



Evaluating Procurement Options for Supply Adequacy

A Resource Adequacy Update to the Minister of Energy
December 11, 2023



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Executive Summary

Ontario's electricity sector is experiencing growing demand, an evolving supply mix and a drive toward grid decarbonization. Combined, these factors are spurring the IESO's ongoing large-scale resource acquisition effort to ensure adequate supply will be available into the 2030s and beyond.

The IESO is planning a cadenced schedule of procurements to include both medium-term commitments for existing resources and long-term commitments for new build and upgraded resources. This approach to procurements will allow for a regular reassessment of needs as time progresses, and for ongoing technological advances to occur that may reduce associated costs.

While the province will have the power it needs in the near-term as a result of recent procurements and other activities, as we look beyond 2029 Ontario's needs will continue to grow along with the economy and with ongoing nuclear outages and the anticipated phase out of natural gas. Forecasts project five terawatt-hours (TWh) of new electricity supply will be needed between 2029 and 2031 - enough to power more than half a million homes for a year. This energy need is expected to grow through the 2030s.

Though the focus of current procurements is capacity, which means forms of supply that are capable of meeting demand specifically during peak system hours, there is also a need for actual energy output during certain periods throughout the year. Over the next four to six years, the IESO expects to run a regular cadence of procurements targeting approximately 5,000 MW of new capacity.

The first of these energy procurements, the long-term RFP 2 (LT2), is expected to seek about 2,000 MW of energy-producing resources to meet the five TWh need. The IESO will run a technology agnostic procurement focusing on non-emitting supply such as wind, hydro, bioenergy and solar generation.

These resources are well suited to meet our emerging need for energy. They can also work in tandem with Ontario's emerging battery fleet. Together they will increase reliability, enabling the province to reduce output from natural gas generators, supporting the process of eliminating emissions from the grid.

Ongoing medium-term procurements will also ensure the power from existing resources remains committed to Ontario, while the IESO will also look at opportunities for resources with long-lead times to participate and compete for later in-service dates.

In addition, procurements will continue to target amounts higher than the calculated adequacy needs to account for demand and supply uncertainties, ensuring Ontario has resources in service to meet the emerging and growing resource adequacy need.

The IESO's competitive procurement process is structured to deliver maximum ratepayer value, helping to ensure the most cost-effective proposals are chosen. For example, current average

benchmark prices for current competitively procured wind resources are less than half of the average rate for wind procured through the Feed-In-Tariff (FIT) program of the mid-2000s.

As part of the overarching effort to prepare Ontario's electricity system for a decarbonized and reliable future, distributed energy resources (DERs) will also be eligible for the LT2, tapping into this growing generation and other forms of supply embedded within communities. Distributed generation, flexible load and storage already play a prominent role in powering local communities as they manage population and economic growth that is expected to grow significantly over time. Their inclusion in LT2 will further enhance the ability of DERs to meet growing system needs.

In moving forward with this transformative effort, the IESO is working to understand the needs of communities and stakeholders across the province. Many communities are being asked to consider locating various types of projects that will support their needs but also have the potential to spark local opposition. Some will face a demanding task as serious and thoughtful decisions must to be made about what works best for communities and our province as a whole.

Preparing Ontario's electricity grid for our future needs is a highly complex process with many interdependencies. By securing output from non-emitting energy producing resources, the IESO is preparing to optimize the province's storage fleet to provide much of the flexibility that will be lost with the retirement of natural gas. The process of securing resources to meet Ontario's growing need for electricity must be carefully planned, supported by meaningful engagements with stakeholders and rights holders as we navigate this course together.

As a prelude to broader engagement about needs in 2030 and beyond, this report outlines upcoming system requirements and the procurement processes being designed to meet them, as well as a number of considerations for timelines and resource acquisition.

Purpose

In response to the December 7, 2023 Letter requesting an Interim Resource Adequacy Update, which includes evaluation procurement options for supply adequacy from the Minister of Energy to the IESO, this report has been prepared to provide an evaluation of procurement options for upcoming resource adequacy needs in Ontario. The report outlines the emerging system needs and outline of the resource types that can meet these needs and what value that they can provide to the system and Ontario ratepayers.

