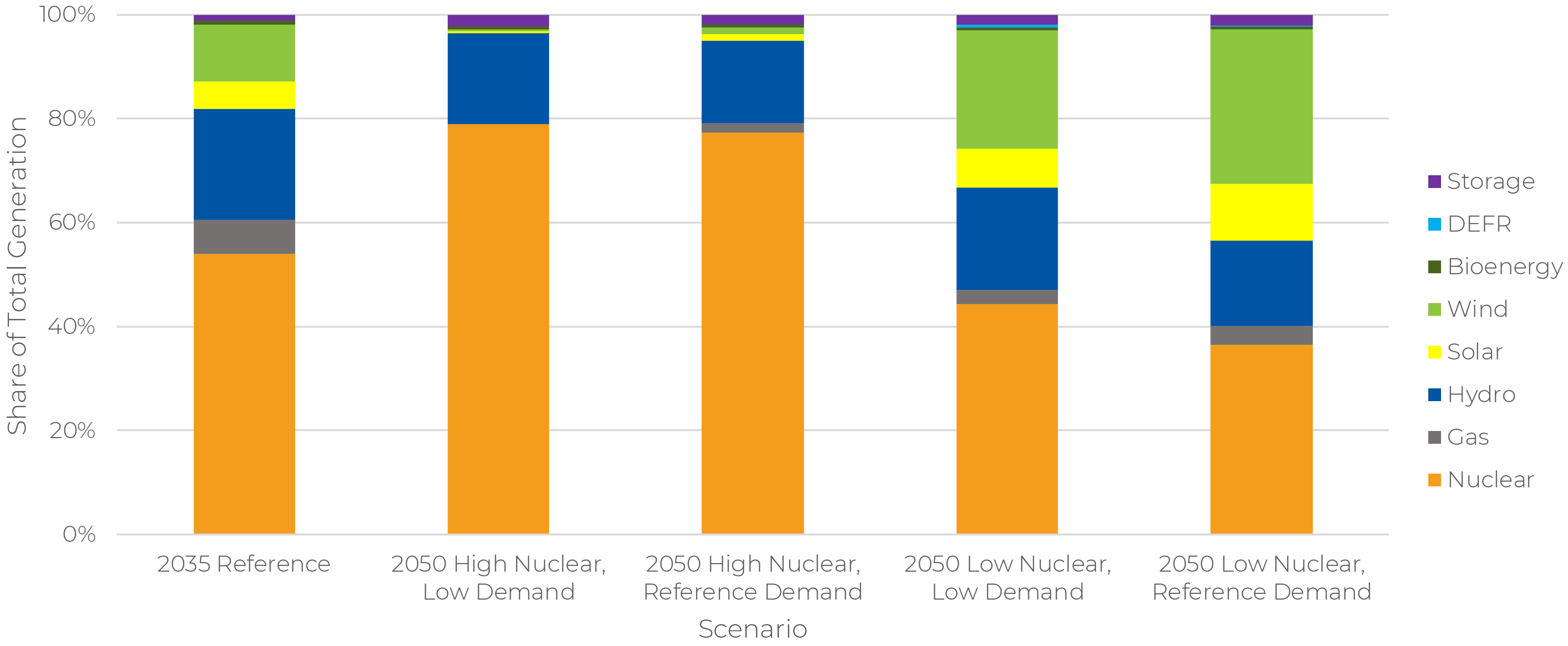
*Modelled as renewable natural gas

Generation Mix (TWh of Supply)



