Mapping Costs and Benefits of Intelligent Charging Systems

Vehicle-Grid Integration Communications Protocol Working Group

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Objectives and topics

- Overview macroeconomic net benefits of PEVs and smart charging
- Understand microeconomic decisions that build the supply of smart vehicles and charging infrastructure.
  - Lifecycle management approach and incremental costs
  - Stakeholder-categorized costs and benefits
  - Deliverable 2 skeleton and proposal for organizing
- Preface the OEM and EVSP experts' presentations
  - Please hold questions until discussion

National Economic Value Assessment of PEVs

1. Market Growth → scale
2. Technology Progress → cost of PEVs & EVSE
3. Price of Gas

Aggressive
    Medium
    Technology
    Reference Oil

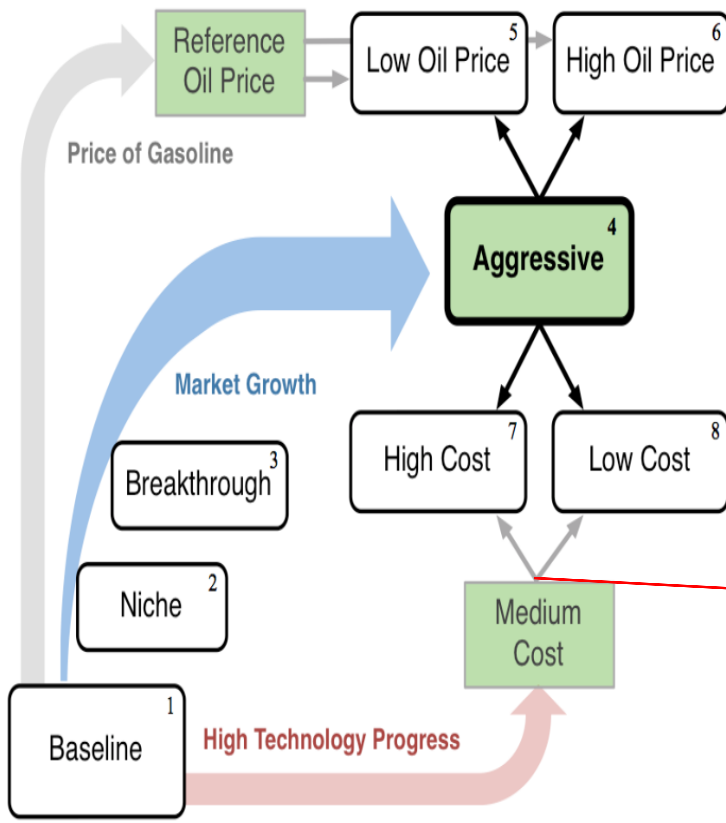


Figure 7. Scenarios and major trends

Low/High sensitivities range from **-10% to +20%** of Medium EVSE costs

per EERE 2015, CalETC 2014b, and NRC 2015 (NREL at p. 40)