As requested, the report also includes estimates of the difference in costs resulting from contract rates that were offered as part of the Feed-in Tariff (FIT) and Large Renewable Procurement (LRP) programs against costs that could be expected to be incurred through a competitive approach contemplated under the proposed second LT2 RFP.



Ontario's Emerging System Needs 2029 - 2035

Electricity demand in Ontario is expected to continue to grow in response to significant economic and population growth. Demand forecasts outlined in the 2022 Annual Planning Outlook (APO) foreshadowed strong and steady growth through the end of the 2030s, fueled primarily by industrial sector development in the mid-2020s in mining, steel, EV battery and hydrogen production; greenhouse construction in the agricultural sector; and the electrification of transportation.

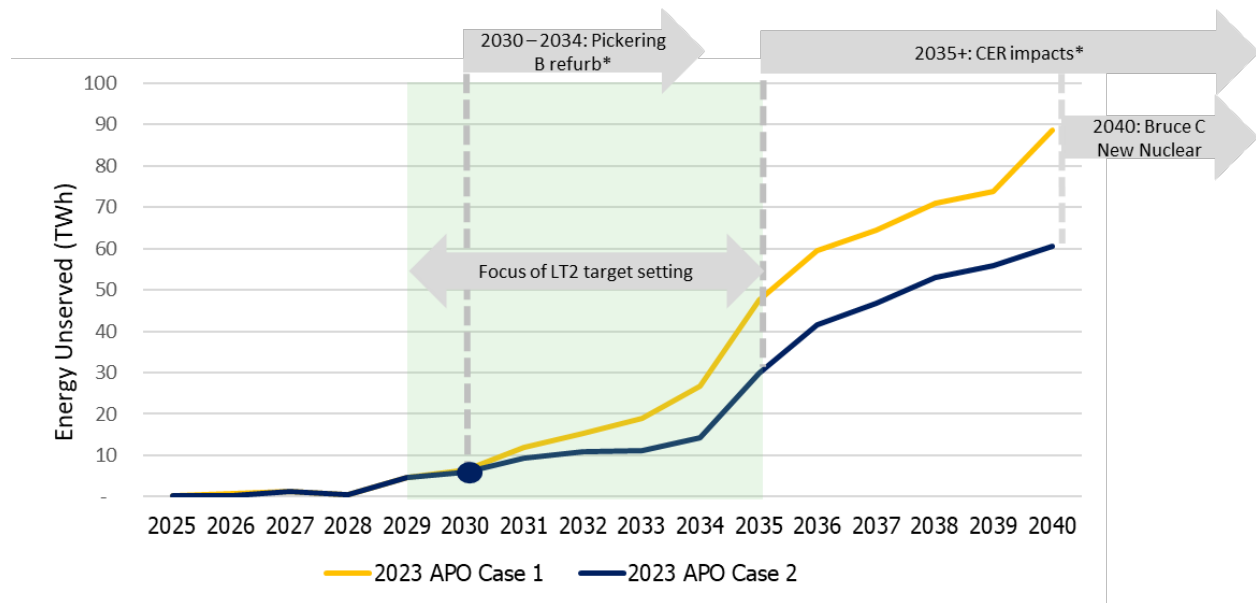
The IESO's 2022 APO shows that energy needs emerge by the end of this decade and grow sharply, driven partly by this demand growth, and compounded by the retirement of the Pickering nuclear station. Policy considerations such as the proposed Clean Electricity Regulations (CER) are expected to exacerbate this need beginning in 2035.

A number of procurements for existing and new resources will be needed to ensure we can meet needs by the end of this decade and prepare for a larger energy transition in the next decade.

