

Electric Vehicle Market Overview – What’s Here, What’s Coming, and What are Utilities Doing about It



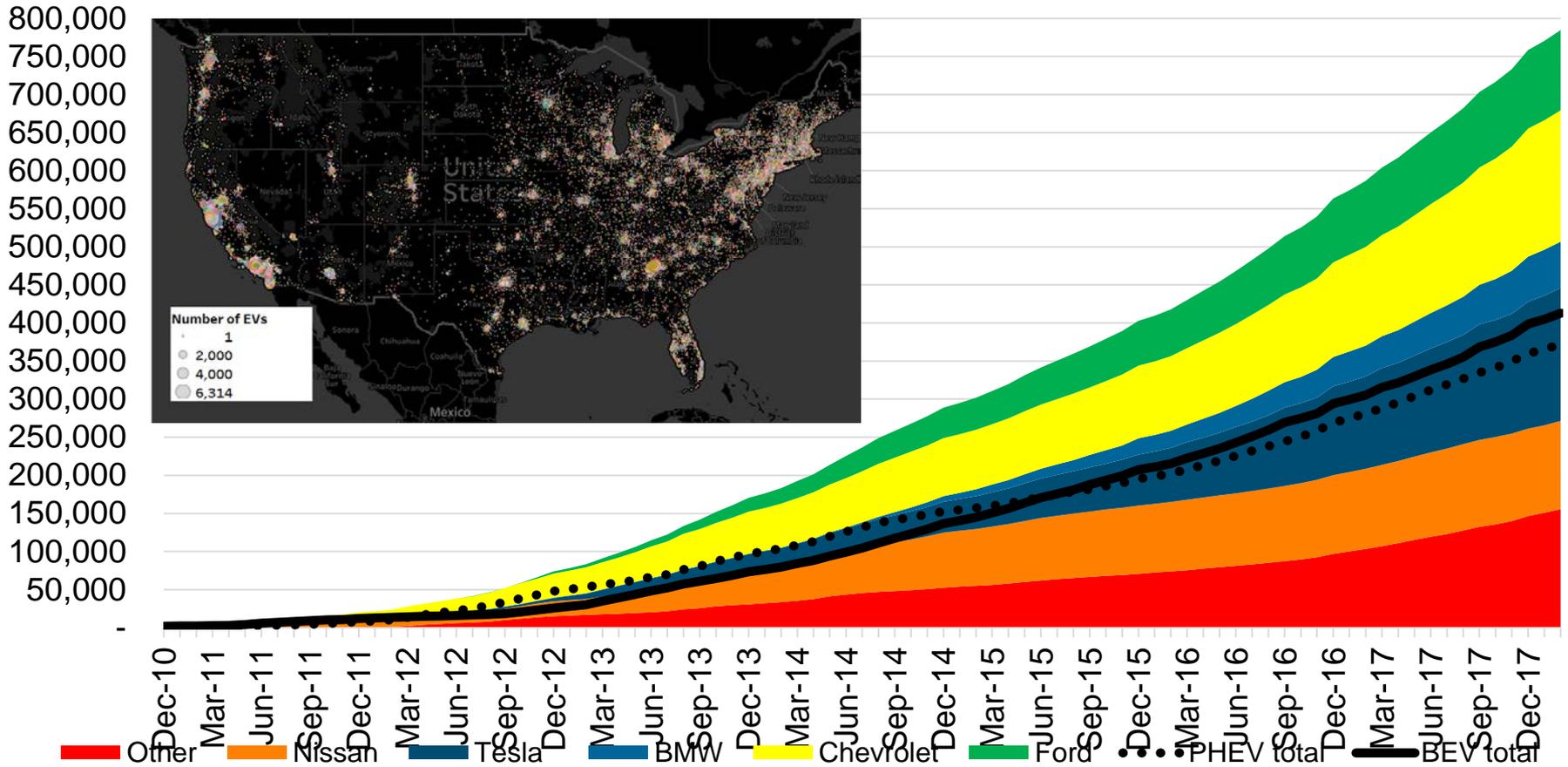
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EPRI Advisory Council
Houston, Texas
March 29, 2018

