DOCKETED	
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Project Title:	Load Management Rulemaking
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Description:	Presentation by Noel Crisostomo on technology options for expanding the demand flexibility of the grid through price-responsive EV charging
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Electric Vehicle Charging Load

Load Management Rulemaking (19-OIR-01)

Panel 3: Responding to Hourly and Sub-Hourly Grid Signals

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Fuels & Transportation Division | California Energy Commission
January 14, 2020

How can California integrate electric vehicle (EV) charging with a 100% carbon-free electricity supply?

Opportunity and System Impacts

- CEC/NREL & LBNL/UCB analysis of 1.3M and 5M EVs by 2025

Demonstrated, Feasible Technologies

- Flexibility-enabling EV Supply Equipment (EVSE)

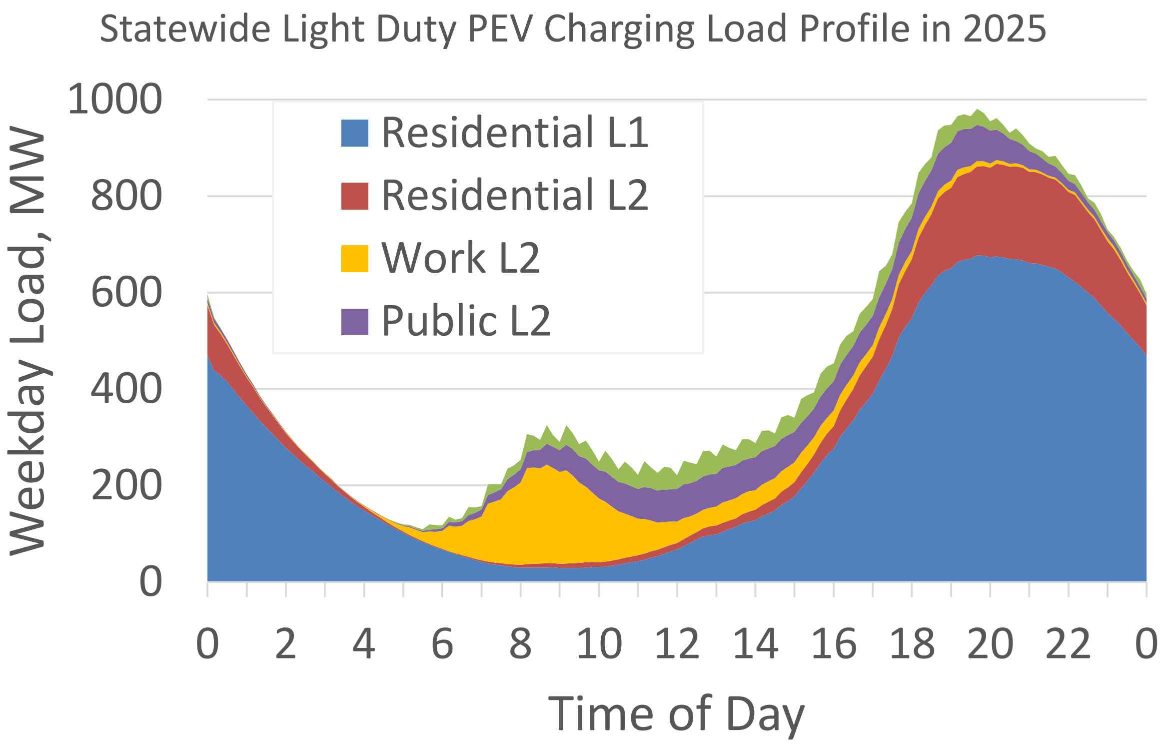
Costs and Benefits

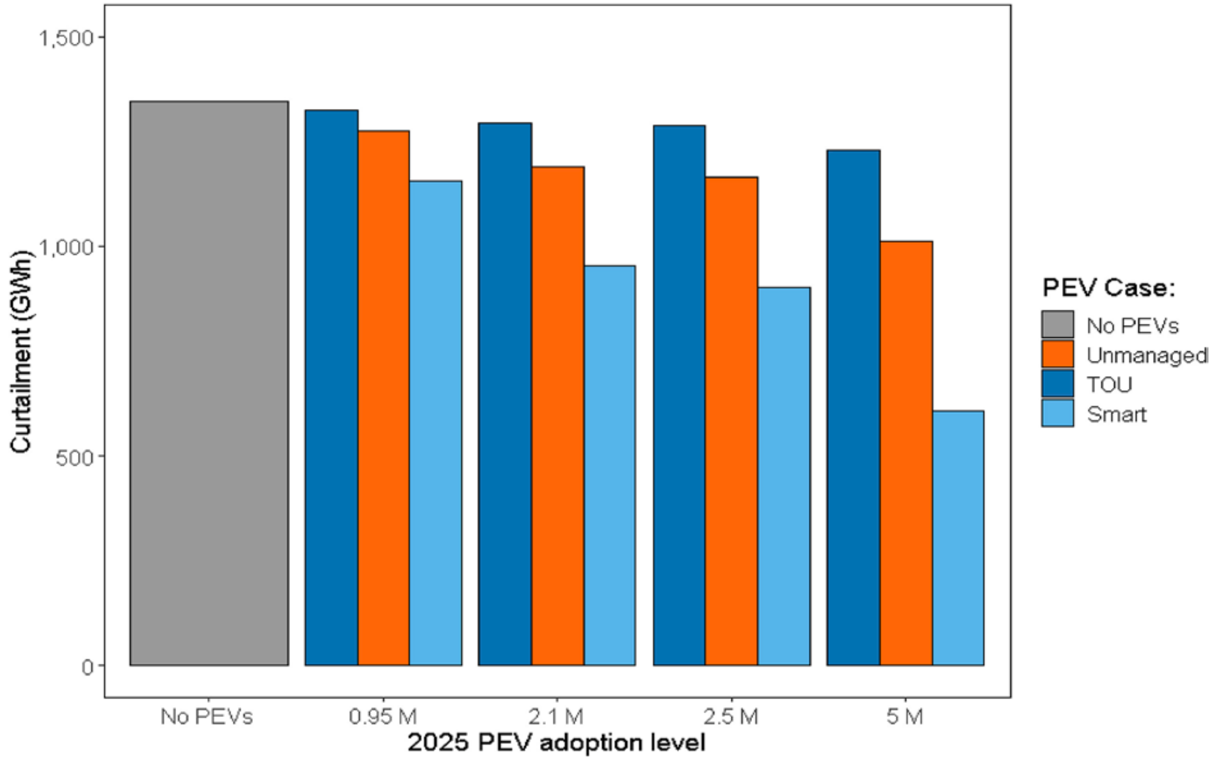
- Market benchmarks, components, and possible savings