To date, the IESO has been focused exclusively on meeting capacity needs that emerge in the mid- 2020s. With contributions from previous and in-flight actions, and subject to coming federal and provincial policies, the IESO sees a need for approximately 5 TWh of new energy beginning between 2029 and 2031 and growing through the 2030s. Targets for the next procurement will be largely driven by these energy needs. Some residual capacity needs may remain in 2029/2030, depending on the mix of resources acquired to meet energy needs; capacity needs are also expected to grow more significantly through the 2030s. Through the Resource Adequacy Framework, the IESO can deploy capacity procurements alongside the planned energy procurements to complement these efforts.

In the upcoming APO, needs are illustrated by two scenarios - Case 1, which shows the supply mix if expiring resources are not recommitted, and Case 2, which builds on Case 1 by including actions contemplated under Ontario's *Powering Ontario's Growth* (POG) report, such as the refurbishment of Pickering B Nuclear Generating Station. Both cases show that a recommitment of expiring resources, as well as supply from new resources, will be required to meet growing demand. The next APO will provide guidance for the upcoming long-term procurement targets.

Figure 1 | Potentially Unserved Energy



Notes:

*Uncertainties in the Clean Energy Regulation can put upward pressure on the energy need in 2035+. Refurbishment of Pickering B will help address needs, but timing is highly uncertain.
Case 1 shows need with no re-commitment of existing resources when contracts end
Case 2 accounts for impact of actions from Powering Ontario’s Growth (SMR’s, etc.)
 Dotted line represents estimated minimum net new energy that is needed

Needs post-2035 will be highly dependent on significant decisions that are expected to come later in 2024, including the final CER and the potential refurbishment of Pickering B.

Uncertainty and Risk Mitigation

The preceding analysis of emerging system needs, as well as the considerations for resource eligibility noted later in this document, take into account uncertainty pertaining to demand growth, the deployment of new technologies, and effectiveness of ageing assets towards the end of this decade and into the 2030s. Practically speaking, the analysis considers the following:

- Likelihood that newly procured assets are able to enter service as anticipated, in the volumes procured;
- Growing pains inherent to new technologies, including their ability to participate and operate effectively in the real-time market and contribute to system needs immediately after entering service;
- Ability for aging assets (i.e., Lennox GS, wind and solar procured more than 20 years ago) to continue to contribute to resource adequacy in a consistent manner;
- Policy considerations inherent to some thermal generation (i.e., natural gas generation).

Based on the uncertainty identified above and as shown in Figure 1, energy needs continue to grow into the 2030s. A continuous cadence of procurements, targeting amounts higher than anticipated adequacy needs to account for these uncertainties, will ensure investment takes place in existing, repowered and new facilities. Such a cadenced procurement approach allows the IESO to adjust to changing system needs.

The Resource Adequacy Framework

To help meet growing system needs and aid in the energy transition, the IESO is leveraging its Resource Adequacy Framework (the framework), to secure supply through competitive means. The framework fosters competition while providing certainty, balancing risk between ratepayers and investors. There are several mechanisms within the framework, and together they provide the IESO with the flexibility to address its evolving needs while also recognizing the unique characteristics of different suppliers and resource types.

Since its launch in 2021, the IESO has used the framework to meet procurement targets, retain existing assets in a cost-effective manner, and attract new investment.

Figure 2 | Resource Adequacy Framework at a Glance

Mechanism	Scope
Capacity Auction	Balances fluctuations in capacity needs from one year to the next, and executed on an annual basis
Medium-Term Commitments	Provides resources greater certainty through longer forward periods and flexible 5-year commitments - cadenced process will provide IESO flexibility to adjust to changes in system needs and adapt processes to lessons learned
Long-Term Commitments	Secures resources with very long forward periods or commitments, such as new-build facilities
Programs	Meets electricity and policy objectives in a more targeted manner as directed
Bilateral Negotiations	Secures resources where a need exists that cannot be addressed in a practical and timely way through competitive processes (i.e. when needs are urgent and/or must be satisfied by supply in a specific location)

Overall, the results of the IESO’s recent resource acquisition activities, including the 2022 Capacity Auction and Medium-Term I RFP, as well as ongoing long-term acquisition mechanisms, have put Ontario on track to meeting capacity needs through 2028.

