FOI 23-05 Records release External 2023 FOI's ×

**Allaire, Natalie (ENERGY)** <Natalie.Allaire@ontario.ca>
to me

Fri, Jun 23, 6:38 AM

Hi Amanda,

The ministry has received your cheque for the final payment of the FOI request ENERGY-23-05. Thank you.
I will forward you the records via a secure email solution called Citizen Direct Email (CDE) today.

If you are a first-time user of CDE, you will be prompted to complete a simple registration. As well, you will be asked to key in a PIN in order to access the email. The PIN is for one-time use only. Once registration is complete and you are identified by CDE (i.e. using the PIN), you will not need to key in the PIN again in future for any subsequent emails via CDE.  Of course, if you have received emails via CDE before, you do not need to register again and you do not need to use the PIN to access the email.
I will send you a test email first to make sure that it works properly on your end before I forward you the records. Could you confirm receipt of the test email please?
The PIN is 4208 (if you need it).

Please contact me if you have any questions.
Regards,

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| **From:** | Zade, Ryan (ENERGY) |
| **To:** | Allan, Fraser (ENERGY); Schwab-Pflug, Emma (ENERGY); Kwan, Helen L. (ENERGY) |
| **Subject:** | Ontario comments on Fed Zero Emissions Vehicles policy |
| **Date:** | February 15, 2022 12:28:00 PM |
| **Attachments:** | Province of Ontario Response - February 2022.pdf<br>Province of Ontario Response -- February 2022.pdf |

FYI

**From:** Hazelden, Joanna (MTO) <Joanna.Hazelden@ontario.ca>
**Sent:** February 15, 2022 11:24 AM
**To:** infovehiculeetmoteur-vehicleandengineinfo@ec.gc.ca
**Cc:** Essaji, Tasneem (MTO) <Tasneem.Essaji@ontario.ca>; Casey, Michael (MTO) <Michael.Casey@ontario.ca>; Roy, Christian (MTO) <Christian.Roy@ontario.ca>; Sara.Ednie@ec.gc.ca
**Subject:** Discussion Paper on Achieving a Zero-Emissions Future for Light-Duty Vehicles: Province of Ontario Response

Hello,

Thank you for the opportunity to provide comments on the discussion paper entitled "Achieving a Zero-Emissions Future for Light-Duty Vehicles".

Please see attached comments from Ontario on the discussion paper. The province has provided considerations on issues concerning the measures required to meet the federal target requiring that 100% of passenger and light-duty truck sales be zero-emissions by 2035.

Please let me know if you have any questions or need any clarification. We look forward to continued engagement in the federal consultation process.

Sincerely,

Joanna

**Joanna Hazelden** *(she/her)* | Manager
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# Federal Discussion Document on the Zero-Emission Vehicles Sales Mandate:
# Province of Ontario Response
# February 2022

The Province of Ontario welcomes the opportunity to respond to the Government of Canada's discussion document on *"Achieving a Zero-Emission Future for Light-duty Vehicles"*. Ontario ministries have provided the following considerations on issues raised in this discussion document related to additional measures needed to achieve a federal mandatory ZEV sales target of 100% for passenger cars and light-duty trucks by 2035.

Ontario recognizes the role of a low carbon transportation system in transitioning to a clean economy and are moving forward with several initiatives to support the uptake of electric vehicles across the province, such as through recent investments in EV manufacturing, supporting EV charging deployment, and establishing requirements for reserved EV parking.

Additionally, the Province recently launched Phase 2 of the Driving Prosperity plan, providing a roadmap to position the province as a North American leader in building the car of the future through emerging technologies, especially EVs.

In North America, Ontario ranks as the number two auto producer (after Michigan) and the second largest information technology cluster (after California). Given the deep integration of the automotive sector in Ontario, we are committed to working with the federal government, industry, and other stakeholders to create an ecosystem that enhances business competitiveness, and would encourage the federal government to consider Ontario's unique position and strengths, as well as regional priorities, automotive readiness and pandemic-related disruptions, when introducing regulatory measures for the automotive industry.

The Province of Ontario looks forward to continued engagement in the federal consultation process and will leverage other opportunities to provide input as required, including through Ontario Ministry of Transportation's participation at the Federal-Provincial-Territorial Zero-Emission Vehicle Working Group (FPT ZEV Working Group).

## <u>Discussion Questions</u>

### (1) Getting to 100% ZEV sales by 2035

1. What should be the approach to achieving 100% in 2035, including ZEV sales of at least 50% in 2030?
2. In addition to ZEV sales targets of at least 50% by 2030 and 100% by 2035, are additional interim targets needed to allow Canada to succeed? What should those targets be?
3. The Government of Canada will be mandating the sale of ZEVs. How should this be designed and what should be considered to ensure its success? What are the

mechanisms in other jurisdictions' mandatory ZEV regulations that should be used or avoided?

**Recommendations:**

Given the low ZEV sales across the country, an ideal ZEV mandate program is one that is flexible for automakers and does not limit consumer choice. Similar to California's ZEV Sales Standard, flexibility mechanism should be in place to allow manufactures to meet the ZEV credit requirements in different ways, such as purchasing credits from automakers that exceed the standard, and exempting small automakers (volume status <4,500) from regulatory requirements. Interim targets, before 2030, could also be introduced to pilot phased-in aspect of a potential program and to provide automakers certainty regarding near-term investments. Additionally, consumers choice should not be limited by model or vehicle type, and plug-in hybrid EVs should count as ZEVs under the program.

While the federal government is aiming to align its light-duty ZEV standards and regulations with those most stringent in North America, the impacts of supply chain disruptions should be considered to ensure that the federal approach is not creating undue regulatory burden on manufacturing regions across the country. The federal government should continue to engage and work with provincial and territorial governments to address jurisdictional needs and priorities.

**Comments:**

Currently, just over 5% of new vehicle sales are ZEVs in Canada. Helping consumers and auto manufacturers to close the gap between current ZEV sales and the federal target will require additional policy actions at the federal level. These additional policy actions must address both supply and demand barriers to EV uptake to enhance consumer confidence in driving ZEVs, while also strengthening the auto sector's competitiveness in the shift towards ZEVs.

Additionally, any stringent regulatory measures considered by the federal government should reflect provincial/territorial priorities related to automotive production and readiness. Given its size, Ontario's automotive industry should be engaged in program design. New initiatives and programs should address industry concerns regarding pressures to produce "compliance vehicles" rather than to respond to consumer demand.

**(2) Other Considerations**

1. What issues impede adoption of ZEVs in Northern and remote communities and by low-income households?
2. How can Government address these issues?
3. What role should PHEVs play in achieving the 100% ZEV sales target?

**Recommendations:**

To encourage ZEV uptake and meet growing charging and refueling demand, existing federal ZEV purchase incentives and charging infrastructure programs should be renewed and additional measures should be introduced to address geographical gaps and improve equity in the transition to electric mobility. s.13 [redacted]

s.13 [redacted] The Zero Emission Vehicle Infrastructure Program and the Electric Vehicle and Alternative Fuel Infrastructure Deployment Initiative are federal programs that support increased infrastructure and are ending in 2024. These programs should be extended to address gaps that remain in the availability of alternative fuelling infrastructure, particularly along remote stretches of highways and in rural or northern regions.

Additionally, similar programs should be developed that offer targeted funding at higher levels to increase available public charging and refueling stations in Canada and support infrastructure deployment. Federal funding should provide provinces and territories flexibility to install suitable infrastructure based on jurisdictional priorities and needs (e.g., location, infrastructure type, regional traffic volumes/types).
Plug-in hybrid EVs should count as ZEVs under the program.

**Comments:**

Ontario's northern and remote communities lack access to an efficient and connected ZEV charging network. This gap in charging infrastructure availability is contributing to lower uptake of ZEVs and long-distance "range anxiety". This is especially a concern during winter months when EV range can fall by nearly 50%, limiting EV driver's ability to plan trips and travel longer distances.

s.13 [redacted]

**(3) Complementary Measures**

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[1] https://www.nature.com/articles/s41560-021-00814-9

1. In addition to the measures already implemented by the Government, are there other actions the Government should explore to complement the regulated sales mandate?
2. What is the role of other actors, including the private sector, to help complement the regulated sales mandate?
3. Should the Government scale up its existing efforts on incentives, infrastructure, and awareness and what are the priorities?
4. Should Canada explore other options to close the price gap between ZEVs and ICE vehicles, including feebates or measures that prevent higher leasing and lending rates for ZEVs?
5. Should Canada's Excise tax on Fuel - Inefficient Vehicles (Green Levy) be modernized to better align with climate objectives (e.g. include a wider range of vehicles?)

**Recommendations:**

The federal government should engage provinces and territories, as well as industry and other stakeholders, to consider undertaking the following actions to complement the regulated sales mandate:

- Expand iZEV to include used vehicles, and explore scaling the incentive to income
- Consider regulatory crediting scheme for engine technologies that use higher ethanol blends (e.g. high compression engines can use E20-E30). Consistent with previous credit provided for E85 vehicles.
- Introduce a scrappage incentive program to encourage the replacement of older gas vehicles with electric vehicles
- Accelerate Measurement Canada's work on establishing technical standards to charge based on kilowatt-hours (kWh) and modernizing the *Electricity and Gas Inspection Act* to reduce red tape for EV charging providers
- s.13 [redacted]
- Provide funding for smart charging technologies to optimise charging by balancing load
- Conduct consumer and dealership awareness campaigns to enhance knowledge and confidence in ZEV technologies
- s.13 [redacted]
- Provide additional guidance to support EV-ready infrastructure, including developing national accessibility requirements for EV charging equipment
- Support upskilling of automotive sector employees for ZEV production
- Develop a national automotive industrial strategy to avoid automotive supply chain disruptions and support the sector's transition

As noted above, additional programs should be developed that offer targeted funding at higher levels to increase available public charging and refueling stations in Canada and support infrastructure deployment. Federal funding should provide provinces and territories flexibility to install suitable infrastructure based on jurisdictional priorities and needs (e.g., location, infrastructure type, regional traffic volumes/types).

**Comments:**

Given Canada's low EV sales figures, strong and ambitious policy actions are required to support the federal sales mandate as consumer concerns around price, charging infrastructure and range remain obstacles to wider adoption of ZEVs. Investments in programs such as purchase incentives, infrastructure funding, educational campaigns, workforce upskilling and supports for ZEV manufacturing and RD&D need to continue. In terms of education, knowledge and awareness campaigns can highlight the cost benefits of EVs, address misconceptions of EVs and promote driving ZEVs in the Canadian cultural context (cold weather, cottaging, skiing, etc.).

The federal government should also consider how the federal ZEV sale mandate would complement any regional sales mandates, and current undersupply of ZEVs at dealerships across the country. Currently, provincial allocation of EVs by auto manufacturers is biased towards British Columbia (B.C.), Quebec, and other jurisdictions that have regional sales mandates and/or purchase incentives, leaving other jurisdictions behind.

**(4) Other Considerations**

1. What are the RD&D gaps to support the uptake of ZEV technologies and charging/refuelling solutions (e.g. higher-power charging solutions, V2G, energy storage, etc.)?
2. What challenges and opportunities do you anticipate for the electricity grid as a result of accelerating our EV sales targets?
3. What role does Canada's critical minerals and battery supply chain have in helping Canada achieve its ZEV targets?
4. What end of life EV battery strategies need to be in place to support our environmental goals while achieving the 100% ZEV target?

**Recommendations:**

The Government of Canada should introduce new funding sources to support research in ZEV technologies, battery recycling programs, as well as the development of regional critical mineral strategies to further support the ZEV ecosystem, including growing the manufacturing opportunity in Ontario, leveraging Ontario's skilled workforce, and developing supply chains

In addition to considering supporting the Ontario Vehicle Innovation Network (OVIN), Ontario's flagship initiative on automotive and smart mobility technologies, the federal government could introduce new research/pilot funding programs for organizations, start-ups or other businesses to research, test and pilot innovative solutions that support the development of new and emerging refueling infrastructure technologies and approaches. Some examples of streams could include:

- By types of technology:
  - hardware (e.g., wireless charging, multi-unit residential managed charging, integration of solar or other renewables, battery storage, battery recycling, hydrogen demonstration); and
  - software (e.g., applications related to payment for the use of refuelling infrastructure, fleet application, vehicle-to-grid applications, transportation demand management applications).
- By nature of project:
  - demonstration of a new technology (e.g., applying a technology that exists in other jurisdictions into a Canadian context); and
  - expansion / enhancement to an existing technology (e.g., expanding way finding applications to link travel options to carbon footprint).
- By regional context:
  - Urban (e.g., refuelling solutions that would achieve a quick turnaround time, adaptive uses of refuelling infrastructure); and
  - Remote/rural communities (e.g., battery storage solutions, renewable electricity applications for charging).
- By vehicle type:
  - personal vehicles (e.g., electric, hydrogen, automated vehicles); and
  - fleet (e.g., commercial vehicles, buses, school buses).

The federal government could also work with provincial and territorial governments, as well as academia and industry, to develop recycling and end of life management strategies for ZEV batteries, including encouraging or requiring industry-led recycling programs for EV batteries. Producer responsibility models typically place operational and financial responsibility on producers for end-of-life management of the products they supply. These programs would provide producers with flexibility to establish and operate collection and recycling networks that are efficient and flexible while ensuring valuable resources are captured and reused. We recommend that governments first look to industry to voluntarily take action to establish and operate recycling programs before considering regulatory action.

Ontario’s local distribution companies will need to ensure their systems can support new EV loads while maintaining reliable service for all their customers. New technologies such as V2G and controlled charging may be able to help address this challenge. Federal funding should consider the system-wide costs of facilitating EV adoption, particularly those costs associated with connecting to and reenforcing electricity distribution networks.

Lastly, as mentioned previously, accelerating Measurement Canada’s work on establishing technical standards to charge based on kilowatt-hours (kWh) and modernizing the *Electricity and Gas Inspection Act* will help modernize Canada’s electricity policies and regulation, and support fair billing practices to enable EV uptake across the country. Additional support also needs to be provided to incentivize smart charging solutions so that utilities and users can manage the timing and speed of charging, and optimize the load on the overall electricity grid.

**Comments:**

Globally, research and development into new technologies are underway to support and complement alternative fuel refuelling infrastructure (e.g., wireless charging, integration of solar or other renewables, hydrogen demonstration, vehicle-to-grid applications and transportation demand management applications). Given that low emission and alternative fuels vehicles are quickly evolving, continued investments in R&D are critical to the development of these emerging technologies in Canada.

