EV Batteries Value Proposition
For Ontario's Electricity System and EV Owners

A Plug'n Drive Report

July 16, 2020

STRATEGIC POLICY ECONOMICS

PLUG 'N DRIVE

Outline

- EVs are more than just cars
- EVs have considerable life in their batteries
- Economic conditions exist for mobile storage
- Emergent Government polices may be strong economic enablers
- Battery use in the electricity system aligns well with climate and energy policy goals
- Second life battery economics for electricity system use are strong
- Lifetime benefits potentially significantly reduce EV ownership cost
- Recommendations

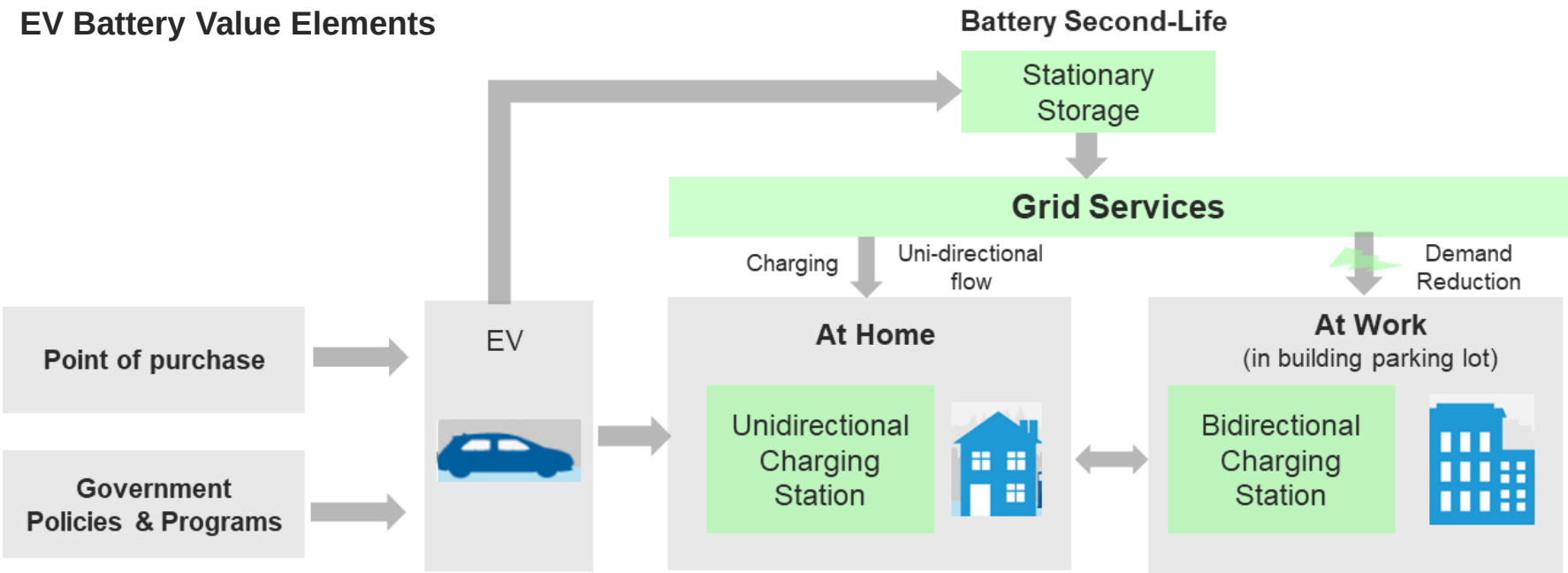
The Project Message: EVs are more than just cars

They are batteries on wheels that can store energy for Ontario's electricity system

Electricity system operators are looking to battery storage solutions to manage system complexity

EV batteries can contribute to Ontario's electricity system in two ways:

- Mobile Storage
- Second Life Storage



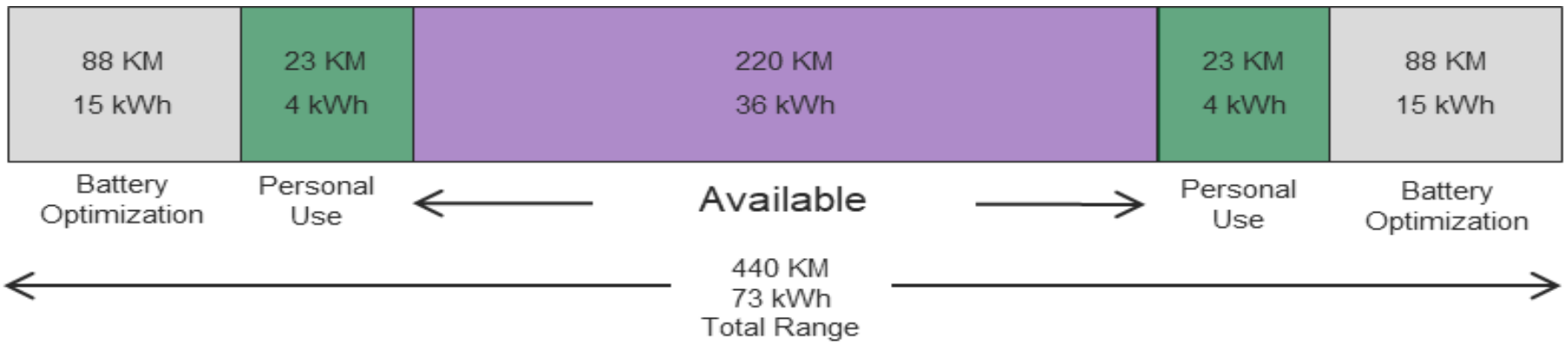
EVs batteries are only mildly used for driving the car

