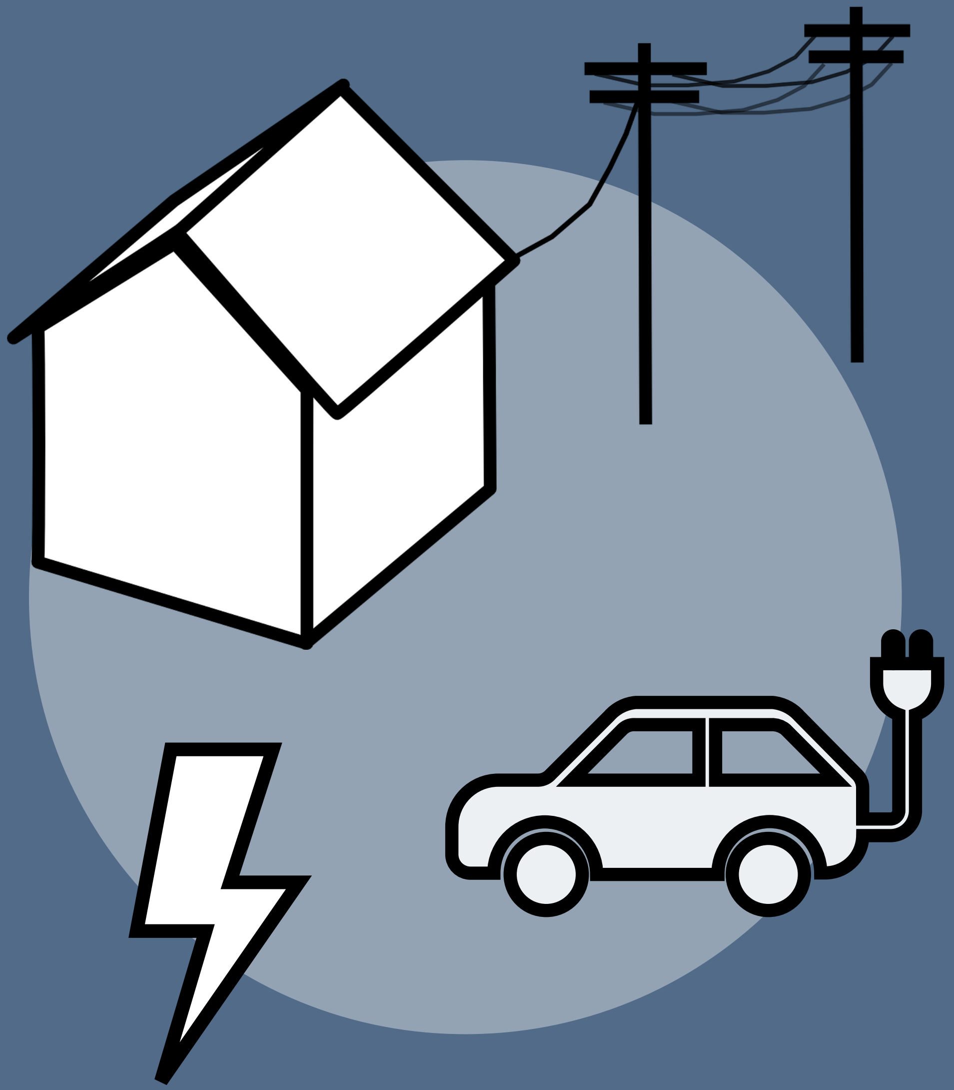
EV NWA DSM Study

How energy efficiency, demand response and smart charging can reduce EV-related distribution costs

Agenda

- Context – Why pursue this study?
  - Evidence from Alberta and beyond
- Methodology
- Results
- Questions

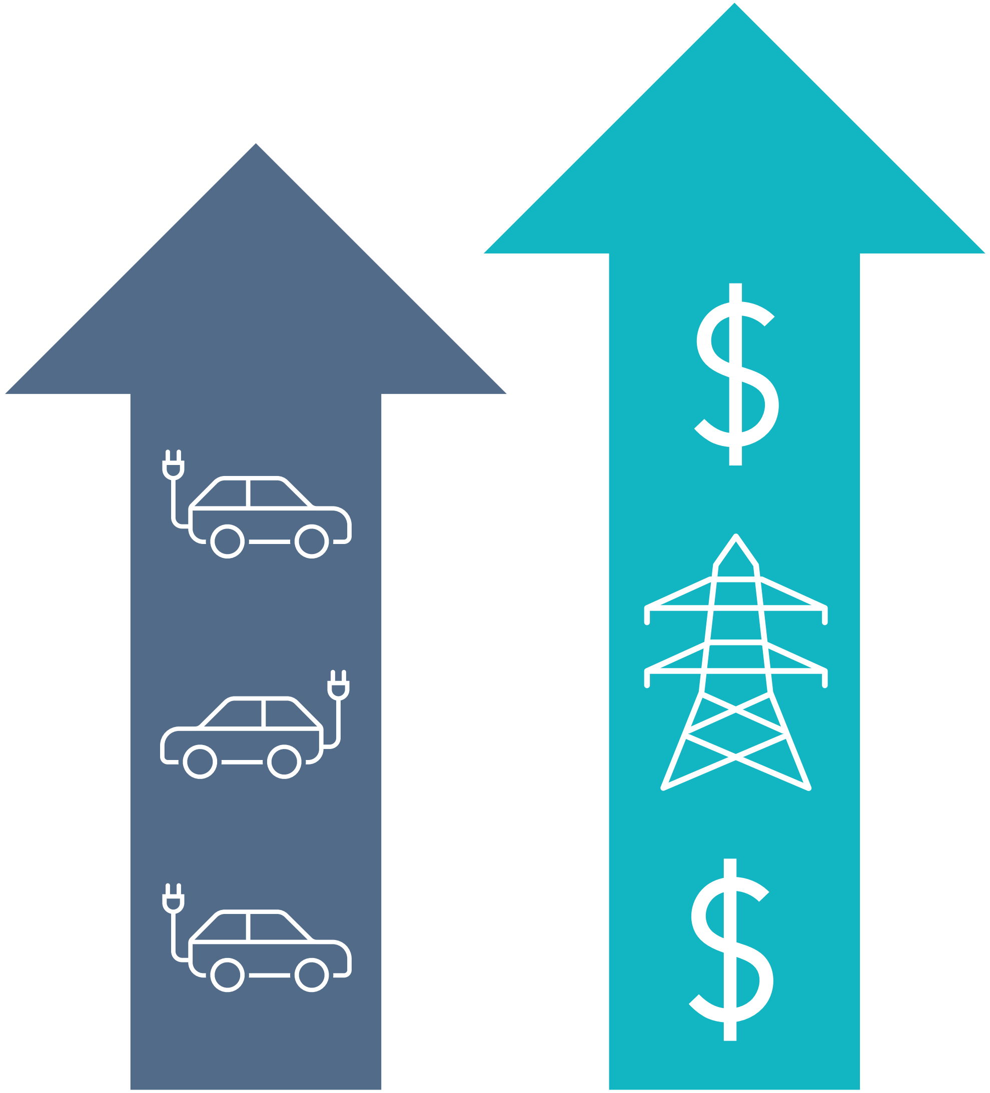


Context

Why?

- Projected increased adoption of electric vehicles (EVs)
- Increase transmission and distribution system costs

Question? Can EE, DR and smart charging cost-effectively mitigate EV's impacts on Alberta's distribution system?