Table 1 | Long-Term Acquisitions

Acquisition Mechanism	Total Capacity (MWs)	Storage (MWs)	Non-Storage (MWs)	Target Commercial Operation Date
Same Technology Upgrades	291	N/A	291	May 1, 2025
Expedited Process (E-LT1 RFP)	1,177	882	295	May 1, 2026
Long-Term 1 RFP*	2,505	1,600	905	May 1, 2028

* Ongoing procurement. MW amounts are target amounts.

Providing Certainty for Investment

A key feature of the framework is the certainty it can provide around next steps in the energy transition. A cadence for long-term procurements, similar to the schedule for medium-term procurements, will provide commitment and visibility to consumers, communities and planners, as well as investors and developers.

The IESO is recommending that a series of long-term procurements be executed approximately every two years, and integrated with the medium-term procurement cadence. This will provide developers with needed certainty to begin project development in a proactive rather than a reactive manner. This also allows the IESO to adapt between procurements to the latest macro-economic trends and policy considerations, avoiding overbuilding while capturing the technological advancements and cost reductions that may result.

A commitment to regular and multiple procurements as early as possible would also accelerate project development and provide different resource types, including those with long-lead times, the opportunity to compete.

Procurement for Energy and Capacity Needs

Analysis is ongoing to assess the annual energy and capacity targets for upcoming long-term and medium-term procurements. Medium-term procurements will target the equivalent capacity and energy of all resources with expiring contracts, and the IESO expects upcoming long-term procurements will look to acquire approximately **5,000 MWs in total** of energy-producing resources over three cycles, running approximately every two years. There are a range of risks and uncertainties that could impact the IESO’s needs assessment; therefore, targets will be adjusted and confirmed prior to each RFP. Depending on the needs, the IESO can leverage commercial structures that incent either energy or capacity resources, or both.

In upcoming engagements, the IESO will provide more detail on targets for future long and medium-term procurements. These will be informed by emerging system needs, as well as the pool of existing resources available, considering forward periods and development timelines for eligible resources.



Resource Eligibility – Non-emitting Resources

As with the IESO's past procurements, the next round will be technology agnostic - open to any non-emitting resources that are able to meet the performance criteria. However, as the LT2's focus is on energy needs emerging in 2029, not all resources types will likely be able to cost effectively compete and meet the requirements. Resources expected to participate could include wind, solar, biofuels, waterpower and hybrids (renewables paired with storage). Participating resources could also include facilities directly connected to the grid, or as distributed energy resources.

Wind and Solar Photovoltaic

Over the last 20 years, Ontario's wind fleet has grown on the system and now provides roughly 10 per cent of total output in the province. At the same time, the IESO has developed extensive operational experience with wind generation, with tools and processes that help manage this intermittent resource reliably and effectively.

Similarly, solar power has grown significantly – particularly as an embedded form of generation, with the IESO incorporating the impact this local supply has on reducing demand from the grid.

New wind and solar projects are suited to coming procurements as they can be developed in four to five years once a contract has been issued, and procurement targets have been calculated to account for resources that produce energy intermittently. Variable generation will become more valuable to the system as electricity consumption patterns change. The province's peak demand periods are expected to shift from summer to winter as home heating electrifies; this is when wind output is generally much higher.

A number of existing wind and solar resource contracts are also beginning to expire over the next decade, a total of 2,932 MW of wind and 1,171 MW of solar will be coming off contract between 2026 and 2034 (see Appendix for breakdown). This provides opportunities to leverage these existing assets to continue to provide energy to the system, as well as incenting repowering at existing sites. Repowering of wind, which consists of fully or partially replacing old turbines with more powerful and efficient models, would allow existing sites to increase their capacity without increasing their footprint (or conversely, maintain their capacity while reducing their footprint).