Appendix

2

The EV “Dragon Curve” & Avoided Curtailment with Smart Charging in 2025





“Networking technologies that enable the shared use of charging should be leveraged to automate demand responsive charging.”

[California Energy Commission & National Renewable Energy Laboratory (2018), California Plug-In Electric Vehicle Charging Infrastructure Projections: 2017-2025.]

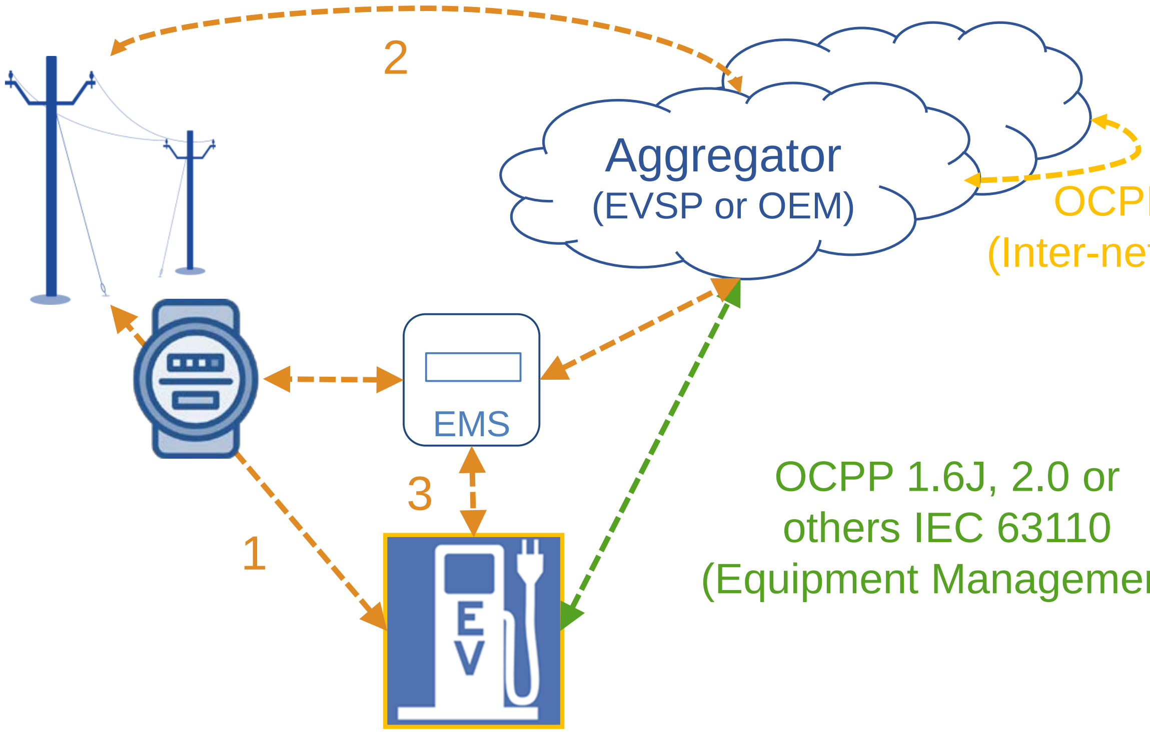
“…Smart charging lowers the cost of achieving CA’s renewable energy targets...Overnight TOU charging is counterproductive…because it results in higher annual curtailment than even unmanaged PEVs.”

[Lawrence Berkeley National Laboratory & UC Berkeley (2020), Reduced grid operating costs and renewable energy curtailment with electric vehicle charge management.]

Open Standards-Based Network Communications provide both implementation and load flexibility

OpenADR 2.0b or SEP 2.0b
(Demand & Price Signals)

1. Utility Direct Load Control
2. Aggregator Managed
3. Energy Management System



CA Department of Food and Agriculture EVSE Regulation implementing elements of NIST Handbook 44 Section 3.40 for commercial metrology of EV fueling systems:

- For AC electricity, 1% Acceptance Tolerance for installations on or after 1/1/21. Prior installations shall comply by 1/1/31.
- For DC electricity, 2.5% Acceptance Tolerance for installations before 1/1/33 and 1% afterward.