Alberta Concerns

35.15 kW EPCOR Transformer

- Ave per house peak load 2-3 kW
- Transformer avg peak 24-36 kW
- Remaining capacity ~11-0 kW

+ Two Tesla's charging 15.4-23 kW

"to replace transformers and increase capacity on a residential feeder, [EPCOR] would incur in the neighborhood of $20 million in capital upgrades."

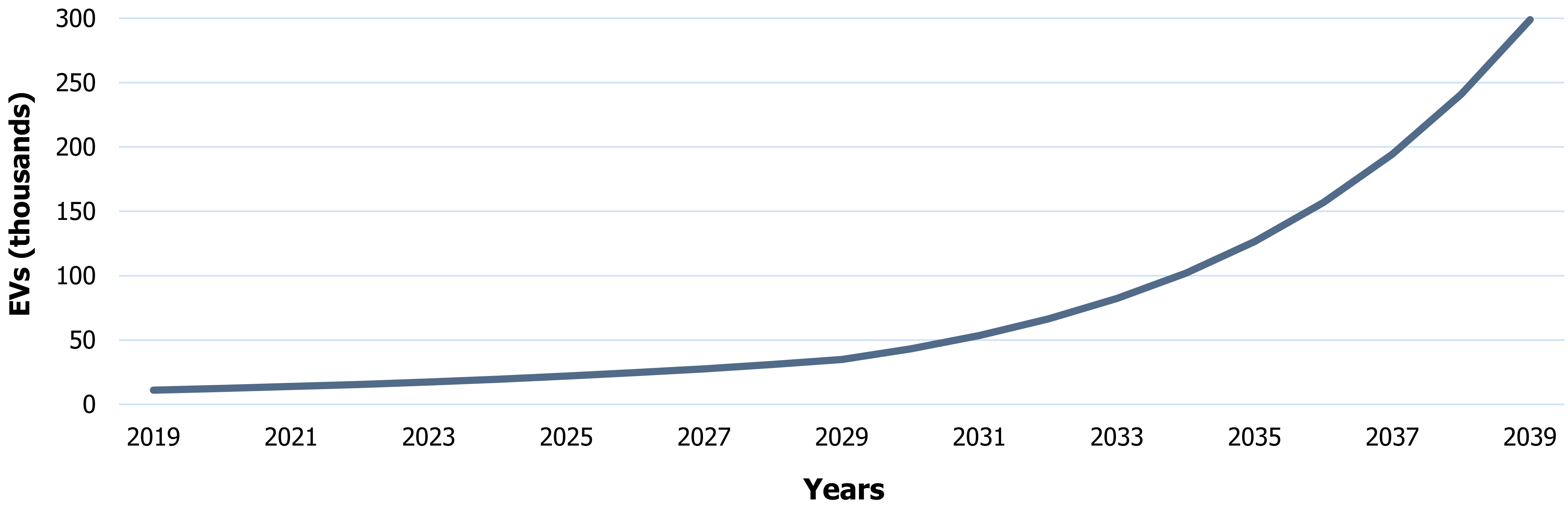
— EPCOR submission to AUC Distribution Inquiry

AESO EV Projections

~40,000 EVs by 2030

+300,000 by 2040

EV forecast for Alberta, 2020-2030, high growth scenario



Source: AESO. (2019). 2019 Long-term Outlook data file, Load Modifiers by Scenario (MW), High Growth. [Data file]. Retrieved from https://www.aeso.ca/grid/forecasting/

EV Cost Impacts

"Unmanaged, substation peak-load increases from EV-charging power demand will eventually push local transformers beyond their capacity… **Without corrective action, we estimate that the cumulative grid-investment need could exceed several hundred euros per EV**." *- McKinsey Center for Future Mobility*

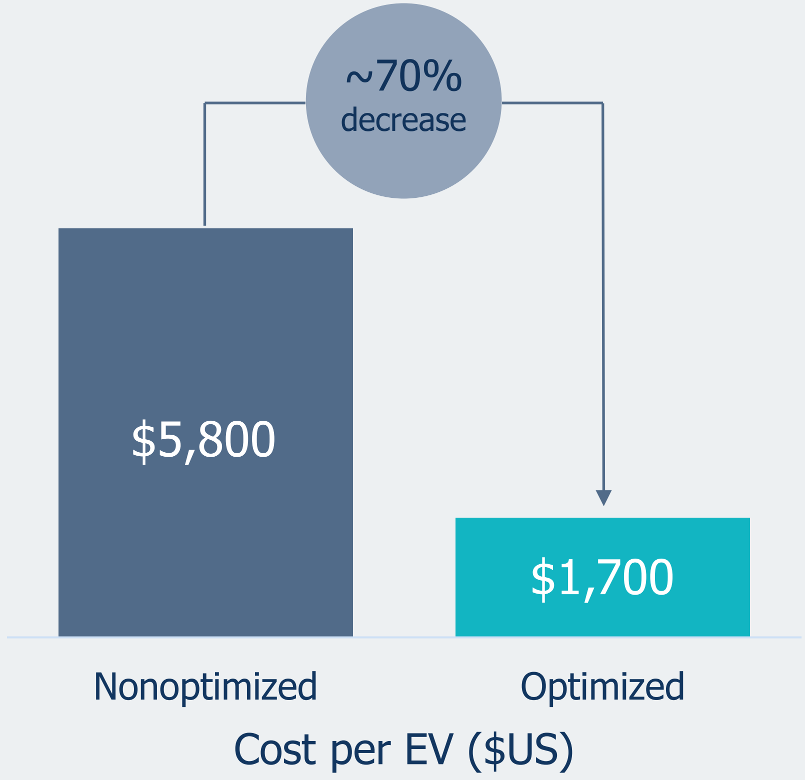
Total Transmission and Distribution Investments through 2030

Source: Sahoo, A., Mistry, K., and Baker, T. (2019). The Costs of Revving Up the Grid for Electric Vehicles. https://www.bcg.com/publications/2019/costs-revving-up-the-grid-for-electric-vehicles.aspx

DSM is an Opportunity

- An increase of 0.75 to 1 per cent can easily offset EV peak load impacts in US Southeast and New England
- Smart charging – reduces distribution costs by 70%