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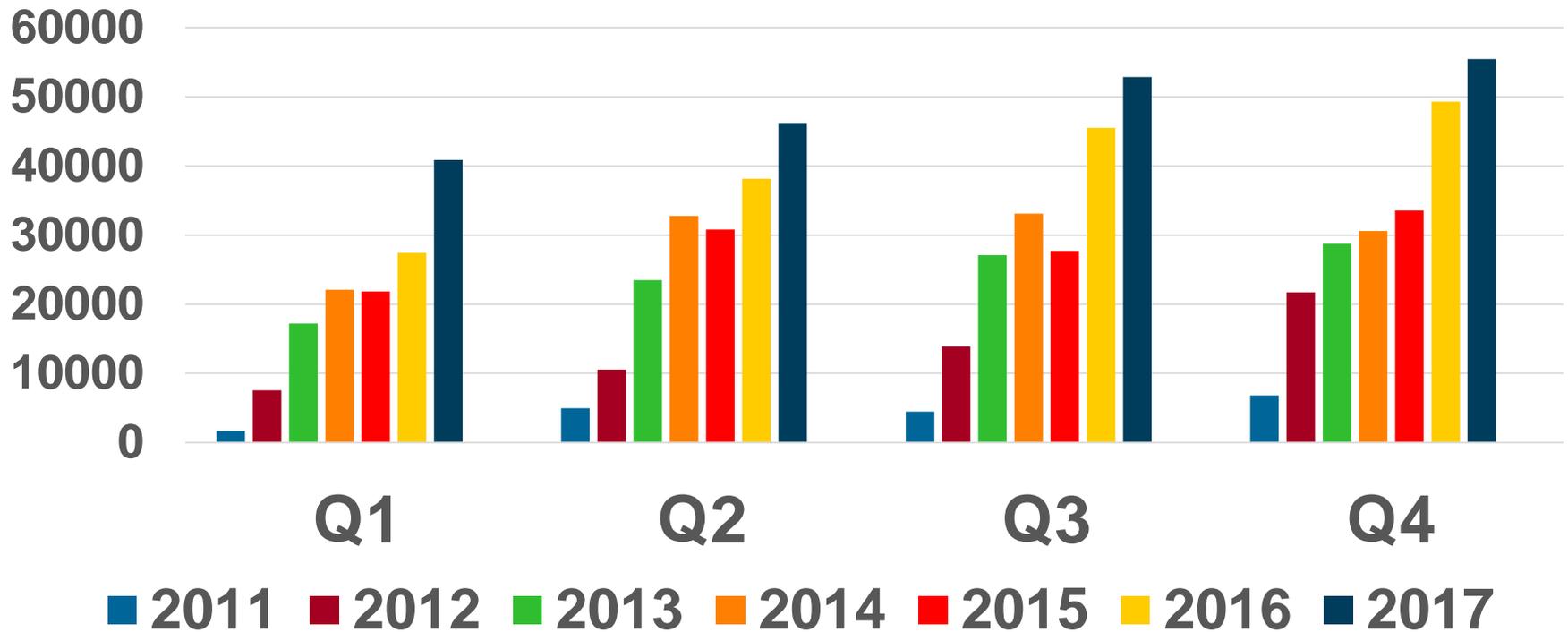
- What EVs are here
- What EVs are coming
- Can the grid handle it?
- Can we be smarter?