Multiple viable protocols, dependent on use or situation, for each EVSE with embedded metering:

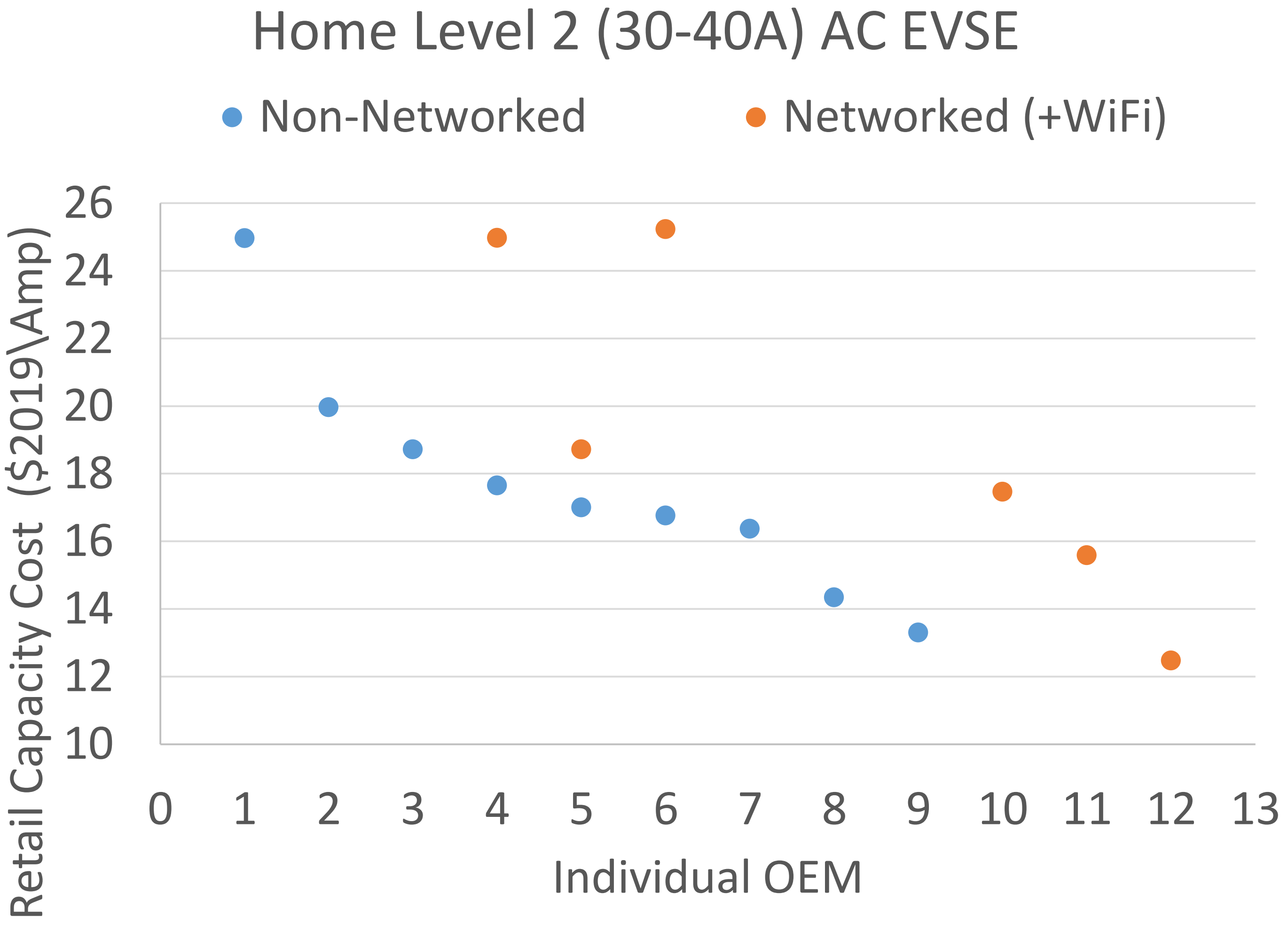
- Utility Direct or Aggregator-managed demand response or resource controls
- Presence of other EVSEs, non-EV loads, and/or an Energy Management System
- Transfer information across networks (direct between networks or via clearing houses)
- Asset protection for potential use of EVSE across multiple EV Service Providers

Networked residential AC Level 2 EVSEs are first-cost competitive, without accounting for flexible tariff savings

EVSE analysis is normalized for the features included (i.e. to avoid bundling options that support commercial or public-facing operations e.g. payment interfaces, WAN/LAN networking, robustness/ weatherization, plug v. hardwire, cord length & management, etc.)

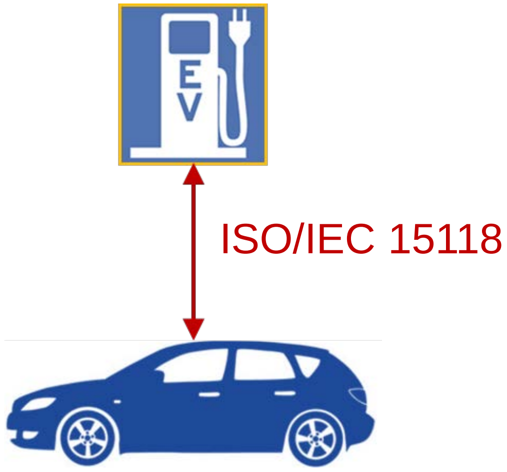
Compare unit costs by ampacity to ensure that the models' functional units are substantially similar.

Consider year of introduction and/or by sales weights, if data is available (excluded at right).