EV batteries are increasingly being equipped with greater range

Over 440km of range can be typically expected today

EV should have half, 220 km or 36 kWh, of battery capacity left over for mobile storage

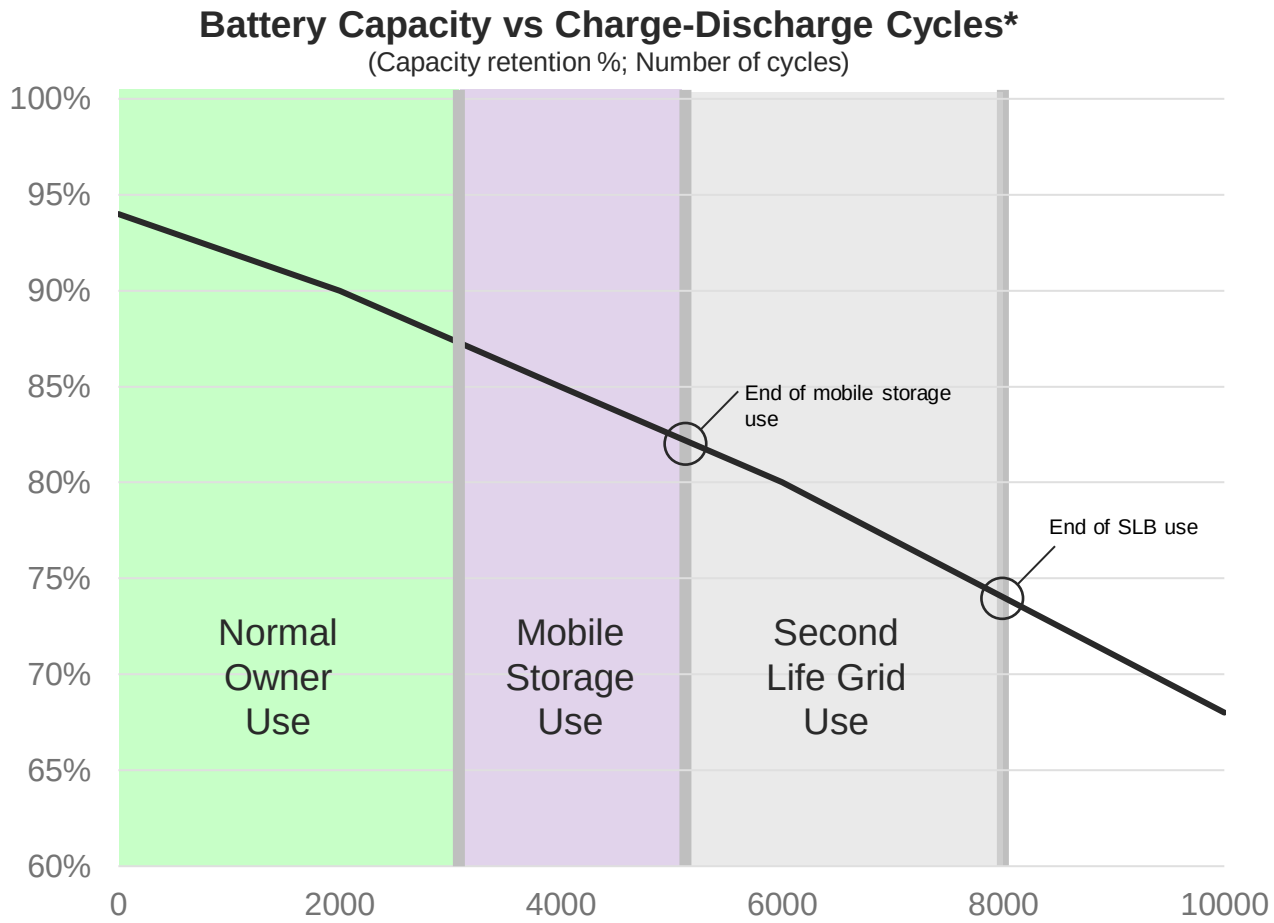
EV Driving Range Availability



Source: BC Hydro, 2019, assume round trip commute in the GTA of 36 km

EVs have significant available battery life for later use in a second life

EV batteries could have over 80% of their capacity after 13 years of providing mobile storage