Our electricity grid also needs to be prepared to support the millions of EVs that will be on our roads in the near future. To support this surge in electricity demand, the electricity system needs sufficient generation capacity as well the ability to maintain system stability when distributing electricity. System operators also need clear signals on ZEV policies (e.g., whether PHEVs will count towards sales mandates) and high-quality data on EV uptake to develop evidence-based forecasts of system load over time attributable to transportation electrification.

Additionally, like many sectors, Ontario’s vehicle manufacturers continue to endure the impacts of supply chain disruptions caused by the current pandemic, particularly the supply of material/parts and labour for vehicle manufacturing, such as semi-conductor chips, aluminium, steel, and rubber. These shortages continue to impact vehicle production and delivery across Canada and delay the transition to light-duty ZEVs. Strong national and provincial supply chains are needed to meet the growing demand for ZEVs and their parts. Developing recycling and end of life management strategies for ZEV batteries, like repurposing and remanufacturing, could extend the life of batteries and address local supply challenges by returning materials back to the value chain.

# Federal Discussion Paper for Heavy Duty Vehicles and Engines in Canada
# Province of Ontario Response
# February 2022

The Province of Ontario welcomes the opportunity to respond to Environment and Climate Change Canada's "*Discussion Paper for heavy-duty vehicles and engines in Canada: transitioning to a zero-emission future*". The province has provided the following considerations on issues raised in this discussion paper.

The Province of Ontario looks forward to continued engagement in the federal consultation process and will leverage other opportunities to provide input as required, including engagement through the Interjurisdictional Task Force on Vehicle Weights and Dimensions Policy, under the Council of Ministers Responsible for Transportation and Highway Safety.

## (1) Regulatory Approach

A) Impacts on Vehicle Weights and Dimensions

**Recommendation**: In developing new regulatory measures to support further decarbonization and adoption of heavy-duty zero-emissions vehicles (HDZEVs), the federal government should recognize and respect the differences in the regulatory environments, conditions and limitations between jurisdictions for HDZEV operations, and as a result, to work with provinces and territories to provide for flexibilities.

**Comments:** Implementation of new federal regulatory measures to encourage the uptake of HDZEVs should consider impacts to existing provincial/territorial weight and dimensions and requirements.

In Ontario, Vehicle Weight and Dimensions regulatory reforms toward Safe, Productive, and Infrastructure-Friendly (SPIF) Vehicles maximized Ontario's allowable weight limits[1], aligning the highest weights allowable with bridge and pavement formula standards so to allow the highest productivity vehicles in North America under a regulated environment. There is little flexibility when it comes to vehicle weights and dimensions under the legislated or regulatory environment.

Alternative-fueled vehicles, whether internal combustion engine or electric motive powered, tend to have a higher curb weight (tare weight), and HDZEVs will carry much higher tare weights until technological advancement achieves a significant weight reduction.

Any increase in allowable weights would implicate bridge and pavement formulae, causing exponential and substantial damage to infrastructure and/or depreciating the dynamic performance of the vehicle. Given that we have

[1] https://www.ontario.ca/laws/regulation/050413

already stretched the limits of our infrastructure with our current vehicle weights and dimension regime to enable high productivity in Ontario, additional allowances would be a challenge.

Furthermore, any increase in allowable weight impacts infrastructure to the power of four, meaning additional weight causes exponential damage to pavement/bridges, leading to exponential costs associated with repair/replacement. This leads to increased emissions related to the repair/replacement of infrastructure, and premature asset depreciation.

In the past, the federal government has allowed for flexibilities respecting greater weight allowances on Canadian roads by provincial and territorial jurisdictions as compared to the weights allowed on U.S. Interstate Highway System (e.g., during the development of the *Heavy-duty Vehicle and Engine Greenhouse Gas Emission Regulations*).

A) Enforcement

**Recommendation:** The lack of coordinated and concerted on-road enforcement across the country for HDV emissions remains an ongoing issue in the transition to cleaner transportation. The federal government should work with all provinces and territories to adopt a coordinated and concerted regime to enforce compliance by the end user, with federal aid and guidance.

**Comments:** Applicable emissions enforcement measures accompanying the federal government's regulatory changes should support coordinated and concerted approach with existing or proposed provincial and territorial measures.

For example, Ontario continues to strengthen on-road enforcement of emissions standards to reduce emissions from heavy-duty diesel commercial motor vehicles, to protect air quality, and to ensure polluters are held accountable.

Ontario's recent proposal to integrate safety and emissions inspection programs will help to ensure that all diesel-powered commercial motor vehicles are in good repair and that their emission control systems remain functioning and intact, to OEM specifications. Regulatory changes have also been made to support on-road enforcement activities, resulting in stronger enforcement of emission standards and enforcement against the tampering or defeating of emission control systems.

The federal government, like all provinces, maintains its compliance regime, authorizes the issuance of various types of orders, and prosecutes environmental offenders. However, the level of environmental regulatory enforcement is not consistent across jurisdictions.

The situation is similar when enforcing National Safety Code (NSC) requirements on US carriers. The Motor Vehicle Transport Act (MVTA) requires all trucking operations in Canada be assigned a NSC operating number. Currently, only Ontario and Quebec monitor US domiciled carriers by requiring an NSC number and assigning safety ratings for those portions of their operations that conduct business in Canadian jurisdictions.

**(2) Supply and Demand**

**Recommendation:** While the federal government is aiming to align its HDZEV standards and regulations with those most stringent in North America, the impacts of supply chain disruptions should be considered to ensure that the federal approach is not setting overly ambitious time-frames creating undue regulatory challenges for the manufacturing sector. s.13 [redacted]

**Comments:** Stringent regulatory measures considered by the federal government, including a target requiring that 100% of select categories of medium-duty (MDVs) and heavy-duty vehicles (HDVs) be zero emission by 2040, should reflect provincial/territorial priorities related to automotive production and readiness.

The discussion paper notes that HDV manufacturers are working to expand their capabilities to produce HDZEVs or related technologies, which could increase the number of available models in North America in the next few years and support accelerated adoption. However, vehicle manufacturers continue to endure the impacts of supply chain disruptions caused by the current pandemic, particularly the supply of material/parts and labour for vehicle manufacturing, such as semi-conductor chips, aluminium, steel, and rubber. These shortages continue to impact vehicle production and delivery across North America and affect the transition to HDZEVs.

**(3) Cost, Benefits and Barriers**

A) HDZEV Federal Purchase Supports

**Recommendation:** The financial incentive offered in the federal budget in 2019 that provides for a 100% write-off for eligible zero-emission vehicles should be continued. In addition, federal funding that reduces the upfront vehicle purchase costs would help accelerate the adoption of HDZEVs and support a potential federal target of 100% of selected categories of zero-emission MDVs and HDVs by 2040.*)*

**Comments:** A federal target requiring that 100% of selected categories of MDVs and HDVs be zero emission by 2040 would necessitate increased federal funding to offset the upfront purchase costs of HDZEVs until greater retail price parity is achieved between HDZEVs and their diesel-powered equivalents.

While the discussion paper notes that HDZEVs will eventually be comparable to diesel HDVs on a total cost of ownership (TCO) basis, the projected advantages and improvements will take time to materialize and are unlikely to reduce upfront purchase costs without dedicated funding from the federal government over the next five to ten years as battery prices decline and energy densities improve.

B) HDZEV Federal Charging and Refueling Infrastructure Supports

**Recommendation:** To encourage uptake and meet growing charging and refueling demand, existing federal programs should be renewed and/or expanded. These programs would support the increase of available public charging and refueling stations in Canada for on-road commercial HDZEV fleets. Federal funding should be designed to provide provinces and territories flexibility to install suitable infrastructure based on jurisdictional priorities and needs (e.g., location, infrastructure type, regional traffic volumes/types).

**Comments:** A federal target requiring that 100% of selected categories of MDVs and HDVs be zero emission by 2040 would necessitate additional federal funding to increase the availability of adequate public charging and refueling infrastructure across the country, in tandem with measures to reduce upfront HDZEV costs.

Current federal programs aimed at supporting the deployment of charging infrastructure are ending in 2024. Gaps remain in the availability of ZEV recharging and fueling infrastructure along Canada’s freight corridors, including remote stretches of highway in rural or northern regions. This infrastructure is particularly important for commercial and industrial fleets that undertake long-distance travel between destinations. Such infrastructure would provide business users and owners confidence including in challenging situations, such as long-distance travel and range.

While the battery electric and hydrogen fuel cell technologies are providing increasingly better vehicle range, limited access to charging/refueling points or facilities will remain a barrier to their adoption and deployment and impede efforts to transition the HDV fleets to a zero-emission future.

Provincial and territorial electricity grids also need to be prepared to support increased ZEV adoption. To support this surge in electricity demand, the electricity system needs sufficient generation capacity as well the ability to maintain system stability when distributing electricity. Lower-carbon electricity grids will increase emissions reductions from ZEVs. The federal government should continue to consider how to best support provincial low-carbon electricity grids, considering the federal commitment to transition to net-zero emitting electricity grid by 2035.

C) Technology-Neutral Federal Supports

**Recommendation:** Federal purchase and infrastructure supports targeting the HDZEV transition should be technology-neutral and extend support to the wide-range of zero-emission vehicles as defined in the discussion paper, such as HDV plug-in hybrids and hydrogen fuel cells. Commercial and industrial transportation sectors will require this flexibility when determining the ZEV technologies that are best suited for their business and operational needs.

**Comments:** The commercial sector continues to adopt various zero-emission propulsion technologies to support the transition to HDZEVs.

For example, heavy-duty hybrid models are growing in availability and offer some important advantages, including low cost of ownership, enhanced range, fuel cycle and charging flexibility, technology readiness and product availability. These vehicles are eligible for government funding programs throughout Canada (e.g., Quebec's Écocamionnage) and the US (e.g., California's HVIP).

Commercial transportation sectors across Canada and the US are deploying hydrogen fuel cell technologies for long-haul commercial trucking applications. Hydrogen fuel cells tend to be favourable for long-distance trucking applications given their comparability in range and fueling times with conventional diesel trucks. Hydrogen fuel cells also offer a smaller onboard battery pack compared to battery-electric vehicles and can support increased payload capacity.

In tandem with supports, improving knowledge, awareness and training associated with MDV/HDV ZEV technologies is needed to address consumer misconceptions and enabling a ZEV-ready skilled workforce.

**(4) Non-Regulatory Measures**

**Recommendation**: Federal support for pilot projects that demonstrate HDZEV technologies, in tandem with other financial and infrastructure supports, will be critical to enable broader commercialization and market penetration of these vehicles across Canada.

**Comments:** The below examples include applications where there is existing technology readiness, product availability or infrastructure that can be deployed to support demonstrations.

- **Transit –** Transit agencies and operators across Canada are continuing to transition their revenue fleets to ZEVs and require additional support to pilot various HDZEV technologies, including battery-electric and hydrogen fuel cell technology.

- **Container Terminals and Drayage –** Port transportations continues to be decarbonized in jurisdictions across the US. Federal support could be provided to stakeholders such as municipalities, port terminal operators and warehouse owners to enable demonstration of electric or hydrogen drayage trucks in high-traffic freight areas around ports.

- **Waste Collection –** As municipalities decarbonize their government operations, a key area where federal support is required is for zero-emission refuse truck pilots, to support greener waste management operations. In the US, Chicago successfully deployed its first electric garbage truck in 2014.

- **Commercial Transportation -** HDZEV propulsion technologies, such as hybrids or hydrogen fuel cells, continued to be favours for vocational applications. The federal government should provide support for business cases, feasibility assessments and HDZEV demonstrations for fleet operators.

**(5) <u>Retrofitting the On-Road Fleet</u>**

**Recommendation:** Federal support will continue to be necessary for addressing emissions from existing vehicles. Supports such as the federal Green Freight Assessment Program should continue, and other programs should be considered to make sufficient funding streams available so that funding for retrofits for the current on-road fleets do not divert companies' investment decisions to HDZEV alternatives which also require funding. Additionally, the federal government should continue to work with manufacturers, provinces, and territories to develop resources that can help fleet operators choose suitably compliant aftermarket devices for fleet retrofits.

**Comments:** The trucking carrier industry continues to request funding for fleet retrofits, and these demands are expected to increase as more regulations are put in place to encourage the adoption of HDZEVs alternatives. Aftermarket products are readily available across Canada but present additional upfront costs for fleet operators. Retrofit technologies will be important for addressing vehicle weight considerations as current MDV/HDV ZEV technologies pose challenges to weight and dimension regulations.

Additionally, as aftermarket technologies are continuously emerging, fleet operators will require up to date resources on the availability of aftermarket products that are compliant with jurisdictional vehicle emissions standards and regulations.

# Federal Discussion Document on the Zero-Emission Vehicles Sales Mandate: The Province of Ontario's Response February 2022

The Province of Ontario welcomes the opportunity to respond to the Government of Canada's discussion document on *"Achieving a Zero-Emission Future for Light-duty Vehicles"*. Ontario ministries have provided the following considerations on issues raised in this discussion document related to additional measures needed to achieve a federal mandatory ZEV sales target of 100% for passenger cars and light-duty trucks by 2035.

Ontario recognizes the role of a low carbon transportation system in transitioning to a clean economy and are moving forward with several initiatives to support the uptake of electric vehicles across the province, such as through recent investments in EV manufacturing, supporting EV charging deployment, and establishing requirements for reserved EV parking.

Additionally, the Province recently launched Phase 2 of the Driving Prosperity plan, providing a roadmap to position the province as a North American leader in building the car of the future through emerging technologies, especially EVs.

In North America, Ontario ranks as the number two auto producer (after Michigan) and the second largest information technology cluster (after California). Given the deep integration of the automotive sector in Ontario, we are committed to working with the federal government, industry, and other stakeholders to create an ecosystem that enhances business competitiveness, and would encourage the federal government to consider Ontario's unique position and strengths, as well as regional priorities, automotive readiness and pandemic-related disruptions, when introducing regulatory measures for the automotive industry.

The Province of Ontario looks forward to continued engagement in the federal consultation process and will leverage other opportunities to provide input as required, including through Ontario Ministry of Transportation's participation at the Federal-Provincial-Territorial Zero-Emission Vehicle Working Group (FPT ZEV Working Group).