Biofuels

While upcoming long and medium-term procurements will provide opportunities for biofuels to compete for contracts, these resources are often limited in terms of the energy that they can provide cost-effectively and may be better suited as capacity resources. Biofuel facilities are often constrained by their unique fuel supply (i.e., wood pellets, forestry by-products) and thus may not be able to economically meet emerging system needs when energy is the focus. Those

biofuel resources that meet the requirements can participate in the upcoming procurement processes.

Waterpower

Waterpower generation is expected to contribute to meeting emerging energy needs both through existing and incremental energy. Waterpower resources who are able to upgrade or expand their facilities can participate in the upcoming procurement processes.

Given that waterpower requires significant time for new-build development and/or significant expansions, the likelihood is that any resources procured will be able to meet needs emerging by 2030 is low. The cadenced procurement approaches, coupled together with some flexibility on in-service dates, should provide options for waterpower resources to emerge in the mid-2030s.

Long Lead-Time Resources

The IESO's cadenced procurement approach aims to provide the requisite investment certainty for a number of different resource types, with varying forward periods to allow for project development. This will provide an opportunity not only for developers and investors who wish to begin pre-development work and focus on a subsequent long-term procurement (i.e., LT3 or LT4), but also for those who may wish to submit a proposal for a future target in-service date.

While the IESO intends to stakeholder this approach and create a framework that enables competition, the basic premise would allow for a proponent seeking to develop an asset with long lead-times (i.e., new hydroelectric) to compete in an earlier procurement (e.g. LT2) but come into service at a later date (e.g. COD 2034). The IESO would set a second stream in the procurement for those resources proposing a later in-service date and would allow like for like competition within that stream. Additional cost containment measures that compare between the two streams may be employed to ensure ratepayer value for long lead-time resources.

System Considerations for Electricity Storage

Through the Expedited Long-Term Process, the IESO added a total of 882 MW of storage capacity to the province's planned storage fleet, and is now targeting an additional 1,600 MW of capacity from storage resources as part of the LT1 RFP. These procurements represent a historic investment in electricity storage and have positioned Ontario as a global leader in this space. The procurement of energy producing resources is key to maximizing the value that electricity storage resources provide and to enable them to effectively meet system needs.

Electricity storage is largely a capacity resource and as such does not meet the outlined energy needs emerging as early as 2029 on its own. With the large volume of storage coming online, it is critical that upcoming procurements drive investment in energy-producing resources to complement storage. As more non-emitting resources are built out they will be highly useful in charging Ontario's new storage fleet. However, hybrid systems, which combine energy generation, usually from renewables, with storage, will also be eligible to participate in the coming long-term procurements.

