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VOLTTRON™ Enabling Vehicle-to-Building Integration

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Software Framework for Transactive Energy: VOLTTRON™

U.S. DEPARTMENT OF ENERGY

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What makes electric vehicle charging control a good market for VOLTTRON™?

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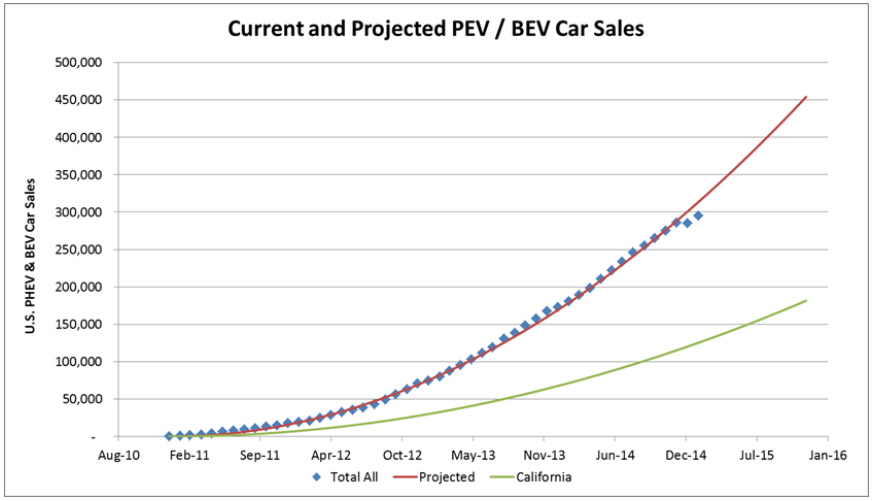
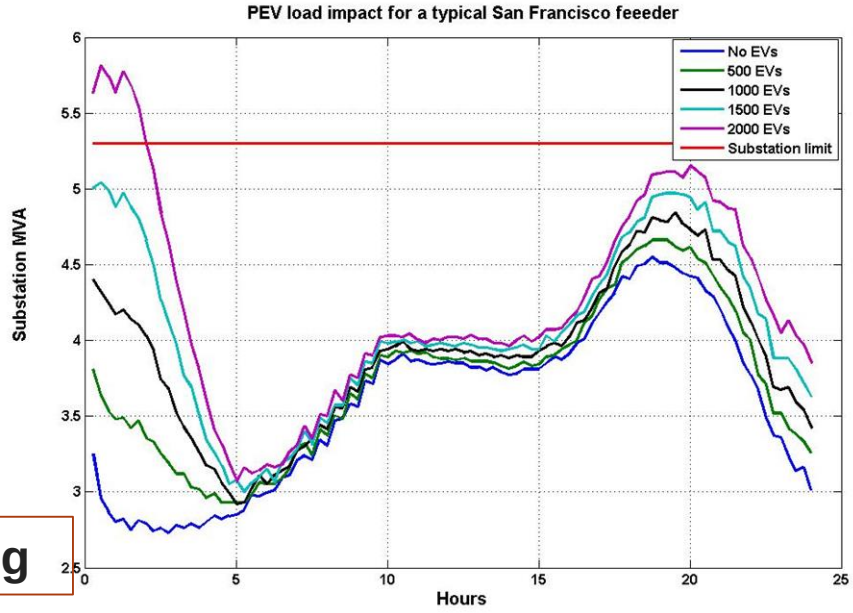
Managed charging is needed

- EV adoption growth expected
  - Distribution feeder loads limiting with growing electric vehicle population
  - EV charging can mitigate the local feeder effects of solar or wind renewables generation
  - Battery capacity (vehicle range) increases and charging power increases
- Regional value proposition
  - Base rates
  - Ancillary & Regulation services rates
  - Demand charges
- Communication latency and bandwidth needed for market participation.





Enables Distributed Managed EV Charging

What related / near markets would open up if this is successful?