## Discussion Questions

### (1) Getting to 100% ZEV sales by 2035

1. What should be the approach to achieving 100% in 2035, including ZEV sales of at least 50% in 2030?

2. In addition to ZEV sales targets of at least 50% by 2030 and 100% by 2035, are additional interim targets needed to allow Canada to succeed? What should those targets be?
3. The Government of Canada will be mandating the sale of ZEVs. How should this be designed and what should be considered to ensure its success? What are the mechanisms in other jurisdictions' mandatory ZEV regulations that should be used or avoided?

**Recommendations:**

Given the low ZEV sales across the country, an ideal ZEV mandate program is one that is flexible for automakers and does not limit consumer choice. Similar to California's ZEV Sales Standard, flexibility mechanism should be in place to allow manufactures to meet the ZEV credit requirements in different ways, such as purchasing credits from automakers that exceed the standard and exempting small automakers (volume status <4,500) from regulatory requirements. Interim targets, before 2030, could also be introduced to pilot phased-in aspect of a potential program and to provide automakers certainty regarding near-term investments. Additionally, consumers choice should not be limited by model or vehicle type, and plug-in hybrid EVs should count as ZEVs under the program.

While the federal government is aiming to align its light-duty ZEV standards and regulations with those most stringent in North America, the impacts of supply chain disruptions should be considered to ensure that the federal approach is not creating undue regulatory burden on manufacturing regions across the country. The federal government should continue to engage and work with provincial and territorial governments to address jurisdictional needs and priorities.

**Additional Considerations:**

Currently, just over 5% of new vehicle sales are ZEVs in Canada. Helping consumers and auto manufacturers to close the gap between current ZEV sales and the federal target will require additional policy actions at the federal level. These additional policy actions must address both supply and demand barriers to EV uptake to enhance consumer confidence in driving ZEVs, while also strengthening the auto sector's competitiveness in the shift towards ZEVs.

Additionally, any stringent regulatory measures considered by the federal government should reflect provincial/territorial priorities related to automotive production and readiness. Given its size, Ontario's automotive industry should be engaged in program design. New initiatives and programs should address industry concerns regarding pressures to produce "compliance vehicles" rather than to respond to consumer demand.

**(2) Other Considerations**

1. What issues impede adoption of ZEVs in Northern and remote communities and by low-income households?
2. How can Government address these issues?
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**Recommendations:**

To encourage ZEV uptake and meet growing charging and refueling demand, existing federal ZEV purchase incentives and charging infrastructure programs should be renewed and additional measures should be introduced to address geographical gaps and improve equity in the transition to electric mobility. s.13 [redacted]

s.13 [redacted]

The Zero Emission Vehicle Infrastructure Program and the Electric Vehicle and Alternative Fuel Infrastructure Deployment Initiative are federal programs that support increased infrastructure and are ending in 2024. These programs should be extended to address gaps that remain in the availability of alternative fuelling infrastructure, particularly along remote stretches of highways and in rural or northern regions and need to be evaluated based on these criteria.

Additionally, similar programs should be developed that offer targeted funding at higher levels to increase available public charging and refueling stations in Canada and support infrastructure deployment. Federal funding should provide provinces and territories flexibility to install suitable infrastructure based on jurisdictional priorities and needs (e.g., location, infrastructure type, regional traffic volumes/types).

Plug-in hybrid EVs should count as ZEVs under the program.

**Additional Considerations:**

Ontario's northern and remote communities lack access to an efficient and connected ZEV charging network. This gap in charging infrastructure availability is contributing to lower uptake of ZEVs and long-distance "range anxiety". This is especially a concern during winter months when EV range can fall by nearly 50%, limiting EV driver's ability to plan trips and travel longer distances.

s.13 [redacted]

s.13 [redacted].

**(3) Complementary Measures**

1. In addition to the measures already implemented by the Government, are there other actions the Government should explore to complement the regulated sales mandate?
2. What is the role of other actors, including the private sector, to help complement the regulated sales mandate?
3. Should the Government scale up its existing efforts on incentives, infrastructure, and awareness and what are the priorities?
4. Should Canada explore other options to close the price gap between ZEVs and ICE vehicles, including feebates or measures that prevent higher leasing and lending rates for ZEVs?
5. Should Canada's Excise tax on Fuel - Inefficient Vehicles (Green Levy) be modernized to better align with climate objectives (e.g. include a wider range of vehicles?)

**Recommendations:**

The federal government should engage provinces and territories, as well as industry and other stakeholders, to consider undertaking the following actions to complement the regulated sales mandate:

- Expand iZEV to include used vehicles, and explore scaling the incentive to income
- Introduce a scrappage incentive program to encourage the replacement of older gas vehicles with electric vehicles
- Accelerate Measurement Canada's work on establishing technical standards to charge based on kilowatt-hours (kWh) and modernizing the *Electricity and Gas Inspection Act* to reduce red tape for EV charging providers
- s.13 [redacted]
- Provide funding for smart charging technologies to optimise charging by balancing load
- Conduct consumer and dealership awareness campaigns to enhance knowledge and confidence in ZEV technologies
- s.13 [redacted]
- Provide additional guidance to support EV-ready infrastructure, including developing national accessibility requirements for EV charging equipment

- Support upskilling of automotive sector employees for ZEV production
- Develop a national automotive industrial strategy to avoid automotive supply chain disruptions and support the sector's transition

As noted above, additional programs should be developed that offer targeted funding at higher levels to increase available public charging and refueling stations in Canada and support infrastructure deployment. Federal funding should provide provinces and territories flexibility to install suitable infrastructure based on jurisdictional priorities and needs (e.g., location, infrastructure type, regional traffic volumes/types).

**Additional Considerations:**

Given Canada's low EV sales figures, strong and ambitious policy actions are required to support the federal sales mandate as consumer concerns around price, charging infrastructure and range remain obstacles to wider adoption of ZEVs. Investments in programs such as purchase incentives, infrastructure funding, educational campaigns, workforce upskilling and supports for ZEV manufacturing and RD&D need to continue.

The federal government should also consider how the federal ZEV sale mandate would complement any regional sales mandates, and current undersupply of ZEVs at dealerships across the country. Currently, provincial allocation of EVs by auto manufacturers is biased towards British Columbia (B.C.), Quebec, and other jurisdictions that have regional sales mandates and/or purchase incentives, leaving other jurisdictions behind.

**(4) Other Considerations** *(partner ministries to review and add/delete details)*

1. What are the RD&D gaps to support the uptake of ZEV technologies and charging/refuelling solutions (e.g. higher-power charging solutions, V2G, energy storage, etc.)? ~~ENERGY~~
2. What challenges and opportunities do you anticipate for the electricity grid as a result of accelerating our EV sales targets? ~~ENERGY~~
3. What role does Canada's critical minerals and battery supply chain have in helping Canada achieve its ZEV targets? MEDJCT
4. What end of life EV battery strategies need to be in place to support our environmental goals while achieving the 100% ZEV target? MECP

**Recommendations:**

The Government of Canada should introduce new funding sources to support research in ZEV technologies, recycling programs, as well as the development of regional critical mineral strategies to further support the ZEV ecosystem.

In addition to considering supporting the Ontario Vehicle Innovation Network (OVIN), Ontario's flagship initiative on automotive and smart mobility technologies, the federal government could introduce new research/pilot funding programs for organizations, start-ups or other businesses to research, test and pilot innovative solutions that support the development of new and emerging refueling infrastructure technologies and approaches. Some examples of streams could include:

- By types of technology:
    - hardware (e.g., wireless charging, multi-unit residential managed charging, integration of solar or other renewables, battery storage, battery recycling, hydrogen demonstration); and
    - software (e.g., applications related to payment for the use of refuelling infrastructure, fleet application, vehicle-to-grid applications, transportation demand management applications).
- By nature of project:
    - demonstration of a new technology (e.g., applying a technology that exists in other jurisdictions into a Canadian context); and
    - expansion / enhancement to an existing technology (e.g., expanding way finding applications to link travel options to carbon footprint).
- By regional context:
    - Urban (e.g., refuelling solutions that would achieve a quick turnaround time, adaptive uses of refuelling infrastructure); and
    - Remote/rural communities (e.g., battery storage solutions, renewable energy applications for charging).
- By vehicle type:
    - personal vehicles (e.g., electric, hydrogen, automated vehicles); and
    - fleet (e.g., commercial vehicles, buses, school buses).

The federal government could also work with provincial and territorial governments, as well as academia and industry, to develop recycling and end of life management strategies for ZEV batteries, including potentially extending the responsibility of EV batteries to producers. The costs of setting up such systems should not put excessive pressure on producers and manufacturers, and funding supports should be available for associated costs.

Ontario’s local distribution companies will need to ensure their systems can support new EV loads while maintaining reliable service for all their customers. New technologies such as V2G and controlled charging may be able to help address this challenge. Federal funding should consider the system-wide costs of facilitating EV adoption, particularly those costs associated with connecting to and reenforcing electricity distribution networks.

Lastly, as mentioned previously, accelerating Measurement Canada’s work on establishing technical standards to charge based on kilowatt-hours (kWh) and modernizing the *Electricity and Gas Inspection Act* will help modernize Canada’s electricity policies and regulation, and support fair billing practices to enable EV uptake across the country. Additional support also needs to be provided to incentivize smart charging solutions so that utilities and users can manage the timing and speed of charging, and optimize the load on the overall electricity grid.

**Comments:**

Globally, research and development into new technologies are underway to support and complement alternative fuel refuelling infrastructure (e.g., wireless charging, integration of solar or other renewables, hydrogen demonstration, vehicle-to-grid applications and transportation demand management applications). Given that low emission and alternative fuels vehicles are quickly evolving, continued investments in RD&D are critical to the development of these emerging technologies in Canada.

Our electricity grid also needs to be prepared to support the millions of EVs that will be on our roads in the near future. To support this surge in energy demand, the electricity system needs sufficient generation capacity as well the ability to maintain system stability when distributing energy. System operators also need clear signals on ZEV policies (e.g., will PHEVs count towards sales mandates?) and high-quality data on EV uptake to develop evidence-based forecasts of system load over time attributable to transportation electrification.

Additionally, like many sectors, Ontario's vehicle manufacturers continue to endure the impacts of supply chain disruptions caused by the current pandemic, particularly the supply of material/parts and labour for vehicle manufacturing, such as semi-conductor chips, aluminium, steel, and rubber. These shortages continue to impact vehicle production and delivery across Canada and delay the transition to light-duty ZEVs. Strong national and provincial supply chains are needed to meet the growing demand for ZEVs and their parts. Developing recycling and end of life management strategies for ZEV batteries, like repurposing and remanufacturing, could extend the life of batteries and address local supply challenges by returning materials back to the value chain.

# APO 2022 Uncertainties



- Uncertainties in the forecast are attributed to the following:

NR

  - **Government Policy:** In addition, there are a number of potential incremental pressures on Ontario's electricity demand driven primarily by government policy supporting electrification and mining

NR

# 2022 vs 2021 APO

The 2022 APO forecast has consistent growth trends when compared to 2021 APO. System becomes winter peaking in 2037, as a function of increased electrification of transportation and updated agricultural assumptions.

| Year | 2026 | | 2040 | |
|---|---|---|---|---|
| | MW | TWh | MW | TWh |
| APO 2022 vs APO 2021 | +257 | +3.8 | +560 | +7.7 |

**Increases in the near-term (2026) are attributed to:**

- Additions of large industrial loads, including electric arc furnaces, electrolyzers, EV manufacturing
- Faster electric vehicle uptake due to federal mandates and changes in supply chain
- Growth in the industrial sector specifically the mining sector in the north east

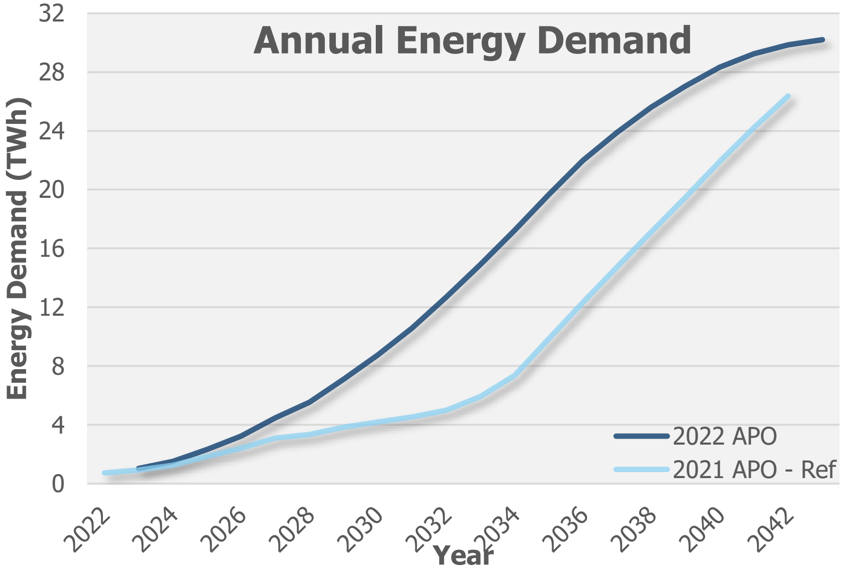
**Increases in the latter years (2040) are attributed to:**

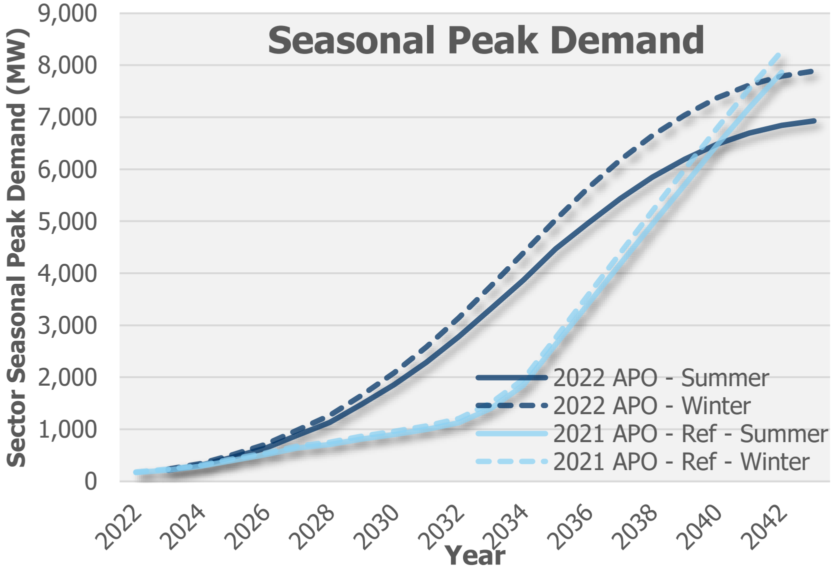
- Transportation electrification supported by government policy and strong supply chain indicators.
- Continued economic growth in the industrial sector

**Changes throughout all years that reduced increases:**

- Lower growth in agricultural sector driven by updated assumptions for cannabis greenhouses
- Larger EE program savings

# 2022 Annual Planning Outlook - Transportation Sector




Accelerated battery electric vehicle adoption, meets federal government 2030 target for 50% of new sales of vehicles to be emissions free

2022 APO vs 2021 APO Ref: demand **increase** maximizes in 2034: annual energy by about 10 TWh; sector summer peak by about 2,000 MW; sector winter peak by about 2,430 MW;

NR

- Transportation electrification includes the forecasted impacts from the federal government's target for at least 50 per cent of sales of new light-duty vehicles to be zero emissions by 2030. Industrial electrification includes a tally of specific projects, including steel-producer electric arc furnaces, automobile-producer electric vehicle (EV) battery factories and hydrogen electrolysis plants.