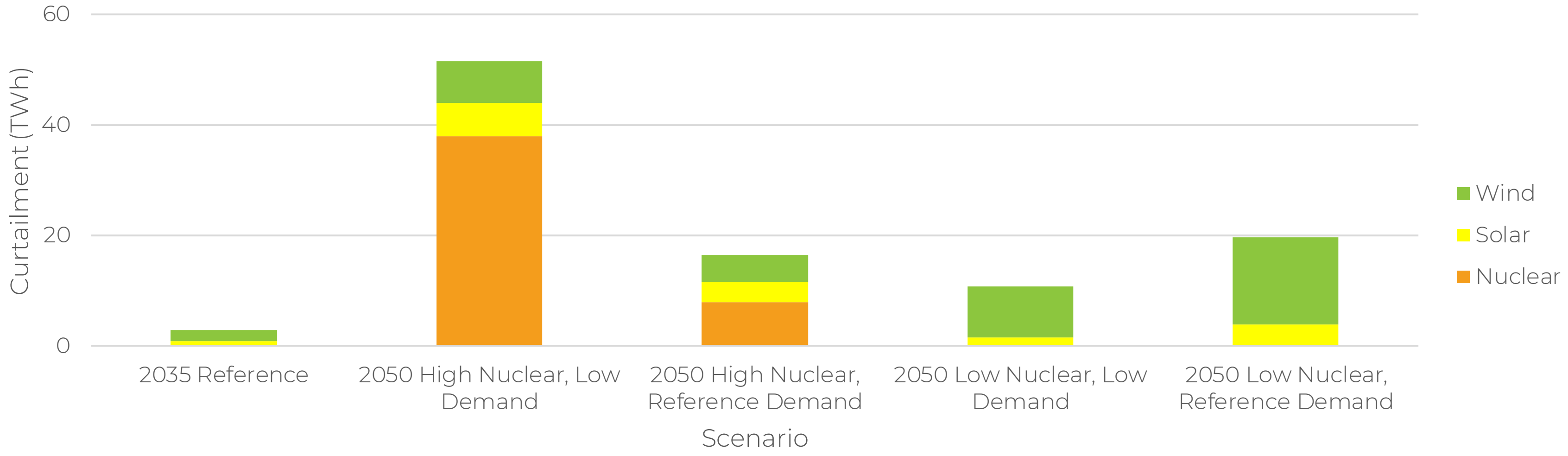
- Supply from gas-fired generation is lower in all scenarios compared to the 2035 Reference Case
- The Low Nuclear scenarios have marginally higher gas-fired generation than the High Nuclear scenarios

Generation Mix (% of Total Supply)



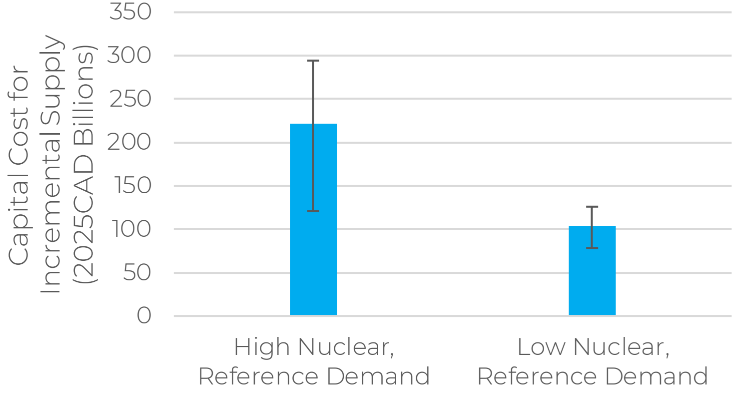
Curtailment by Scenario

- The High Nuclear, Low Demand scenario has considerable surplus baseload generation (i.e. curtailment)
- Wind and solar curtailment is higher in the low nuclear supply scenarios
  - Material curtailment is normally observed in the least-cost supply mix for forecast scenarios with very low emissions requirements