US EV sales exceed 787k through end of February 2018

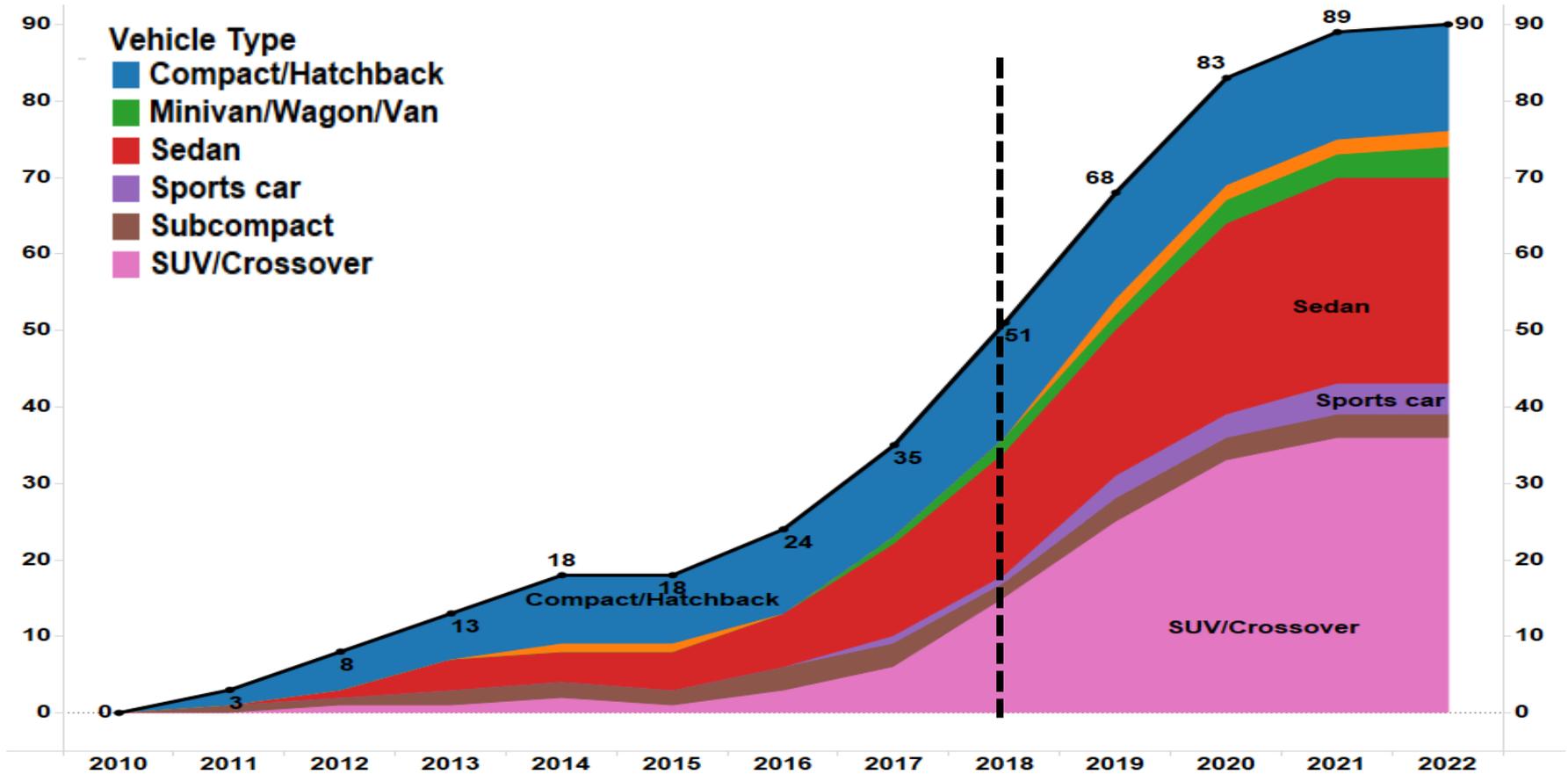


EV sales ~flat in 2013-2015, but increasing in 2016 and 2017

Quarterly EV Sales 2011 through 2017

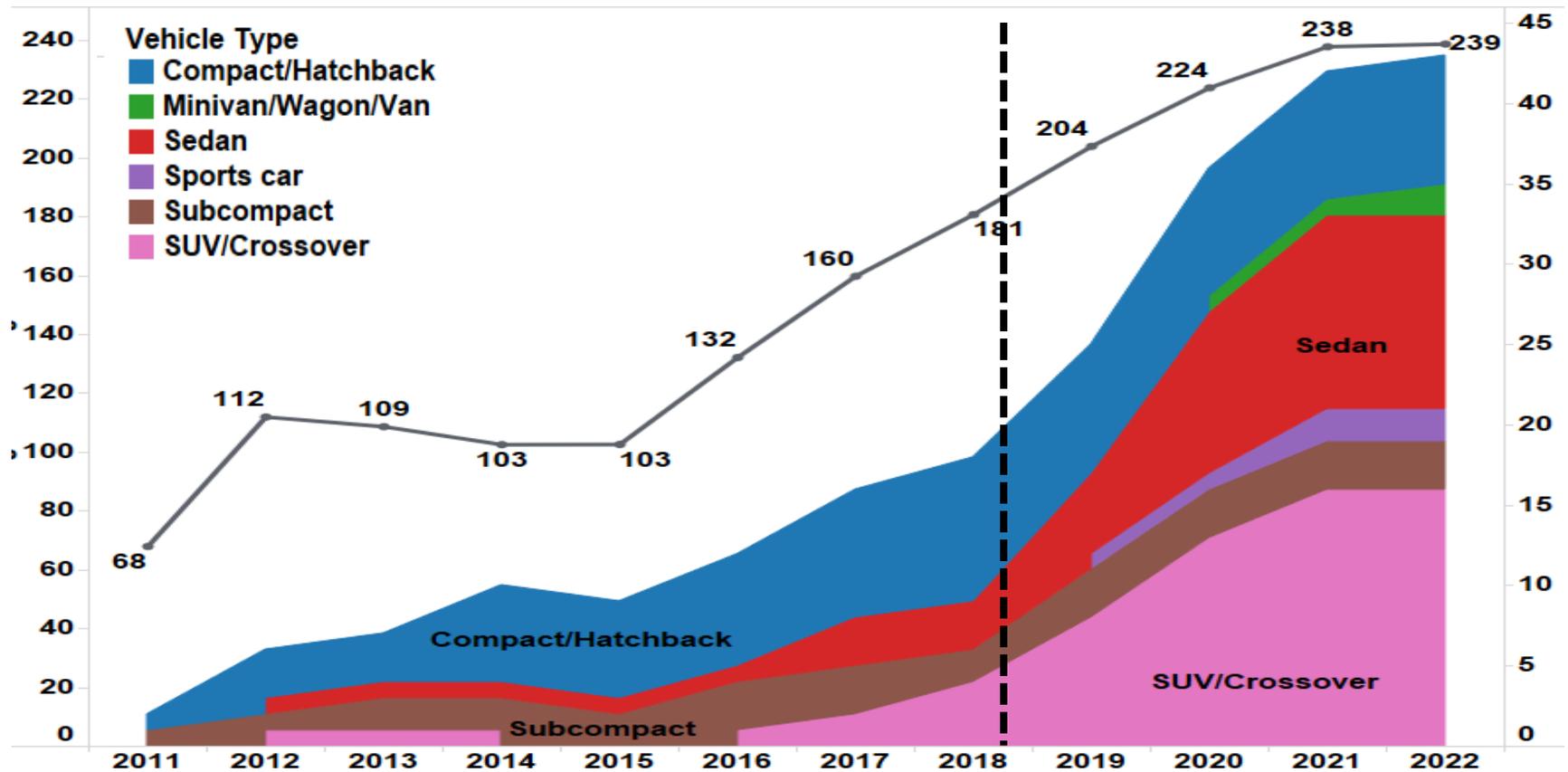


Customer choice increasing with ~~~90-93~~ EVs by 2022



Updated 1/15/2018