*Illustrative, adapted from Battery University, 2019, at a 25%-85% state of charge/discharge duty cycle

Pricing conditions exist for mobile storage

Ontario's business rates enable electricity to be sold at the workplace

Two mechanisms are available for workplaces:

- Class B consumer arbitrage of residential TOU rates
- Class A consumer leverage of the Industrial Conservation Initiative (ICI)

Ontario Consumer Rate Mechanisms

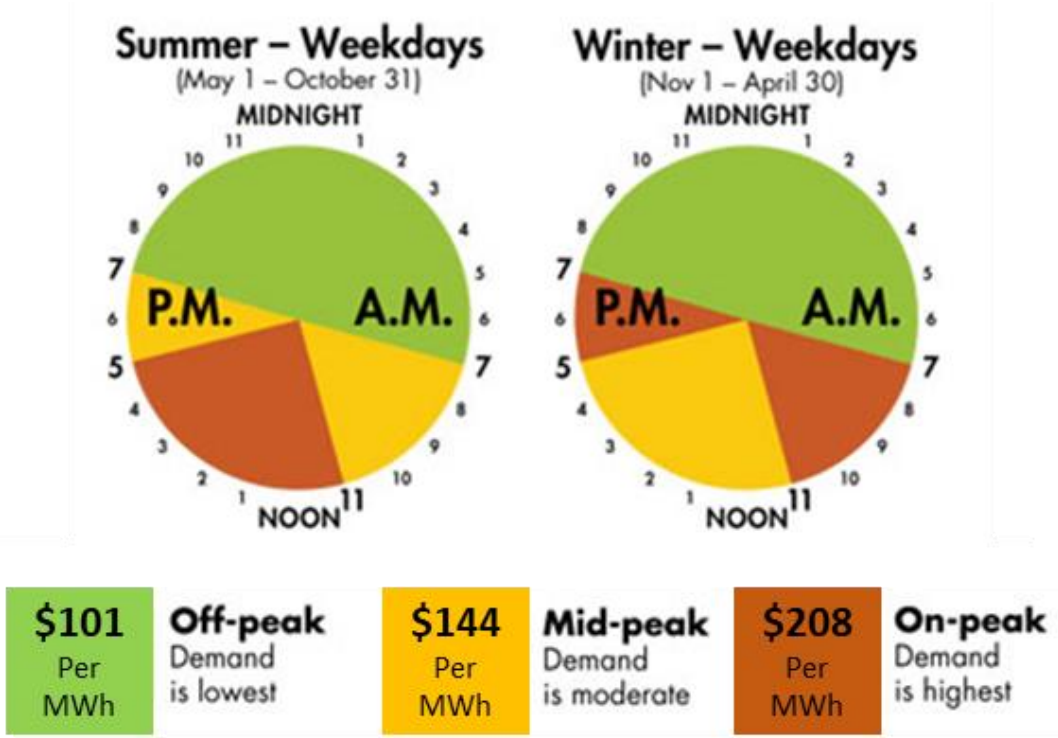
Class A Service \ Class B Service	Charge at Home Residential Rate	Discharge at Work Commercial/Industrial Rate
	RPP TOU Pricing *(BTM)*	RPP TOU Pricing *(BTM)* GS > 50kW *(BTM, Monthly GA + HOEP)*
	Not Applicable	Capacity *Demand Response ICI* Energy *HOEP*

Source: OEB 2019; ICI = Industrial Conservation Initiative, TOU = Time of Use Pricing

Ontario's electricity rate structure allows EV owners to derive value from mobile storage

The Regulated Rate Plan (RRP) time-of-use (TOU) pricing scheme for Class B customers allows for price arbitrage

Ontario Regulated Rate Plan Time of Use Prices



Source: OEB 2019; ICI = Industrial Conservation Initiative, TOU = Time of Use Pricing