NR

# 2 Demand Forecast

In this year's APO, electricity demand is ramping up more quickly and growing at a slightly quicker pace than the 2021 forecast, , driven primarily by economic development and government policy on climate change. Notable updates include emerging electrification in the building, transportation and industrial sectors, with planned changes in new buildings in the City of Toronto; accelerated federal targets for EVs; and industrial sector electrification projects.

NR

### 2.4.6 Electric Vehicles

The federal government set a mandatory target for all sales of new light-duty cars and passenger trucks to be zero emissions by 2035,[5] with an interim target of 60 per cent by 2030,[6] and the IESO assumes that these targets will be achieved. The number of light-duty EVs (LDEVs) on the road has increased significantly in recent years. At the end of 2021, there were 71,000 LDEVs registered in Ontario, representing 1 per cent of automobiles in the province. Policy measures, improved technology, production maturation and consumer preference contribute to the shift from internal combustion-engine vehicles to EVs. The IESO's LDEV adoption forecast is in line with federal government targets, which project 7.3 million LDEVs in Ontario by 2043.

Other types of EVs, such as electric buses and medium- and heavy-duty EVs, and their associated electricity demand, are also considered and included in the sector-level electricity demand forecast.

Besides EV adoption, which determines the quantities and types of vehicles, fuel efficiency and driving distance also have impacts on electricity demand levels. Peak sector-level electricity demand is largely influenced by charging patterns that need to and can be managed to avoid adding a significant burden on electricity system capacity needs.

NR

NR

## 8.3 Greenhouse Gas Emissions

The projected emissions are based on the methodology change, which assumes the existing supply mix and the acceptance of unserved energy. The Clean Electricity Regulation (CER) proposed by the federal government for a net-zero emission target by 2035 is not considered in this analysis, as only projections up to 2029 are being analyzed in terms of GHG emissions. Ontario is substaintially energy adequate up to 2029. Resources will need to be added past this time, which comes with significant uncertainty around emissions depending on what fuel type is added. Therefore this is not forecasted.

Electricity sector emissions are forecast to increase to over 11 Mt $CO_2e$ by 2029 due to reduced nuclear production and growing demand, resulting in increased production from gas-fired geneation, as shown in Figure 48.

An increase in electricity sector emissions does not necessarily mean an increase in economy-wide emissions. The carbon intensity of electricity remains far below that of other fuels, such as gasoline for automotive transportation or fuel oil for space heating. Switching from higher-emission fuels to low-carbon electricity could increase electricity sector emissions while reducing province-wide emissions. As electricity consumption increases, the attendant rise in electricity sector emissions could be reduced by increased energy efficiency, improved management of peak demand or the entry of non-emitting resources to the Ontario market.

[38] 2021 actual HOEP is year-to-date as of December 7, 2021.

| | |
|---|---|
| **From:** | Hacatoglu, Kevork (ENERGY) |
| **To:** | Ford, Richard (ENERGY); Thompson, Mark A. (ENERGY); Zade, Ryan (ENERGY); Wittenbrinck, Joerg (ENERGY); Fasano, Rocco (ENERGY); Bromfield, Kristen (ENERGY); Traub, Alison (ENERGY); Cheng, Clarence (ENERGY); Buck, Keigan (ENERGY); Cayley, Daniel (ENERGY) |
| **Cc:** | Kersman, Paul (ENERGY); Schwab-Pflug, Emma (ENERGY) |
| **Subject:** | IESO"s Electric Vehicle Forecast |
| **Date:** | May 2, 2022 12:07:02 PM |
| **Attachments:** | LDEV forecast following Federal Emissions Reduction Plan.pdf |

Hi,

The 2021 Annual Planning Outlook (APO) included a forecast of light-duty EVs out to 2042. This forecast was partly based on the federal government's 100% sales mandate of zero-emission vehicles by 2035. The attached deck includes two potential EV forecasts informed by additional provincial or federal policy assumptions. IESO would like input on the selection of an EV forecast for the:

- 2022 APO
- Pathways to Decarbonization study

We would like to respond to IESO soon so they can avoid having to redo work. Please provide your ADM-approved input (or whichever level you're comfortable with) by **Wednesday, May 4, 12:00 PM**.

Apologies for the rushed request. Please let me know if you have any questions or would like to discuss.

Thanks,

**Kevork Hacatoglu, Ph.D., P.Eng. | Senior Policy Advisor**
**Energy Conservation Policy | Ministry of Energy**
**77 Grenville Street | Toronto, ON**
**416-319-7975**

# Light-Duty EV (LDEV) Forecast Policy Factors

- EV forecasting for the 2022 Annual Planning Outlook and Pathways to Decarbonization (P2D) project are underway. There are two options – both of which assume that 100% of new light-duty vehicles sales will be zero emission by 2035.
  - Option 1 incorporates the provincial interim target that EVs are 33% of new sales by 2030 with one million EVs on the road
  - Option 2 incorporates the higher federal Emission Reduction Plan interim targets that EVs are 20% of new sales by 2026 and 60% by 2030
- The two forecasts reflect various paths to achieve the 2035 federal sales target and result in on-the-road penetration converging in the mid-2040s

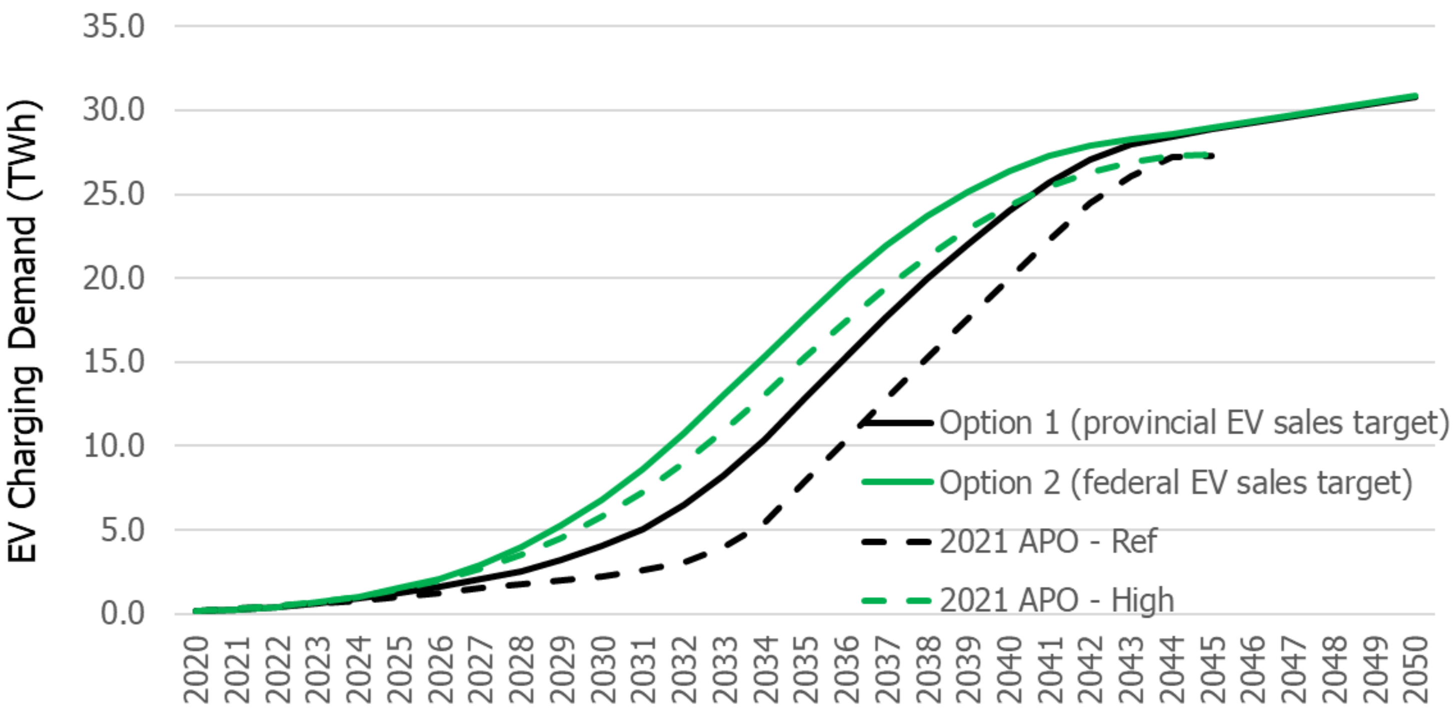
# Consideration for the 2022 APO Forecast

- IESO's analysis points tentatively towards using the lower Option 1 forecast (provincial interim sales target) for the 2022 APO as:
  - Provincial targets are generally considered more relevant than national targets for provincial power system planning
  - Presently Ontario EV sales are below the national average
  - The application of the provincial interim sales target for the 2022 APO still results in an increase to the forecasted EV energy and peak demand impacts relative to the 2020 APO reference case

# Consideration for the 2022 APO Forecast (cont'd)

- IESO's analysis points tentatively towards using the higher Option 2 (federal interim sales target) forecast for the P2D project reflecting broader assumptions about accelerated transportation electrification under P2D scenarios
- **The IESO welcomes input on the selection of EV forecast for the 2022 APO and P2D project noting input is time-sensitive**

# EV Charging Energy Forecast (Preliminary)



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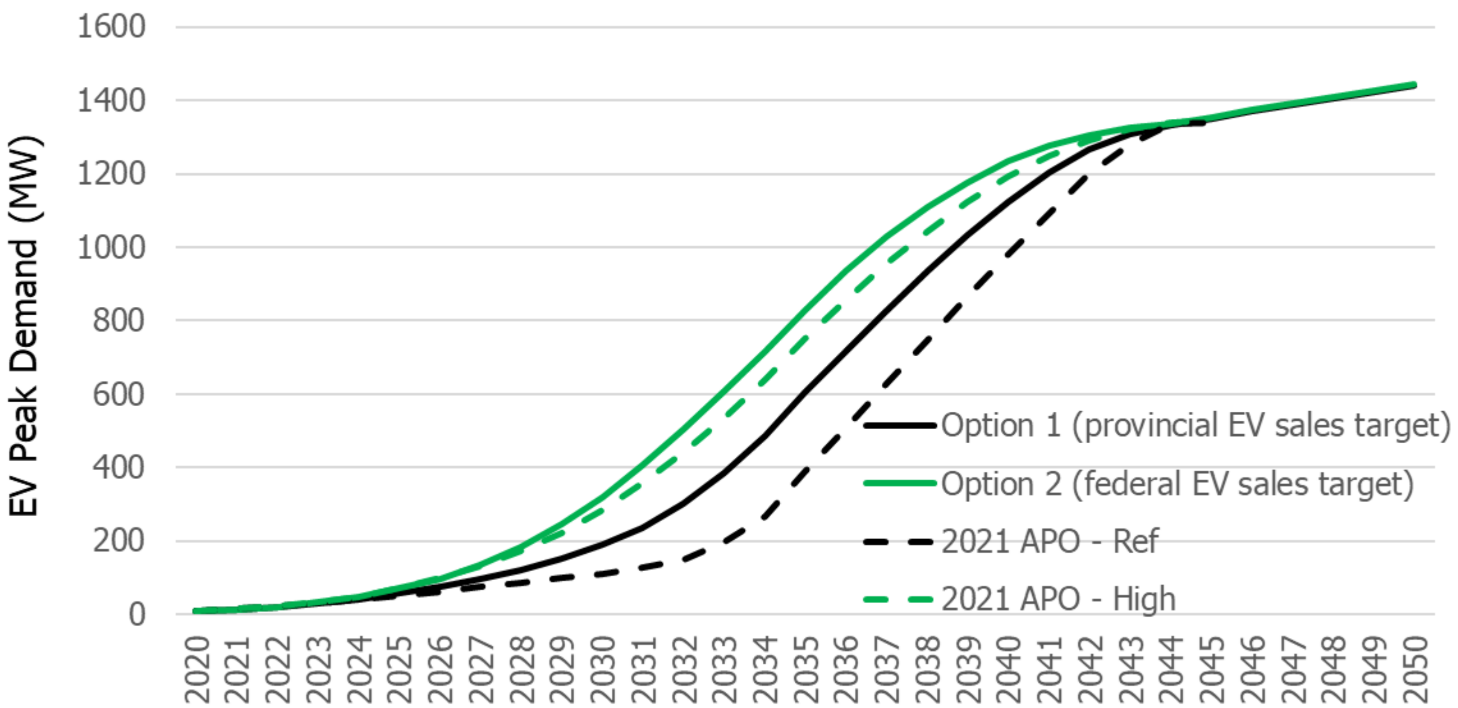
# EV Charging Peak Impact Forecast (Preliminary)



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# Appendix - LDEV Assumptions Across Studies

- The table summarizes the LDEV assumption planned for the 2022 APO and Pathways to Decarbonization project, and provides comparisons with the previous APO forecasts

| | **2021 APO Reference Forecast** | **2021 APO High Forecast** | **2022 APO and P2D Option 1 (provincial interim sales target)** | **2022 APO and P2D Option 2 (federal interim sales target)** |
|---|---|---|---|---|
| Light-duty EV market penetration | 12% new sales by 2030<br>100% new sales by 2035 | 50% new sales by 2030<br>100% new sales by 2035 | 33% new sales by 2030<br>100% new sales by 2035 | 20% new sales by 2026<br>60% new sales by 2030<br>100% new sales by 2035 |

NR

**From:** Hacatoglu, Kevork (ENERGY) <Kevork.Hacatoglu@ontario.ca>
**Sent:** May 3, 2022 4:26 PM
**To:** Ted Chang <Ted.Chang@ieso.ca>
**Cc:** Kersman, Paul (ENERGY) <Paul.Kersman@ontario.ca>; Schwab-Pflug, Emma (ENERGY) <Emma.Schwab-Pflug@ontario.ca>
**Subject:** RE: IESO's Electric Vehicle Forecast



Hi Ted,

Thanks for sharing. This will be very useful for our cost-benefit analysis.

