Tesla Motors Canada ULC
1325 Lawrence Avenue East
Toronto, ON M3A1C6 Canada

Ministry of Energy, Energy Supply Policy Division
77 Grenville Street, 7th Floor
Toronto, ON, M7A 2C1

Submitted via Environmental Registry of Ontario (ERO)
and via email to P2D.Consultation@ontario.ca

May 12, 2023

RE: ERO Number: 019-6647: IESO Pathways to Decarbonization Study

Tesla is pleased to offer our recommendations on the Pathways to Decarbonization Report (P2D) in response to ERO Posting 019-6647. Thank you for the opportunity to comment.

I. OVERVIEW

Tesla has a material interest in all aspects of energy reliability and grid resilience in Ontario. Sustainability drives the Tesla corporate mission and is core to the value proposition we present to our customers, employees, and shareholders. Tesla is engaged in multiple businesses that depend on the resiliency and sustainability of electric grids around the world. Tesla is a leader in manufacturing electric vehicles, building grid-interconnected networks for charging electric vehicles, building and operating front-of-meter and behind-the-meter battery energy storage technology and distributed solar, and commissioning some of the largest industrial loads in the world such as our vehicle and cell production facilities. To achieve a zero-emissions future that centres on increasing value and resiliency for our products, services, and the products that make the products, Tesla is very focused on advancing electric market design so that policies and physics of grid operations both align squarely with our goals to sustain decarbonization without compromising reliability.

The province of Ontario is on the cusp of a massive period of energy transformation. We are already witnessing this in the conversion of major industries, like steelmaking to electric arc furnaces and the electrification of transportation. This is stretching the ability of Ontario's system to provide energy, capacity, and ancillary services to keep pace with demand. Concurrently, ageing assets such as nuclear facilities are reaching the end of life, which will compound the scarcity of resources but also pose new challenges for managing system strength as more inverter-based resources are brought online and spinning machines (gas turbines) are retired or replaced. Additionally, there is the stress and uncertainty of new load: the need for new power

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production commences in the mid-2020s at an approximate 3-4 GW deficiency, going up to an approximate 16 GW deficiency by the end of the 2030s.[1] To decarbonize Ontario's electricity system and keep pace with demand, the Independent Electricity System Operator (IESO) has forecasted the need for approximately 69 GW of non-emitting power at an estimated capital cost of $375 billion to $425 billion.[2]

Tesla is active in energy supply markets on a global scale and appreciates the opportunity to provide feedback to the Government of Ontario in supporting its clean energy transition.

To this end, our submission is organized into the following sections:

II. TESLA STORAGE PRODUCTS AS AN EMISSIONS REDUCTION MECHANISM

Tesla is considered a leader in the industry when it comes to emissions reduction. In 2022, our customers avoided about 13.4 million metric tons of CO2e emissions through the integration of electric vehicles[3]. We intend to continue our efforts to avoid CO2e emissions with the integration of more electric vehicles and the sale of distributed storage and solar to support our customers' ability to add clean energy resiliency to their home energy and charging needs. Tesla also

[1] IESO Pathways to Decarbonization Report: https://www.ieso.ca/-/media/Files/IESO/Document-Library/gas-phase-out/Pathways-to-Decarbonization.ashx
[2] IESO Pathways to Decarbonization Report: https://www.ieso.ca/-/media/Files/IESO/Document-Library/gas-phase-out/Pathways-to-Decarbonization.ashx
[3] Tesla 2022 Impact Assessment Report: https://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M500/K989/500989847.PDF

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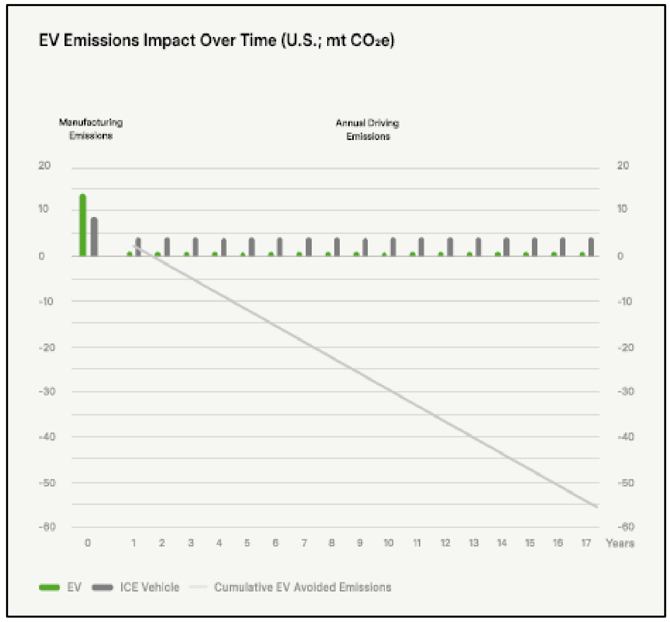
provides the software and program capabilities on a global scale to turn solar and storage deployments at residential premises into large-scale virtual power plants[4], providing a 24x7 source of clean, dispatchable energy which customers can deploy for all or most of their home energy consumption needs, including electric vehicle charging at their residence.