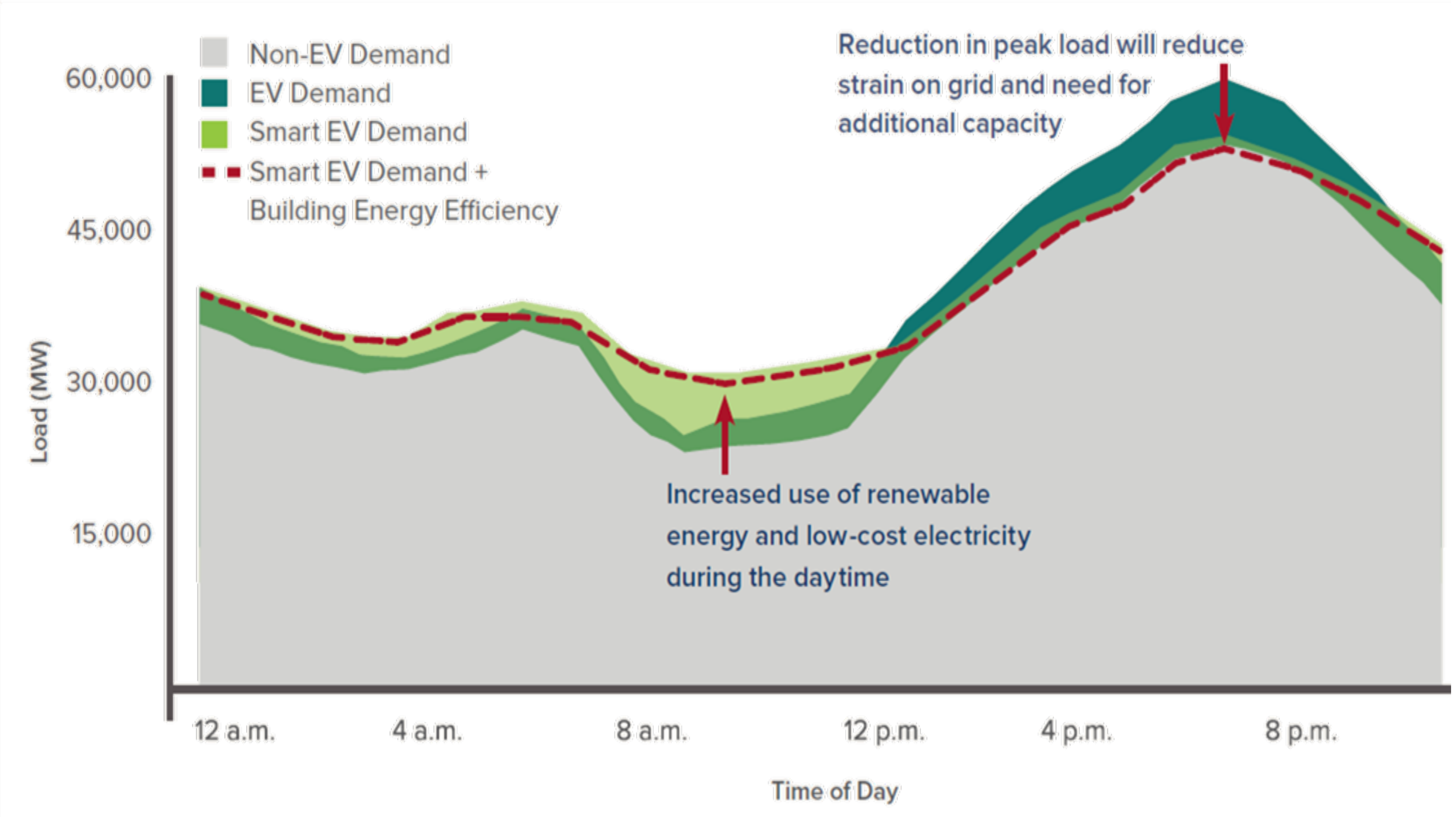
Total Transmission and Distribution Investments through 2030



Source: Sahoo, A., Mistry, K., and Baker, T. (2019). The Costs of Revving Up the Grid for Electric Vehicles. https://www.bcg.com/publications/2019/costs-revving-up-the-grid-for-electric-vehicles.aspx

Energy efficiency can help manage the peaks

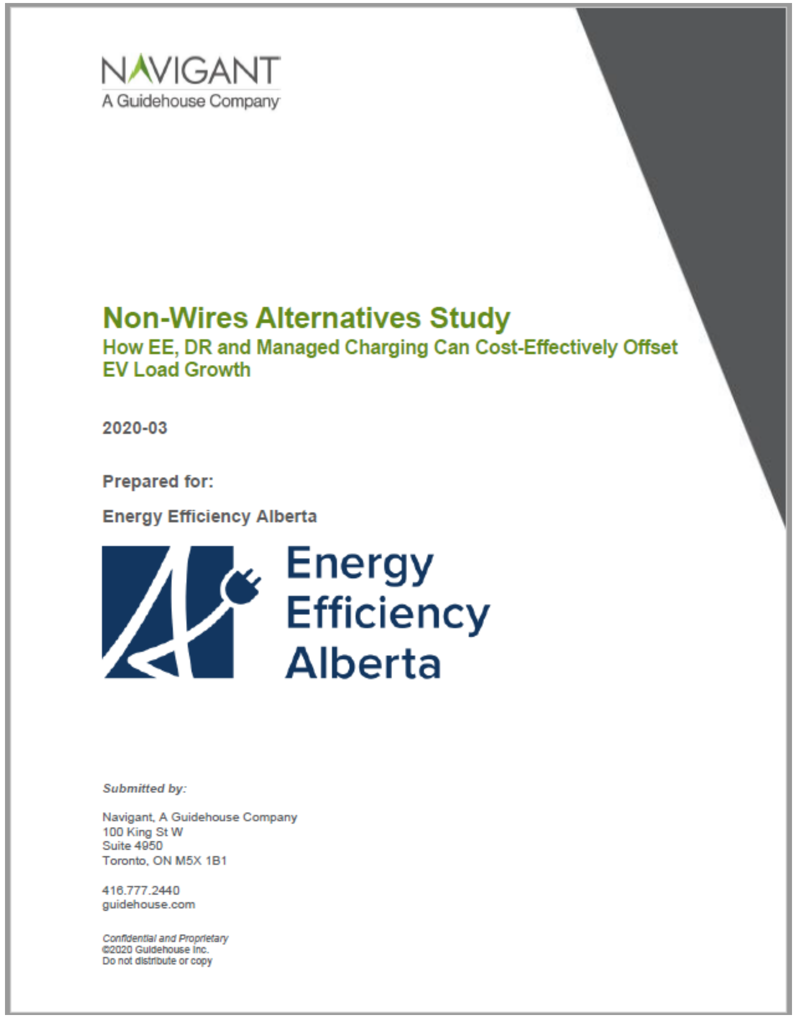
- Energy efficiency and smart charging can manage the peaks associated with high EV penetration



Source: Rocky Mountain Institute. (2018). Energy Efficiency and Electric Vehicles: How Buildings Can Pave the Way for the Global EV Revolution.

EEA's NWA Study

Can Energy Efficiency, Demand Response, and Smart Charging reduce peak demand at the transformer level to avoid upgrades?



NAVIGANT
A Guidehouse Company

Non-Wires Alternatives Study
How EE, DR and Managed Charging Can Cost-Effectively Offset EV Load Growth

2020-03

Prepared for:

Energy Efficiency Alberta

Energy Efficiency Alberta

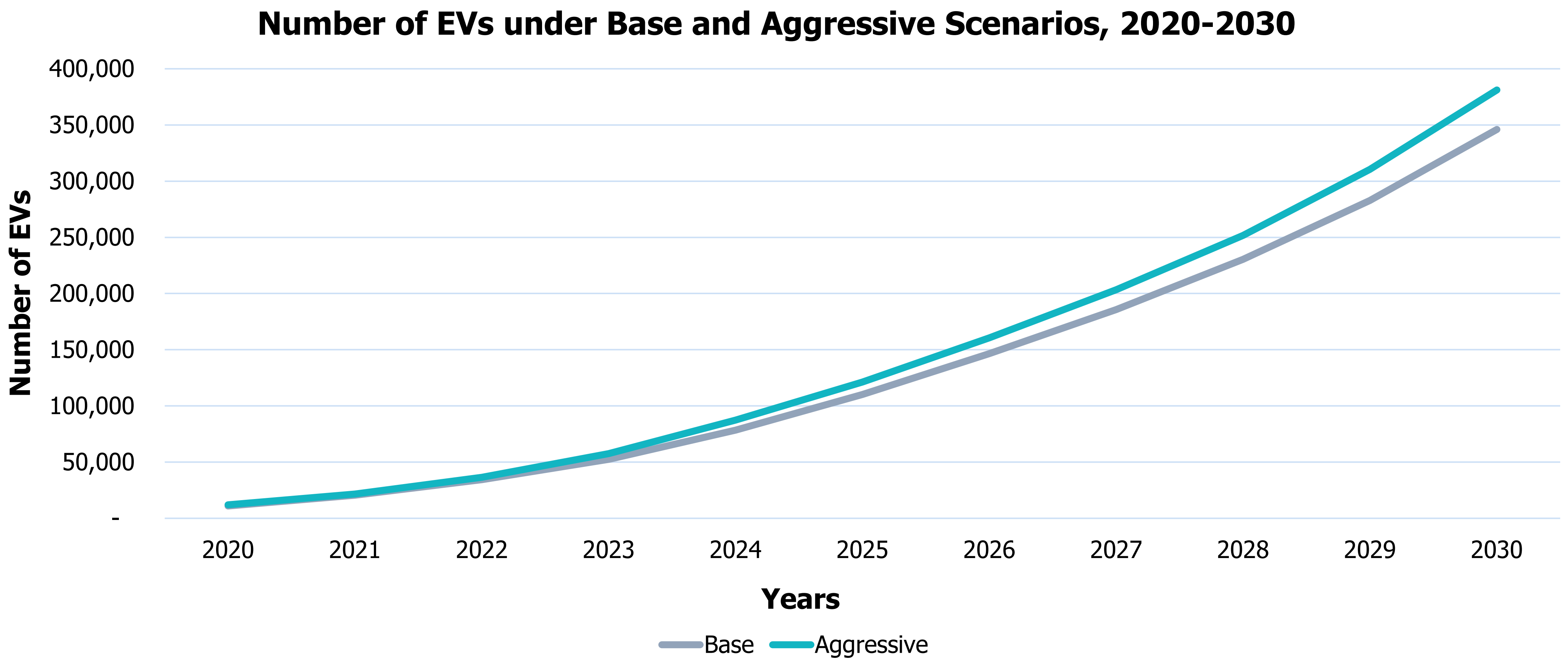
Submitted by:

Navigant, A Guidehouse Company
100 King St W
Suite 4950
Toronto, ON M5X 1B1

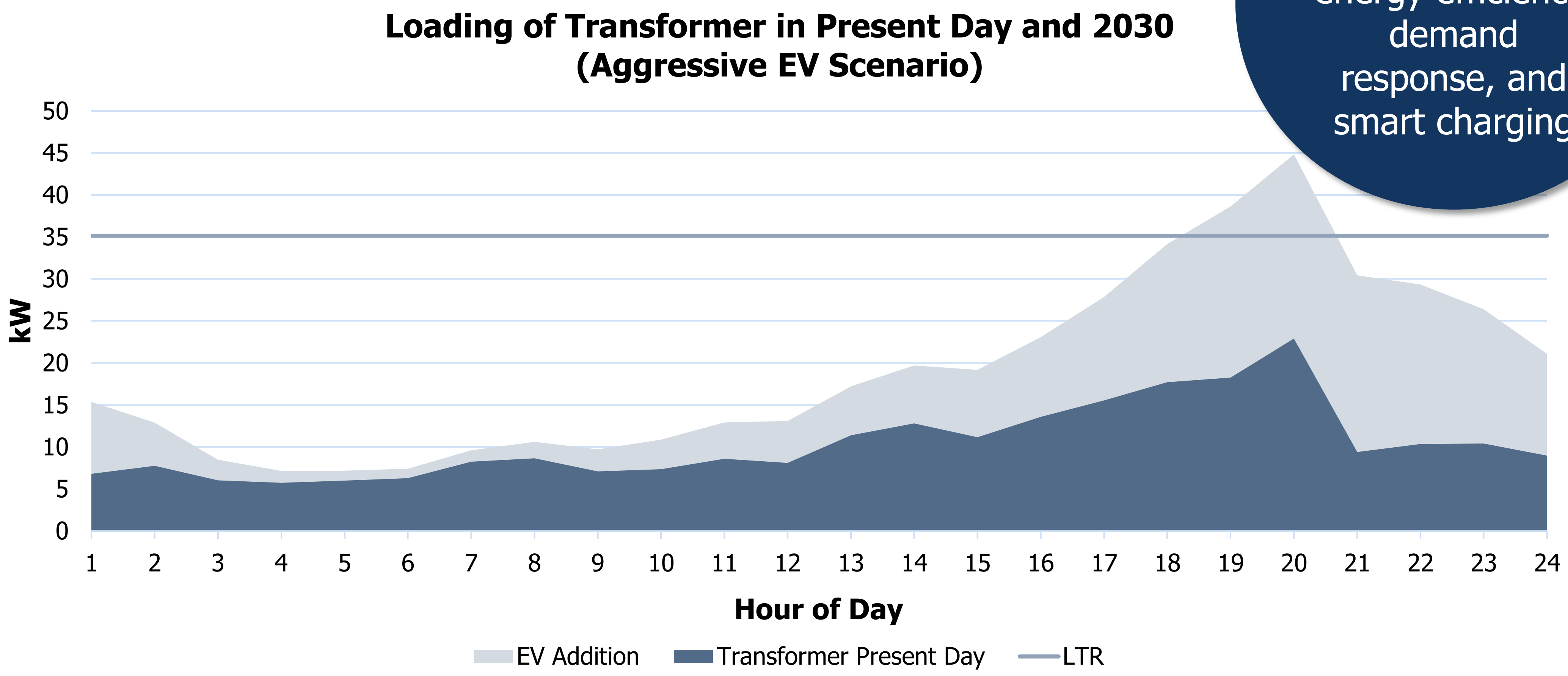
416.777.2440
guidehouse.com

Confidential and Proprietary
©2020 Guidehouse Inc.
Do not distribute or copy

Study’s EV Projections

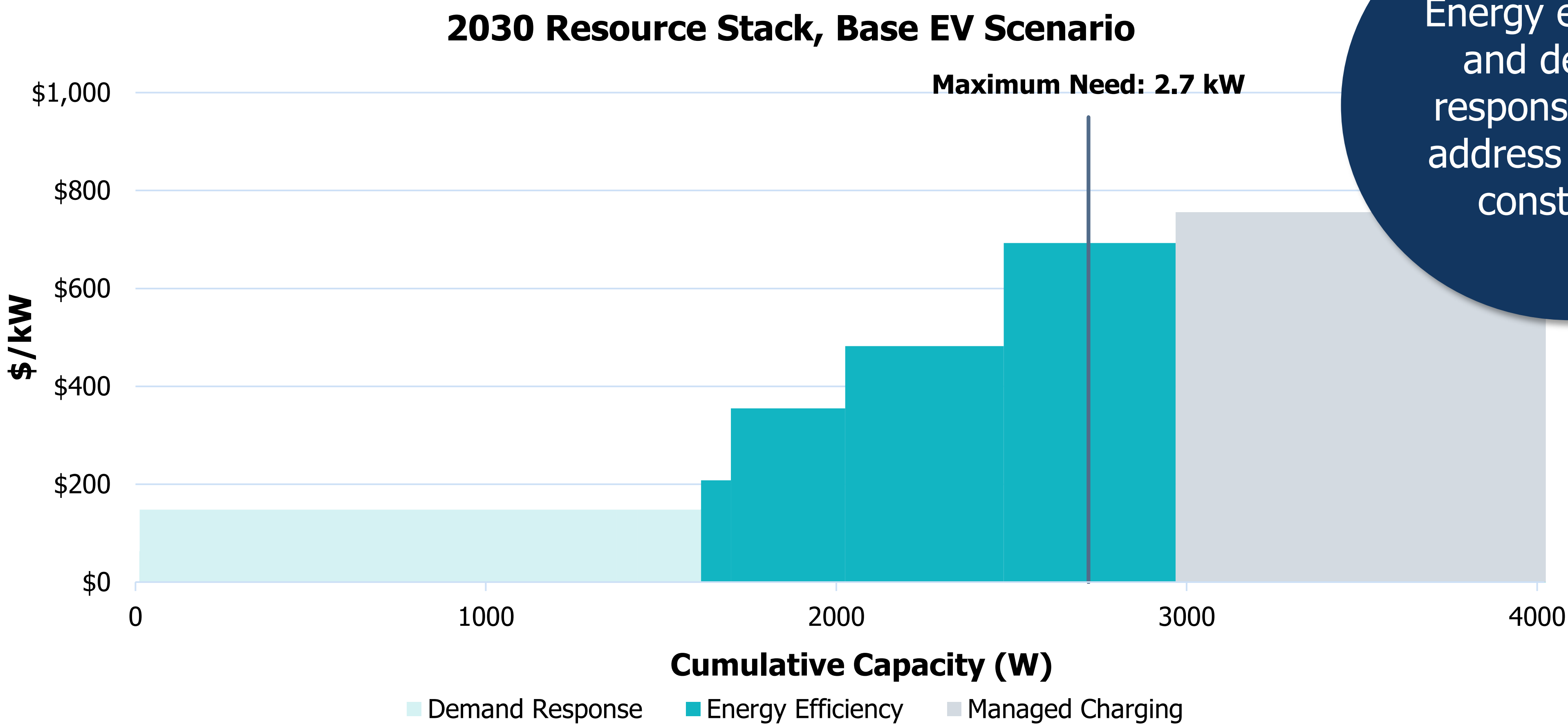


EEA's EV Study



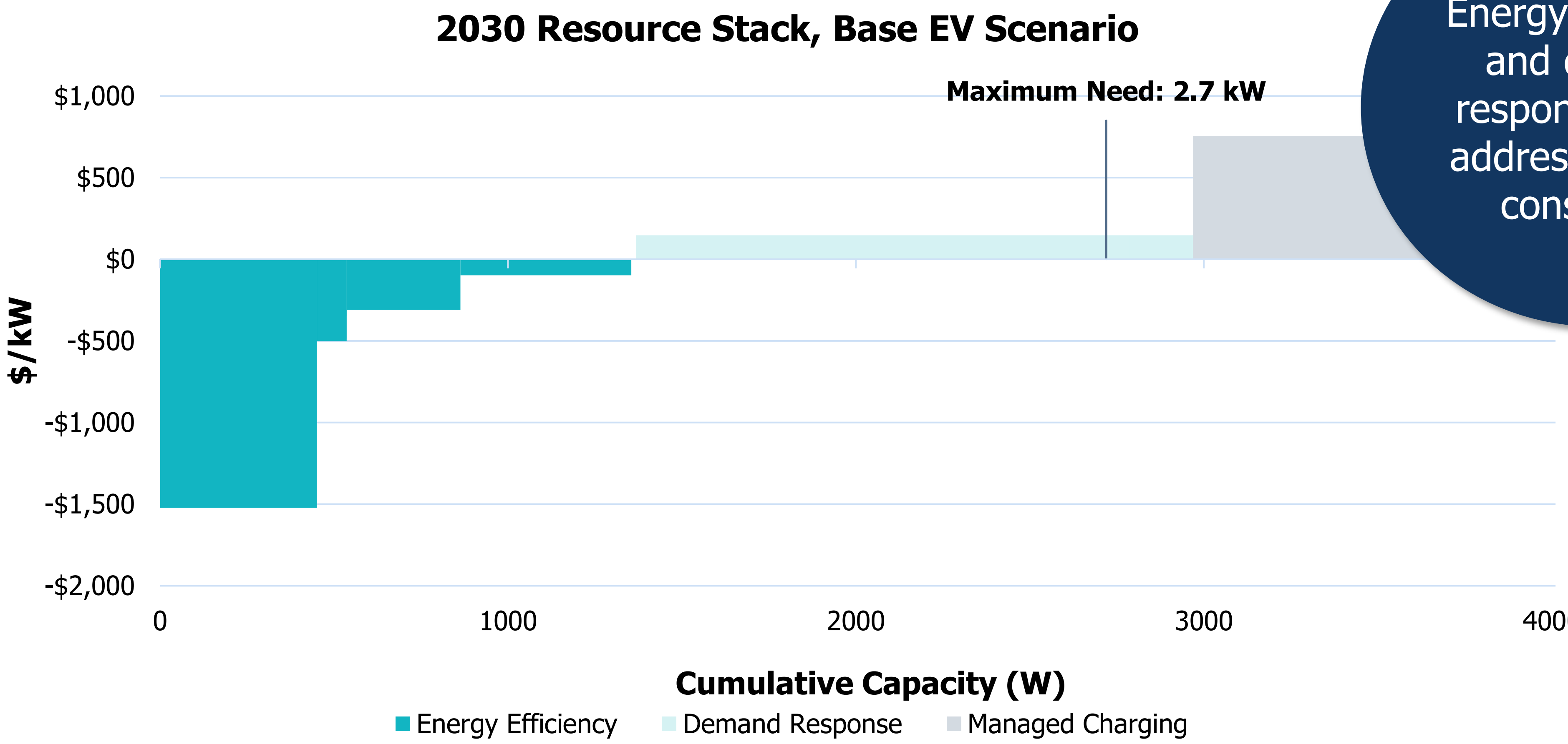
Capacity constraints addressed by energy efficiency, demand response, and smart charging