PEVs yield net social benefits, even with costly tech and cheap gas

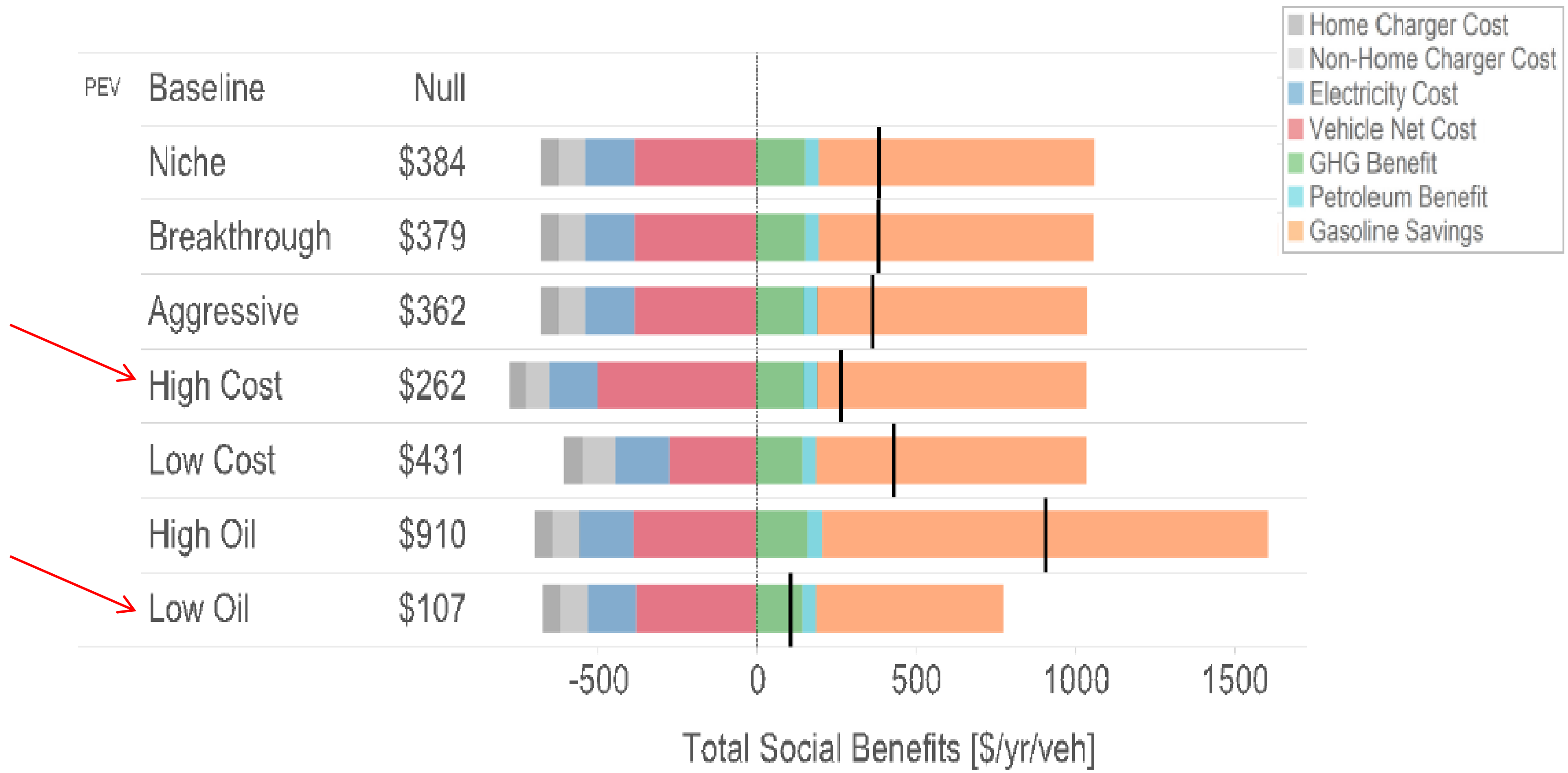


Figure ES-8. Breakdown of total costs and benefits in each scenario for 2035

High-level electricity system highlights

- Demand from 73 million PEVs
  - Increases installed capacity <5% and generation <4%, primarily with RE
  - Electricity price increases 1.2 – 2.2%
  - Increased renewable penetration.
- Smart charging reduces system capacity and costs
  - 2.9% incremental system cost (Aggressive)
  - 2.7% incremental system cost (Aggressive w/ Smart charging)
  - ***More detailed simulations needed to understand smart charging + EV rates***
- Cost of public charging is half the societal benefits in 2035
  - $6.2 B/y for supporting workplace and public charging – economic benefits
  - 14.1 B/y societal benefits per GHG and petroleum reductions

https://www.afdc.energy.gov/uploads/publication/value_assessment_pev_v1.pdf

Collaborating for a distributed and smart charging infrastructure market.