Emergent Government polices may be strong economic enablers

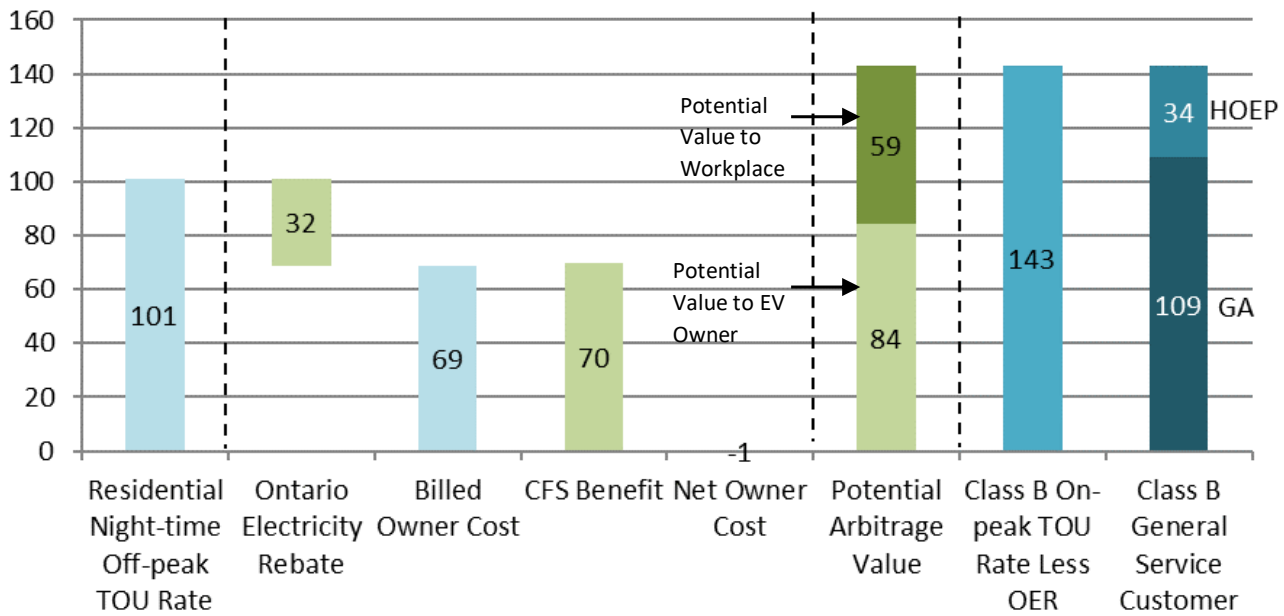
Ontario Energy Rebate and Federal Clean Fuel Standard improve TOU pricing arbitrage

EVs charging at night will benefit from TOU rates

- Ontario Energy Rebate (OER) changes the arbitrage value
- Federal Clean Fuel Standard (CFS) may provide additional incentives for charging EVs

Residential EV Price Arbitrage Benefit Components

($/MWh)



With current and expected policies, charging an EV at night could effectively cost $0/MWh

Source: Government of Canada, Federal CFS Proposed Regulatory Design, 2019; Strapolec analysis

Battery use in system aligns well with climate and electricity policy goals

Lowering rates and reducing emissions

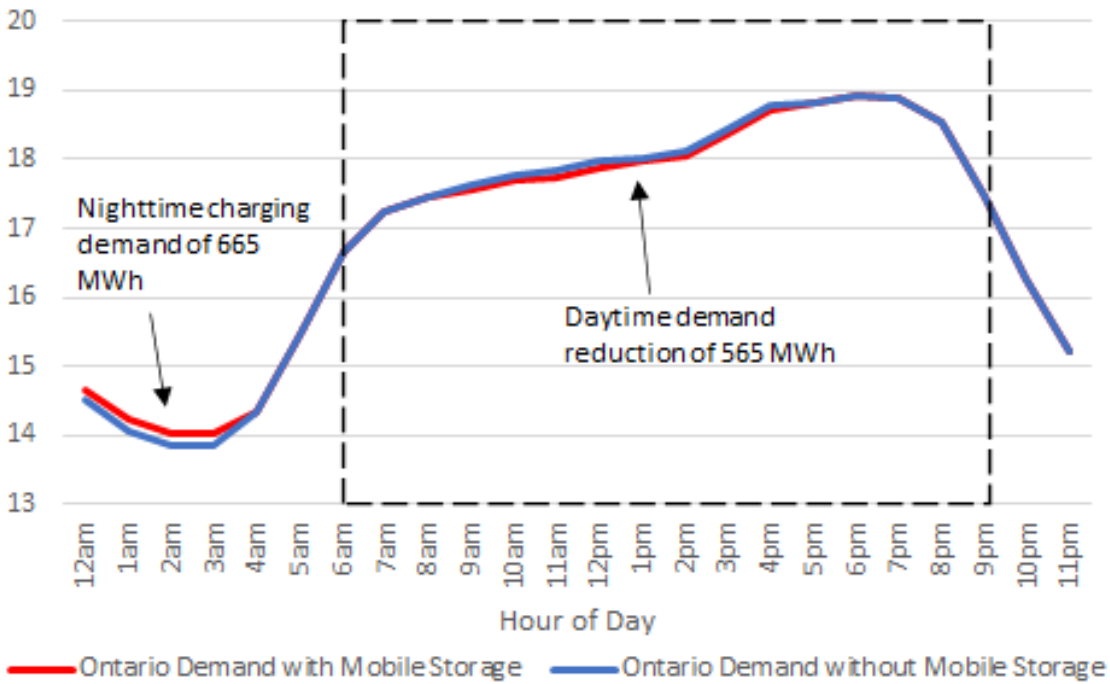
Mobile storage would increase residential electricity demand at night, and decrease commercial/ industrial demand in the day