Since the EV file crosses different divisions within the ministry, we are consulting internally for input on the selection. We've requested responses soon to try to meet your request, although I realize it's been more than one week since you shared the slide deck.

We'll let you know as soon as the input is in. Let me know if you have any questions or would like to discuss.

**Kevork Hacatoglu, Ph.D., P.Eng. | Senior Policy Advisor**
**Energy Conservation Policy | Ministry of Energy**
**77 Grenville Street | Toronto, ON**
**416-319-7975**

---

**From:** Ted Chang <Ted.Chang@ieso.ca>
**Sent:** April 29, 2022 11:06 AM
**To:** Hacatoglu, Kevork (ENERGY) <Kevork.Hacatoglu@ontario.ca>
**Cc:** Kersman, Paul (ENERGY) <Paul.Kersman@ontario.ca>; Schwab-Pflug, Emma (ENERGY) <Emma.Schwab-Pflug@ontario.ca>
**Subject:** RE: IESO's Electric Vehicle Forecast



Hi Kevork,

Please find attached our underlying EV projections for Options 1 and 2, as requested.

Best,

**Ted Chang** | 416-506-2807
Independent Electricity System Operator (IESO)

---

**From:** Hacatoglu, Kevork (ENERGY) <Kevork.Hacatoglu@ontario.ca>
**Sent:** April 28, 2022 3:31 PM
**To:** Ted Chang <Ted.Chang@ieso.ca>
**Cc:** Kersman, Paul (ENERGY) <Paul.Kersman@ontario.ca>; Schwab-Pflug, Emma (ENERGY) <Emma.Schwab-Pflug@ontario.ca>
**Subject:** RE: IESO's Electric Vehicle Forecast



Hi Ted,

Thanks for sharing this and apologies on my end for the delay in responding. Please note that we are consulting internally on the provincial government's lower interim sales target. We'll try to get back to you as soon as possible.

Separately, we noticed on slides 4 and 5 that IESO already has long-term projections for both Options 1 and 2. Would it be possible for you to please share the underlying EV projections for those options (i.e., number of light-duty EVs on the road each year)? IESO previously provided this projection for the 2021 APO reference case (see attached), which informed the development of our internal cost-benefit analysis of the proposed new TOU price plan that OEB recently reported back on.

Let me know if you have any questions or would like to discuss.

Thanks,

**Kevork Hacatoglu, Ph.D., P.Eng. | Senior Policy Advisor**
**Energy Conservation Policy | Ministry of Energy**
**77 Grenville Street | Toronto, ON**
**416-319-7975**

NR

AUGUST 27, 2021

# Electric Vehicle Demand Forecast – 2021 APO

Prepared for the Ministry of Energy

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# Purpose

- This meeting is a follow-up to the March 2021 discussion with Ministries on EV modelling methodology (previous deck in Appendix).
- The IESO will review the two EV forecasts being used in the 2021 Annual Planning Outlook (APO): a reference demand forecast and a high demand forecast
- Ministry staff are encouraged to ask questions and provide feedback on the reasonableness of the EV forecasts for the purposes of the 2021 APO



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# Executive Summary

- The IESO's APO forecasts electricity demand, assesses the reliability of the electricity system, identifies capacity and energy needs, and explores the province's ability to meet them.
- A key input in the 2021 APO is the electricity demand from EVs
- By the end of 2020 there were approx. 51,000 EVs registered in Ontario
- The 2021 APO considers the following growth of EVs in the demand forecast
  - **Reference forecast:** 5.4 million LDEVs by 2040 (20 TWh / 980 MW charging demand)
  - **High forecast:** 6.6 million LDEV by 2040 (24 TWh / 1200 MW charging demand)

# Categories of EVs Included in the 2021 APO Forecast

The IESO EV forecast consists of two major categories:

1. **Light duty EV (LDEV):** Cars, SUVs, and pick-up trucks; both personal use and commercial fleet.
2. **Electric buses:** transit bus and school bus

# Light Duty Electric Vehicles Forecast

- The Canadian government advances its target of all new light duty vehicles sold in Canada to be zero emissions by 2035
- IESO considered Transport Canada's uptake curve (s-curve) showing EV uptake to 2035.
- Two cases of LDEV forecasts were prepared for the 2021 APO:
  - **Reference forecast:** moderate adoption in early years and fast ramp-up after 2030 to meet the 100% new sale target in 2035
  - **High forecast:** mimic US EV sales target, which is 50% by 2030

# Electric Buses Forecast

- Two main categories of bus electrification: transit bus and school bus
- Policy directions and announcements:
  - Canadian government committed funding to help purchase 5,000 zero emission buses over the next five years
  - Toronto Transit Commission (TTC) set a goal of a zero emission fleet by 2040
  - OC Transpo (Ottawa) aims to have a fully electric bus fleet by 2036
- High demand forecast assumes 10% more e-buses than the reference forecast

# Key Factors Impacting EV Charging Demand

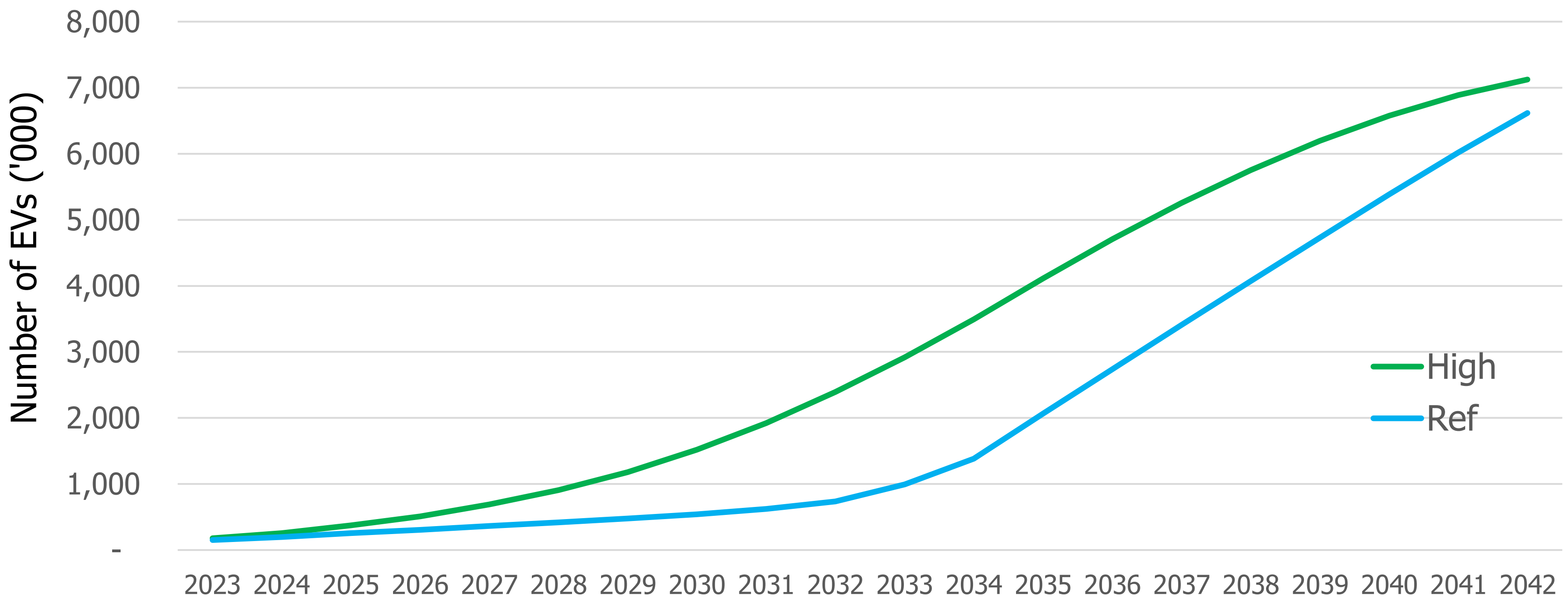
- EVs is a unique electricity end-use with its own characteristics
- Need to monitor the EV growth and manage charging demand to ensure system reliability
- Potential larger impact on distribution system than transmission system

- Number of EVs

- Driving distance
- Fuel efficiency
- Environment conditions

- Time & place of charging
- Characteristics of charger and battery

# By 2040, Ontario will have 5.4 million LDEVs in reference forecast and 6.6 million with high forecast




Note: Reference and high forecasts diverge beginning 2022

# Comparison of the IESO's EV forecasts

| | 2020 APO | 2021 APO - Reference | 2021 APO - High |
|---|---|---|---|
| Key policy direction – Light duty EV (LDEV) | 100% zero emission new sales by 2040 in Canada | 100% zero emission new sales by 2035 in Canada | 100% zero emission new sales by 2035 in Canada; 50% by 2030 in US |
| LDEV # by 2040 | 1.2 million | 5.1 million | 6.6 million |
| Key policy direction – E-Bus | Short term plans of some transit agencies | 5000 E Buses in 5 years; Goals of major transit agencies | 10% higher than the 2021 APO's reference forecast |
| E-Bus # by 2040 | n/a | 9,700 | 10,700 |
| Total EV charging demands by 2040 | 4 TWh / 240 MW | 20 TWh / 980 MW | 24 TWh / 1200 MW |



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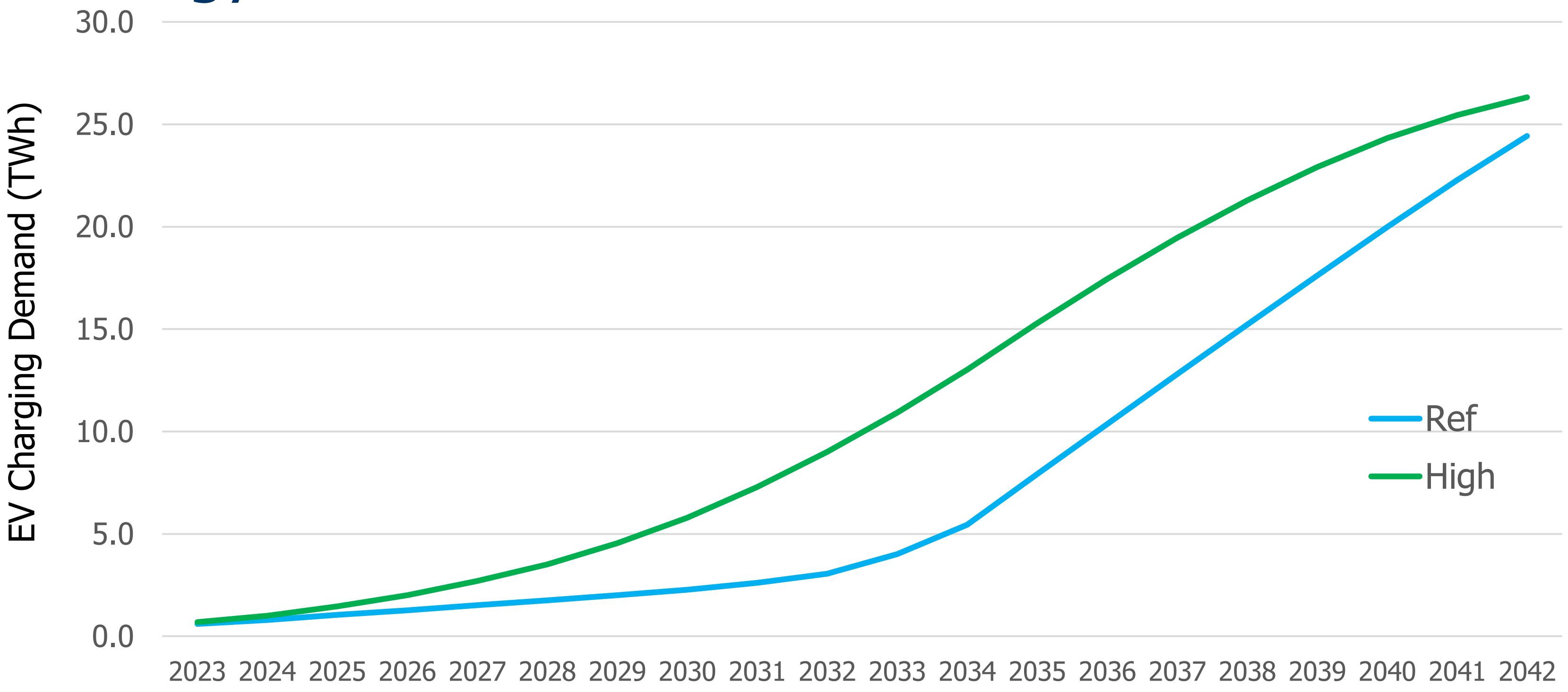
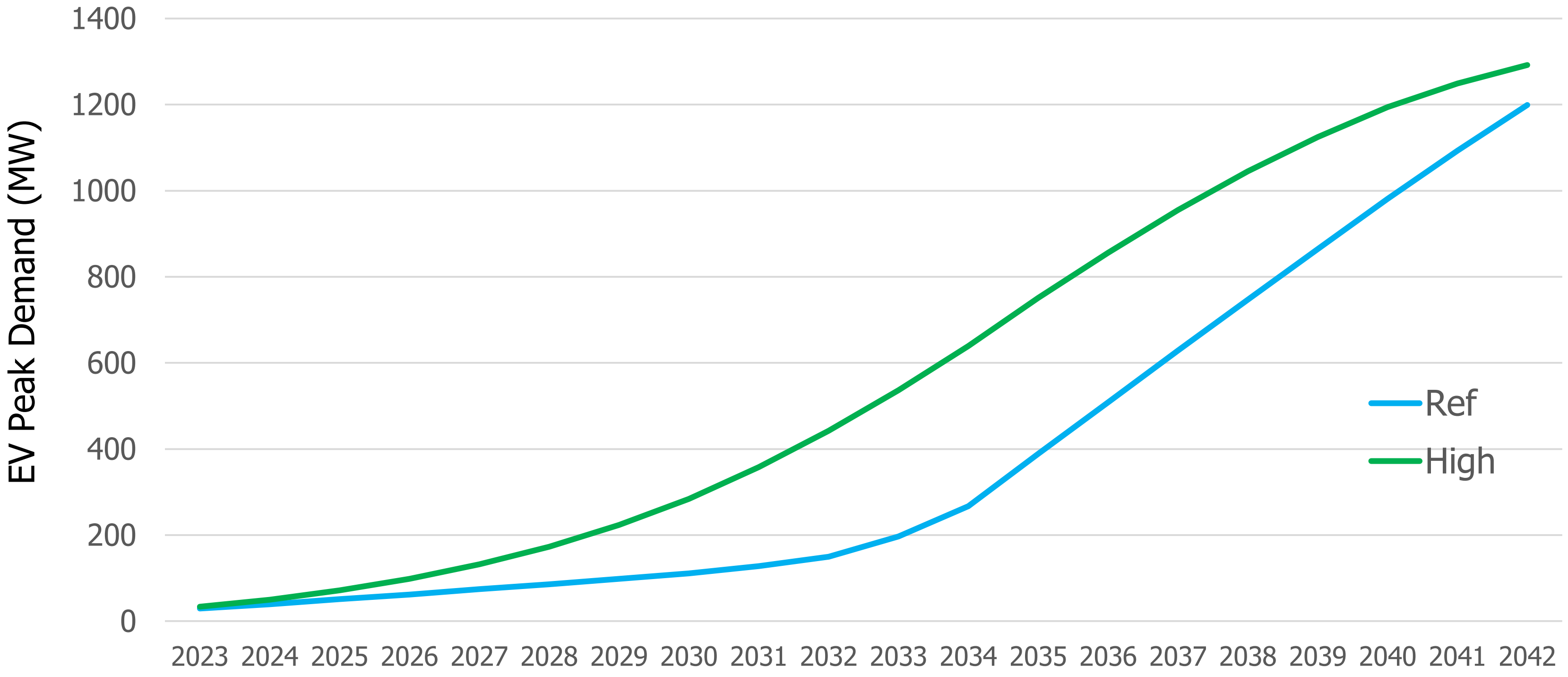
# EV Energy Demand Forecasts