CREATING NEW INFRASTRUCTURE

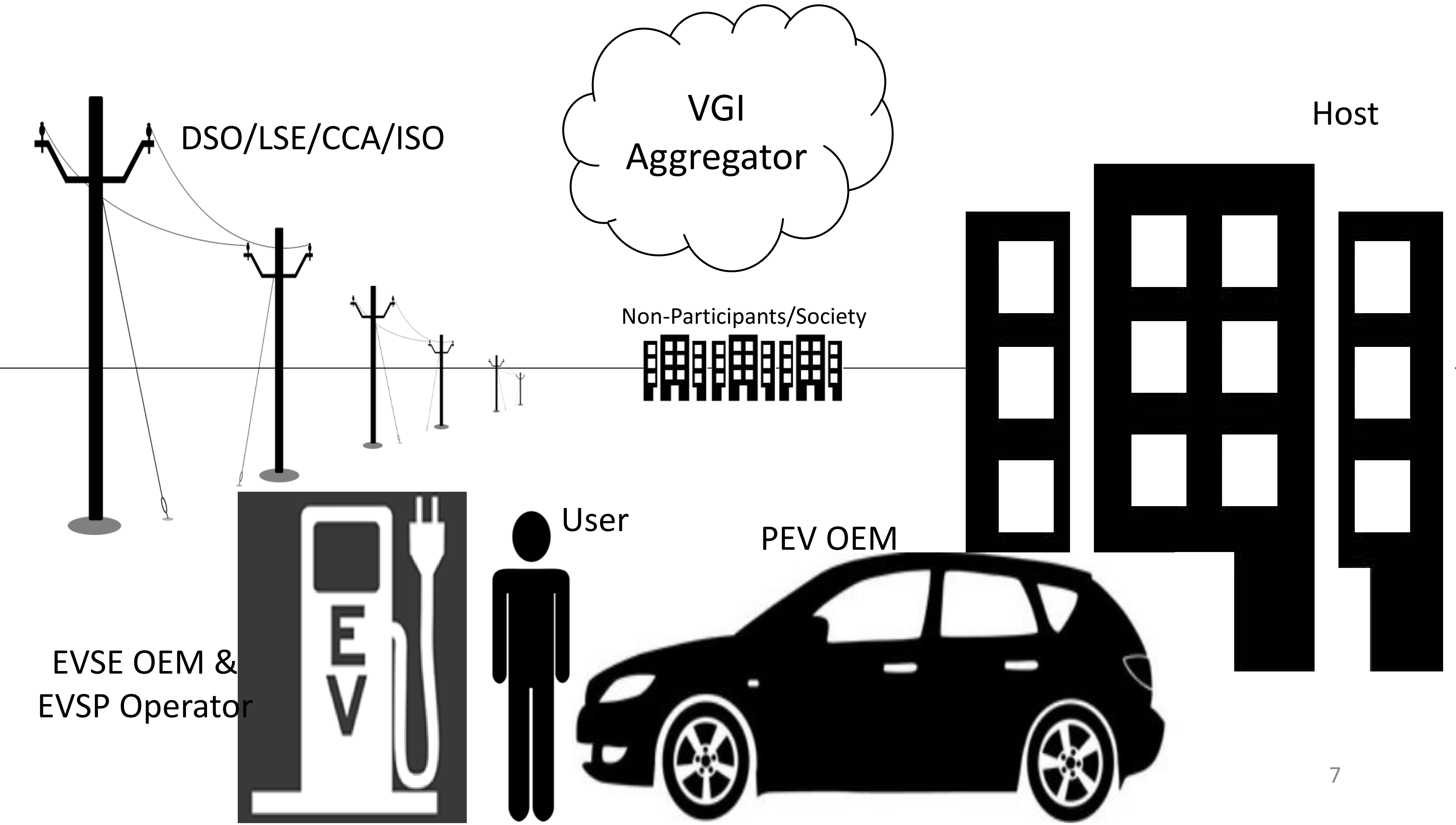
If successful, electric vehicles could make established energy delivery infrastructure and value chains obsolete. Vehicles will move away from centralized fueling points, such as gas stations, to a new, distributed and ideally smart electric-grid-based delivery system. This shift will inevitably open a service industry to handle customer recharging needs – with a new set of players and rules.