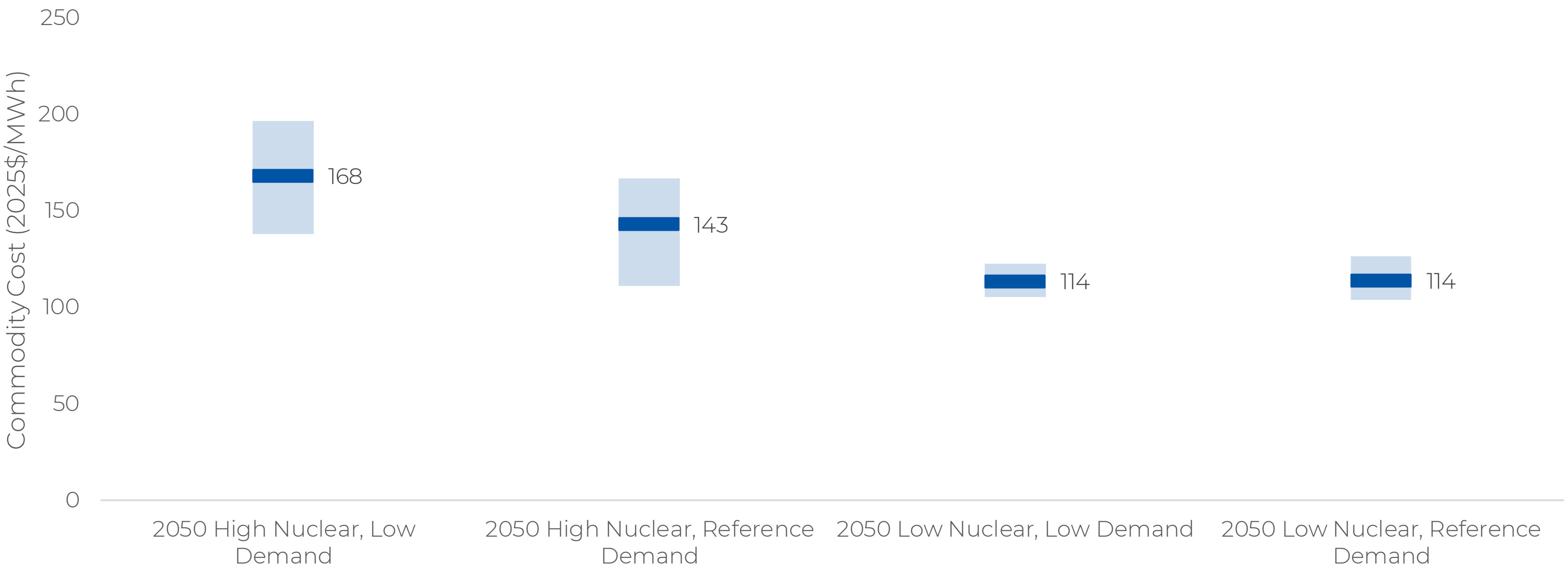
Incremental Capital Cost by Scenario

- The Low Nuclear supply scenarios considers an alternative to 14.4 GW of proposed nuclear expansion comprising 8 GW at Wesleyville, 4.8 GW of new capacity at Bruce, and 1.6 GW of refurbished capacity at Bruce
- The figure and table to the right shows Base Case costs and a range of uncertainty reflecting high and low cost estimates and the underlying capital costs
- The high nuclear buildout scenario results in $221 billion in capital costs compared to $104 billion in a low nuclear buildout and more aggressive renewable buildout instead, but the upper range is nearly $300 billion in the nuclear buildout compared to upper range of $126 billion in the low nuclear, high renewable scenario
- The Low Nuclear scenario has a lower capital investment required compared to the High Nuclear scenario
  - Comparing capital costs alone does not show the full cost of electricity supply. To understand the impact on annual supply costs, capital investments must be spread over the expected life of each resource and combined with its ongoing operating costs