Together, Tesla's residential products, electric vehicles, and investment in grid-aware software controls and programs are changing the energy consumption carbon life cycle on regional electric grids all over the world. These types of solutions create a path forward and enable customer choice for a non-emitting future.

Tesla also deploys a grid-scale energy storage product, Tesla Megapack. The Tesla Megapack is Tesla's commercial and utility scale lithium-ion battery product that is modular, fully integrated, and AC-coupled; it can be sized and scaled to the space and energy requirements of any site, from very small commercial applications of just under 1 MW up to hundreds of Megawatts for utility scale deployment alongside renewable generation or as standalone grid-connected.

Megapack is the most advanced pre-assembled commercial scale battery solution in the world: it can be transported by road, rail, and sea and installed and commissioned in a matter of days. The first iteration of the commercial-scale product was deployed in Australia in 100 days to help the grid avert blackouts and support 30,000 homes.

[4] A Virtual Power Plant is an aggregate group of customer-sited energy resources controlled and dispatched by a central entity – an aggregator – in response to grid conditions. They are comprised on distributed batteries and can provide energy, capacity, and ancillary services identical to a single large-scale battery sited on the transmission system. These batteries both inject power and reduce demand, depending on home energy use.

All Megapacks connect to Powerhub, an advanced monitoring and control platform for large-scale utility projects and microgrids, and can also integrate with Autobidder, Tesla's machine-learning platform for automated energy trading. Tesla customers have already used Autobidder to dispatch more than 100 GWh of energy in global electricity markets. Just as Tesla vehicles benefit from continued software updates over time, Megapack continues to improve through a combination of over-the-air and server-based software updates.

III. ONTARIO NEEDS A COMMERCIAL PATH TO PROCURE COST-EFFECTIVE STORAGE

The P2D report emphasizes the need for non-emitting resource innovation and investment to support future electrification and support the phase out of natural gas starting in the 2030s. The phase-out highlights strategic opportunities for non-emitting investments to be made and that the needed new non-emitting electricity generation will not fulfill current capacity demands on its own. Ontario will need storage technology that will help to optimize electrification and non-emitting resources.

Tesla supports the Government of Ontario's prioritization of up to 2500 MW of battery energy storage through its recent Long Term 1 procurement[5] to meet the reliability needs that have arisen in the mid-2020s. This is a strong signal from the Province of Ontario. To meet longer term 2040 objectives in the P2D report storage will need to remain part of future procurement solutions. Ontario should continue integrating storage and distributed energy resources (DERs) into Ontario's grid as a flexible resource to help support decarbonization and retirement of natural gas use.

[5] IESO: https://www.ieso.ca/en/Sector-Participants/Resource-Acquisition-and-Contracts/Long-Term-RFP-and-Expedited-Process

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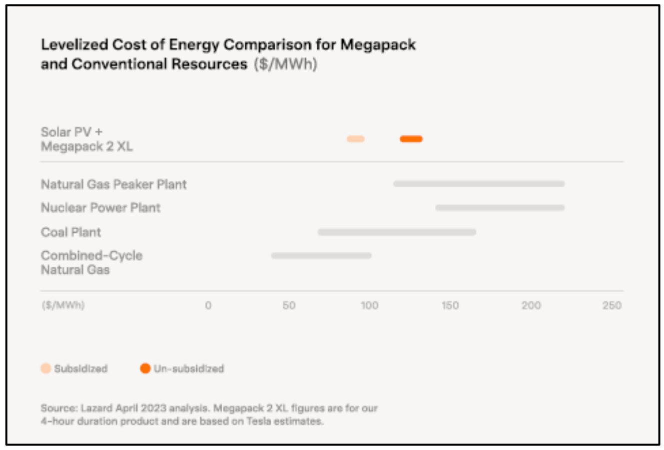

Tesla's Megapack is cheaper per MWh than many fossil fuel alternatives. A single Megapack XL has almost 4 MWh worth of battery storage capacity, and given its scale ability, enables projects over 1000 MWh.[6] When pairing a Megapack with renewables, it is already cheaper than other conventional solutions.