WHAT TO DO: COLLABORATE TO COMPETE

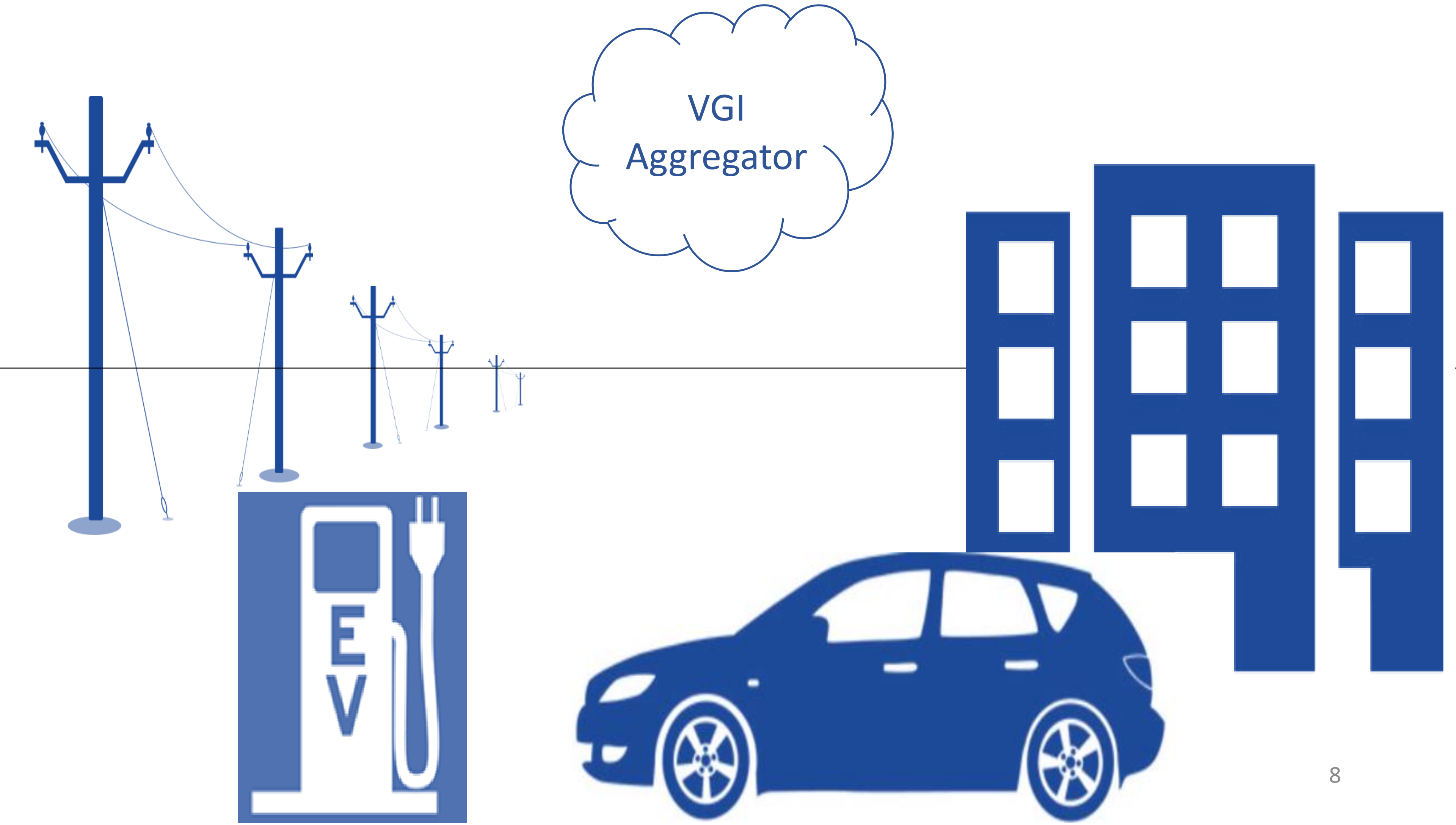
To accelerate the overall electrification trend once it gains critical mass, markets need legislative decisions that align across all forms of transportation, and ideally across borders in ways that reinforce each other. Strong lead markets could form the tipping point of a true electric vehicles disruption. At the same time, the willingness of carmakers and suppliers to work with competitors will limit their risk exposure while driving technology forward and costs down for the benefit of all participants. ●