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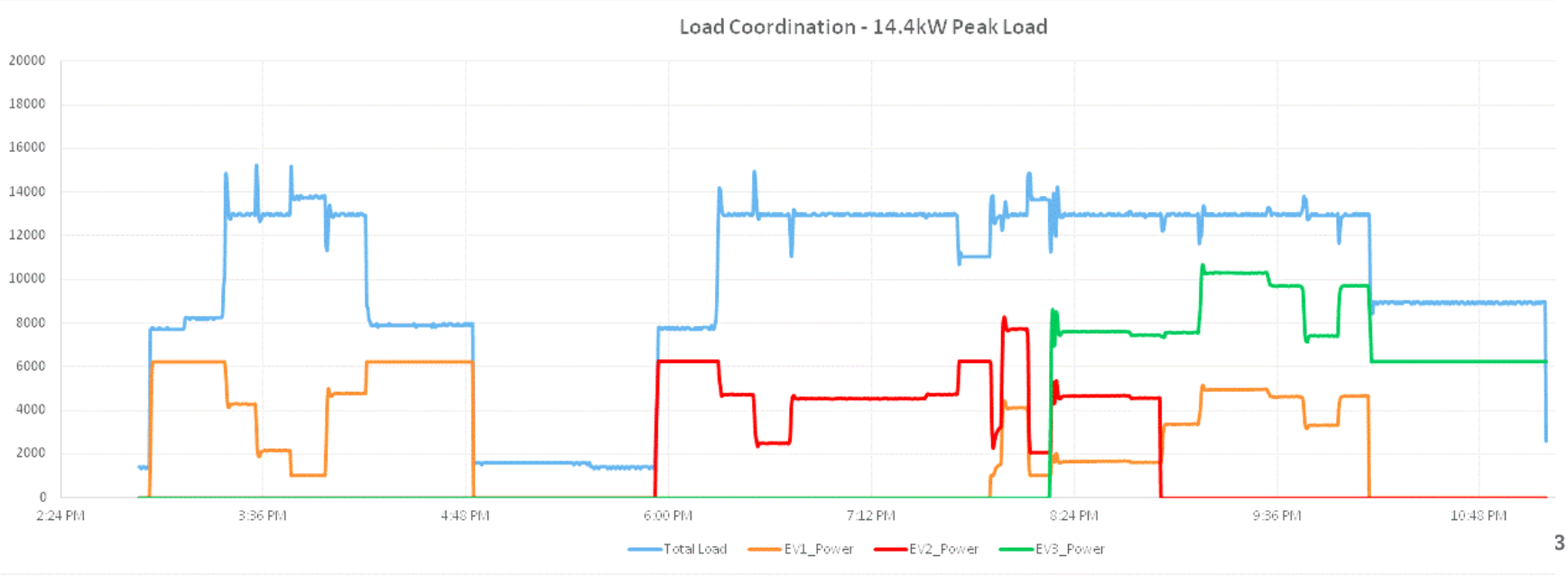
VOLTTRON™ can enable unique EV charging characteristics:

- Flexible – charging can typically be delayed without impact
- Variable charging rates
- Dynamic charging rate change capability
- Peak loading / demand charge reductions
- EV charging is geographically distributed
- Longer range PEVs will use higher charging power



What enhancements to VOLTTRON™ are required for successful application?

- An extensive portfolio of sample agents and implementation designs / considerations
- Tools / frameworks / active user groups to minimize initial agent development effort
- **Design methods / approaches that enable continued system operation even with network faults**

VOLTTRON™ Drivers / Agents needed:

- ISO/IEC 15118 & SEP2.0
- OpenADR2.0 & CEA 2045
- OEM Central Server
- OpenEVSE
- Owner interface
- Markets / Renewables

NREL Parking Garage PEV Charging

What are the non-technical barriers to this market?