Storage resources can and should be paired with existing and new resources to maximize their value to the system, as well as efficiently utilizing established connection points on the Ontario transmission and distribution system. As of today, Ontario has no established commercial path or procurement for pairing energy storage with existing facilities and this has left a significant gap for how Ontario can meet future energy needs and lower costs for consumers. Tesla encourages Ontario and IESO to consider the establishment of market and commercial pathways that enable the hybridization of existing and future facilities.

Successful contractual procurements for storage value stacked services are beginning liftoff in the US, starting with the pioneering work occurring in California. For example, California Public Utilities Commission (CPUC) recently approved three energy project contracts proposed by San Diego Gas & Electric,[7] and four contracts proposed by Southern California Edison,[8] that will enable more than 800 MW of new solar and storage capacity to help ensure the reliability of the state's electric grid this decade. These types of hybrid projects are examples of opportunities that Ontario should be considering optimizing the additional renewable generation in the Ontario system and lower energy costs and emissions for consumers as demand growth is expected to accelerate.

The following is an overview of the various applications Megapack is compensated for under similar hybrid market asset/transmission/microgrid controller/voltage/VAR control applications around the world at Tesla-deployed Megapack locations.

[6] Tesla 2022 Impact Assessment Report, pg 94: https://www.tesla.com/ns_videos/2022-tesla-impact-report.pdf
[7] CPUC: https://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M500/K819/500819279.PDF
[8] CPUC: https://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M500/K989/500989847.PDF

Key Modes/Functionality of the Megapack:

- The primary purpose of Megapack is to function as a grid asset, providing valuable services to the local grid like peak load shaving. Megapack will act as a sustainable alternative to fossil fuel "peaker" power plants.
- Peaker power plants fire up whenever the local utility grid can't provide enough power to meet peak demand. They can cost hundreds of thousands of dollars per day to operate and are some of the least efficient and dirtiest plants on the grid. Instead, a Megapack installation can use stored excess solar or wind energy to support the grid's peak loads.
- Using Megapack, an emissions-free 250 MW, 1 GWh power plant can be constructed in less than three months on about a three-acre footprint – four times faster than a traditional fossil fuel power plant of that size.

Operational Values:

- Renewable Smoothing (seamless 24x7 dispatchability from solar and wind)
- Demand Support (discharge during peak demand to help support straining distribution infrastructure)
- Infrastructure Investment Deferral (postpone costly grid transmission and distribution infrastructure upgrades by storing power at a single location)
- Voltage and Frequency Regulation (stabilize voltage levels by absorbing reactive power and adjusting output instantaneously)
- Market Participation (provide energy and capacity services to the electric grid and respond to system operation constraints)
- Microgrid (build a localized grid that can disconnect from the main power grid)

IV. TESLA'S INVOLVEMENT IN THE ONEIDA PROJECT: ENABLING AND SUPPORTING VALUE STACK FOR ENERGY STORAGE

There are trends in the energy storage sector that will influence how the Ontario energy transition is supported by grid-scale storage facilities between now and 2040. The 250Mw/1000MWh Oneida Energy Storage Project[9] in Ontario will be a pioneering facility that

[9] For more details see NRStor's portfolio of projects at: http://nrstor.com/portfolio/ and the Canada Infrastructure Bank at https://cib-bic.ca/en/projects/clean-power/oneida-energy-storage/

highlights how grid scale storage can support improved efficiency of the electricity system, as well as how commercial equity arrangements can be structured to enable the participation of local Indigenous groups. Tesla is a proud supplier of our Megapack products for this project. In another sense, it also paves the way to highlight some of the competing market and regulatory forces that need to be considered in current and future procurements.

Grid-scale battery energy storage systems (BESS) success is driven by a combination of:

(i) underlying volatility of commodity markets.

(ii) pricing for key direct inputs to BESS modules including critical minerals and control system components.

(iii) pricing and supply constraints on auxiliary and interconnection parts and supplies such as electric power transformers,

(iv) the relative speed at which other competing project commitments for the same battery supply promise a faster and simpler timescale for completing interconnection studies, modeling, and commissioning (leading to faster recognition of commercial operation revenue), and

(v) in the development phase, the speed, predictability, and efficiency of achieving key construction and EPC milestones that enable the project to be built on the timeline and cost schedule that can be realistically expected to guarantee commercial revenue by a certain operation date.