-The Oliver Wyman Automotive Manager, 2017

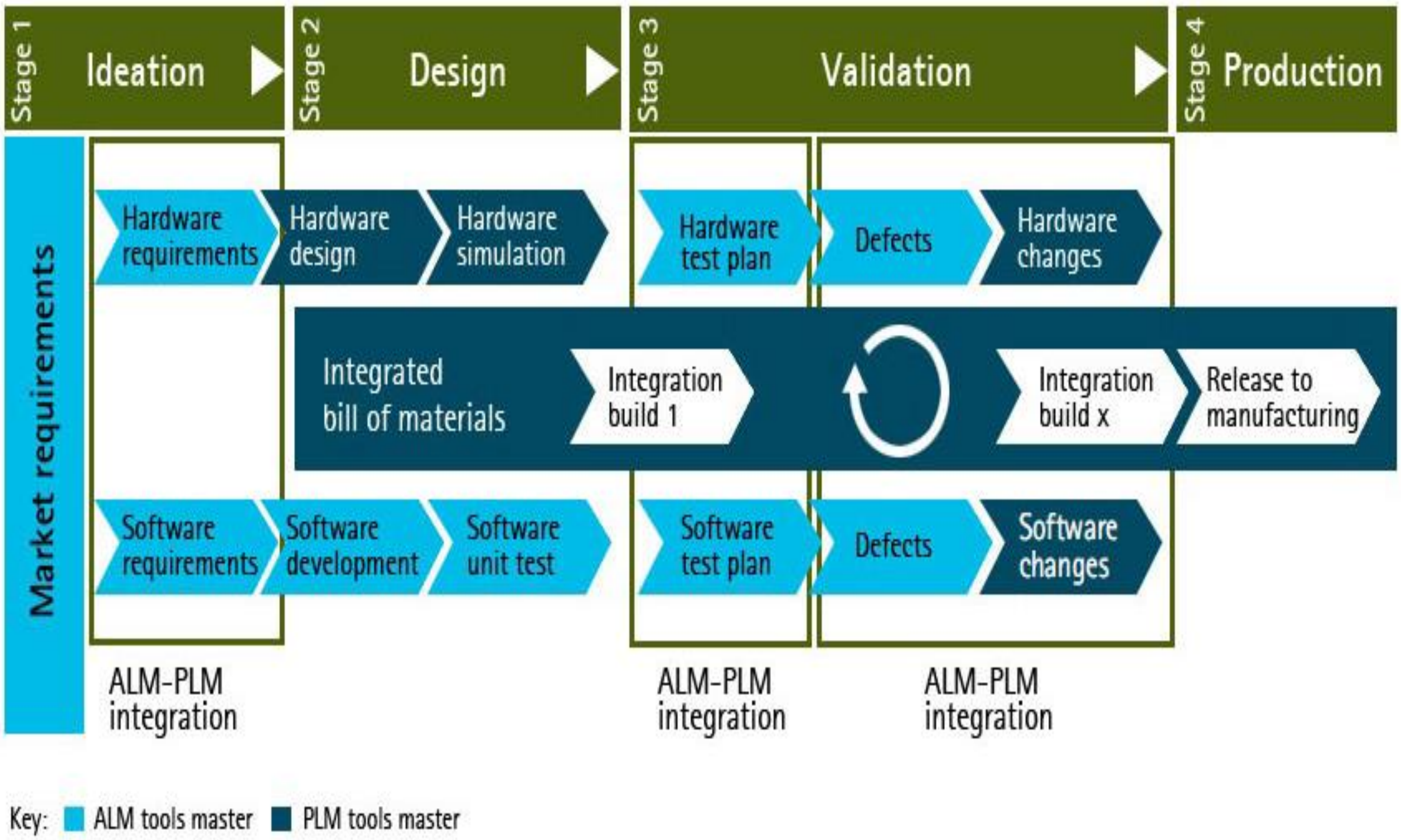
Decisions of individuals and firms



Key agents developing vehicles and or smart charging services



Application and Product Lifecycle Management (ALM/PLM)



Source: Accenture analysis.
Note: This chart appears in "Maximizing the return on your billion-dollar R&D investment: Unified ALM-PLM," an Outlook Point of View from November 2013, an Accenture publication.