Range of battery electric vehicles (BEVs) is also increasing



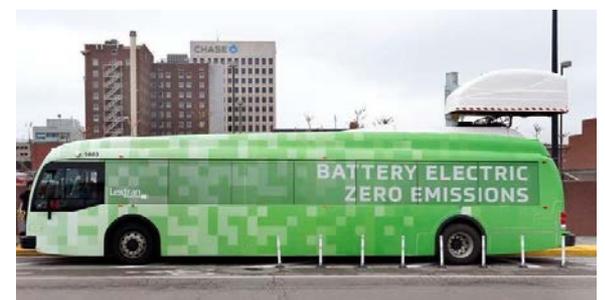
Updated 1/15/2018

Major auto shows are featuring a variety of EVs



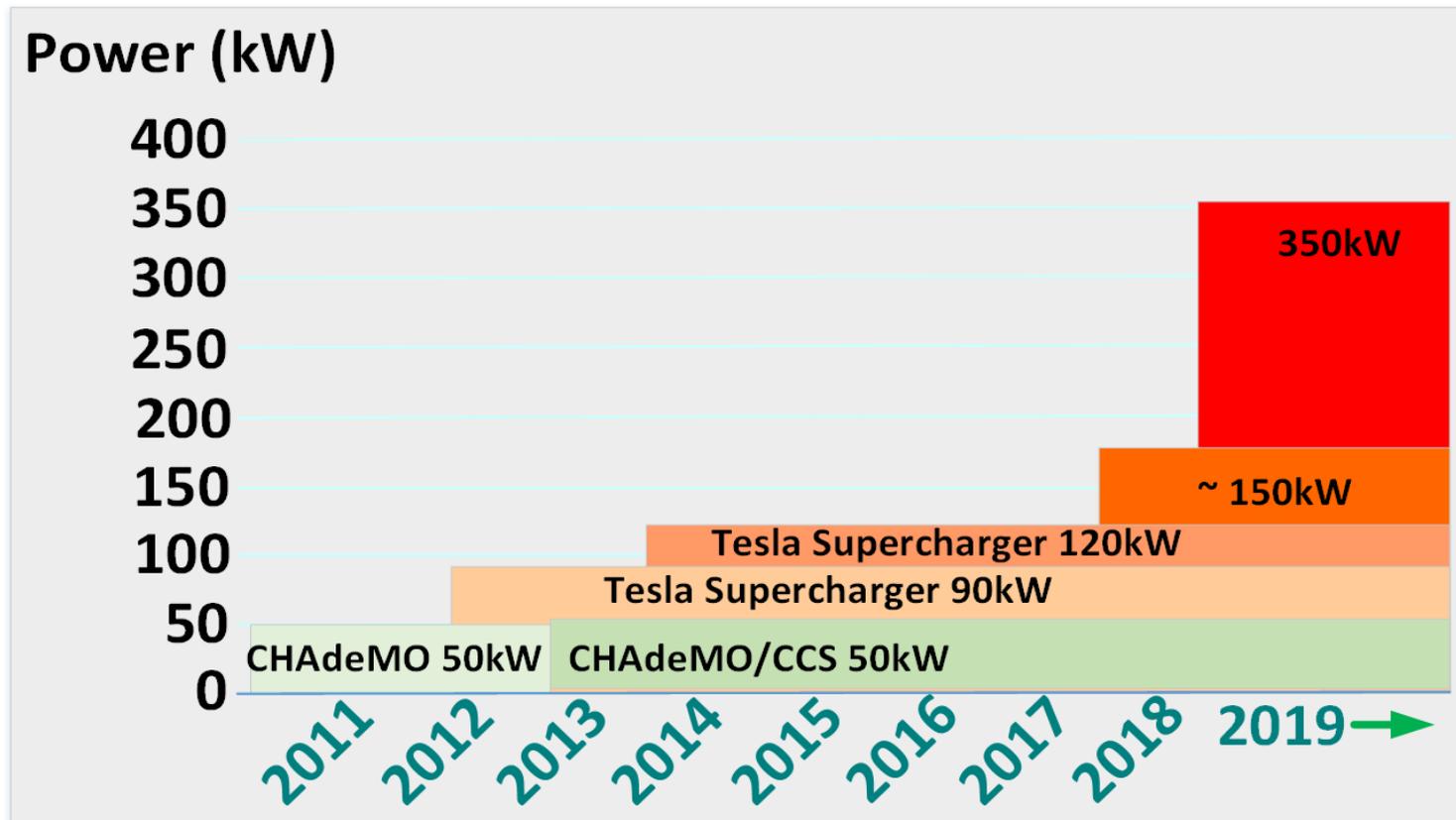
Source: Dan Bowermaster, Los Angeles, December 2017; www.insideevs.com, accessed 3/28/2018