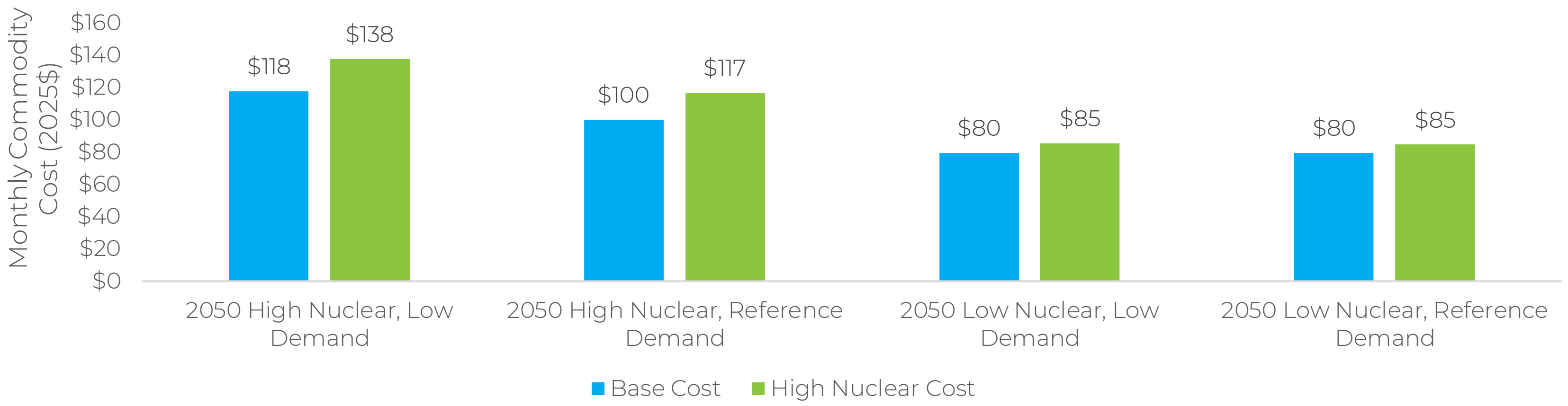
Resource Type	Average Capital Cost per Unit ($/kW)	Capital Cost for High Nuclear Buildout, Reference Demand Scenario ($Billions)	Capital Cost for Low Nuclear Buildout, Reference Demand Scenario ($Billions)
Nuclear	14,980	216	0
Solar	1,776	0	27
Wind	2,770	0	56
Storage and Non-Emitting Peak Resources	2,016	5	21
Total	n/a	221	104

Commodity Cost by Scenario



- The figure above shows forecasted commodity cost (i.e., the total anualized cost of generation and storage per MWh delivered) with a range of uncertainty reflecting high and low costs for nuclear, renewables, and storage
- The low nuclear scenarios consistently have the lowest supply cost – with the High Nuclear, Low Demand scenario being the most expensive option

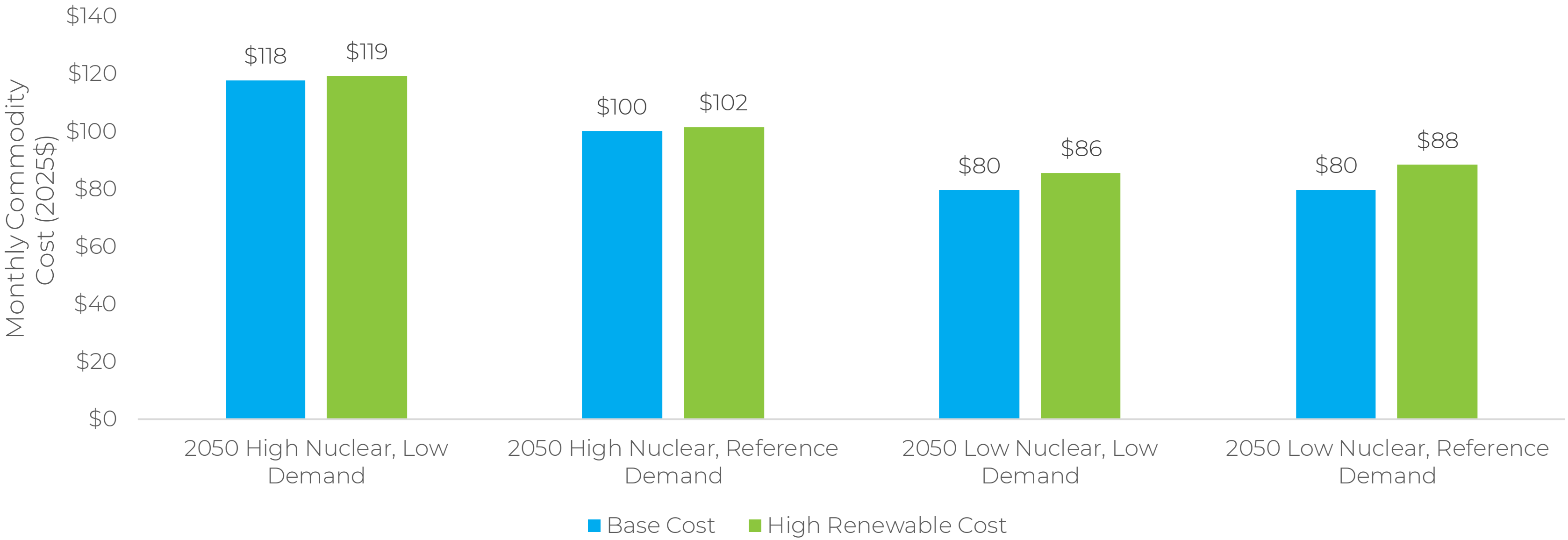
2050 Monthly Commodity Cost for Residential Customer