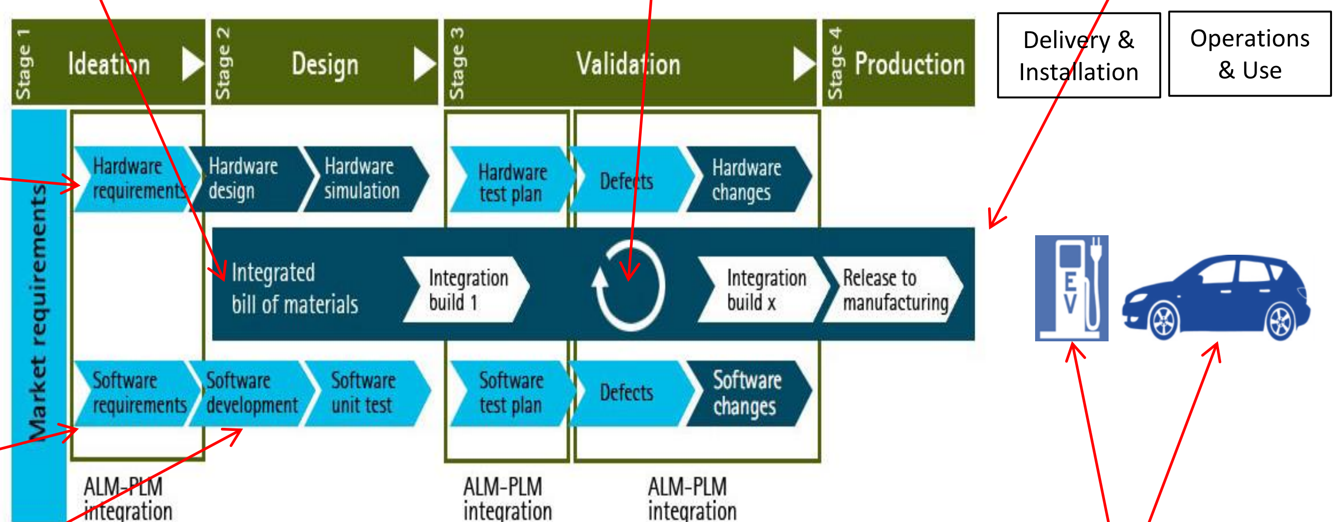
What is the *incremental cost** to develop a standards-based smart charging system?

Integrated circuit: chipsets, modem, radios, powerline communication, memory, processor

Conformance and interoperation testing and certification

Ordering, supplier tooling, manufacturing, per-unit pricing

Vehicle and/or equipment-based charge controller



Requirements to implement a protocol(s)