Provides two desirable outcomes

- Using surplus energy at night, lowering electricity prices
- Reduce higher emitting generation during the day, reducing GHG emissions → 55kt/year

Impact of Mobile Storage on Ontario's Daily Demand Profile

(GW by hour; 2035, average summer demand, Impact of 18,000 EVs)



Source: Strapolec analysis of IESO data

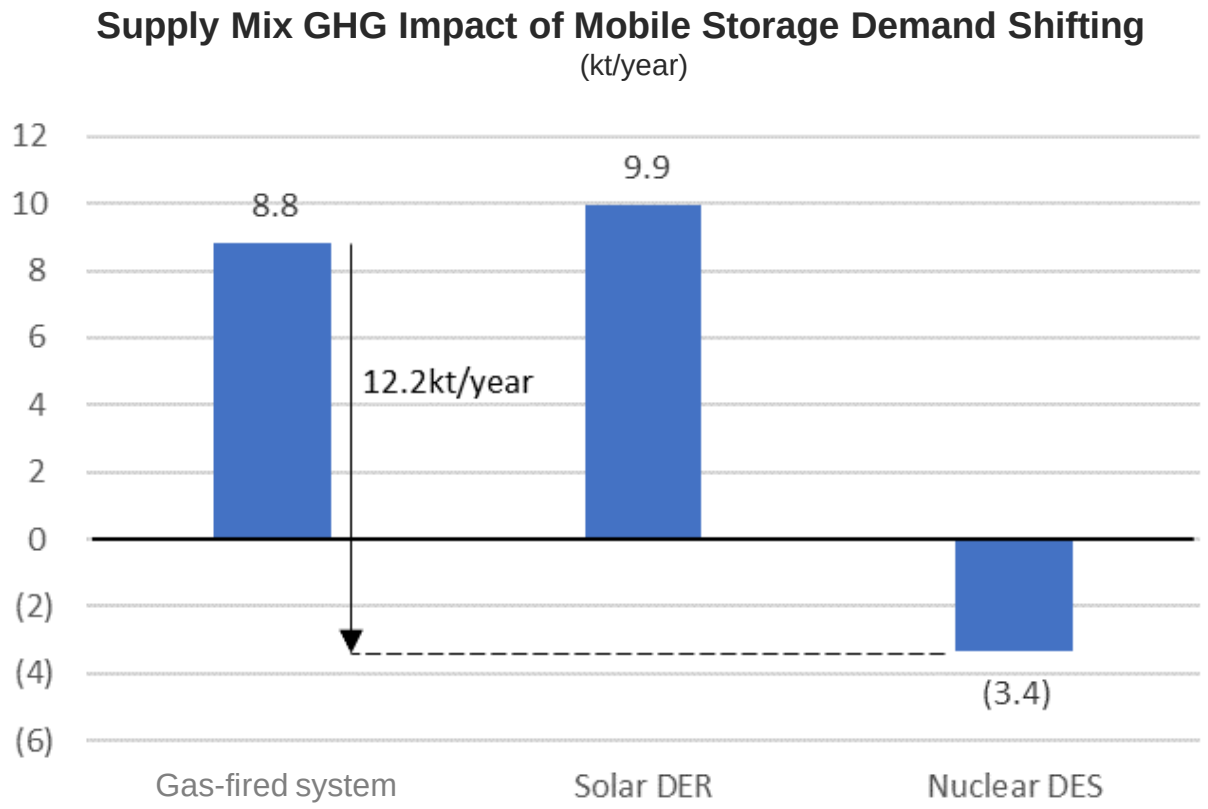
Future supply mix impacts GHG emissions benefits of mobile charging

Availability of emission free nightly charging is most desirable

A gas-fired generation based system would increase GHG emissions

Counterintuitively, a solar based system reduces benefits further

A simulated nuclear-based distributed energy storage (DES) system enhances emissions reduction