And here come the big EVs

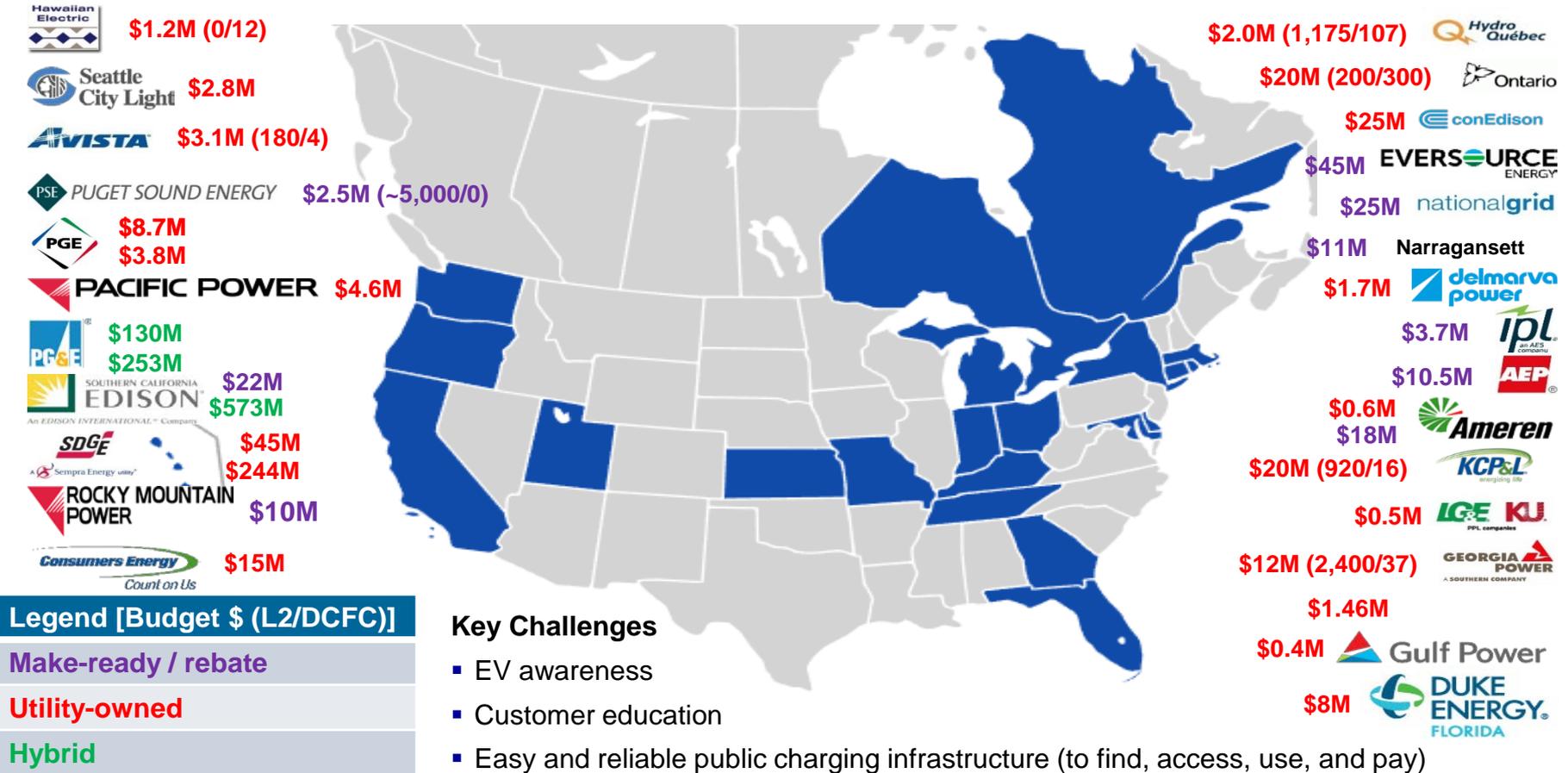


Sources: CleanTechnica.com, GreenCarReports.com, SchoolBusFleet.com; electrive.com, LG&E and KU, Dan Bowermaster

Higher charging power enables an EV to fuel similar to a gas car



Utilities are proposing ~\$2.5B in EV charging



Legend [Budget \$ (L2/DCFC)]

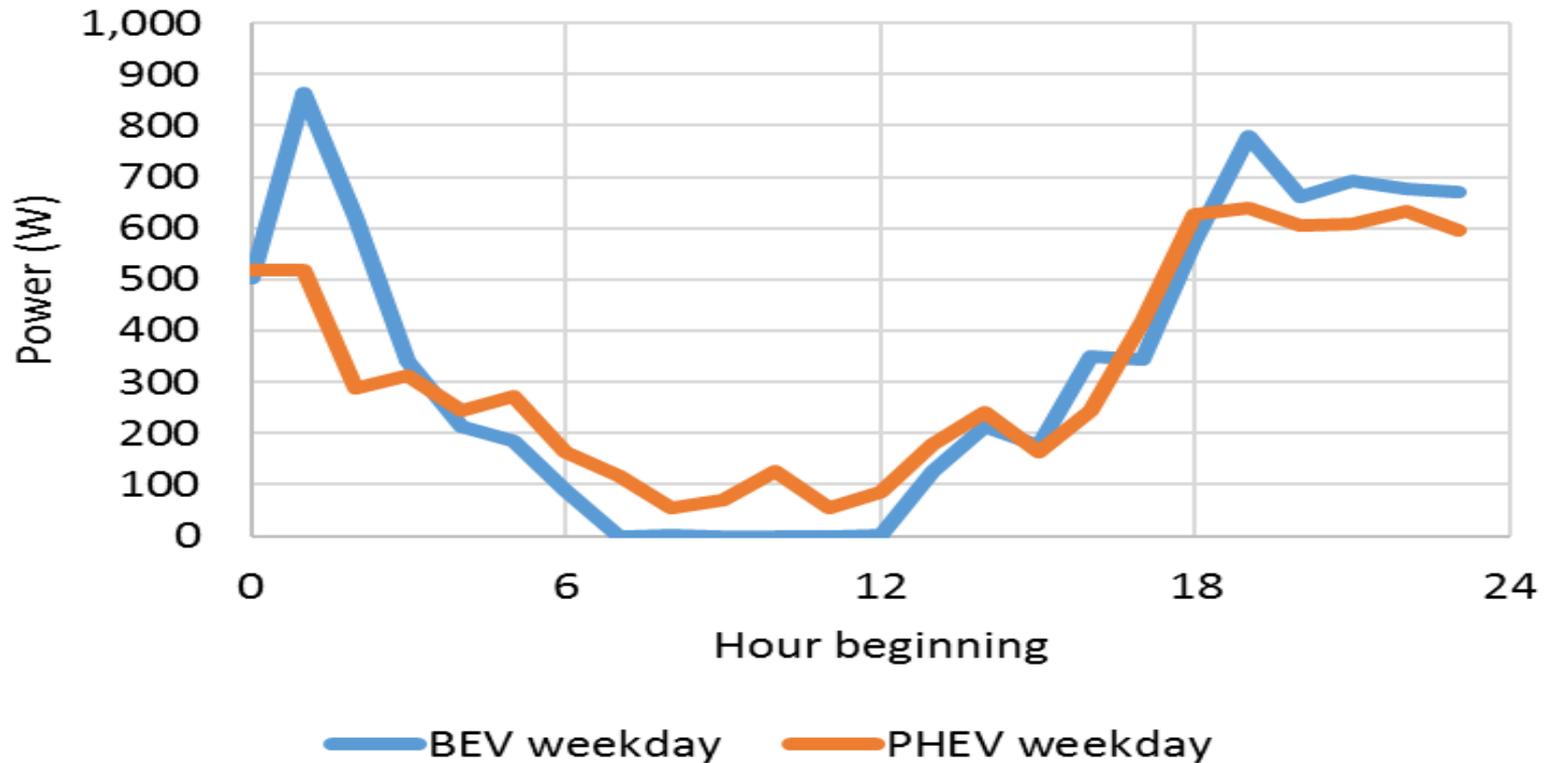
- Make-ready / rebate
- Utility-owned
- Hybrid