Decarbonization & Federal Regulatory Considerations

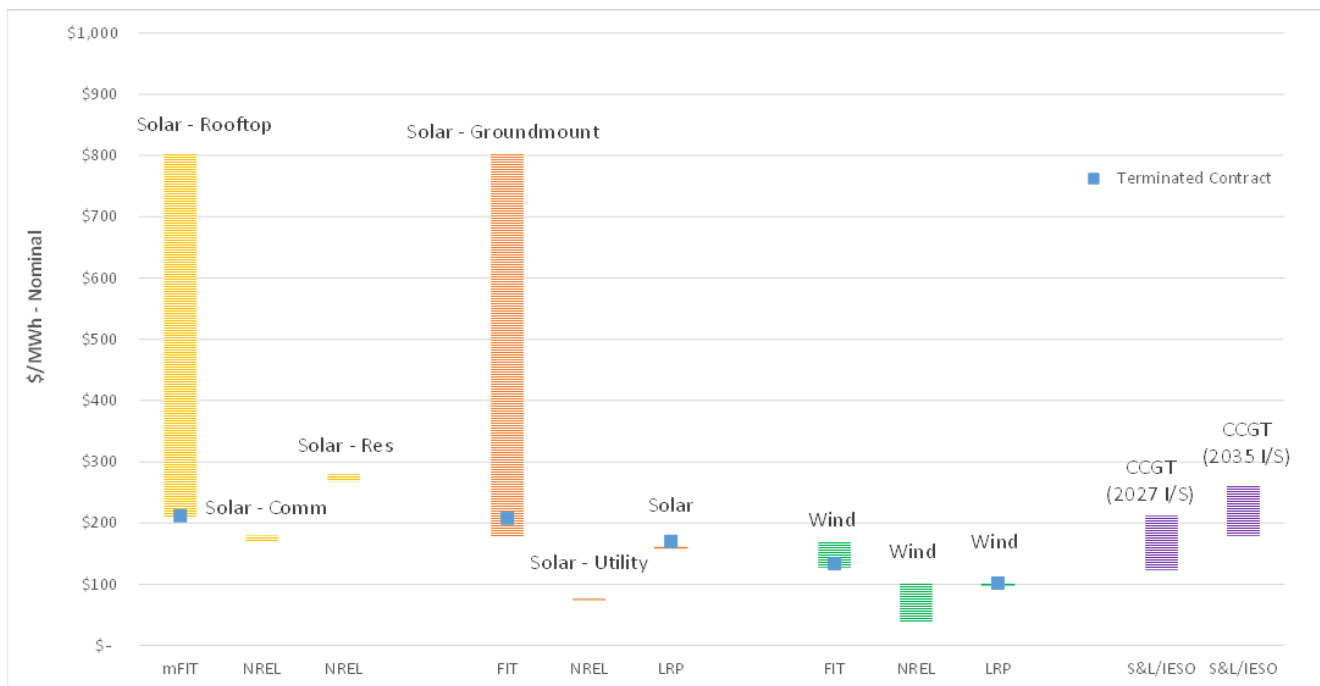
Natural gas generation will continue to play an important role as a reliable transitional resource, and current procurements are seeking a limited amount of new natural gas capacity to bridge the gap between today's supply mix and a build out of the province's non-emitting resource fleet. The province's next procurements will make a significant contribution to decarbonizing its supply mix.

Looking further, as part of its commitment to achieving a zero-emissions grid that supports broader decarbonization, the IESO is currently working with federal partners to inform achievable Clean Electricity Regulations that eliminate the use of emitting generation and contribute to a net-zero economy by 2050, in a manner that maintains system reliability and affordability.

Wind & Solar Value Assessment and Cost Estimates

Some past acquisition mechanisms such as the FIT program were standard offer programs with pre-set contract rates. As can be seen below, MicroFIT/FIT program's¹ current prices for wind and solar are substantially higher than the National Renewable Energy Laboratory (NREL) benchmarks². On the other hand, the competitively-procured contracted prices from the Large Renewable Projects (LRP) program are closer to or consistent with the NREL benchmarks.

Figure 3 | Wind and Solar Cost Comparison



¹ LRP and FIT costs for wind and solar are from the IESO's August 2023 Contract List

² National Renewable Energy Laboratory (NREL) 2023 Electricity ATB Data Workbook Levelized Costs in 2021 USD, converted into 2023 CAD: <https://atb.nrel.gov/electricity/2023/data>

In general, the graph above indicates that the average price of MicroFIT solar (\$600/MWh) is well above the NREL range of \$170/MWh to \$280/MWh for residential and commercial rooftop solar. Ground mounted solar for NREL ranged from \$75/MWh to \$80/MWh while the standard offer FIT solar rate averaged \$475/MWh. The competitive process of LRP resulted in a lower average solar rate of about \$160/MWh, which was 3 times lower compared to the FIT rate.

The NREL wind benchmark ranges from \$38/MWh to \$100/MWh compared to average FIT rate of \$160/MWh. The competitively procured LRP wind rate averaged \$100/MWh, which is consistent with the high end of the NREL benchmark. Wind and ground mounted solar rates from NREL indicate that they are competitive or less expensive when compared to future natural gas prices that include the higher cost of carbon of \$170/tCO₂e.

In conclusion, unlike the standard offer procurement model that provided a set price to projects that met program requirements, a competitive procurement mechanism as established for the LRP, the Expedited Process and LT1 RFP encourages lower bids to ensure that the most economically-priced resources are procured to meet system reliability needs.