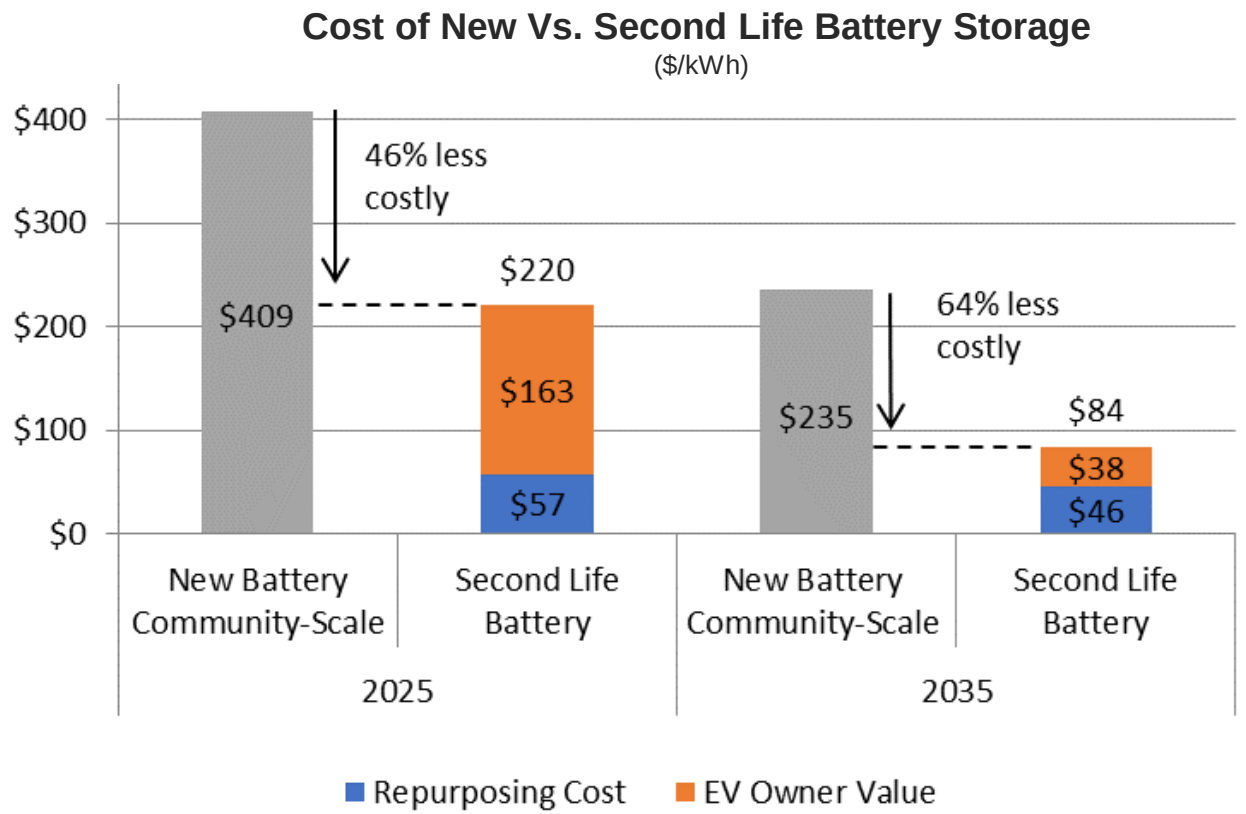


Source: Strapolec analysis of IESO data

Second life battery economics for system use are strong

SLBs can lower initial cost of DER storage solutions

Used batteries can be acquired for 20% of their initial cost

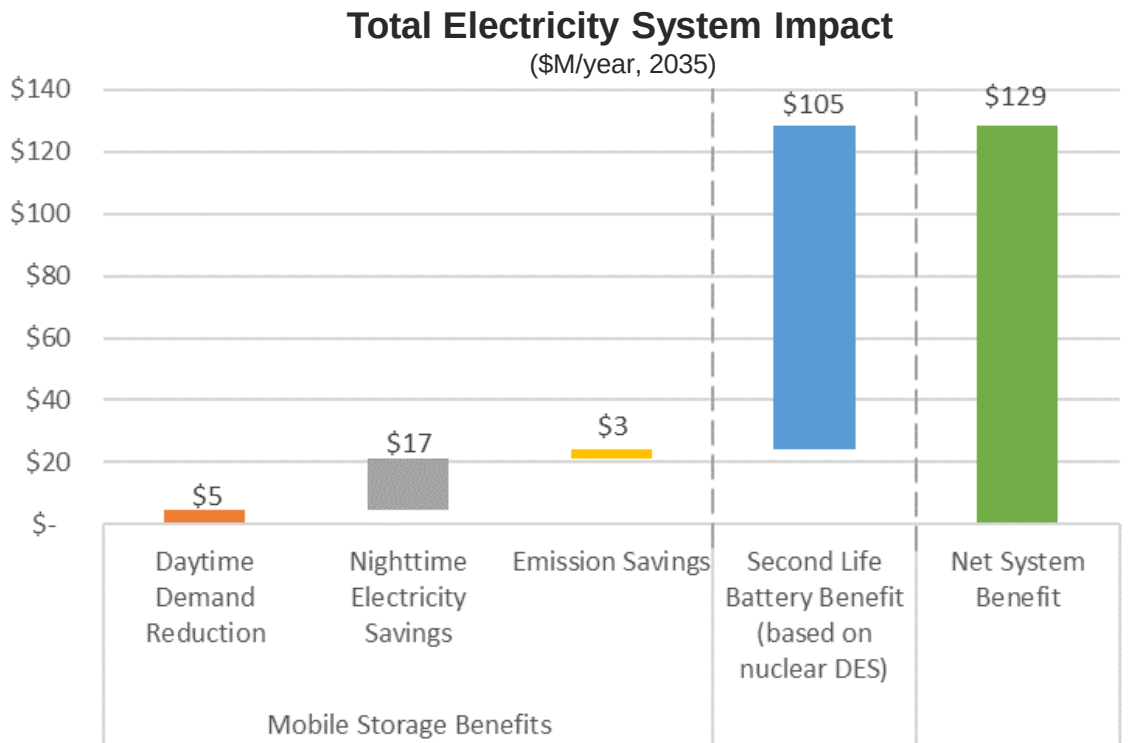


Source: Lazard, 2017; Element Energy, 2019; Debnath et. al., 2014; PV Magazine, 2018; Inside EVs, 2019; Strapolec analysis; Fleetcarma, 2018; IESO, Preliminary 2019 Long-Term Demand Forecast, 2019.