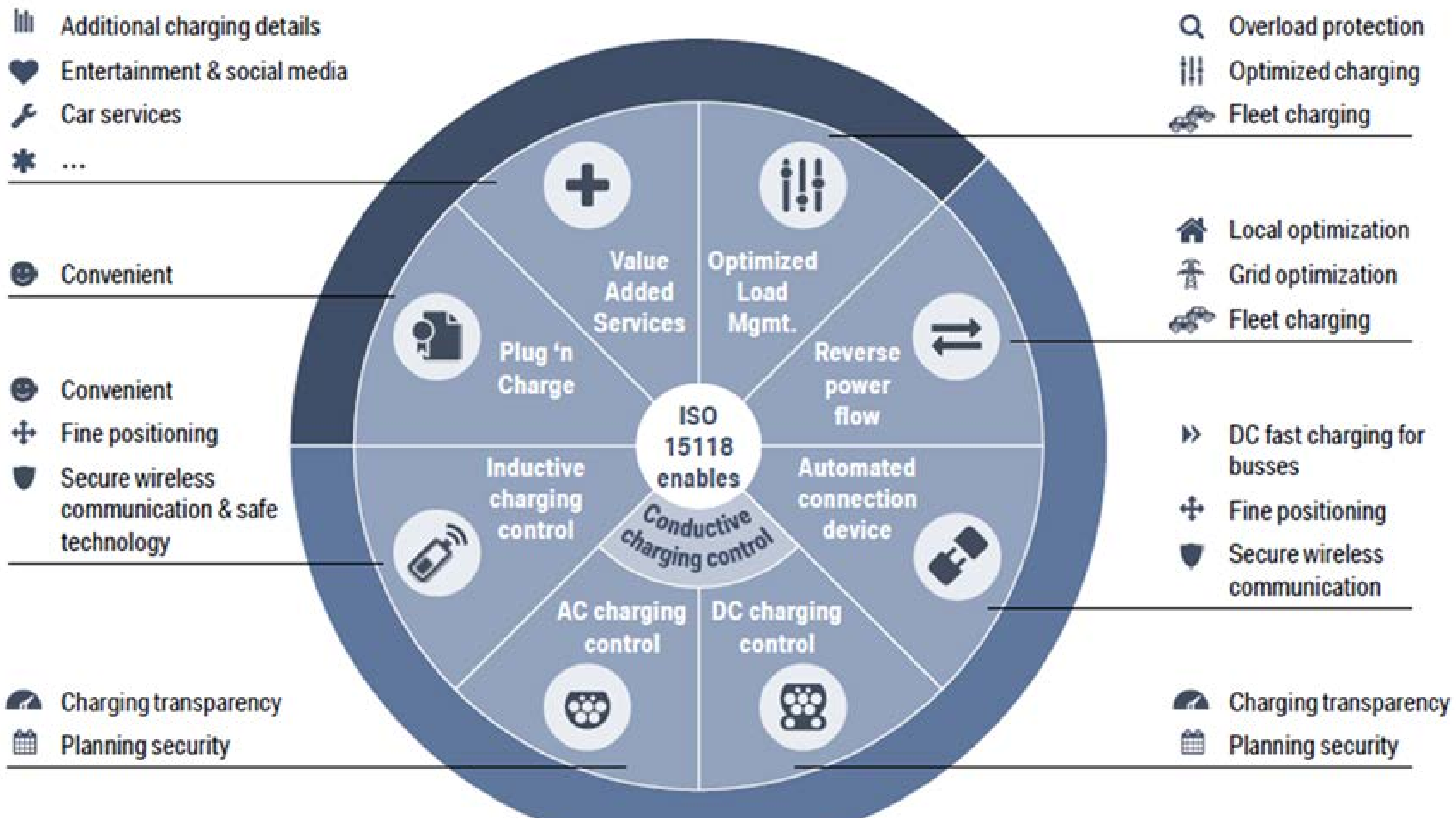


Source: CEC March 2019 analysis of EVSE product pages, work papers, and OEM interviews.

EV to EVSE High Level Communications (HLC) based on ISO/IEC 15118 V2G Protocol



Automaker comments (1, 2, 3) to CA Energy Commission and public statements (4, 5, 6, 7).
OEM list not exhaustive.