Moderate Scenario – Costs



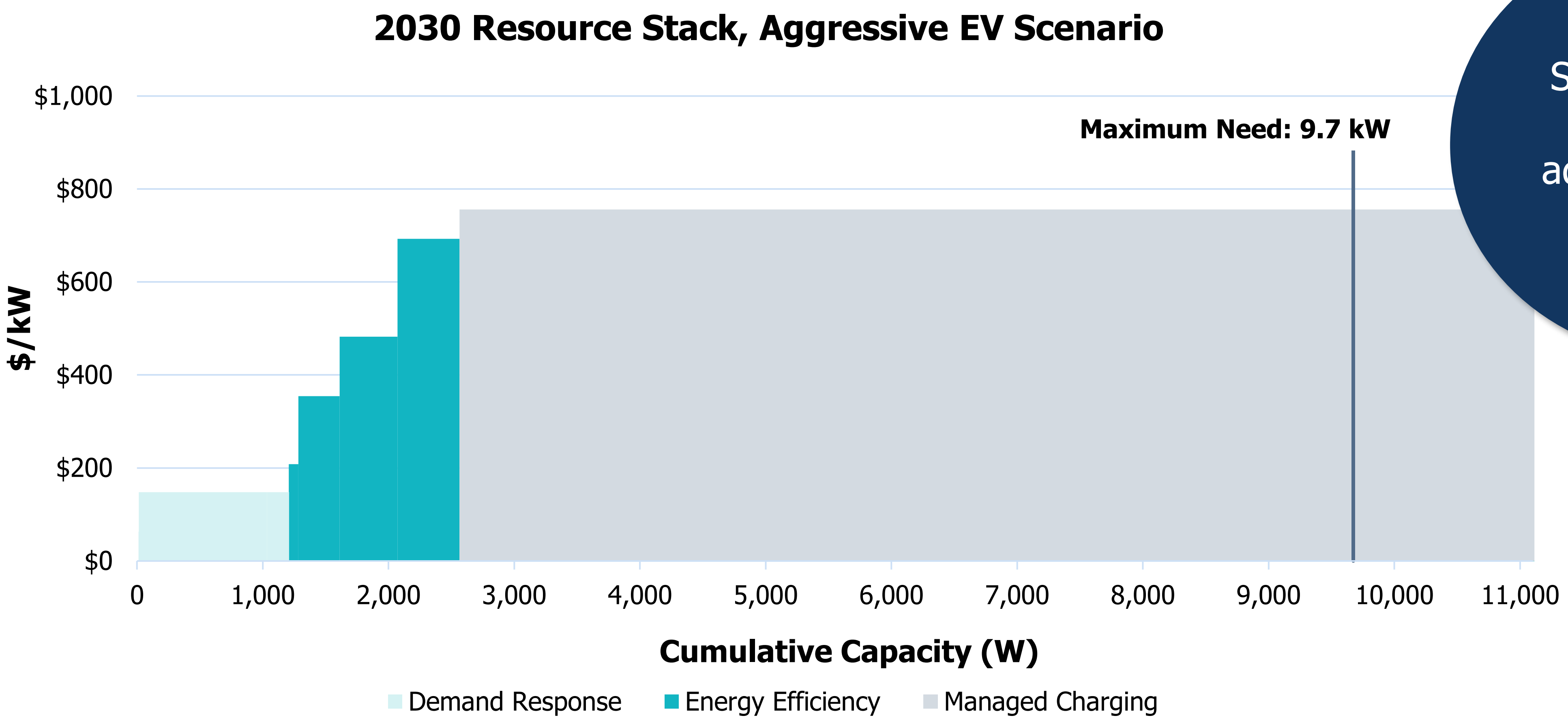
Energy efficiency and demand response **alone** address capacity constraints

Moderate Scenario – Net Benefits



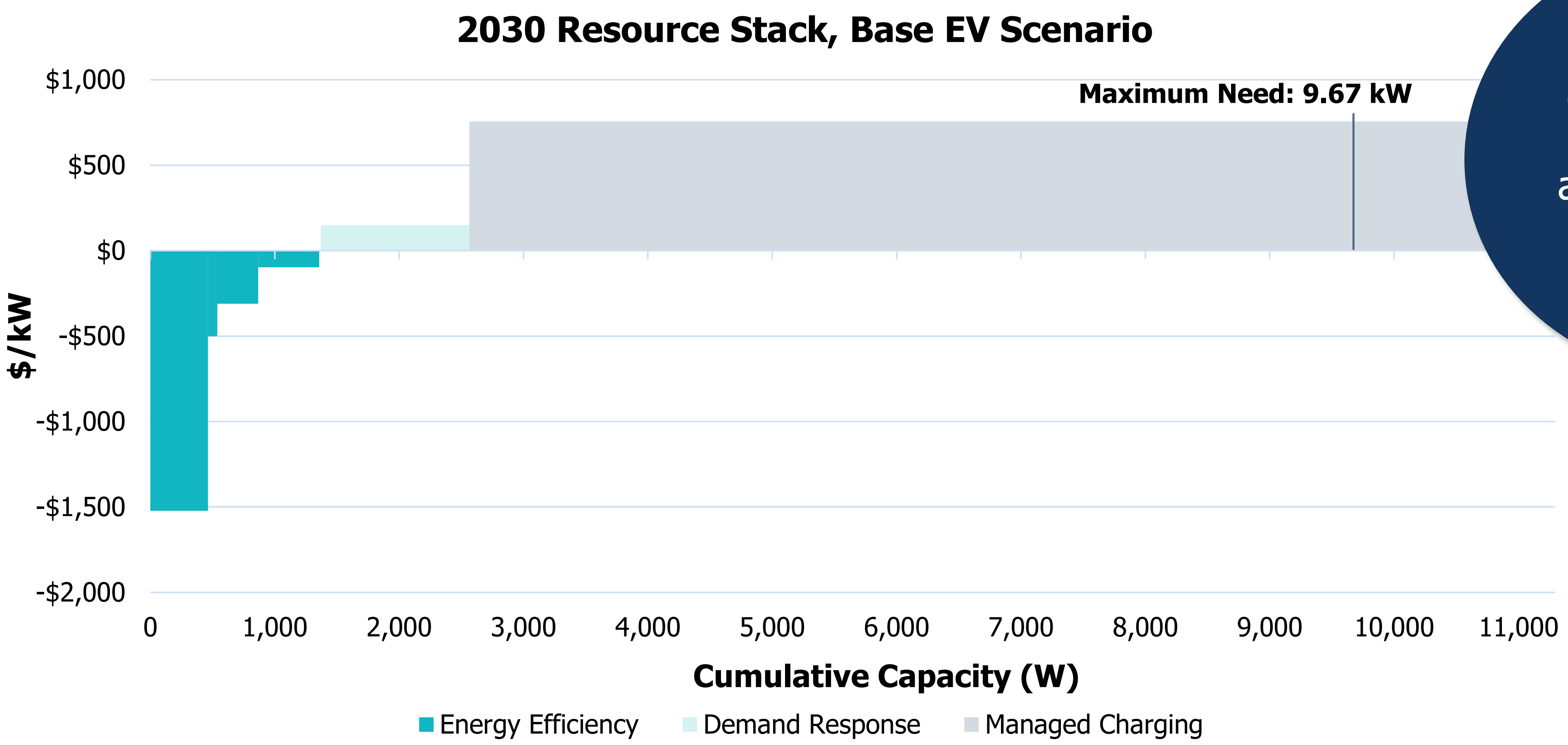
Energy efficiency and demand response **alone** address capacity constraints

Aggressive Scenario – Costs



Smart Charging is required to address capacity constraints

Aggressive Scenario – Net Benefits



Smart Charging is required to address capacity constraints

DSM is a Cost-Effective Alternative

NWAs provide a net benefit of between $7,600 - $18,000 over traditional wires investments.

	NWA investment only	With energy savings	With energy savings and avoided carbon
Moderate Scenario	$10,082	$10,921	$12,252
Aggressive Scenario	$7,614	$11,699	$18,379

Summary

- DSM mitigates residential transformer overloading from EVs
- DSM (EE, DR and smart charging) is 2.5 to 24 times more cost-effective than upgrading residential transformers
- EE and DR are more cost effective than smart charging
- EE provides a net benefit if considering energy cost savings; this increases when costing carbon

Questions?