- Using the commodity cost figures from the previous slide and assuming that the average residential customer consumes 700 kWh per month (based on OEB estimates), the High Nuclear, Low Demand scenario will result in a monthly average commodity cost of $118, compared to $80 in the alternative scenario (in both the Low and Reference Demand scenario)

- If the cost of the incremental nuclear supply comes in at the “high” estimate, then the monthly cost in the High Nuclear, Low Demand is $138 compared to $85 in both the Low and Reference Demand scenario in the renewable buildout scenarios

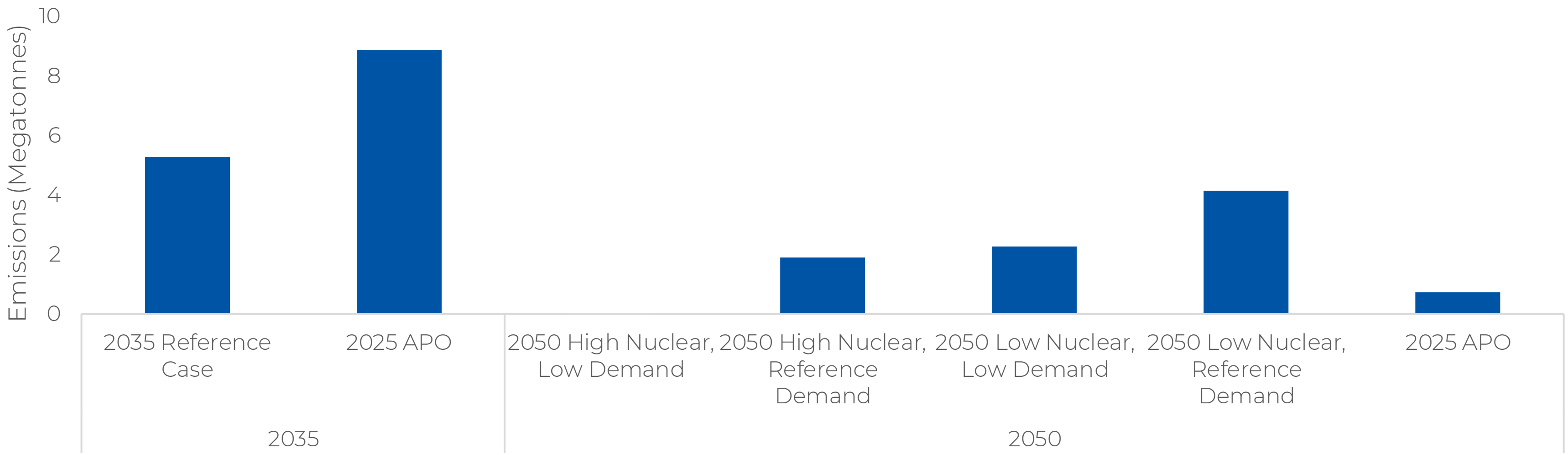
Alternative Commodity Cost of Residential Customer