Note: Reference and high forecasts diverge from 2022.

# EV Peak Demand Forecasts




Note: Reference and high forecasts diverge from 2022.

# High-level Re-Cap of EV Demand Forecast Process

- Estimate number of EVs
- Estimate annual charging energy demand
- Develop hourly EV demand in Ontario
- Allocate hourly EV demand to ten transmission zones
- For more information on the methodology please see Appendix

# Thank You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# Appendices

MARCH 29, 2021

# Electric Vehicle in Demand Forecast and Power System Planning

Prepared for the Ministry of Energy, Northern Development and Mines

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# Purpose

- To provide an overview of IESO's modelling forecast for Electric Vehicles (EV)

# Executive Summary

- Currently, electric vehicle (EV) charging demands have a relatively small impact on demand, but are increasing gradually.
- EV charging demands have been considered in the demand forecast and power system planning.
- The 2020 APO forecasts Ontario EV fleet grows from 44 thousand in 2019 to 660 thousand in 2030, 1 million in 2035, and 1.2 million in 2040.
- EV charging demand has a high uncertainty as it is impacted by a number of factors, including government policy, technology improvement, and consumer behavior.

# Key Factors Impact EV Charging Demand

- EV is a special electricity end-use with its own characteristics.
- Need to monitor the EV growth and manage charging demand to ensure system reliability.
- Potential larger impact on distribution system than transmission system.

- Number of EVs

- Driving distance
- Type of vehicles
- Environment conditions

- Time & place of charging
- Characteristics of charger and battery



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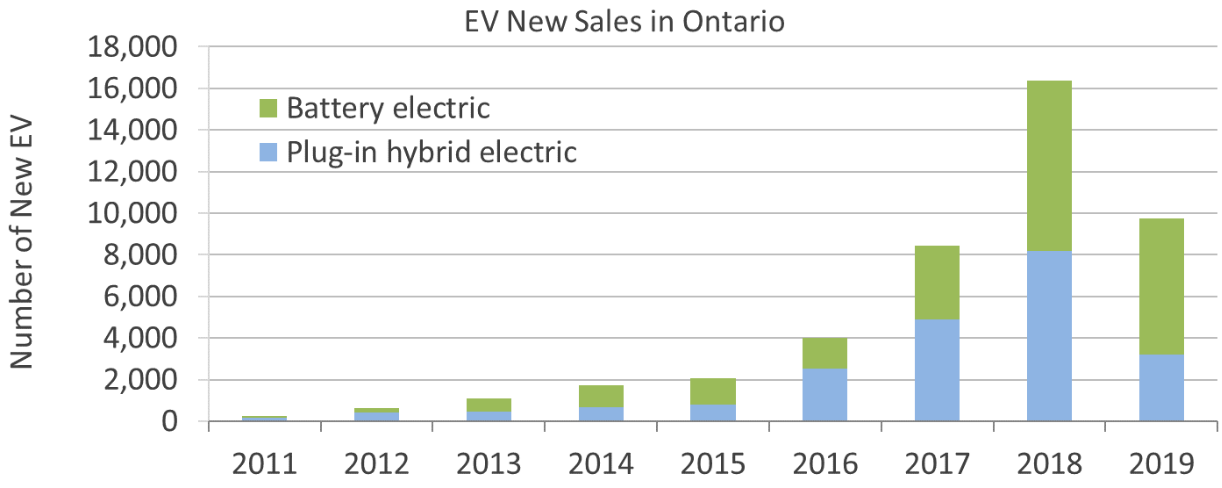
# The IESO’s EV Demand Forecast Process

- Estimate number of EVs
- Estimate annual charging energy demand
- Develop hourly EV demand in Ontario
- Allocate hourly EV demand to ten transmission zones

# History of Electric Vehicle in Ontario

- Significant increases in new sales of EVs over a few year period.
- There were over 44,000 EVs in Ontario by the end of 2019, with an estimated annual charging demand of 130 GWh.



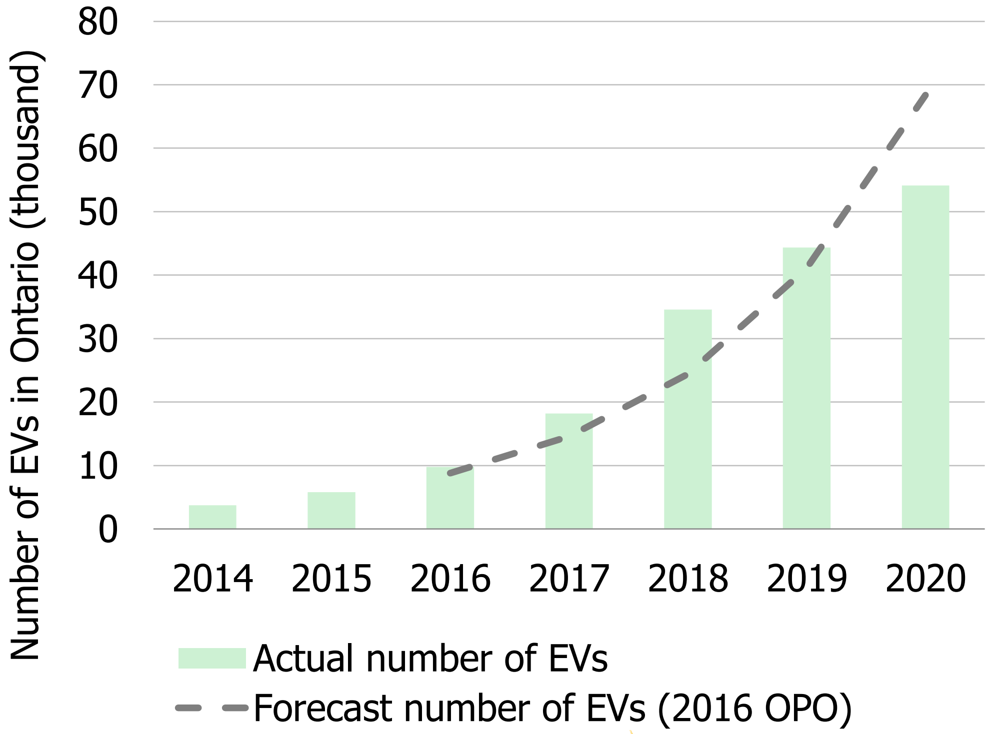

Note: Ontario's Electric Vehicle Incentive Program was cancelled in September 2018



Source: Statistics Canada

# Previous EV Forecast vs Actual

- EV demand has been considered in various planning reports over years, including OPO and APO.
- Previous forecasts are reasonably accurate.
- Higher uncertainty than other electricity end uses.




Note: EV number of 2020 is estimated

# Up-trend EV Projection

- The Canadian government has set a long-term target to sell 100 per cent zero-emission vehicles by 2040, with interim sales goals of 10 per cent by 2025 and 30 per cent by 2030.
- Almost all major auto manufacturers have EV models available.
- Improved technology has been increasing EV adoption:
  - Charger efficiency and battery efficiency have improved over time to reach over 90%. Therefore, increases in EV adoption does not always equate to an equivalent increase in electricity demand.
  - EV battery price has decreased 87% over the past decade, making EV economically comparable to internal combustion engine vehicle.

# Scenarios of EV Adoption in Ontario

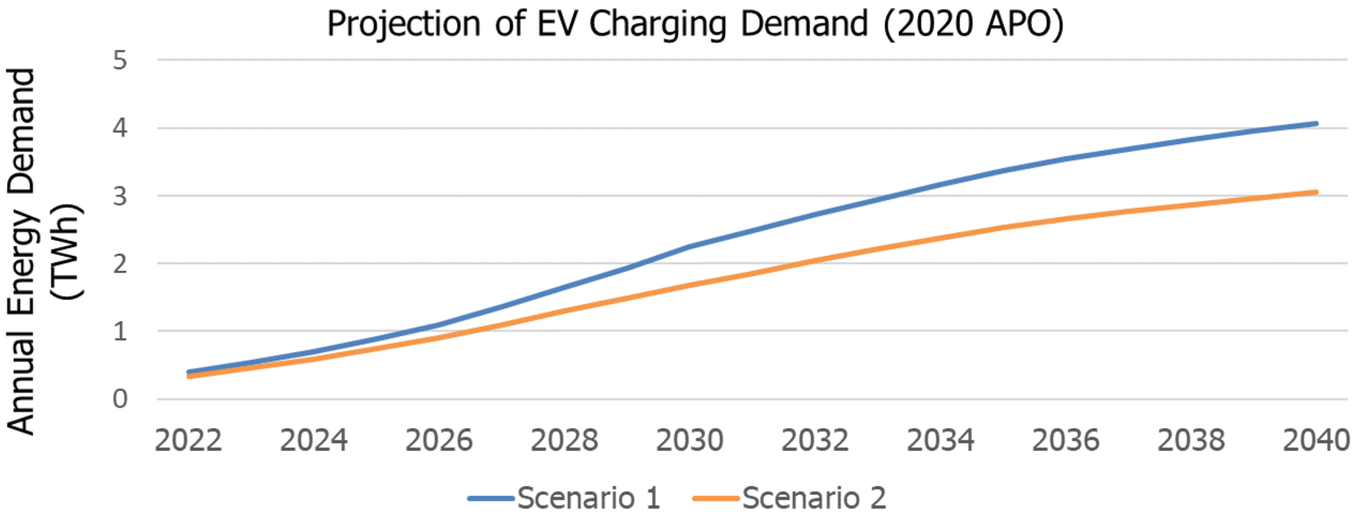
- The IESO's EV forecast is informed by various available information, including historical sales and registration data, government policy and targets, and projections from various organizations (see Appendix).
- General assumptions of EV adoption
  - High case: 35% annual increase in sales over the next 10 years and stabilizes thereafter
  - Medium case: 20% annual increase in sales over the next 10 years and stabilizes thereafter
  - Low case: 10% annual increase in sales over the next 10 years and stabilizes thereafter
- The medium case EV forecast was analyzed in the 2019 APO and the reference case of 2020 APO.

# Key Parameters of Estimating EV Energy Demand

- Average annual driving distance: 16,000 km
  - Source: Canadian Vehicle Survey
- Fuel efficiency: 0.19 kWh/km
  - Source: DOE, Impacts Assessment of Plug-in Hybrid Vehicles on Electric Utilities and Regional US Power Grids
- Charger efficiency: 85%
  - Source: various charger manufacturers

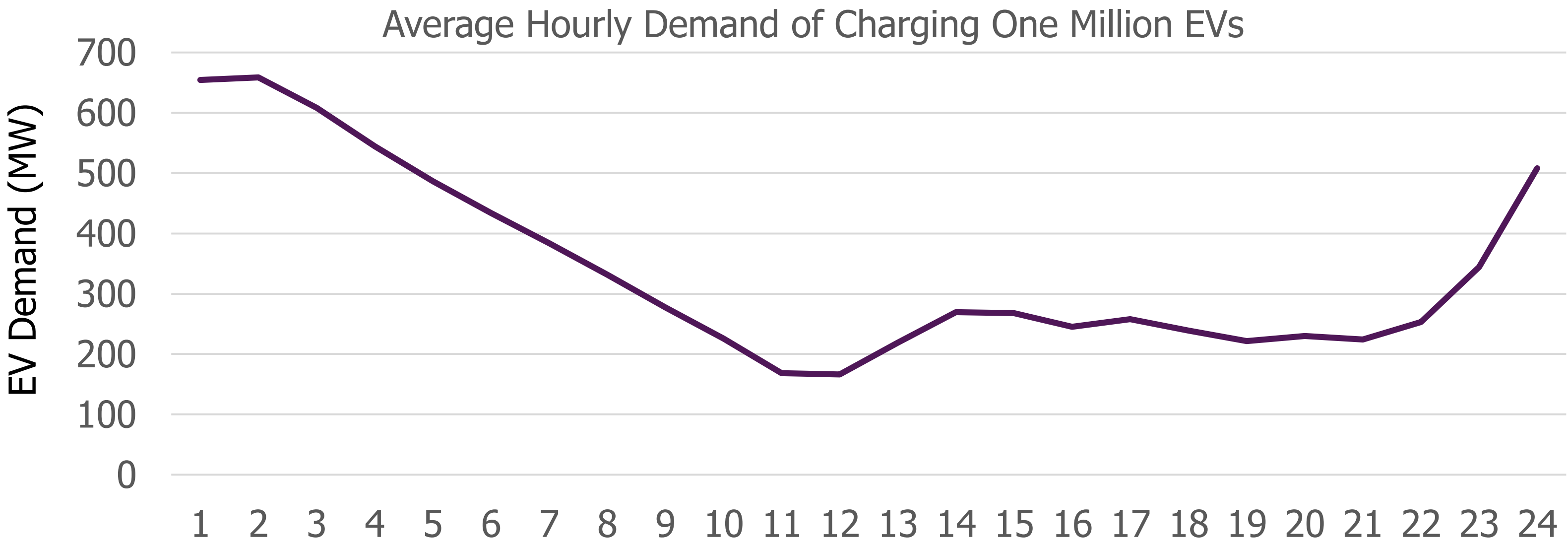
# EV Forecast in 2020 APO

- Scenario 1 projects 1.2 million EVs by 2040 in Ontario, with a charging demand of 4 TWh, or 2.3% of the provincial net forecast of 174 TWh.
- Scenario 2 assumes a slower EV uptake, reaching 75% of Scenario 1 level in the medium and long term. (about 3 TWh in 2040)



# Estimate EV Hourly Demand with Charging Profile

- Two year real-world charging data of 220 electric vehicles was used to develop hourly charging profile.
- Hourly demands are developed from annual energy forecast by applying charging profile.