Opportunities for Competitive Value

When compared to past procurements, the upcoming LT2 RFP is expected to ensure even more cost-effective acquisitions of wind and solar considering pricing trends, as noted in IESO's analysis, provided as part of this report. As technological advancements and process improvements continue to be made for wind and solar, the capital costs of new wind and solar projects have decreased since 2017 and are expected to continue to fall in the long term.³ The reduction in capital costs of new build wind and solar, as well as the fact that they do not have a fuel cost associated with their operation, positions these resources as competitive options within Ontario's power system.

Acquisition of Resources Driven by Reliability Need

In order to meet the 5TWh energy need identified above, The IESO's upcoming Long-Term 2 RFP will likely have to acquire 2,000 MW of new build resources, much of it likely coming from wind and solar PV generation. Further long-term procurements will likely need to target about 1,500 MW of additional new-build resources to be in service in each of 2032 and 2034, for a total of 5,000 MW in the period 2029 – 2034. These figures represent the approximate installed capacity of new non-emitting generation⁴ that would be required to meet emerging energy needs. It is possible that some further capacity needs will remain even after the acquisitions described above have been accounted for. These needs will be described in future APOs and accounted for in future procurements.

³ <https://www.cer-rec.gc.ca/en/data-analysis/energy-markets/market-snapshots/2018/market-snapshot-cost-install-wind-solar-power-in-canada-is-projected-significantly-fall-over-long-term.html>



⁴ For additional clarity, these figures represent the installed capacity of typical wind resources in Ontario; in practice, capacity factors are both technology and location dependent, and the actual volume procured will depend on the mix of projects successful in the procurement. In either case, the driver of procurement volumes will be the energy needs described in this report.

Table 2 | Long-Term Procurements 2029-2034

Long-Term RFP	RFP Launch Date	Target Commercial Operation Date	Procurement Target (for energy needs)	Additional Capacity Needs
LT2	2025	2030 ⁵	2,000 MW	-
LT3	2027	2032	1,500 MW	TBD
LT4	2029	2034	1,500 MW	TBD
TOTAL		2029-2034	5,000 MW	TBD

The needs assessment above also notes the importance of re-committing existing resources. A number of wind and solar resources have expiring contracts between 2026 and 2034. The IESO can deliver ratepayer value by ensuring it provides opportunities to facilities that have additional life to continue to operate post-contract expiry, and to facilities to repower/refurbish when and where it provides value.

Table 3 | Expiring Wind and Solar Contracts (2026-2034)

	2026 - 2029	2030 - 2034
 WIND	1,092 MW	1,840 MW
 SOLAR	10 MW	1,161 MW

Note: MW Values expressed in Installed Capacity (ICAP). See **Appendix 1** for additional detail.

⁵ Needs to be addressed by LT2 emerge between 2029 and 2031; these are expected to be addressed by flexible Commercial Operation Dates

The IESO is therefore exploring designing its long-term procurements to enable the participation of both existing and new wind and solar facilities willing to repower. Encouraging competition between existing and new resources can provide greater ratepayer value by spurring existing asset owners to make investments in the most efficient manner possible. It would also ensure only repowered assets that provide system value compared to new assets are recommitted. Existing resources will also have the option to participate in the medium-term procurements.

Other Considerations for Resource Development

In order to maintain reliability, a significant level of development is required to meet emerging energy needs by the end of the decade. In order for this activity to be efficient, cost-effective and timely, the IESO, Ontario Government, and developers will need to work together to ensure effective and timely project development. It will also be critical that there is purposeful and regular engagement with and support from stakeholders, municipalities and Indigenous Nations.

Transmission and Connection Constraints – While the expansion of transmission infrastructure continues, currently there is limited availability for new resources to deliver energy when and where it is needed. These limitations may impact the volume and timing of needed resources (wind and solar). Planning for the building out of transmission in an expedited and coordinated manner to enable future project development will be key to providing signals to the sector as to where on the system new energy producing resources can be added.