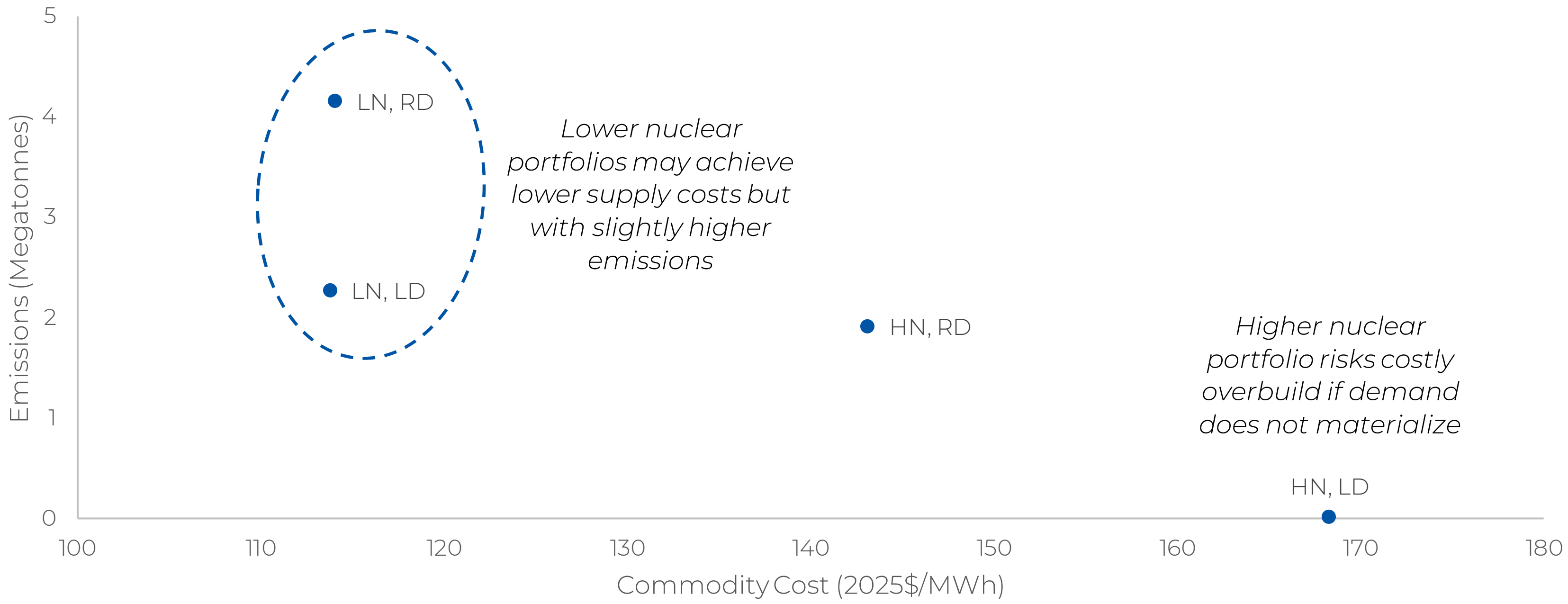
- If the cost of renewable and storage supply comes in at the "high" estimate, the monthly increase in residential bills is more moderate – growing from $80 per month to $86 and $88 per month in the Low and Reference demand scenarios

Emissions by Scenario

- 2035 Reference Case has slightly lower emissions than the 2025 APO, mainly due to lower forecasted demand in the 2026 APO
- The 2050 cases all have low emissions, consistent with the forecast in the 2025 APO and compliant with the Clean Electricity Regulations



Potential Emissions/Cost Trade-off



- All scenarios considered have very low electricity sector carbon dioxide emissions compared to other sectors of the economy
- The marginal emissions reduction in the High Nuclear scenarios costs $2,000/tonne or more; other emissions reduction options are likely more cost-effective

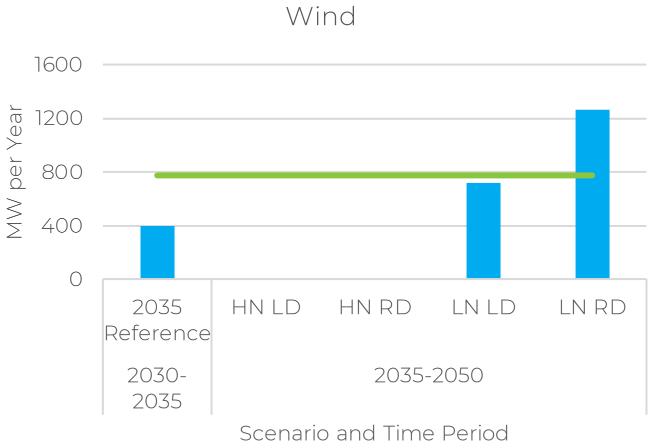
Commentary About Cost and Other Assumptions