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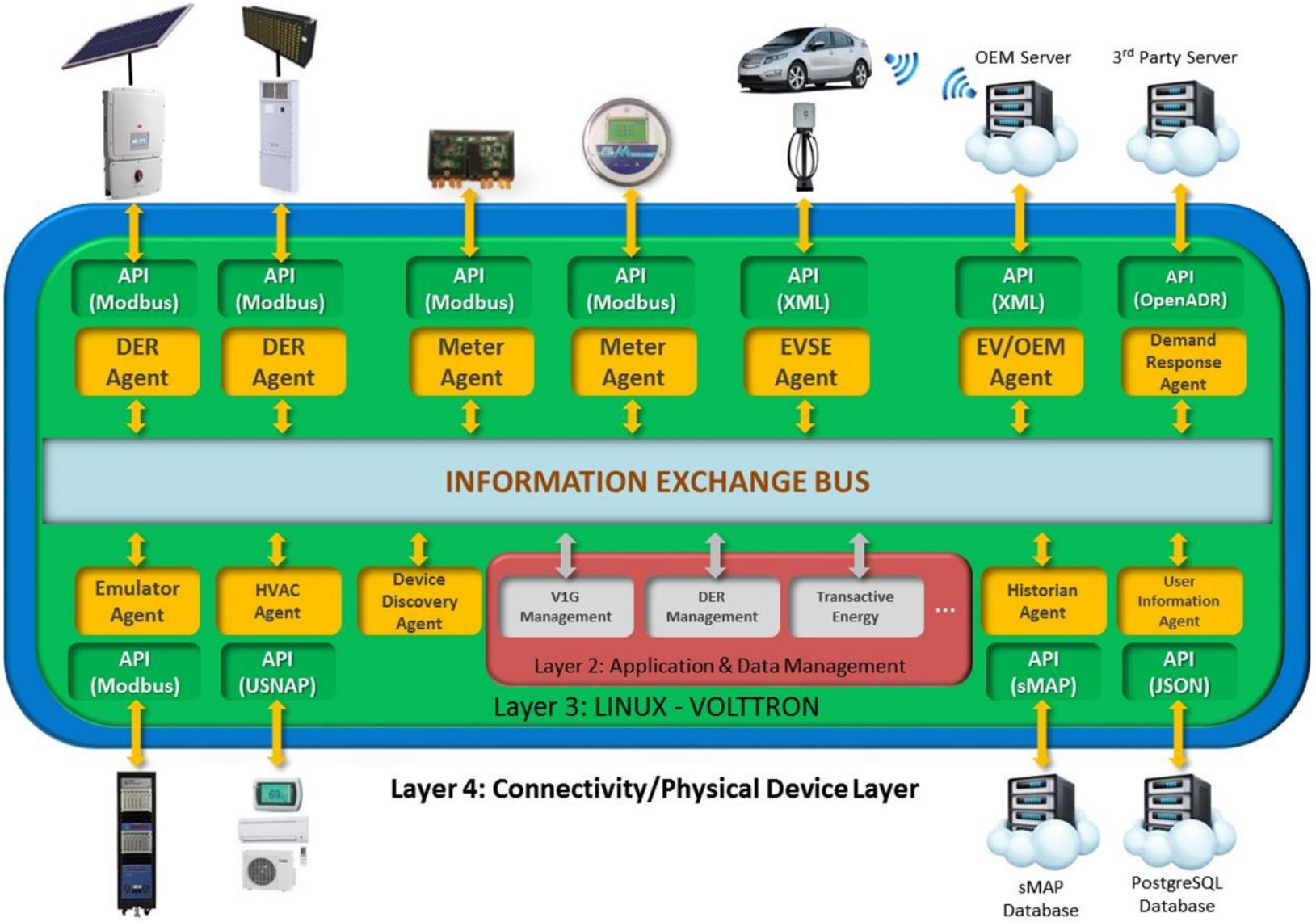
- Technology development level of maturity – EV chargers can have varying control capability - from very simple to using advanced communications
- Implementing and monetizing ancillary services value to customers
- Simulated basis for Vehicle Grid Integration (VGI) business models needed to develop additional businesses
- Analyses needed to articulate benefits to OEMs, PEV owners, utilities and policy makers.
- Are policy changes needed to enable controlled PEVs to participate in VGI

ANL EV Charging Station Infrastructure interfaced with Energy Storage and Solar Generation System

VOLTTRON™ to Vehicles



VOLTTRON™ Agents and Drivers

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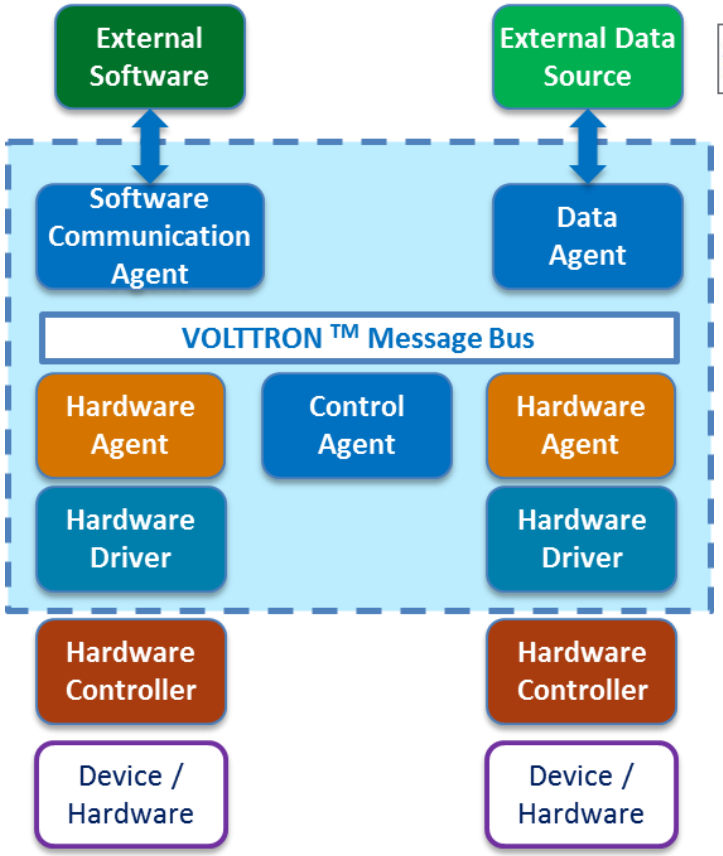

California ISO
Shaping a Renewed Future

PNNL Lab Homes PEV Charging Stations