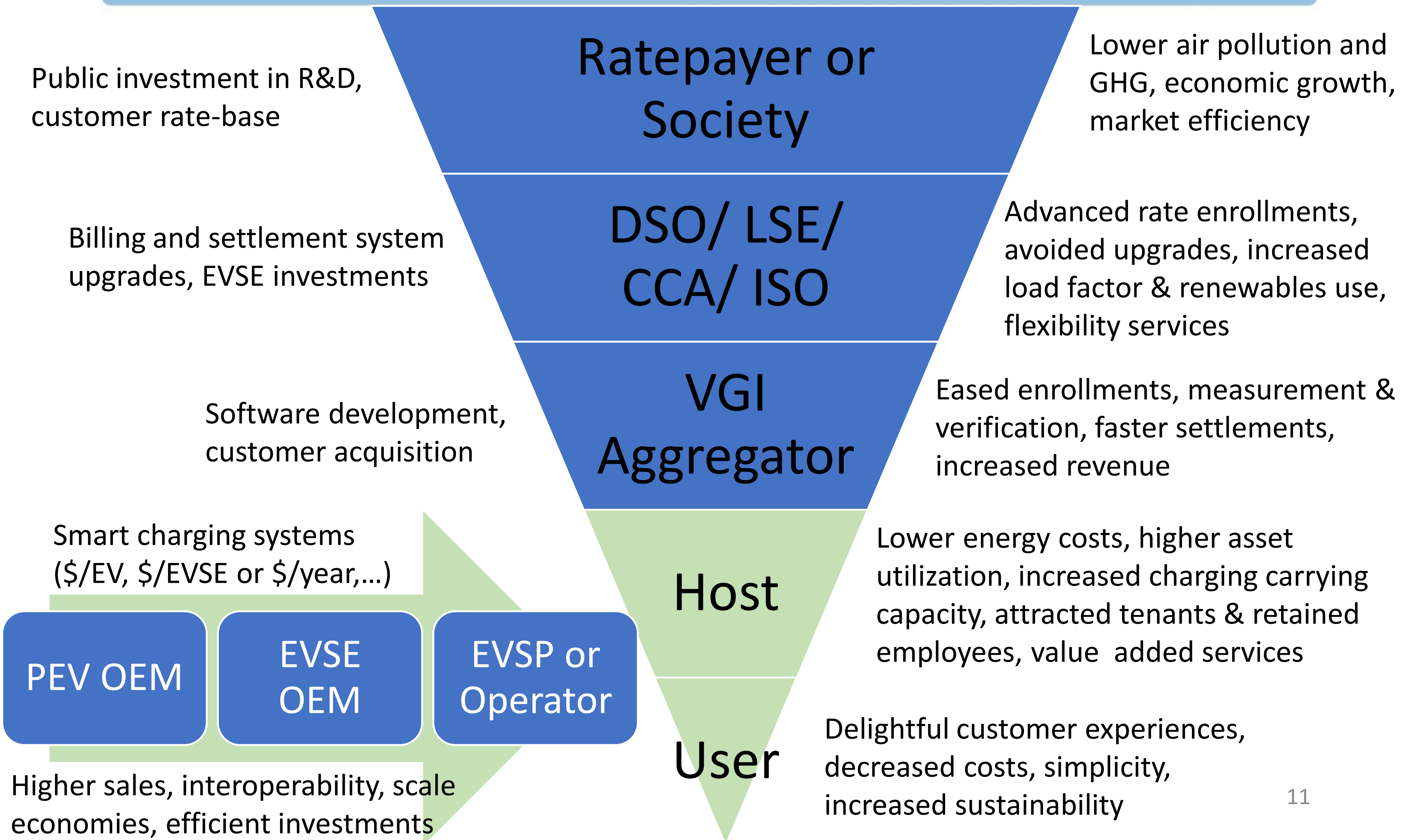
Electrical & Software Engineering Labor

Use of open source or programming original code

Upgrades or Repair

***What are the reasonable counterfactual ("base cost") assumptions for the market?**

Stakeholder costs can yield private and social benefits



Achieving benefits for California relies on PEV charging data

Data should be

- Accountable
- Specific
- Verifiable
- Fungible
- Secure

Other non-policy uses for this data will exist!

Select Agency ZEV Activities
Reliable operation of the grid by **scheduling PEV demand**
Locating electric vehicle **charging stations**
Open, **authenticated access** to public charging sessions
Charge control per Time-Of-Use or Dynamic rates
Provision and settlement of **grid ancillary services** as DERs
Accurate **receipt of commercial sale** of electric fuel
Monitoring traffic flows/congestion, road capacity, and tolling
Validating **Credit Generation** for Low Carbon Fuel Standard
Analyzing utilization and maintenance of deployed networks
Improving load and generation **forecasting and grid planning**
Allocating construction costs to drivers proportionate to use
Target future **strategic investments** in charging networks
Track **deployment, petroleum & emissions** reduction goals
Meet energy efficiency and **fleet procurement** targets

Revised per CEC/CPUC December 7, 2016 Vehicle-Grid Integration Communications Standards Workshop

Identify opportunity costs and risks

- What benefits are accrued with certain information and what is foregone without it?
  - How is adoption enabled or hindered?
  - What will encourage private investment?
  - What future use cases are stifled without intelligence?
- What are the implementation costs if levelized over “widespread” scale?
  - Sensitivity to thousands of units? Millions?
- How can the efficiencies of a international automotive market be leveraged?
- What advanced technologies are concerning? How do risk tolerances differ among stakeholders?

Deliverable 2 example and proposal

1. Evaluate use of [Comm. Protocol 1] to implement Use Case [1]

Stakeholder	Costs	Inc/Dec Factors	Benefits	Inc/Dec Factors
User				
Host				
PEV OEM				
EVSE OEM				
Operator				
VGI Aggregator				
DSO/LSE/CCA/ISO				
Ratepayer/Society				

2. Repeat for [Comm. Protocol 1-X], or alternative, for Use Cases [1 – X]
3. Juxtapose use case implementations, delineate opportunity costs

- Subgroups?
- Divide and Conquer:
  - Type of implementation: Comm. Protocol, alternative, or null *(Suggested)*
  - Use Cases
  - Costs
  - Benefits

Bridging a gap to transformative investments

- Supplier decision-making to develop smart charging systems
  - Automotive Original Equipment Manufacturer
  - EV Service Provider/ EVSE Operator
  - EVSE Manufacturer
  - VGI Resource Aggregator

Honda **Daimler**

eMotorWerks **IoTecha**

- Automotive and charging service competitors can cooperate during the nascent phases of the market to minimize their exposure to risk, advance technology, and reduce costs needed for electrification's success.
  - Legislative decisions, aligned and reinforced, across borders
  - Economies of scale
  - Increase supply chain efficiencies
  - Commoditize communications technologies and charge controllers
  - Compete on delivery of differentiated services and benefits

Feedback sought after presenters…

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