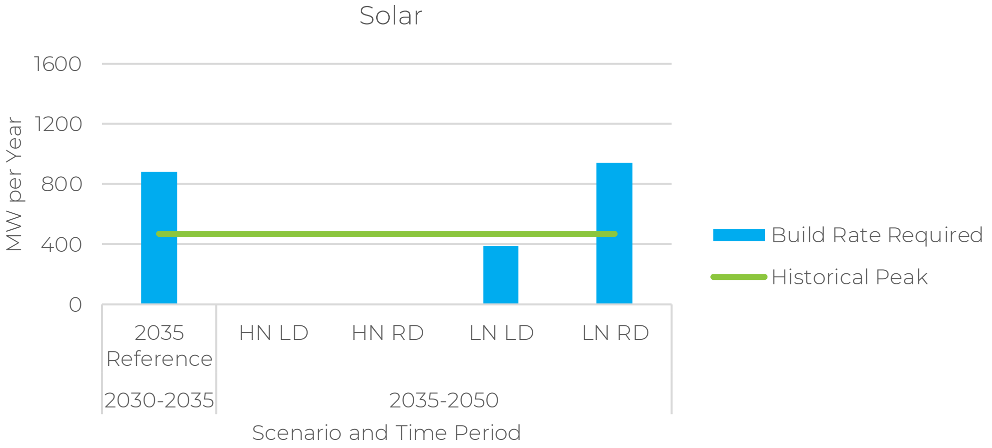
- Power Advisory relied on publicly available data for its modeling

- Nonetheless, there are a number of other considerations that may materially impact the findings:
  - We have relied upon nuclear cost estimates from a public agency in the United States (NYSERDA), but the most recent nuclear facility constructed in the United States (the first-of-a-kind Vogtle nuclear plant) had a capital cost that was significantly higher than the Base Case NYSERDA cost.
    - We should note that the high NYSERDA cost reference earlier in this report incorporated Vogtle costs
  - We assumed a 60-year operating life for new nuclear assets, as there are multiple nuclear plants operating in the United States that are significantly older than 40 years and licensed to operate for 60 years
  - If we assumed a 30-year life, the levelized cost of new nuclear facilities would be significantly higher
    - The most recent nuclear unit in Ontario — the Darlington Nuclear Generating Station — required significant refurbishment after around 30 years of operation, while other nuclear units in Ontario have operated beyond 30 years before requiring refurbishment
  - Historically, a number of nuclear facilities had lower capacity factors than we assumed (90%) – utilizing a lower capacity factor would increase the cost of the nuclear scenario
  - The cost of transmission was specifically not considered in this analysis – there could be substantial transmission to move energy from Northern Ontario where large renewable assets are more likely to be sited
  - And finally, our analysis assumes a capacity of 8,000 MW for the new nuclear facility in Wesleyville, per provincial planning documents – though we note that OPG is seeking a license for up to 10,000 MW

3. Discussion and Risks Around Future Supply Needs

Build Rates Required To Achieve Supply Needs





- The rate of wind and solar development in the low nuclear, low demand scenario between 2035 and 2050 is generally consistent with the highest historical rate of development in the 2014 to 2016 period
  - The low nuclear, reference demand scenario requires a substantially higher rate of supply growth
- The rate of nuclear development required in the high nuclear scenarios over the same 2035 to 2050 period, about 800 MW per year, is comparable to the rate of new nuclear development in the 1970 to 1986 period when the Pickering and Bruce generating stations were commissioned

Risks in High Nuclear, Low Renewables Supply Scenarios

Project Execution Risk

- There is a wider range of uncertainty for nuclear capital cost and development timeline relative to other types of generation
- While recent refurbishment projects have reported cost and schedule outcomes generally consistent with initial estimates, costs for ongoing maintenance can be significant. OPG has applied for an additional $3.3 billion in capital spending on the Darlington plant in the 6 years after completion of its $12.7 billion refurbishment (which was slightly below the $12.8 billion expected budget). In addition, large new-build nuclear projects have historically exhibited greater variability in realized outcomes
- As a result, high nuclear pathways may be exposed to greater uncertainty in supply cost and in-service timing compared to pathways relying more heavily on resource types with recent, repeatable deployment experience and delays in nuclear in-service dates may result in higher GHG emissions due to increased dispatch of gas-fired generators