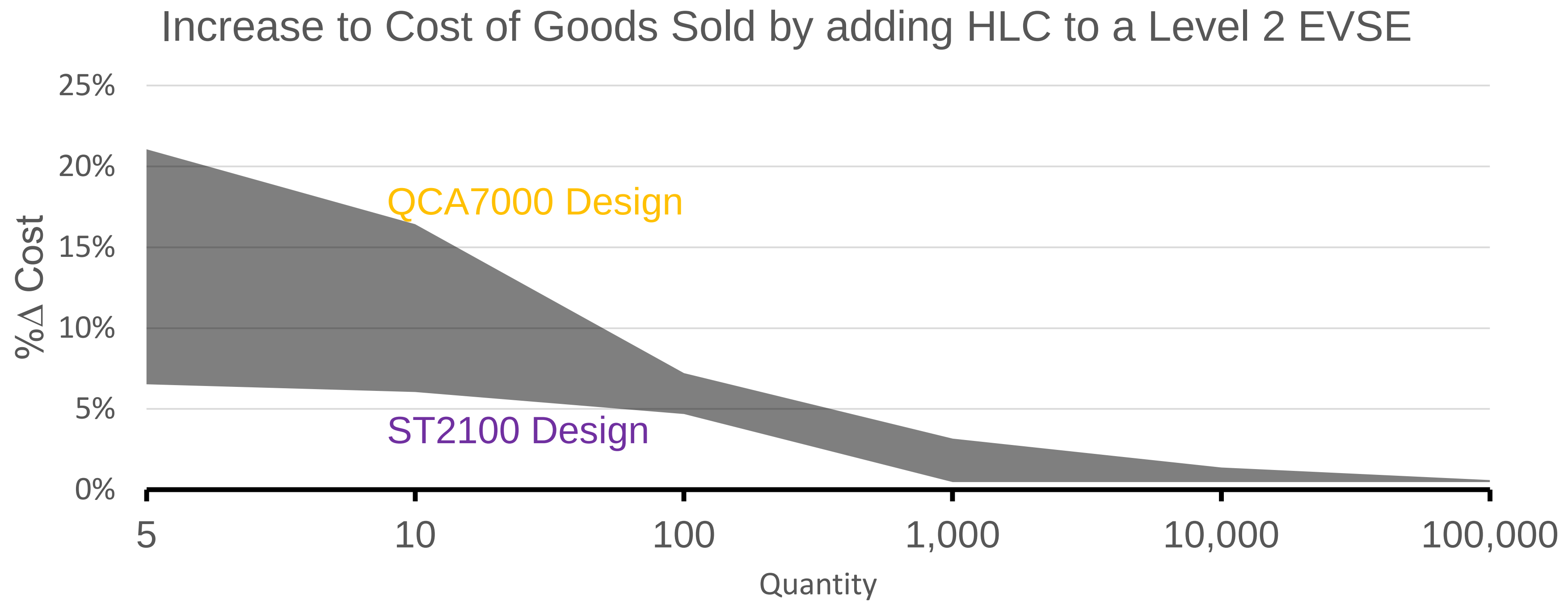


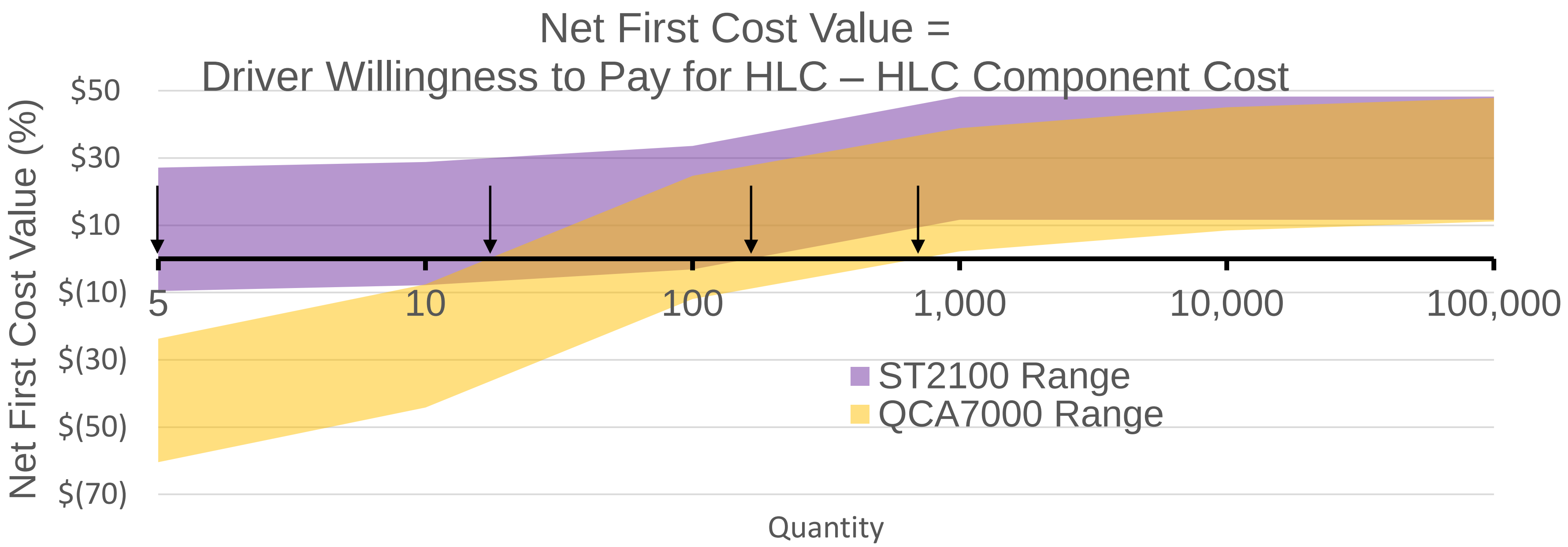
Electrify America and BMW

Implementing a common, unique EV/EVSE communications protocol based on ISO 15118 is crucial for seamless charging interoperability to reduce EVSP network software costs and site hosts' utility operational costs.

With economies of scale production, including a transceiver adds de minimis upfront costs to a L2 EVSE (excluding mfr. design, engineering, supply chain and software integration)

Using conservative assumptions for driver willingness to pay and higher-end component costs demonstrates ***net value*** for OEMs at volumes <1k units, *excluding* load management benefits.