# Break Down EV Demands to Ten Transmission Zones

- Obtained EV registration data by postal code from Ministry of Transportation Ontario
- Map existing EV stock to ten transmission zones
- Allocate 20-year provincial hourly EV demand forecast to transmission zones
- Integrate with other end uses for further resource modelling and analyses

# Next Steps

- Update EV electricity demand forecast in the 2021 Annual Planning Outlook - seeing higher trend of electric vehicle projections.
  - Key considerations include: government policies, programs, EV market information, and outlooks from other organizations.
- Continue analyzing EV impact on power system.
- Welcome more information on EV and rail transit projects.

# Thank You

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linkedin.com/company/IESO

# EV Projection from Various Organizations

| Organizations | EV Outlooks |
|---|---|
| International Energy Agency (New Policies Scenario) | 130 million EVs on the road globally by 2030<br>https://webstore.iea.org/global-ev-outlook-2018 |
| International Energy Agency (The EV30@30 scenario) | 230 million EVs on the road globally by 2030<br>https://webstore.iea.org/global-ev-outlook-2018 |
| Navigant Research | Global EVs are expected to increase 10 times from 2018 to 2027<br>https://www.businesswire.com/news/home/20180508005003/en/Navigant-Research-Report-Shows-Revenue-Sales-Installation |
| Bloomberg New Energy Finance | EV represents 2% of vehicles on the road by 2025, 7% by 2030, and 19% by 2035<br>https://about.bnef.com/electric-vehicle-outlook/ |
| Boston Consulting Group | EVs will represent approximately 20% of the automotive market in 2030<br>https://www.bcg.com/en-ca/publications/2018/future-battery-production-electric-vehicles.aspx |
| Simon Fraser University | EV new market share reaches over 20% by 2030 (British Columbia)<br>http://rem-main.rem.sfu.ca/papers/jaxsen/Electrifying_Vehicle_(Early_Release)-The_2015_Canadian_Plug-in_Electric_Vehicle_Study.pdf |

# Electric Vehicle Incentives in Canada

- **Federal:** up to $5,000
- **British Columbia:** up to $3,000 provincial incentive and up to $6,000 from Scrap-it program
- **Quebec:** up to $8,000 for new EV; up to $4,000 for used EV
- **Ontario:** Ontario's former EV incentive program offered a rebate up to $8,500 from July 2010, increased to $14,000 in February 2016, and cancelled in September 2018.

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Our electricity grid also needs to be prepared to support the millions of EVs that will be on our roads in the near future. To support this surge in energy demand, the electricity system needs sufficient generation capacity as well the ability to maintain system stability when distributing energy. System operators also need clear signals on ZEV policies (e.g., will PHEVs count towards sales mandates?) and high-quality data on EV uptake to develop evidence-based forecasts of system load over time attributable to transportation electrification.

Duplicate

**Electric Vehicle Demand Forecast – 2021 APO**

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- Slide 5: The Reference case projected number of light-duty EVs on the road in Ontario by 2040 (i.e., 5.4 million) as 4.5 times larger than what was projected in the 2020 APO (i.e., 1.2 million). We understand there are many underlying reasons for this increase, including federal policies and commitments by manufacturers. Nevertheless, given the significant increase, can the IESO further explain its forecast by comparing to other jurisdictions in North America and whether they're also projecting similar rates of EV uptake?

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**2021 Annual Planning Outlook (APO) Summary**
**Briefing Note**

## Purpose:

- Provide an update on the status of the 2021 Annual Planning Outlook (APO).

## Key Information:

- To help ensure the reliability and cost-effectiveness of Ontario's power system, the Independent Electricity System Operator (IESO) regularly evaluates future demand and supply, using the resulting forecasts as the basis to assess resource and transmission requirements.

*Long-term reference demand forecast*

- On August 26, 2021, IESO briefed ENERGY on the results of the 2021 APO long-term demand forecast.
    - The 2021 APO demand forecast reference scenario has annual growth rates of 1.8% and 1.3% for energy and peak demand, respectively. These growth rates are significantly higher than the 2020 APO (**see Table 1**).

**Table 1: Average Annual Growth Rate 2023–2040.**

| Report | Energy | Summer Peak Demand |
|---|---:|---:|
| 2020 APO | 1.2% | 0.9% |
| 2021 APO | 1.8% | 1.3% |

- 
    - Near-term demand increases attributed to:
        - Faster economic recovery from the pandemic
        - Increased residential demand due to immigration and work from home
        - Growth in the industrial sector, specifically the mining sector in northeastern Ontario
        - Southwestern Ontario agricultural greenhouses
    - Long-term demand increases attributed to:
        - Transportation electrification
        - Strong economic growth in the industrial sector
        - Algoma Steel electric arc furnace project

*EV demand forecast*

- On August 27, 2021, IESO briefed ENERGY and other ministries (MTO, MECP, MEDJCT) on the 2021 APO EV demand forecast.
    - A key input to the 2021 APO is the electricity demand from EVs. There is likely to be strong stakeholder interest in this estimate, which partially accounted for the need for an inter-ministry discussion.

  - The IESO updated its EV demand forecast to account for market trends, commitments by automakers, and the Canadian government's target that all new light-duty vehicles sold will be zero emissions by 2035.
  - IESO estimated energy and demand impacts of EVs based on real-world charging profiles for Ontario-registered EVs.
    - ENERGY shared this information with the Ontario Energy Board (OEB) to inform future work on design options for a new enhanced time-of-use rate that would incent load shifting to lower-demand periods.
  - The 2021 APO reference EV demand forecast is significantly higher than the 2020 APO (**see Table 2**).
    - Other ministries did not have any concerns with the higher forecast.
    - MECP commented that the IESO EV demand forecast aligns with the internal MECP forecast.

**Table 2: Comparison of IESO EV Forecasts for the Year 2040.**

| Report | EVs | Energy Demand (TWh) | Peak Demand (MW) |
|---|---|---|---|
| 2020 APO | 1.2 million | 4 | 240 |
| 2021 APO | 5.4 million | 20 | 980 |

*Resource adequacy outlook*

- On September 23, 2021, IESO briefed ENERGY on the 2021 APO resource adequacy outlook.
  - Overall, resource adequacy requirements in the 2021 APO are similar to the 2020 APO but become larger in the longer term driven by demand increases.
  - Capacity adequacy needs are greater in the summer than the winter.
    - Needs emerge in 2023 and continue to increase, consistent with previous APOs.
    - Post-2035, the capacity adequacy needs in the 2021 APO are greater than the 2020 APO due to demand increases.
  - Potential for unserved energy begins in 2026 and increases in 2029 if resources coming off contract exit the market.
    - However, if existing resources continue to be available, Ontario is expected to experience minimal unserved energy. This drives the need to focus on capacity in future resource acquisitions.
    - In the long term, higher demand leads to increased natural gas dispatch. If natural gas were to become unavailable or constrained, energy needs grow substantially.

*Long-term high-demand forecast*

- On November 5, 2021, IESO briefed ENERGY on the 2021 APO high-demand forecast.

  - IESO developed a high-demand scenario in response to government commitments on decarbonization and economic development that have the potential for significant increases in electricity demand.
  - Preliminary advice from IESO staff is that the high-demand forecast will not be used to inform near-term policy decisions, such as conservation and demand management (CDM) investments at the mid-term review for the 2021–2024 CDM Framework. This could be further considered with the IESO CDM team.
  - Drivers for the high-demand scenario include electric space heating, mining projects, Dofasco electric arc furnace project, higher agricultural growth, and earlier EV adoption.
    - This leads to a higher long-term demand forecast relative to the 2021 APO reference scenario (**see Table 3**).
    - Winter peak demand is forecasted to exceed summer peak demand by 2042 in the high-demand scenario driven by electric space heating and agricultural greenhouses.

**Table 3: Comparison of 2021 APO Reference and High-Demand Scenarios for the Year 2042.**

| Scenario | Energy Demand (TWh) | Summer Peak Demand (MW) | Winter Peak Demand (MW) | EVs[1] |
|---|---|---|---|---|
| Reference | 202 | 31,300 | 30,500 | 5.4 million |
| High-demand | 224 | 33,700 | 33,800 | 6.6 million |

[1]EV estimate is for the year 2040.

*Electricity sector emissions – 2021 APO reference scenario*

- Electricity sector GHG emissions are a key area of stakeholder interest given the 2020 APO forecasted increase from 4.4 Mt in 2019 to 10.9–12.2 Mt by 2030.
- GHG emissions are still projected to increase in the 2021 APO due to a combination of increasing demand and utilization of the gas fleet.
  - However, the 2021 APO includes elements that significantly increase demand (e.g., electrification of transportation and Algoma Steel) but drive GHG emission reductions in other sectors (i.e., transportation and industry).
  - IESO has estimated the net effect on GHG emissions to provide additional context and inform future discussion. By 2042, the net effect is forecasted to result in a decrease in GHG emissions (**see Table 4**).
  - Attribution of transportation- and industry-related GHG emission reductions would need further discussion.

**Table 4: Electricity Sector and Net GHG Emissions (in Mt $CO_2e$).**

| Sector | 2022 | 2030 | 2042 |
|---|---|---|---|
| Electricity | 7 | 12 | 18 |
| Net | 6 | 8 | -5 |

- A proxy resource is used for modelling purposes to meet unserved energy requirements and forecast emissions.
    - This resource is assumed to have zero emissions and is priced as a simple cycle gas turbine.
    - However, this resource does not actually exist, and the emissions outlook depends on the source of new generation:
        - If new, emitting resources are added to the system, emissions would be **higher** than forecasted.
        - If some or all existing emitting resources are replaced with non-emitting resources, emissions would be **lower** than forecasted.
        - If new, non-emitting capacity is added to the system, the gas fleet would run less, and emissions would be **lower** than forecasted.

**Next Steps:**

- **Week of November 8:** MO briefing
- **Early November 2021:** ENERGY review of 2021 APO report
- **Early December 2021:** IESO to publish 2021 APO report.

**Date Prepared:** November 10, 2021
**Prepared By:** Conservation and Energy Efficiency Branch

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# APO 2022 Uncertainties

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- **Government Policy:** In addition, there are a number of potential incremental pressures on Ontario's electricity demand driven primarily by government policy supporting electrification and mining

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# 2022 vs 2021 APO

The 2022 APO forecast has consistent growth trends when compared to 2021 APO. System becomes winter peaking in 2037, as a function of increased electrification of transportation and updated agricultural assumptions.

| Year | 2026 | | 2040 | |
|---|---|---|---|---|
| | MW | TWh | MW | TWh |
| APO 2022 vs APO 2021 | +257 | +3.8 | +560 | +7.7 |

**Increases in the near-term (2026) are attributed to:**

- Additions of large industrial loads, including electric arc furnaces, electrolyzers, EV manufacturing
- Faster electric vehicle uptake due to federal mandates and changes in supply chain
- Growth in the industrial sector specifically the mining sector in the north east

**Increases in the latter years (2040) are attributed to:**

- Transportation electrification supported by government policy and strong supply chain indicators.
- Continued economic growth in the industrial sector

**Changes throughout all years that reduced increases:**

- Lower growth in agricultural sector driven by updated assumptions for cannabis greenhouses
- Larger EE program savings



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| 4 | Winter peak demand | For the 2022 APO reference forecast, where the system becomes winter peaking by 2037, to what extent does electrification of heating (e.g., heat pumps) contribute to the increase in winter peak demand? | The extent of electrification of heating or electrically powered heat pumps, contributing to the increase in winter peak demand is not significant to the forecast of the system becoming winter peaking in 2037. No signficiant change in fuel shares (i.e. electricity, natural gas, and other fossil fuels including propane, heating oil, etc.) for building space heating is assumed, which is based on the currently forecasted capital and operating costs of space heating powered by electric vs natural gas and no current policy to indicate a change in fuel shares.<br><br>A large contributor to to the increase in winter peak demand is the electricity demand attributed to charging electric vehicles which is forecasted to be predominantly in evening hours regardless of season. As the winter system peak occurs at this time period and the summer system peak does not, the charging |
| NR | | | |
| 7 | Annual summer peak demand | The 2022 APO forecast of summer peak demand appears to begin to deviate from the 2021 APO forecast in the late 2030s. Can IESO please elaborate on the underlying causes? | For annual summer peak demand, the 2021 forecast grows from 26,991 MW in 2032 to 31,336 MW in 2042, while the 2022 forecast grows from 27,044 to 30,453, a difference of 883 MW in 2042.<br><br>The factors contributing to the determiniation of the annual summer peak demand include all sectors and drivers. The primary underlying causes to a decrease in the growth of annual summer peak demand in the 2022 forecast vs the 2021 forecast can be attributed to:<br><br>1) electric vehicle adoption growth that is more front loaded in the late 2020s to mid 2030s, and correspondingly decelerating in the late 2030s to early 2040s, arriving at similiar total fleet count by the end of the outlook period; and<br><br>2) to a lesser extent of impact, growth in the Industrial Conservation Initiative impacts over the course of |
| 7 | Annual summer peak demand | Has IESO found evidence in climate modelling studies that Ontario is expected to experience warmer summer temperatures? If so, how has that been incorporated into the forecast of annual summer peak demand? | No, the IESO has not formally found evidence in climate modelling studies that Ontario is expected to experience warmer summer temperatures. The IESO is currently undertaking a a study of potential climate change in Ontario and any potential impact on electricity demand and expects any findings to be identified in time for incorporation into the 2023 Annual Planning Outlook |
| NR | | | |
| 11 | Transportation - Seasonal peak demand | Winter peak demand for the transportation sector is forecasted to exceed summer peak demand by about 1000 MW near the end of the outlook period for the 2022 APO. Can IESO please elaborate on the underlying causes? | The transportation sector includes electricity demand attributed to charging electric vehicles, which are expected to see significant increase in adoption in the late 2020s through the end of the outlook period, supported by government policy requiring sales of new vehicles to be zero emissions by 2035, and are forecasted to be charged in the evening time period, which is when the winter system peak occurs and not when the summer system peak occurs.<br><br>An EV charging profile was developed from data of an NRCan EV study and Charge the North project. The same 8760 hourly EV profile was used throughout the planning horizon. As the overall demand forecast |
| NR | | | |

**Questions for IESO on the 2021 Annual Planning Outlook**

- **GHG forecast**: Our understanding is that the GHG forecast (APO Figure 42) uses a different energy mix than assumed in the reference case (Figure 24). Could you please provide the energy (TWh/y) by source (i.e. nuclear, natural gas, hydroelectric, non-hydro renewables, imports, the proxy resource) and exports for each year that's aligned with the GHG forecast in the APO?
  - Note: numbers that haven't been rounded would be preferred.
  - Do you plan on modelling the federal net zero by 2035 electricity generation commitment?