Key Challenges

- EV awareness
- Customer education
- Easy and reliable public charging infrastructure (to find, access, use, and pay)

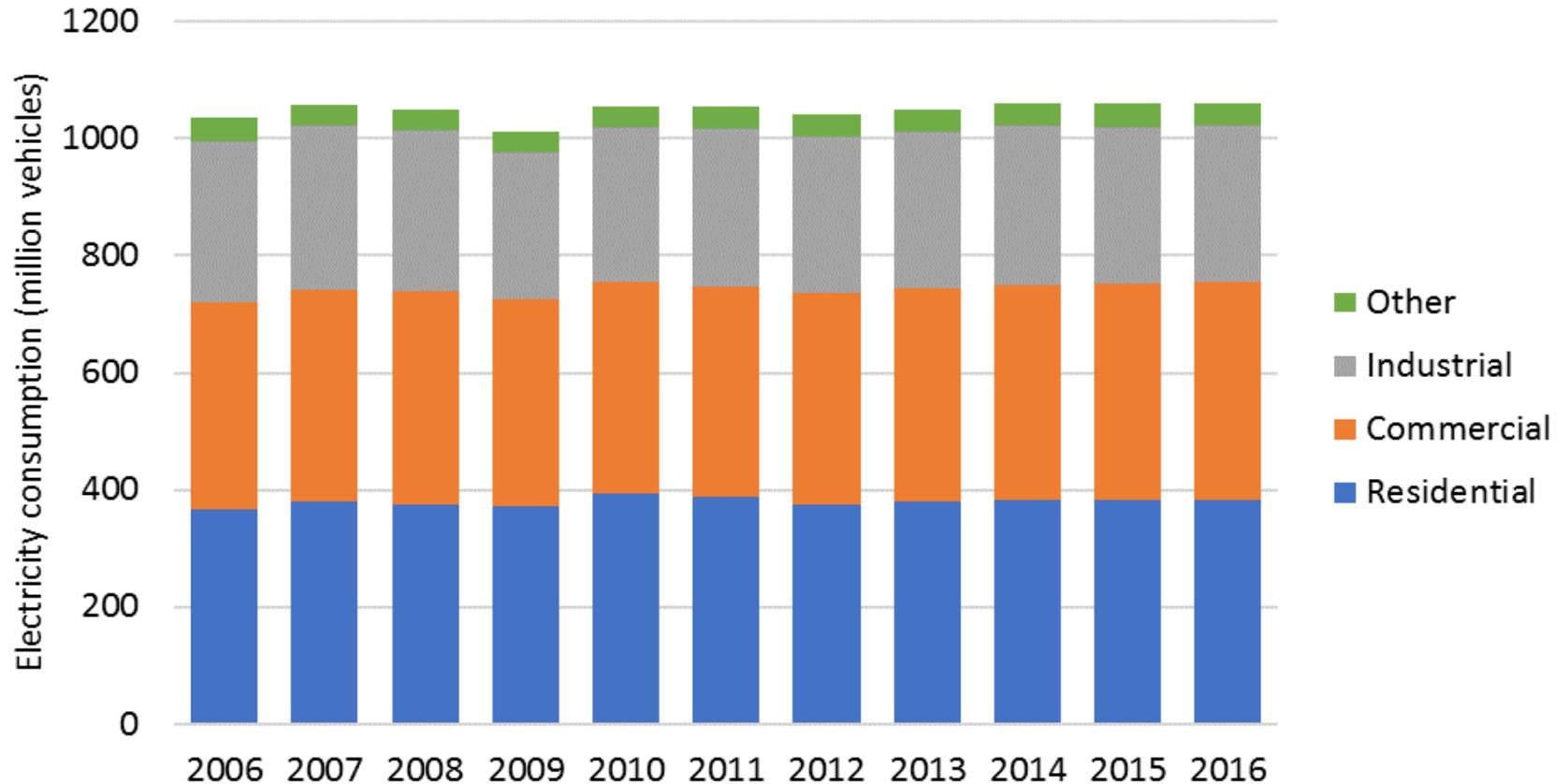
Updated: 3/28/2018

Power impacts per EV are lower than one might expect