Lead Time and Load Forecast Risk

- Nuclear generation is planned and constructed on a longer timeline than other types of generation
- Investments are made for the long term (e.g. 60+ years) at large, discrete facilities
- If actual load growth is lower than forecasted, committed nuclear capacity may exceed local needs for an extended period, with limited ability to defer or right-size supply once construction is underway, potentially resulting in high curtailment and/or exports at low prices

Risks in Low Nuclear, High Renewables Supply Scenarios

Clean Firm Capacity Technology Risk

- Deep decarbonization pathways with high shares of wind and solar capacity generally require a dispatchable, low- or zero-emissions resource for resource adequacy during extended periods of low renewable output
- In modelling studies, this resource is often represented as hydrogen- or renewable natural gas-fueled combustion turbines and/or very long-duration storage technologies (e.g. 100+ hours)
- Several of these technologies have limited commercial deployment at scale, and their future cost and scalability remain uncertain. If dispatchable emissions-free resources are not available at reasonable cost and scale, natural gas generation may be required for longer than anticipated

Siting and Transmission Risk

- There are frequently challenges with siting renewable generation (e.g. unwilling host municipalities), particularly for land-based wind resources
- Considerable transmission expansion is necessary to enable the siting and interconnection of variable renewable generation, but transmission costs are uncertain
- As a result, if substantial transmission expansion is required, the additional network investment could offset the commodity cost advantage of high-renewables pathways, such that total system costs may be comparable to or higher than those of high-nuclear pathways

Mitigating Long-Term Supply Risk

- *Reduce Transmission Cost Uncertainty*
  - Analyze transmission needs to enable 10+ GW of new land-based wind in high-potential regions
  - Improve transmission cost predictability for renewable developers (e.g. proactively build enabling transmission, standardize interconnection charges, etc.)
- *Preserve Flexibility and Incorporate Optionality in Supply Needs*
  - Maintain a diversified resource mix to reduce reliance on any single technology
  - Plan for nuclear off-ramps and decision gates to be used if costs exceed expectations or load growth is lower than expected
  - Evaluate higher intertie capabilities to better integrate with neighbouring markets and manage surplus or deficit periods
- *Target Emissions Reduction in both Short and Long-Term*
  - Deploy long-term solutions such as new nuclear while simultaneously implementing demand-side measures and accelerating new renewable generation in the 5- to 10-year timeframe
  - Consider programs to identify high-potential wind/solar development areas and incorporate into transmission planning process to expeditiously build non-emitting resources

Potential for Accelerating Near-Term Emissions Reduction

- The modelling in this study was focused on demand and supply needs in 2050, as the supply resources anticipated to enter service between now and 2035 are largely known based on projects that are in flight or expected IESO procurements, though the final cost and timelines of both the SMRs and Pickering Refurbishment will not be known until those projects are completed in the 2030s
- Between now and 2035, the province's fleet of gas-fired generators are expected to run at a much higher capacity factor – with the 2025 APO's supply scenario including more than 50 TWh per year of gas-fired supply in some years
    - In 2025, gas-fired supply totaled more than 30 TWh, which was a record amount of gas supply in Ontario – with that figure expected to nearly double in multiple years over the next decade
- While the IESO is moving forward with multiple procurements for new supply from non-emitting resources, there may be potential to increase the magnitude of those procurements in an effort to reduce emissions in the electricity grid between now and 2035 and hedge against the cost of volatile gas prices that impact supply costs from gas-fired generation
- As shown previously in this report, Ontario installed an average of more than 700 MW of wind capacity annually during the last major supply buildout in 2013-2015, which is nearly double the amounts expected in Long-Term procurements from the IESO over the next decade
- An expedited buildout of renewable supply will limit the dispatch of gas-fired generation, although most (if not all) gas-fired capacity will continue to be required for capacity needs (mainly for peak demand hours) and system-wide flexibility
- An expedited procurement of non-emitting supply may require transmission investments that have not been modelled, but should be considered

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