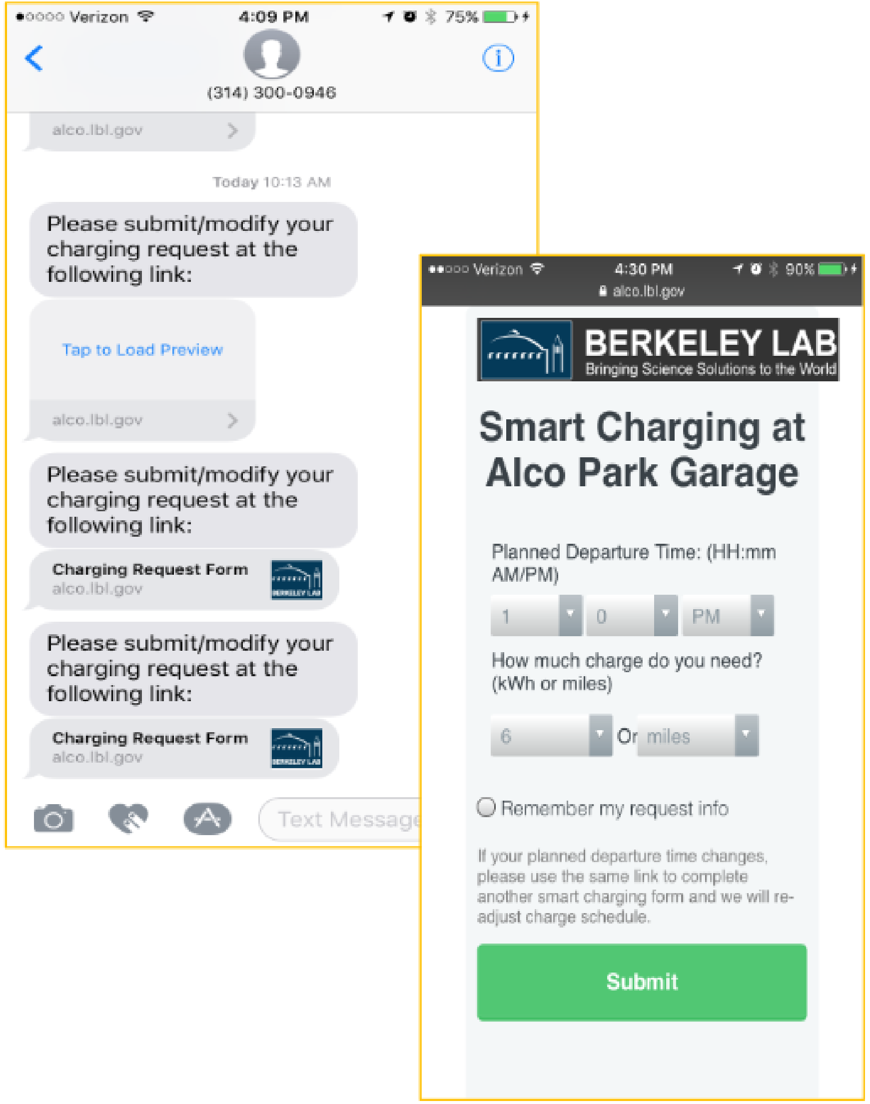


Source: Energy Commission analysis of OEM interviews (slide 11); Geske & Schumann, Energy Policy (2018). "Net First Cost" excludes HLC operational savings (slide 8).

All parties want lower costs, but asking drivers for inputs overly complicates charging and limits load management

Workplace & Public Charging

- Text message-based user inputs of high-level communication data:
  - Planned departure time
  - Energy (kWh or mi)
- DR participation rate = 48%



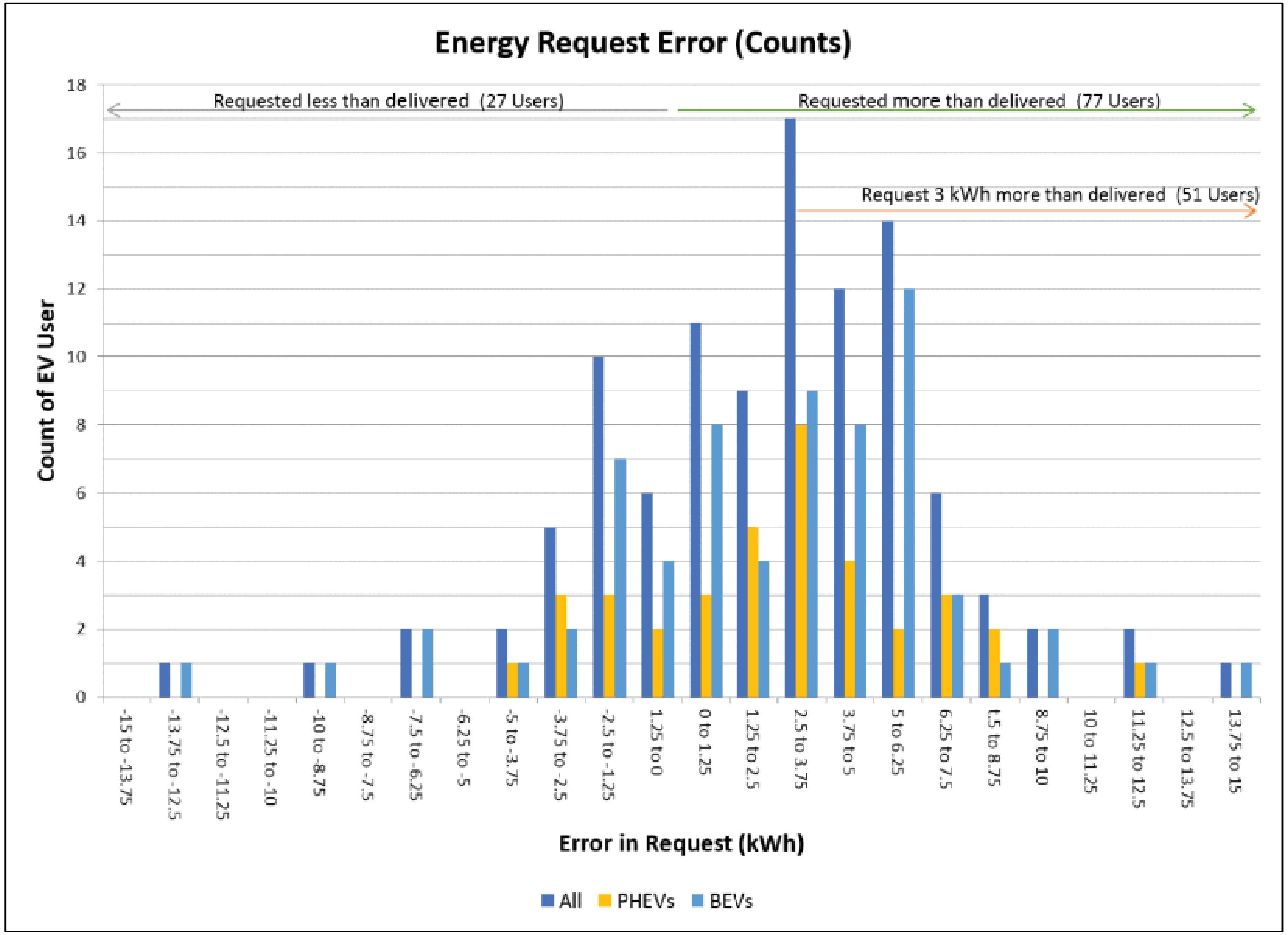
Sources:

1) American Honda Motor Co, CEC-600-2019-033 at 60
2) Lawrence Berkeley National Laboratory, CEC-500-2019-036 at 40

All parties want lower costs, but asking drivers for inputs overly complicates charging and limits load management

Workplace & Public Charging

- Histogram of error in user-requested kWh
- 74% request > delivered, 26% request < delivered
- ModeBEV - ModePHEV = 2.5 kWh in excess of delivered charge



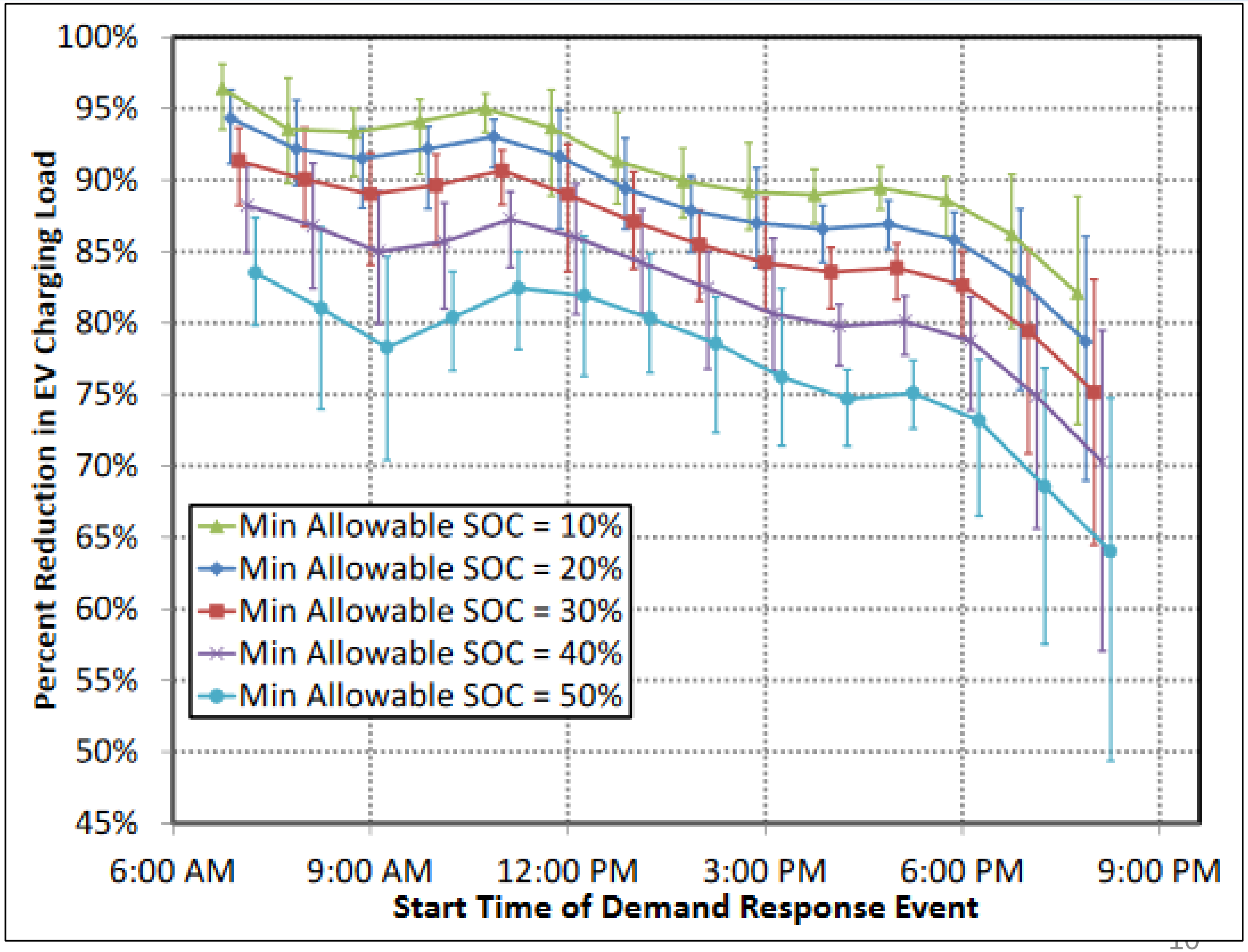
Source: National Renewable Energy Laboratory,
DOI: 10.1109/ITEC.2018.8450227