Supplementary Slides

EEA’s EV Study

- Are EE, DR, and smart charging more cost-effective than upgrading representative* residential transformer?
- Study period (2020-2030) based on **moderate** and **aggressive** EV adoption scenarios
- Portfolio of non-wires solutions can completely mitigate transformer overload
- The adoption scenarios are based on Navigant’s EV forecasts that are developed independently of this study

* The study uses one of EPCOR’s transformers as a representative sample on whether demand-side management options could mitigate peak loading

Conservative Elements of the study

Factors contributing to a lower cost-benefit ratio:

- More aggressive EV adoption than Navigant's model predicted – at a local level, EV uptake may be lower
- Demand response program delivery likely more costly than in reality
- Considered only transformer distribution costs for the traditional wires investment
- EE's multiple benefits were not quantified – only peak capacity reductions

EE could have a greater impact on peak demand than modelled because of the study's assumptions:

- Demand reduction potential has not increased since 2017, the time of the study.
- No new energy efficient technologies are introduced overtime.

Cost Effectiveness

	Traditional Wires Investment (base and aggressive EV scenarios)	Non-Wires Alternatives (base and aggressive EV scenarios)	Net Benefit of employing Non-Wires Alternatives
Non-energy savings PV	$10,524 to $12,792	$442 to $5,178	$10,082 to $7,614
Including PV of energy savings	$10,524 to $12,792	-$397 to $1,094	$10,921 to $11,699
Including PV of energy savings and avoided carbon	$10,524 to $12,792	-$1,728 to -$5,587	$ 12,252 to $18,379

Cost Effectiveness

Moderate Scenario – Up to $12,252 NPV

Project Costs		Differences		Total NPV
Traditional Cost	$1,0524	Traditional Cost	$10,524	**$0**
NWA Cost	$442	Cost Only	-$10,082	**$10,082**
Cost + Energy Benefit	-$397	Energy Only	-$839	**$10,921**
Cost + Energy Benefit + Carbon Benefit	-$1,728	Carbon Only	-$1,331	**$12,252**

Aggressive Scenario – Up to $18,379 NPV

Project Costs		Differences		Total NPV
Traditional Cost	$12,792	Traditional Cost	$12,792	**$0**
NWA Cost	$5,178	Cost Only	-$7,614	**$7,614**
Cost + Energy Benefit	$1,094	Energy Only	-$4,084	**$11,698**
Cost + Energy Benefit + Carbon Benefit	-$5,587	Carbon Cost	-$6,681	**$18,379**

Cost Effectiveness – Cost Only

Scenario	PV of Traditional Wires Investment Cost ($)	PV of Non-Wires Alternative Cost ($)	Cost-Benefit Ratio
Base EV Uptake	$10,524	$442	23.8
Aggressive EV Uptake	$12,792	$5,178	2.5

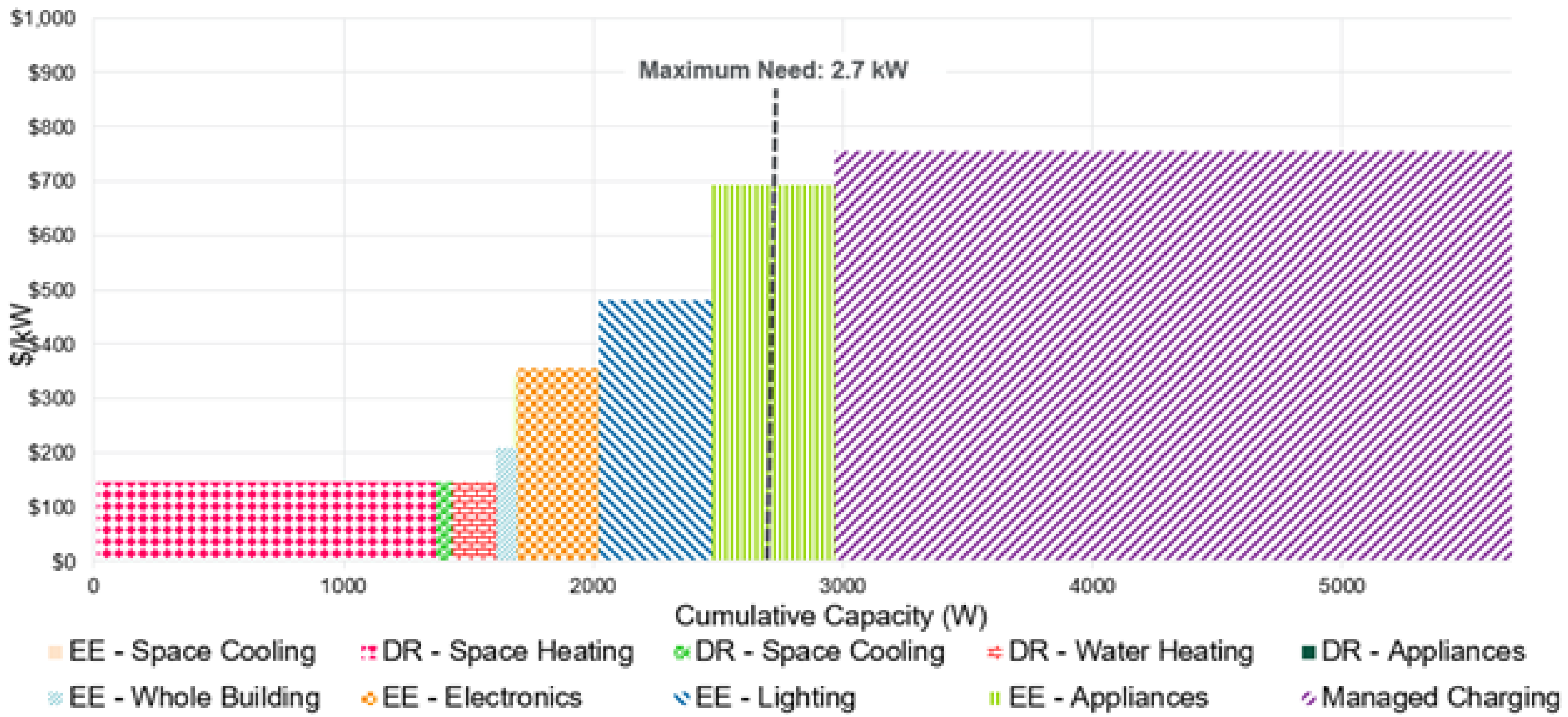
NWA portfolio is more cost-effective

Key messages from additional chapter

- The additional analysis takes a more complete valuation of energy efficiency that includes societal benefits, such as avoided carbon emissions and energy savings.
- Non-wires alternatives, notably energy efficiency, include societal benefits that are not present in traditional wires investments. This amendment evaluates the least-cost option when taking these benefits into consideration
- When the energy cost savings are included in the analysis, energy efficiency is no longer a net cost to society; it provides a net benefit of almost $400/kW.
- Energy efficiency clearly provides capacity benefits that, in conjunction with demand response and smart charging, can reduce distribution costs imposed by EVs. Even if this capacity contribution is required in five to ten years, there is value in implementing energy efficiency programming immediately to allow consumers to benefit from the cost savings.