  The GHG forecast and the reference case use the same energy mix but provide perspective on the net change in provincial emissions due to electrification.

- **LD EVs**:
  - Could you please provide the number of light-duty (LD) electric vehicles (EV) on the road and their energy usage for each year of the reference and high demand forecast?
    Please see the attached spreadsheet, EV Summary 2021 APO – MECP 2022-03-07.xlsx

  - Are you developing a forecast for the ratio of battery to plug-in hybrid electric vehicles? If yes, when will it be released or publicly shared?
    The current Ontario stock BEV-to-PHEV ratio (2:1) was used throughout the planning horizon in the 2021 APO. There is no plan to update the forecast at this time.

  - Could you please provide the annual sales number of electric LDVs and non-electric LDVs for each year of the reference and high-demand forecast?
    The IESO's forecast focuses on the total EVs on the road, which are directly related to electricity demand. The on-road EV forecast is included in the attached spreadsheet, EV Summary 2021 APO – MECP 2022-03-07.xlsx

  - There is some discussion on the EV assumptions in section 2.4.5.1 of the APO and section 3.5.1 of the Demand Forecast Module. Could you provide the rationale for the assumption behind the growth in the sales numbers?
    Two EV cases were developed for the APO, reference and high. Both assume the achievement of 2035 target that 100% of light-duty new sales will be zero emission. The two cases were built on the assumed pathways from today's market share to 2035. The high forecast assumes a market share of 50% by 2030 and the reference forecast is lower than that. They are assumed growth based on other organizations' forecasts, historical trend, internal discussion, and professional judgements.

- **HD EVs**: Could you please provide the number of heavy-duty (HD) EVs on the road and their energy usage for each year of the reference and high demand forecast? If there is additional granularity (e.g. electric buses, Class 8 trucks) and if it is convenient to provide, please provide.
  Only electric buses were considered in the 2021 APO demand forecast. The forecast can be found in the attached spreadsheet, EV Summary 2021 APO – MECP 2022-03-07.xlsx

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- **High-demand forecast**: In future APOs, what additional analysis will be conducted for the high-demand forecast (e.g. as done for the reference forecast: energy adequacy and production, GHGs, and transmission security)?
  - Will a net zero by 2050 scenario, aligned with federal commitment, be considered, that relies on more electrification (e.g. heat pumps, broader transportation, etc.)?
    Currently, there is no high-demand scenario planned for the 2022 APO and planning for APOs after 2022 has not yet been initiated.

    For the IESO's Pathways to Decarbonization report to be published later in 2022, the Pathways to Zero Emissions Scenario considers an electrification demand scenario "that relies on more electrification," but does not include an assumption of a net-zero economy by 2050.

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| 2021 APO Forecast | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 | 2029 | 2030 | 2031 | 2032 | 2033 | 2034 | 2035 | 2036 | 2037 | 2038 | 2039 | 2040 | 2041 | 2042 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **LDEV#** | thousand | | | | | | | | | | | | | | | | | | | | | | |
| Ref | 51.1 | 80 | 118 | 153 | 196 | 254 | 307 | 364 | 419 | 478 | 541 | 622 | 737 | 992 | 1385 | 2065 | 2739 | 3409 | 4073 | 4732 | 5386 | 6020 | 6620 |
| High | 51.1 | 80 | 122 | 177 | 254 | 372 | 510 | 688 | 907 | 1181 | 1517 | 1923 | 2393 | 2917 | 3493 | 4116 | 4706 | 5254 | 5754 | 6198 | 6579 | 6889 | 7128 |
| | | | | | | | | | | | | | | | | | | | | | | | |
| **E-Bus #** | unit | | | | | | | | | | | | | | | | | | | | | | |
| Ref | 60 | 200 | 400 | 700 | 1,300 | 1,700 | 2,100 | 2,700 | 3,200 | 3,800 | 4,200 | 4,800 | 5,300 | 5,900 | 6,300 | 6,900 | 7,400 | 8,000 | 8,600 | 9,000 | 9,700 | 9,900 | 10,100 |
| High | 60 | 200 | 400 | 700 | 1,300 | 1,700 | 2,310 | 2,970 | 3,520 | 4,180 | 4,620 | 5,280 | 5,830 | 6,490 | 6,930 | 7,590 | 8,140 | 8,800 | 9,460 | 9,900 | 10,670 | 10,890 | 11,110 |
| | | | | | | | | | | | | | | | | | | | | | | | |
| **Total EV energy (LDEV & Ebus)** | TWh | LDEV & Ebus | | | | | | | | | | | | | | | | | | | | | |
| Ref | 0.2 | 0.3 | 0.5 | 0.6 | 0.8 | 1.0 | 1.3 | 1.5 | 1.8 | 2.0 | 2.3 | 2.6 | 3.1 | 4.0 | 5.4 | 7.9 | 10.4 | 12.8 | 15.2 | 17.6 | 20.0 | 22.3 | 24.4 |
| High | 0.2 | 0.3 | 0.5 | 0.7 | 1.0 | 1.5 | 2.0 | 2.7 | 3.5 | 4.5 | 5.8 | 7.3 | 9.0 | 10.9 | 13.0 | 15.3 | 17.4 | 19.5 | 21.3 | 22.9 | 24.3 | 25.5 | 26.3 |
| | | | | | | | | | | | | | | | | | | | | | | | |
| **LDEV energy** | TWh | | | | | | | | | | | | | | | | | | | | | | |
| Ref | 0.18 | 0.29 | 0.42 | 0.55 | 0.70 | 0.91 | 1.10 | 1.30 | 1.49 | 1.71 | 1.93 | 2.22 | 2.63 | 3.54 | 4.94 | 7.37 | 9.77 | 12.16 | 14.53 | 16.88 | 19.22 | 21.48 | 23.62 |
| High | 0.18 | 0.29 | 0.44 | 0.63 | 0.91 | 1.33 | 1.82 | 2.45 | 3.24 | 4.21 | 5.41 | 6.86 | 8.54 | 10.41 | 12.46 | 14.68 | 16.79 | 18.74 | 20.53 | 22.11 | 23.47 | 24.58 | 25.43 |
| | | | | | | | | | | | | | | | | | | | | | | | |
| **EBus energy** | TWh | | | | | | | | | | | | | | | | | | | | | | |
| Ref | 0.01 | 0.02 | 0.03 | 0.05 | 0.10 | 0.14 | 0.17 | 0.22 | 0.26 | 0.31 | 0.34 | 0.39 | 0.42 | 0.47 | 0.51 | 0.56 | 0.59 | 0.64 | 0.69 | 0.72 | 0.78 | 0.80 | 0.81 |
| High | 0.01 | 0.02 | 0.03 | 0.05 | 0.10 | 0.14 | 0.19 | 0.24 | 0.28 | 0.34 | 0.37 | 0.43 | 0.47 | 0.52 | 0.56 | 0.61 | 0.65 | 0.71 | 0.76 | 0.80 | 0.86 | 0.87 | 0.89 |

# ORIGINALLY PRESENTED AUGUST 26, 2021; UPDATED SEPTEMBER 28, 2021

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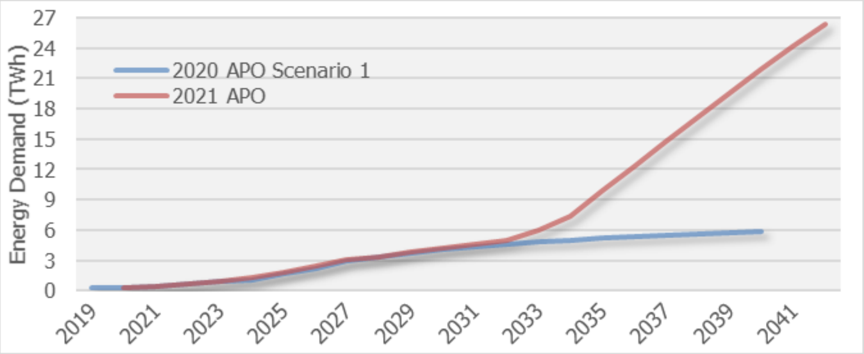
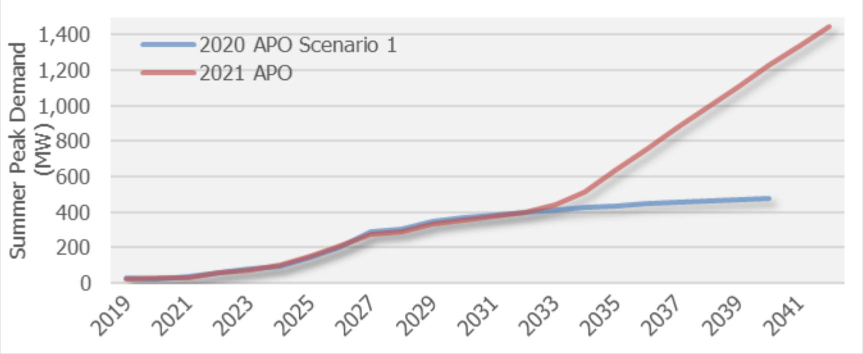
# Transportation Electrification

- **Forecast Highlights**
  - 2020 APO: 1.2M EVs with charging demand of 3.5 TWh/year and 230 MW[1] in 2040
  - 2021 APO: 5.4M EVs, 19.2 TWh and 980 MW[1] in 2040
- **Drivers & Assumptions**
  - Light duty vehicle forecast based government policy of 100% of new sales in 2035 to be zero emissions vehicles[2]
  - No changes to rail transit electrification in 2021 APO
- **Uncertainties & Sensitivity Analyses**
  - Government support (incentives and infrastructure)
  - EV adoption, distance travelled, charging profile
  - Rail technology, electricity demand and implementation timelines
    - Subway extension in GTA, Light rail transit projects, and GO Rail system electrification






1) System summer peak coincident demand; 2) June 29, 2021 announcement;
The IESO 2021 APO has an outlook period beginning January 1, 2023 and ending on December 31, 2042
Figures presented demonstrates update in relevant overlapping years with the IESO 2020 APO outlook period.

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# Transportation Electrification - Electric Vehicles

- EV charging electricity demand is affected by a number of factors, including number of EVs, fuel efficiency, driving distance and pattern, environment conditions, and charging pattern
- Forecasted EV adoption is based on government policies:
  - Federal government:
    - advanced its target of all new light duty vehicles sold in Canada to be zero emissions by 2035
    - committed funding to help purchase 5,000 zero emission buses over the next five years
- Reference Transport Canada's uptake curve. It is estimated that Ontario will have 5.4 million LDEVs by 2040

"Reference Transport Canada's uptake curve" means to reference Transport Canada uptake curve for the country. Transport Canada does not estimate provincial level electric vehicle uptake.

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# Government Policy

- "Net-zero" policies from all levels of government have created demand for batteries to support electricity systems and transportation electrification
  - Ontario's mining industry is well positioned to compete
- The federal government has committed approximately $12 billion on transit projects in Toronto and Hamilton
- Aggressive federal targets for zero emission vehicles reaching 100% of light-duty vehicles sales by 2035
- Industrial sector specific electricity rates continues to be an active file in Ontario

# Demand Uncertainties: Government Policy

Municipal, provincial and federal government announcements have the potential to impact electricity demand in the outlook period

| # | Policy | Details | Impact |
|---|---|---|---|
| 1 | Electric Vehicles | Aggressive government policy coupled with supply chain changes | +200 MW |

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# Transportation Electrification

- The 2021 APO reference scenario demand forecast already includes the June 29, 2021 Federal government policy announcement requiring 100% of car and passenger truck sales to be zero-emissions by year 2035 in Canada and associated increase in electricity demand
- The high demand scenario includes increased electricity demand from:
  - Light Duty Electric Vehicles (LDEV):
    - Adoption of American federal government voluntary target of 50% of new vehicle sales to be carbon emissions free by year 2030
    - Results in earlier LDEV adoption curve, increased LDEV stock and electricity demand due to cumulative effects

# Transportation Electrification, continued

- The high demand scenario includes increased electricity demand from:
  - Electric Buses:
    - Incremental 10% increase in electric bus electricity demand from urbanization and economic development

| # | Demand Forecast Edition | Assumption | Forecast in 2040 (last year of 2020 APO outlook period) | | |
|---|---|---|---|---|---|
| | | | Vehicles in Operation | Annual Energy Demand | Peak LDEV Demand |
| 1 | 2020 APO – Scenario 1 | 100% zero emission new sales by 2040 | 1.2 million | 4 TWh | 240 MW |
| 2 | 2021 APO – Reference Scenario | 100% zero emission new sales by 2035 | 5.4 million | 20 TWh | 980 MW |
| 3 | 2021 APO – High Demand Scenario | 100% zero emission new sales by 2035; 50% by 2030 | 6.6 million | 24 TWh | 1,200 MW |

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