All parties want lower costs, but asking drivers for inputs overly complicates charging and limits load management

Residential Charging

- Maximum % Reduction in EV Load for different reserve SOC values without adversely impacting mobility, for DR events beginning at different hours

- ~65% reduction possible with ½ of battery reserved



Source: ChargePoint, CEC-500-2019-009 at 30

The market is evolving toward a shared vision where "Any PEV can plug into any EVSE, anywhere, anytime and they are able to function without special effort…"

Harmonized standards and regulations [will create:]

- Interoperable PEVs, EVSE, and communication networks
- Predictable investment requirements [for industry to achieve scale][1]

The Energy Commission can support this vision by:

- Convening automotive and equipment manufacturers
- Driving innovation while supporting commercialization[2]

Sources:
1) European Commission Joint Research Center / U.S. Department Of Energy - Argonne National Lab, EV-Smart Grid Interoperability Centers
2) Stakeholder comments to Docket 17-EVI-01

11

Thank You!

Questions or comments?

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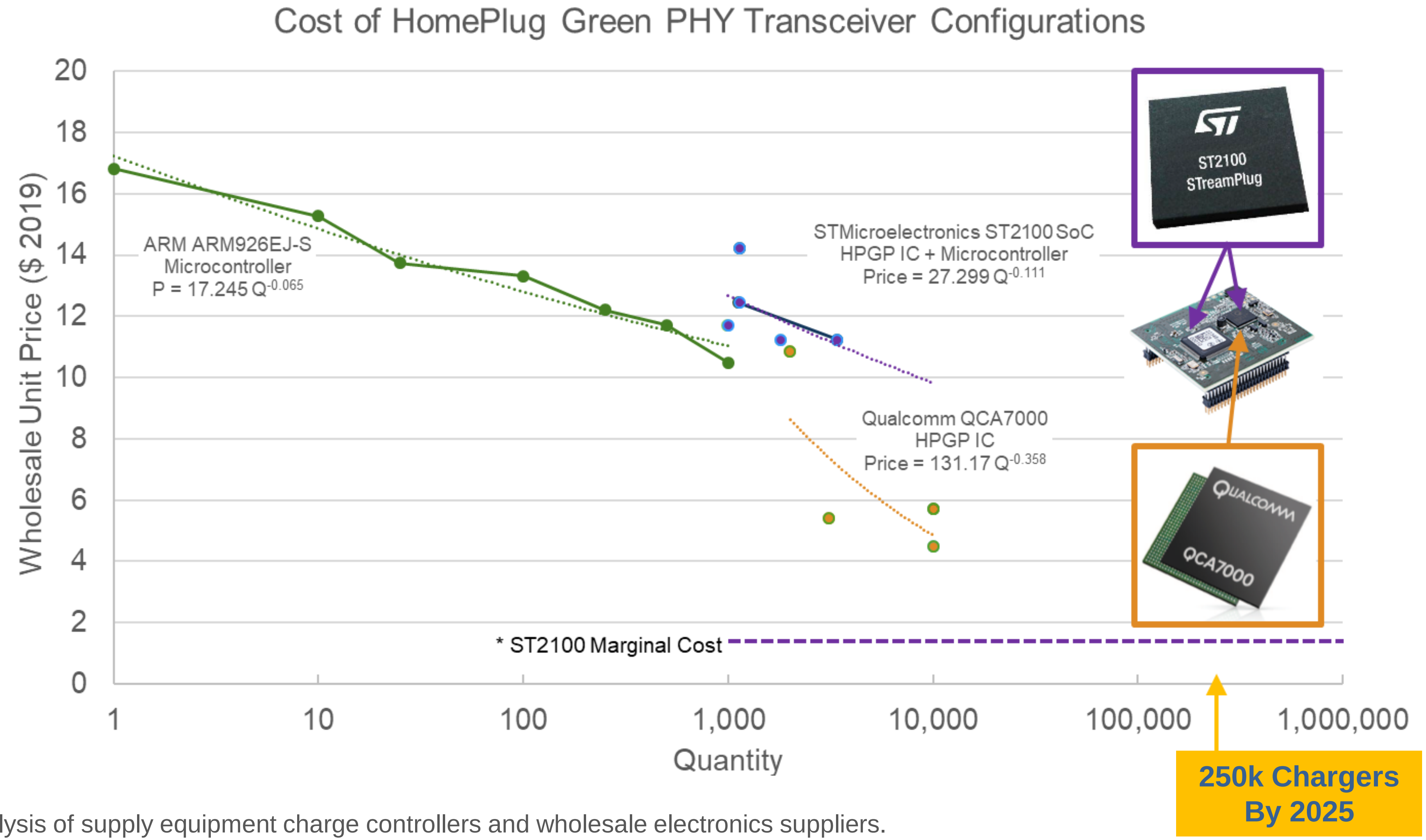
Appendix: Incremental costs of HomePlug Green PHY HLC transceiver decrease with mass-market production

Based on 2 example configurations:

Conservatively, ISO 15118 enabling circuits cost <$10/unit at scale.

Assuming that the Level 2 EVSE is networked, the transceiver marginal cost is about $1.5/unit.



Source: Energy Commission March 2019 analysis of supply equipment charge controllers and wholesale electronics suppliers.