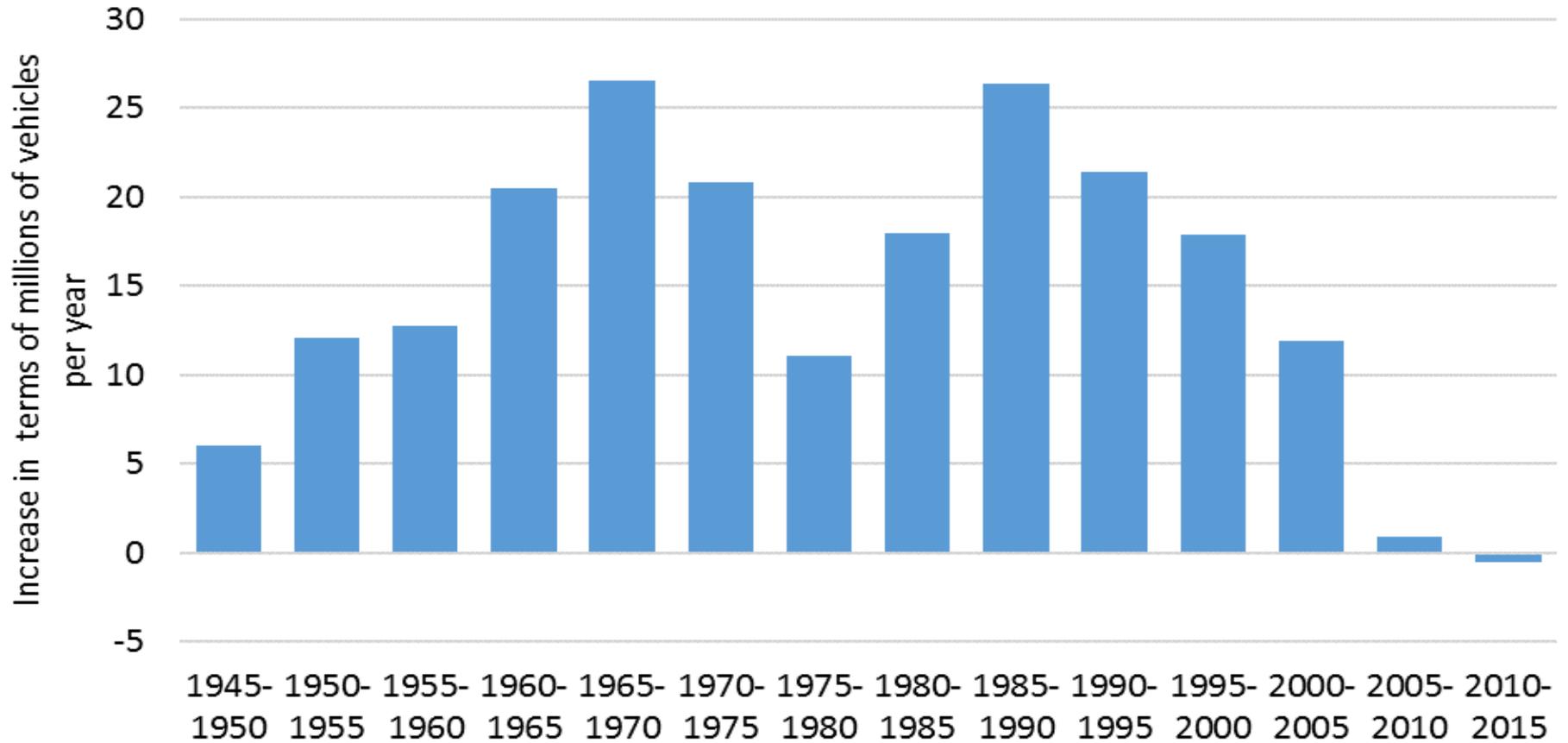


- An average PEV has a power impact of ~1 kW and an energy impact of ~ 2,800 kWh/year

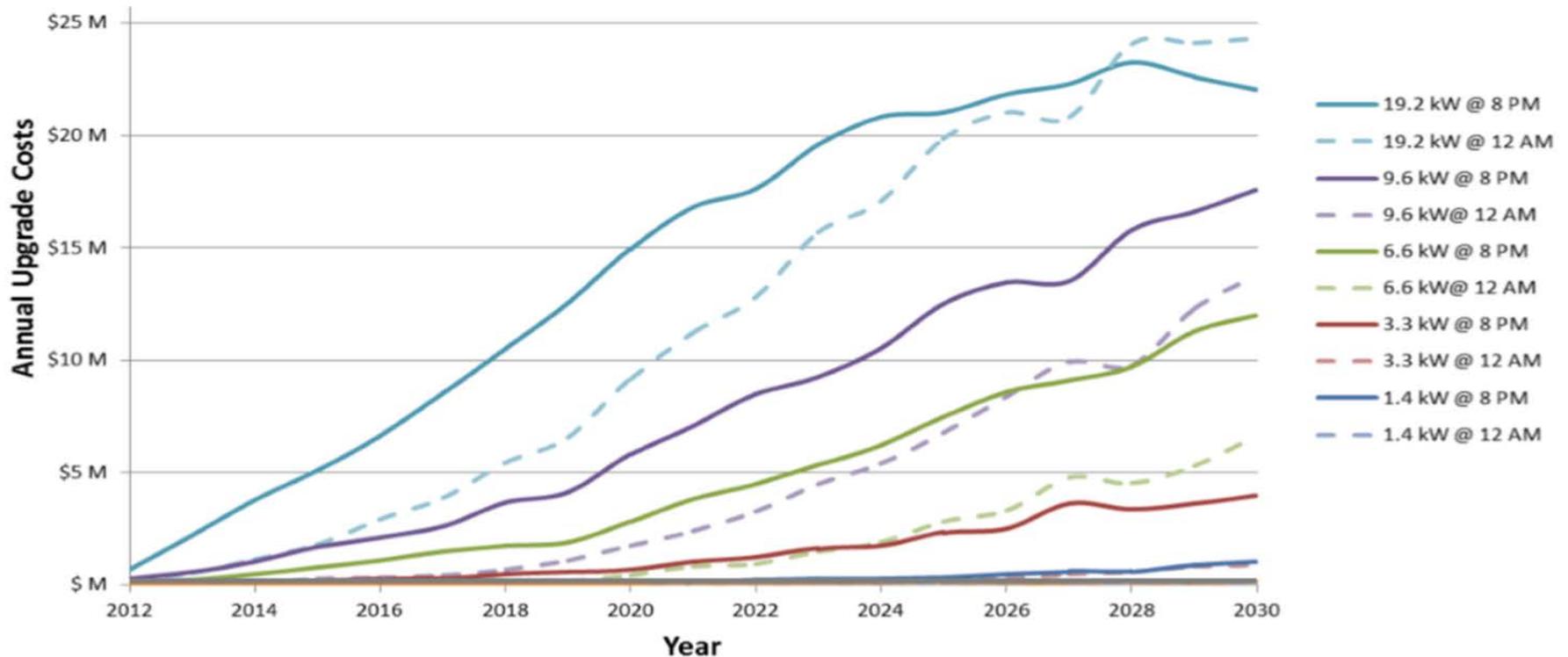
How much generation exists today and how is it consumed?