Moderate Scenario

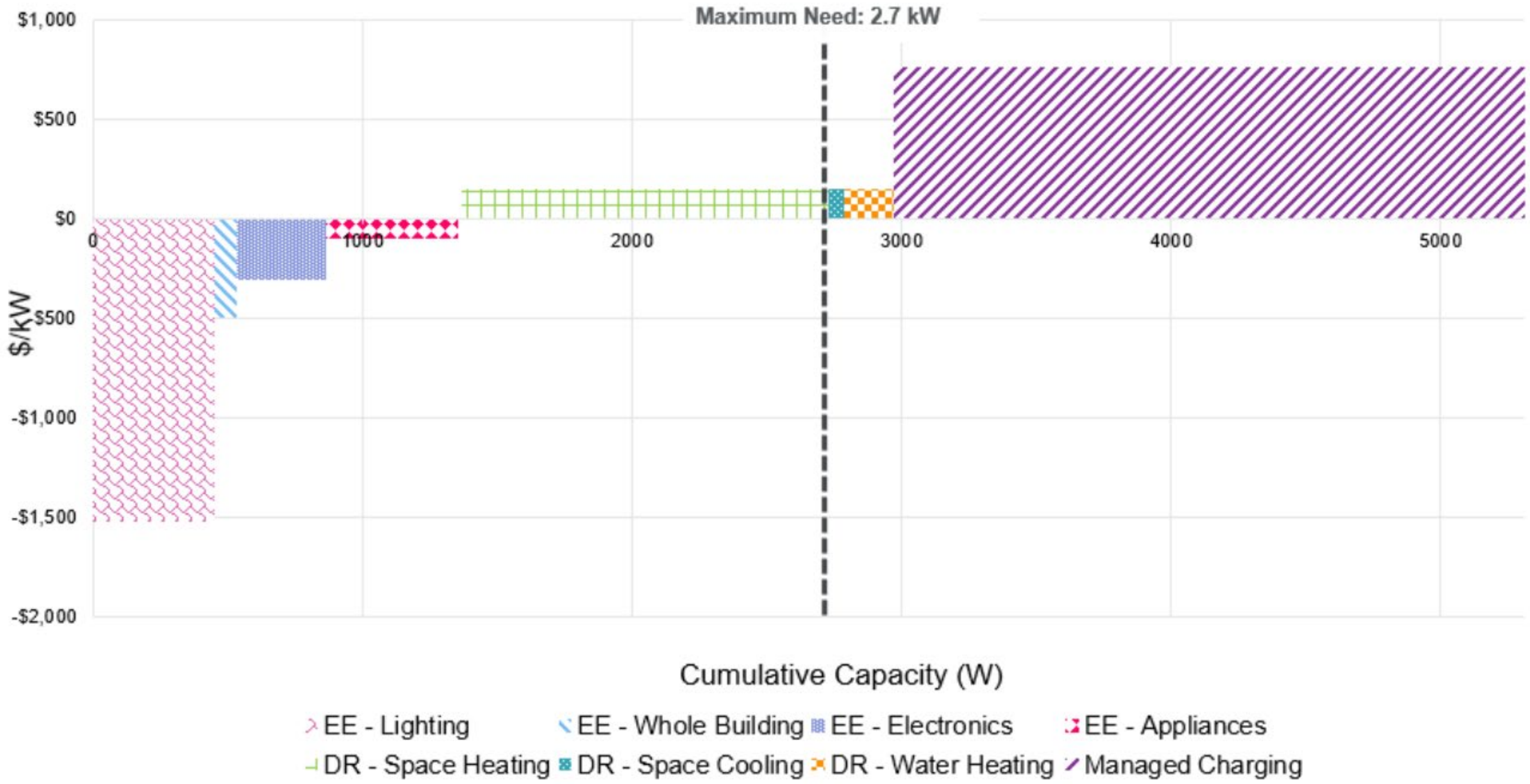
Figure 1: 2030 Resource Stack, Base EV Scenario



Source: Study Non-Wires Alternatives Study: How EE, DR and Managed Charging Can Cost-Effectively Offset EV Load Growth

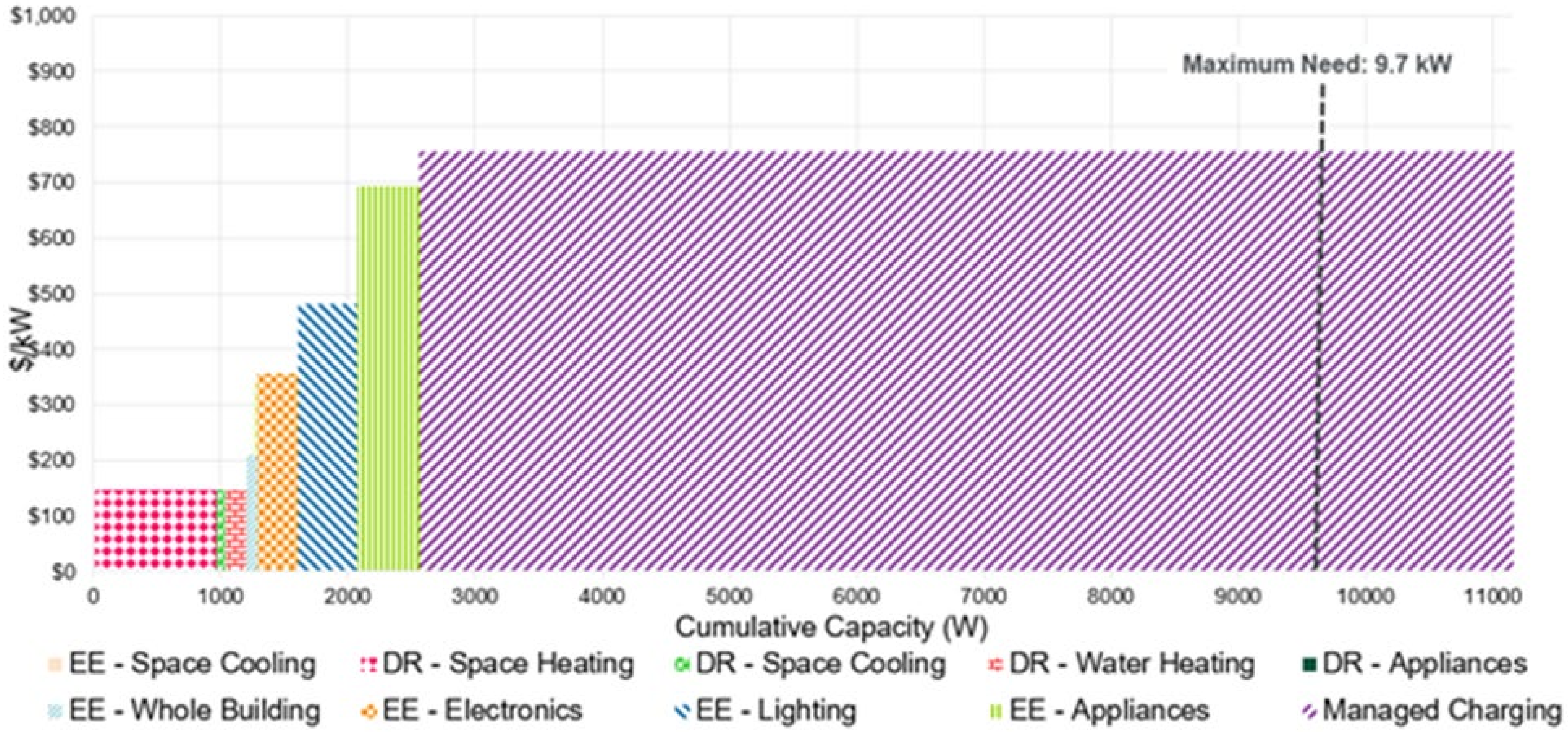
Energy Efficiency Alberta

Moderate Scenario



Aggressive Scenario

Figure 2 : 2030 Resource Stack, Aggressive EV Scenario



Source: Study Non-Wires Alternatives Study: How EE, DR and Managed Charging Can Cost-Effectively Offset EV Load Growth

Aggressive Scenario