Given these competing forces, BESS developers are operating in an environment that necessitates careful consideration of commercial upside against the speed and predictability of achieving commercial operations in a given market. In Tesla's experience, project commitments for BESS development across the Original Equipment Manufacturing (OEM) sector are executed in the 18 to 24 months-prior timeframes to avoid unsustainable opportunity cost related to extended contract timelines and pricing lock-ins that equipment suppliers cannot sustain.

Streamlining the regulatory, approval and permitting processes will provide a high-level of efficiency and is largely important in enabling the growth and expansion of the electricity system. A streamlined and predictable process will also help to manage timelines for how far in advance Ontario will need to commit to supply and highlight opportunities for entities like Tesla to commit time and resources. As long lead times do not match up with Tesla's current observed procurement risks, we are affected by the timeline of contracts delivered. Long project timelines generally lead to requests for locked pricing for extended periods (seen 1+ years) which OEMs cannot typically support giving dynamic pricing and supply chain risks; these timelines be factored into procurement design. We recognize that the IESO has acknowledged these types of risks and offered mechanisms for developers to help manage them, like the *Materials Cost Index Adjustment Factor* that was enabled through the Expedited Long Term 1 procurement.[10] These types of considerations may be necessary until certain underlying risks to supply chain and market volatility is resolved.

As the expansion of electricity systems and resources accelerate to accommodate decarbonization efforts, an ongoing focus around efficient and clear interconnection process and timelines will also be critical. Tesla would be please to provide examples of interconnection handbooks and guidelines upon request, largely those assembled internally at our company from a selection of the best practices seen across the U.S.

V. ENABLING THE ADDITIONAL VALUE OF DISTRIBUTED ENERGY RESOURCES

While bulk grid investment will continue to feature prominently in Ontario's electricity system; targeted asset deployment such as rooftop solar and distribution connected storage, enable end use customers and communities to produce and distribute their own electricity, reducing the reliance on the provincial electricity system.

The bulk grid and power markets around the world have been positively impacted by the emergence of DERs. According to the IESO in Ontario, enabling DERs will give customers more control, lower system costs, and provide increased energy security.[11] DERs will give end use customers more control by supplying some (or all) of the energy needed for a home, facility, or business and can result in lower power rates for customers because there is less reliance on the provincial electricity grid. The need for new or enhanced transmission lines is also decreased (or eliminated) as DERs can be located close to urban centres. These benefits provided from DERs would modernize Ontario's current system and is a realistic solution of current technology available to help Ontario with the clean energy transition.

Since DERs are often deployed close to load centres on the electricity system, they can be targeted in ways that will also help to enable the electrification of other parts of the economy, especially transportation. As EV policy mandates are met, corporate environmental objectives proliferate, and customer preference for electrification increases, so too will the need for more electricity production close to load centres.

[10] IESO E-LT1 RFP - Consolidated: https://www.ieso.ca/-/media/Files/IESO/Document-Library/long-term-rfp/E-LT1-RFP-incorporating-Addenda-20230203.ashx
[11] IESO website: https://www.ieso.ca/en/Learn/Ontario-Electricity-Grid/Distributed-Energy-Resources

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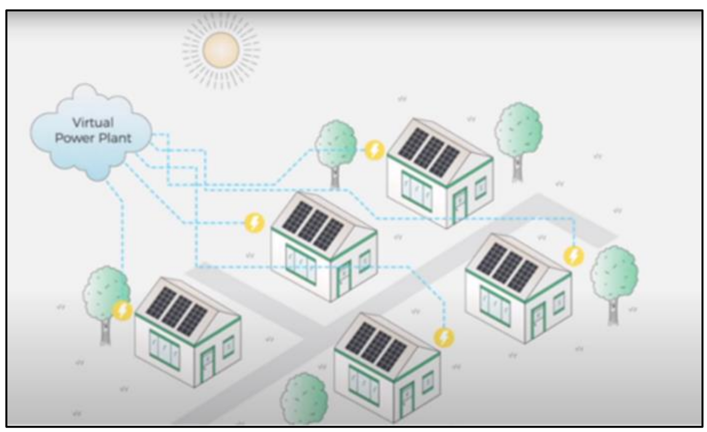
Tesla supports the implementation of net-metering regulations in Ontario, which has helped to enable some rooftop solar and storage. Tesla encourages the government and its energy agencies to work together and lay out a clearly defined regulatory structure, implementation plan and target for DER adoption and integration which takes the value proposition for storage-paired solar, which is fully dispatchable and displaces co-located load beyond the distribution transformer and provide wholesale-equivalent value to customers (virtual power plant).