Adding generation also support millions of EVs



So what about potential distribution impacts of EV charging?



- Power level and time of day impact annual distribution impacts

Source: [SMUD analysis of potential distribution impacts of EV charging, EPRI 2013](#)

What else does the data show?

EPRI Grid Impact Phase 1 Study, 2012

AC Charge Rate	Circuit 1 Upgrades (of 286 Transformers)	Circuit 2 Upgrades (of 292 transformers)	Circuit 3 Upgrades (of 161 transformers)
3.3 kW	5 (2%)	7 (2%)	37 (23%)
6.6 kW	62 (22%)	88 (30%)	103 (64%)
9.6 kW	192 (67%)	132 (45%)	136 (84%)
19.2 kW	285 (100%)	229 (78%)	155 (96%)

California IOU Upgrade Real World Results, October 2017

	PG&E	SCE	SDG&E	Total
EVs	142,732	108,135	26,498	277,365
Service Upgrades	228	197	35	460 (0.16%)

Source: [Understanding the Grid Impacts of Plug-In Electric Vehicles \(PEV\): Phase 1 Study -- Distribution Impact Case Studies, EPRI, 2012; 6th Joint IOU Electric Vehicle Load Research Report: December 2017, p. 8](#)

Options to improve

■ Charge management

– Dynamic pricing

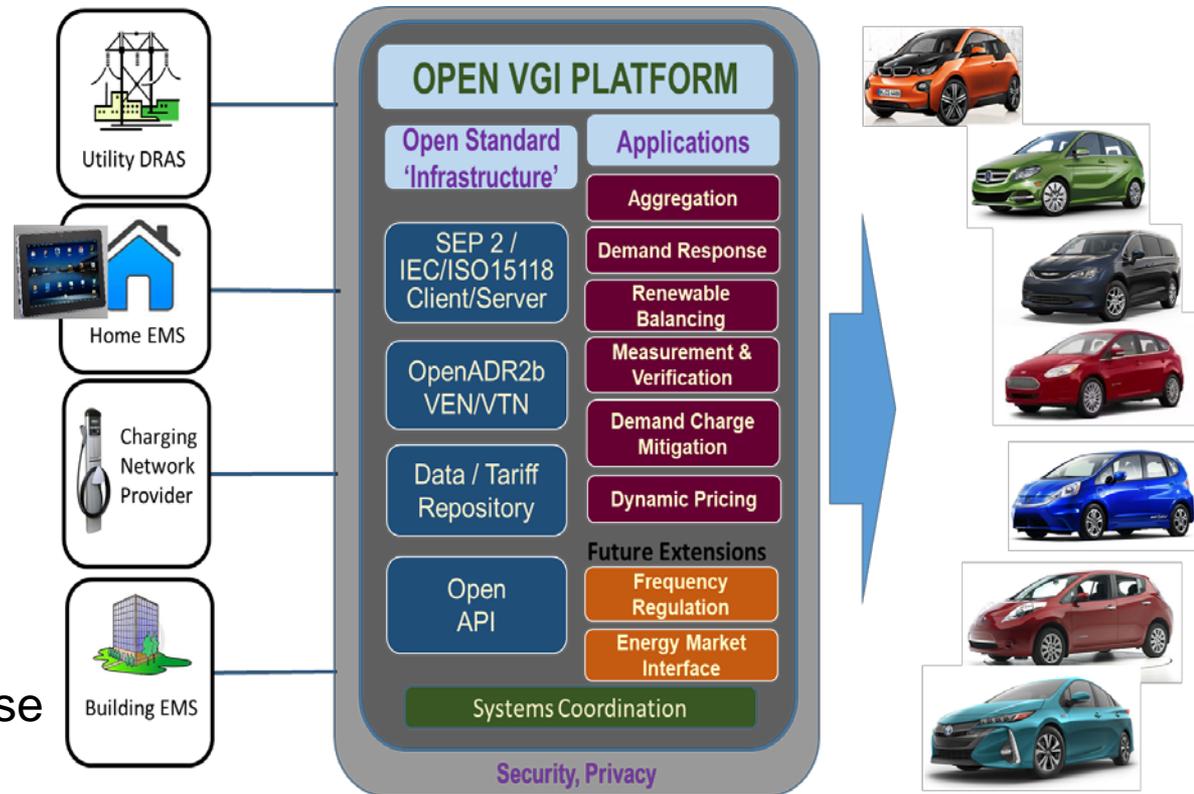
- [SRP EV Pilot](#)

– Direct signaling

- [Automaker-utility “Open Vehicle-Grid Integration Platform”](#)

– Integrated demand response

- [Pepco Smart Charging Pilot](#)



Options to improve

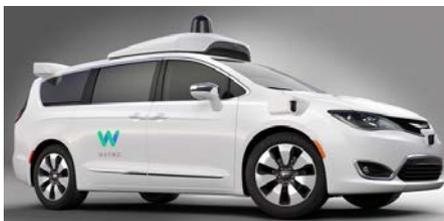
- Vehicle-to-grid
 - Smart Power Integration Node
- Integrated planning
- High power DC fast charging
 - Scoping
 - DC-as-a-service



Looking Ahead – Today and Tomorrow

Time

- New transportation models
- 200+ mile mass-market battery EVs
- High power charging
- Smart charging programs
- Autonomous driving





Together...Shaping the Future of Electricity