EV battery economics for system use are strong

Benefits from both mobile storage and SLB use

Electricity system benefits accrue from four areas

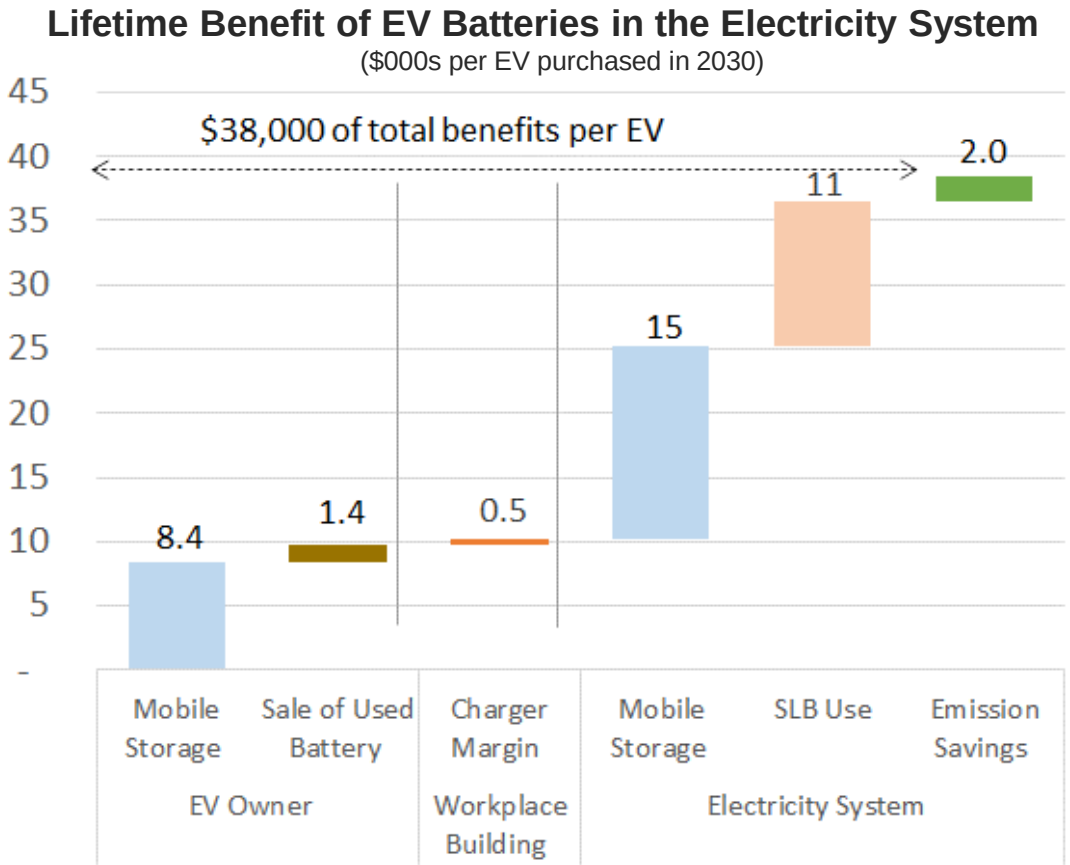


Source: Lazard, 2017; Element Energy, 2019; Debnath et. al., 2014; PV Magazine, 2018; Inside EVs, 2019; Strapolec analysis; Fleetcarma, 2018; IESO, Preliminary 2019 Long-Term Demand Forecast, 2019.