However, given the energy need identified and operating profile of energy producing resources (i.e., energy provided at all times not just at peak), the IESO anticipates that the deliverability testing constraints that were present during prior capacity focused procurements, may not be the same. This is largely due to the roughly 2,500 MW of electricity battery storage anticipated on the system in 2028 as part of the current long-term procurement, and may allow for project siting in more parts of the province.

Agricultural land use restrictions and permitting – In response to the July 10, 2023 letter from the Minister of Energy to the IESO, the IESO will be further assessing and engaging on agricultural land use, including its impact on past procurements, engagement feedback and potential mitigation strategies. Significant restrictions on using agricultural land could limit opportunities to repower/expand existing facilities, as well as the volume and timeliness of new resources that are needed to maintain reliability. While restrictions on siting based on agricultural land use were previously limited to ground-mount solar PV generation, some parties have called for restrictions to be expanded to include wind.

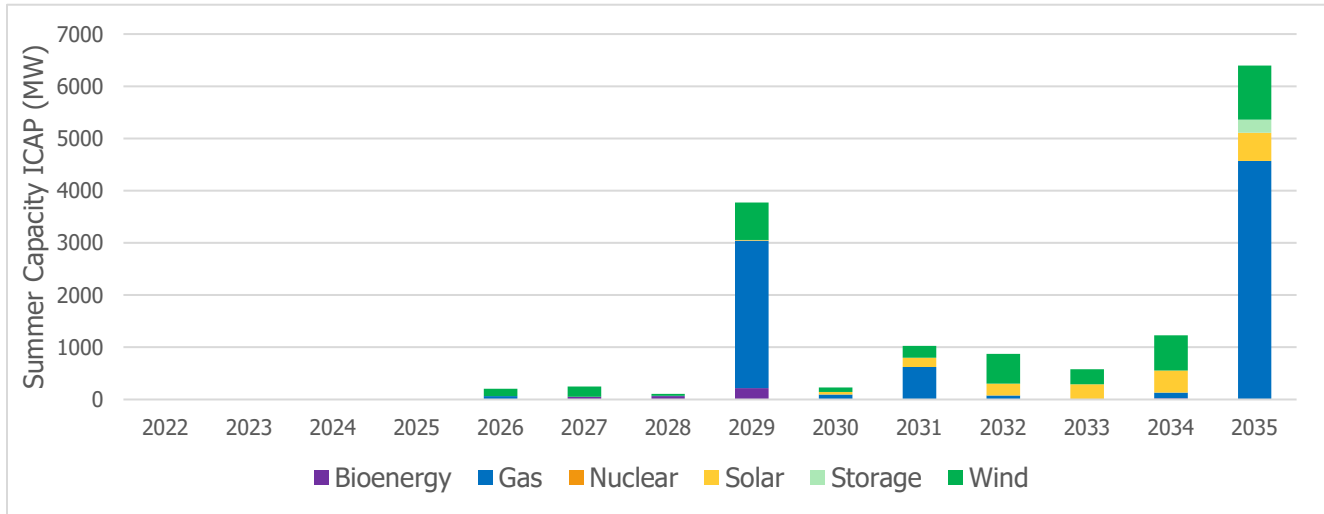
Municipal support requirements - Municipal council support has been an important design element in the Expedited Process and LT1 RFP. As development activity increases in the province for these upcoming needs, so will the level of activity and involvement of municipalities. There is a need for effective engagement with municipalities and communities to mitigate against the risks of a growing incidence of unwilling hosts as volume of development and deployment of electricity infrastructure increases.

Crown Land processes – There is an opportunity to utilize crown land for new build projects. Based on the timing and volume of the need, it is critical that the procurement process and the process for accessing Crown Land work together in an effective manner.

Environmental approvals & permitting requirements – Developers will be looking for certainty on the permitting and approval processes for new renewable development as well as for existing facilities where upgrades, expansions and repowering are possible. It will be important to provide the market with clarity on permitting and approval requirements to ensure investors can make confident decisions on the deployment of capital and future use of their facilities.

Appendix 1

Contract Expiries by Year and Resource Type



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