For example, FERC Order 2222 in the United States provides a framework to ensure that DERs can be fairly compensated in wholesale markets for all services they are technically capable of providing, on par with supply-side resources. In Texas, wholesale participation of DERs is being piloted by Tesla under a brand new market design which enables export value for DERs on par with centralized generation in the ancillary and real-time energy markets. In California, utility tariffs provide compensation for DERs to export and reduce load (energy and capacity payments), reflecting the value of that capacity in the California wholesale energy market. System operators and local utilities in the US are also developing “bring your own device” and residential and commercial storage procurements which support value stacking for all services batteries can provide; these programs have increased DER adoption and utilization as a result in lieu of more expensive and long lead time infrastructure upgrades and new generation build. Ontario should consider a similar approach and simplify the regulatory and approval processes for DER integration to allow the market to take hold and DER systems to support decarbonization efforts more effectively.



As an example, thousands of aggregated, distributed Tesla Powerwalls can support the grid , if a program or tariff is created to support compensation for extra capacity in these systems (injection or withdrawal). In these virtual power plant programs, Powerwall customers can set a battery reserve level to ensure capacity is available for home use during a grid outage, while the remainder of the capacity can be used to support grid needs. For example,10,000 Powerwalls could unlock as much as 50 MWs of dispatchable capacity over a 2-3 hour duration, similar to a gas peaking plant but far faster and accurate in its provision of fast response services). These types of DERs can help local utilities defer or avoid distribution asset upgrades, provide bulk reliability services (capacity, energy, ancillary), as well as support the local energy end user. Regulatory and procurement structures that enable virtual power plant value stacking at various levels of the system is an important tool that has yet to be fully enabled in the Ontario market.

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VI. STORAGE AS TRANSMISSION

Energy storage is a flexible and nimble resource that can provide several services to the grid, as outlined above. These are often considered in the context of energy supply – firming of capacity of other resources, lower emissions alternative to fuel-based facilities, or for end use customers as backup supply – but there is growing examples that storage can also be useful as a transmission asset. In several jurisdictions around the world, system operators and regional transmission organizations have been exploring how storage can be integrated into transmission planning and operation.

Storage-as-transmission (“SAT”) is an energy storage system use case where batteries are deployed for reliability service on the transmission system. By integrating storage facilities into transmission equipment, they can help to moderate power flows on transmission lines at key periods. Used like this, storage can enhance existing transmission lines or as an alternative to building new transmission projects. In terms of a model, the Alberta Electric System Operator (AESO) Transmission Must-Run (TMR)[12] service is an example of how a contract can be layered onto a market in a fair, open, efficient, and competitive manner. TMR is a generation or storage resource that is required to be online and operating at specific levels in parts of the province's electricity system to compensate for insufficient local transmission infrastructure relative to local demand. These agreements are used to ensure reliability until adequate transmission infrastructure is built in that local area. This is an example for Ontario to consider of how to layer contracts for transmission services onto a market agreement.

Further, in the United States, system operators and regional transmission organizations are siting storage purely for their transmission services value. For example, the American Transmission Co.’s proposed Waupaca Area Storage Project was approved after the proposal was deemed by its energy regulator, the Federal Energy Regulatory Commission,[13] to be less expensive than an alternative to rebuild a transmission line in the area. The project includes a 2.5 MW/5 MWh lithium-ion battery and is the first storage as transmission project in the Midcontinent Independent System Operator footprint. The battery increases area transmission reliability and operational flexibility by providing frequency, voltage and short-circuit support.

Ontario and the IESO should explore how storage can be compensated for grid stability and system strength services as a transmission investment, not just viewed from the lens of energy supply. Tesla’s Power Systems teams would be pleased to provide additional information on

[12] https://www.aeso.ca/market/market-participation/ancillary-services/transmission-must-run-service/
[13] FERC eLibrary: https://elibrary.ferc.gov/eLibrary/filelist?document_id=14882597&optimized=false

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1325 Lawrence Avenue East
Toronto, ON M3A1C6 Canada

transmission services that can be provide in market-based and rate-based programmatic settings in addition to their energy capacity value.[14]

Thank you for your consideration on these matters. We would be pleased to answer any questions you may have and can be reached per the information below.

Yours Sincerely,

Audrey Dépault
Senior Advisor, Public Policy, and Business Development | Canada
Tesla Motors Canada ULC
adepault@tesla.com

[14] For a comprehensive overview of the various modes, please visit https://www.tesla.com/megapack