EV batteries could create value for EV owners, workplace buildings, and the electricity system

EV battery mobile storage and SLB grid storage creates $38,000/vehicle value from 3 areas:

- EV Owners from mobile storage and sale of used battery
- Workplace buildings can capture mobile storage value
- System level benefits from second life batteries



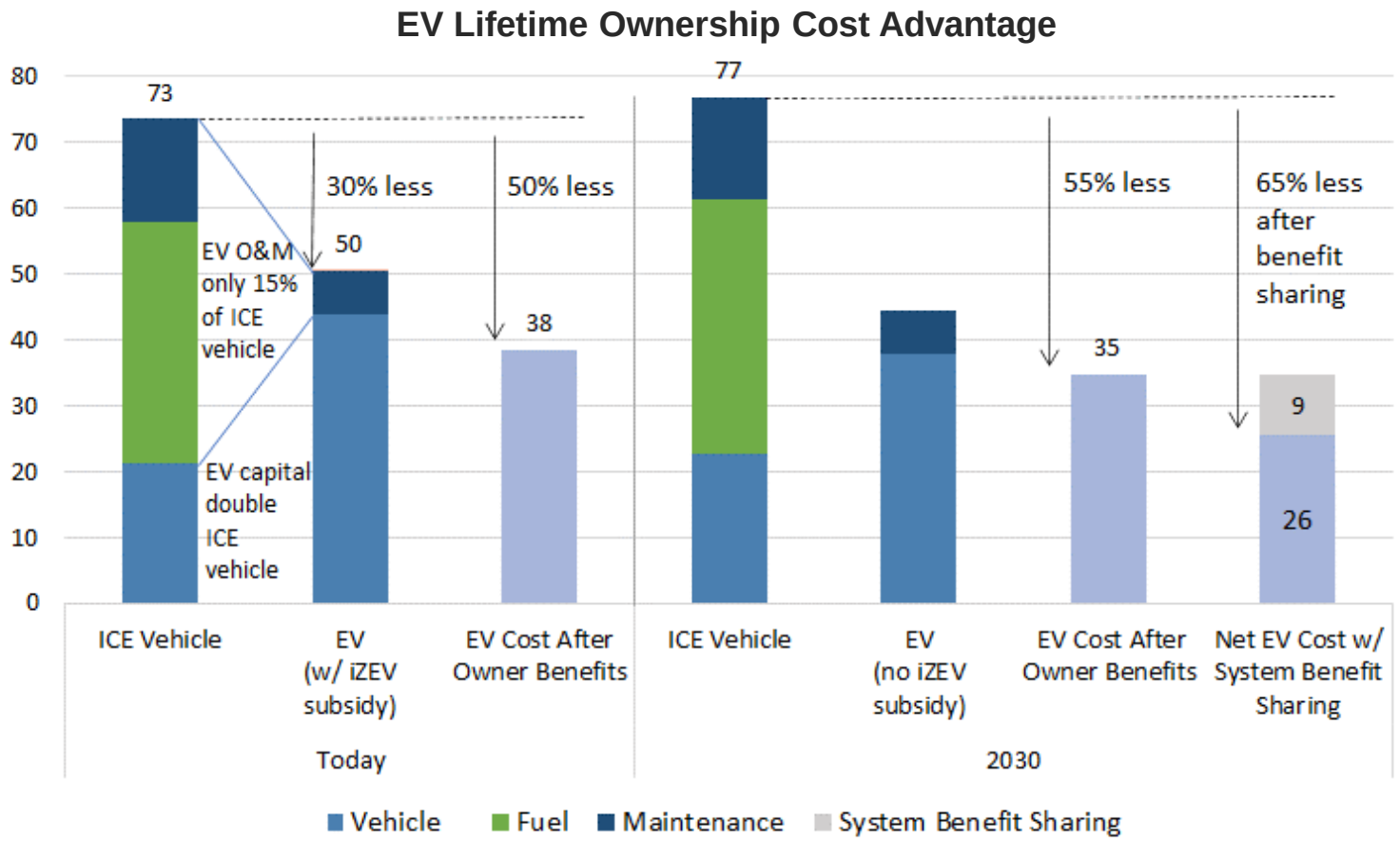
Source: Strapolec analysis

Lifetime benefits potentially significantly reduce EV ownership cost

EV batteries could create value for EV owners, workplace buildings, and the electricity system

EV ownership could be 50% less expensive than owning an ICE vehicle today

- Potentially 65% less by 2030



Could be a game changer for EV adoption

Source: Strapolec analysis

Recommendations

To maximize the benefits to owners, workplaces and the electricity system

Proponents of EVs should consider:

New Business Models	1. **Developing** a business model to optimize value elements to promote EV adoption
CFS Alignment to EV Use	2. **Advocating** for an EV friendly Federal Clean Fuel Standard
Realistic EV Adoption Forecasts	3. **Refining** the forecast of EV adoption in Ontario over the next 5 to 10 years to better establish the value to the system
Need for Low Emissions Electricity Supply	4. **Advocating** for a future low-emission Ontario electricity system to get full value of CFS