

GMMLC Interoperability Technical Review Meeting Ecosystems Panel



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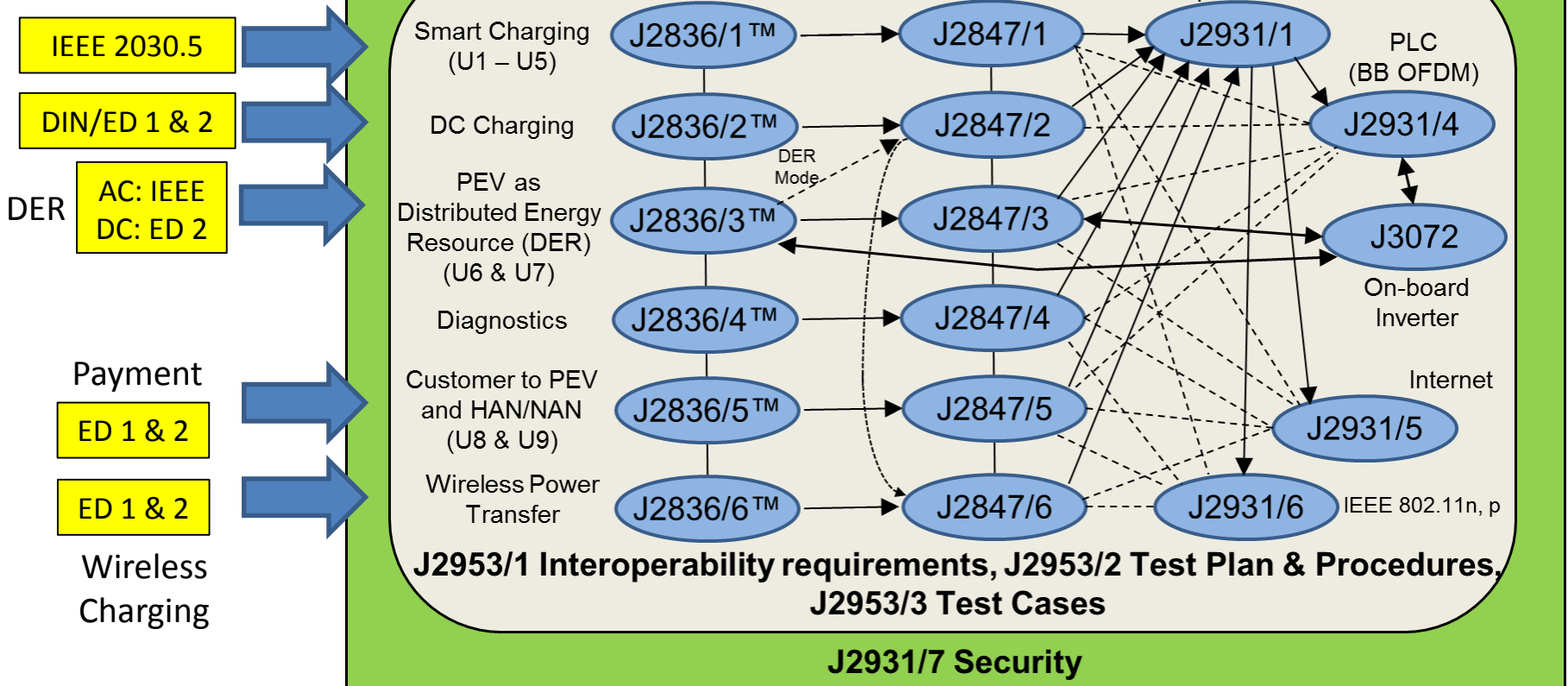
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SAE/IEEE/ISO/DIN

Standards Summary

J2836 - Instructions for PEV Communications, Interoperability and Security Documents



DIN/ISO: DIN 70121:2014, ISO 15118 ED 1, ED 2

DER: J2847/2 for DC DER using ED 2, J2847/3 for AC DER using IEEE

Utility Energy Usage

Planning tools for peak load reductions

Price programs

- Time of Use (ToU) – **year ahead price** based on expected peak and non-peak loads for average home in area
- Critical Peak Pricing (CPP) – **day ahead updates** to ToU price that varies price at various conditions (e.g. ToU may be 0.12/kWh from 4-9pm and CPP changes it to \$1.00/kWh, for the next day only)
- Real Time Pricing (RTP) – **real time updates** to price based periods, can be a 5 to 15 minute interval for updates.
 - Allows both positive and negative price (if excess energy is available)
 - Can still be predictive so delayed/scheduled charging can be planned during negative period

Demand Charge programs

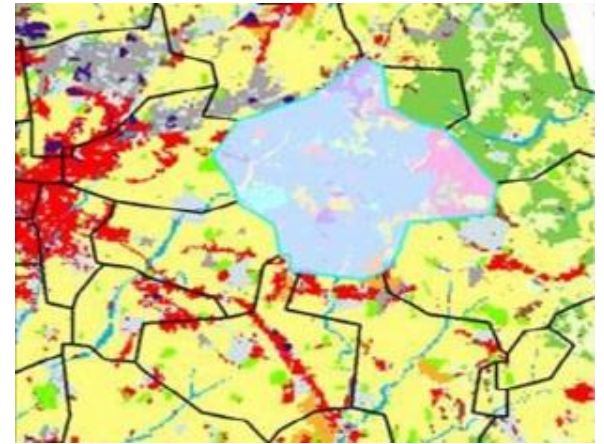
- Some have a monthly peak: charge on the maximum peak anytime during the month (\$7+/kW for any peak) for the entire home
- Some have a daily peak: if over a preset limit but perhaps only the during peak load period for the day. Some of these are for separately metered EVSEs only, not for the rest of the home.
- ...

Utility Energy Usage

Reactive tools for grid stabilization

Demand Response Load Control (DR or DRLC)

- Applied to certain loads
 - Air conditioning
 - Hot water heater (if electric)
 - Pool pumps
- Not applied to these loads
 - Entertainment (TV, etc.)
 - Cooking (range, oven, ..)
- Signal sent to device to curtail or delay usage
 - Grid is monitored for voltage, temp or frequency issue (hot spots are targets)
- Customer has choice to “opt out” for event
 - If abused, rate will increase to normal



SEP2 Optimized charging

Combines price, DR with energy planning

IEEE standard

- IEEE 2030.5-2013 - Smart Energy Profile 2.0 Application Protocol Standard

SAE standards

- J2836/1™ - Use Cases for Communication Between Plug-in Vehicles and the Utility Grid
- J2847/1 - Communication for Smart Charging of Plug-in Electric Vehicles using Smart Energy Profile 2.0
- J2931/1 - Digital Communications for Plug-in Electric Vehicles
- J2931/4 - Broadband PLC Communication for Plug-in Electric Vehicles

Energy Planning: Adds FlowReservation use case and Function set, for the vehicle to identify to the utility, the (1) Time Charge Is Needed (TCIN), (2) Power level and (3) Energy requested for session, initially, then adjust to the actual charge session selected

SEP2 Function Sets

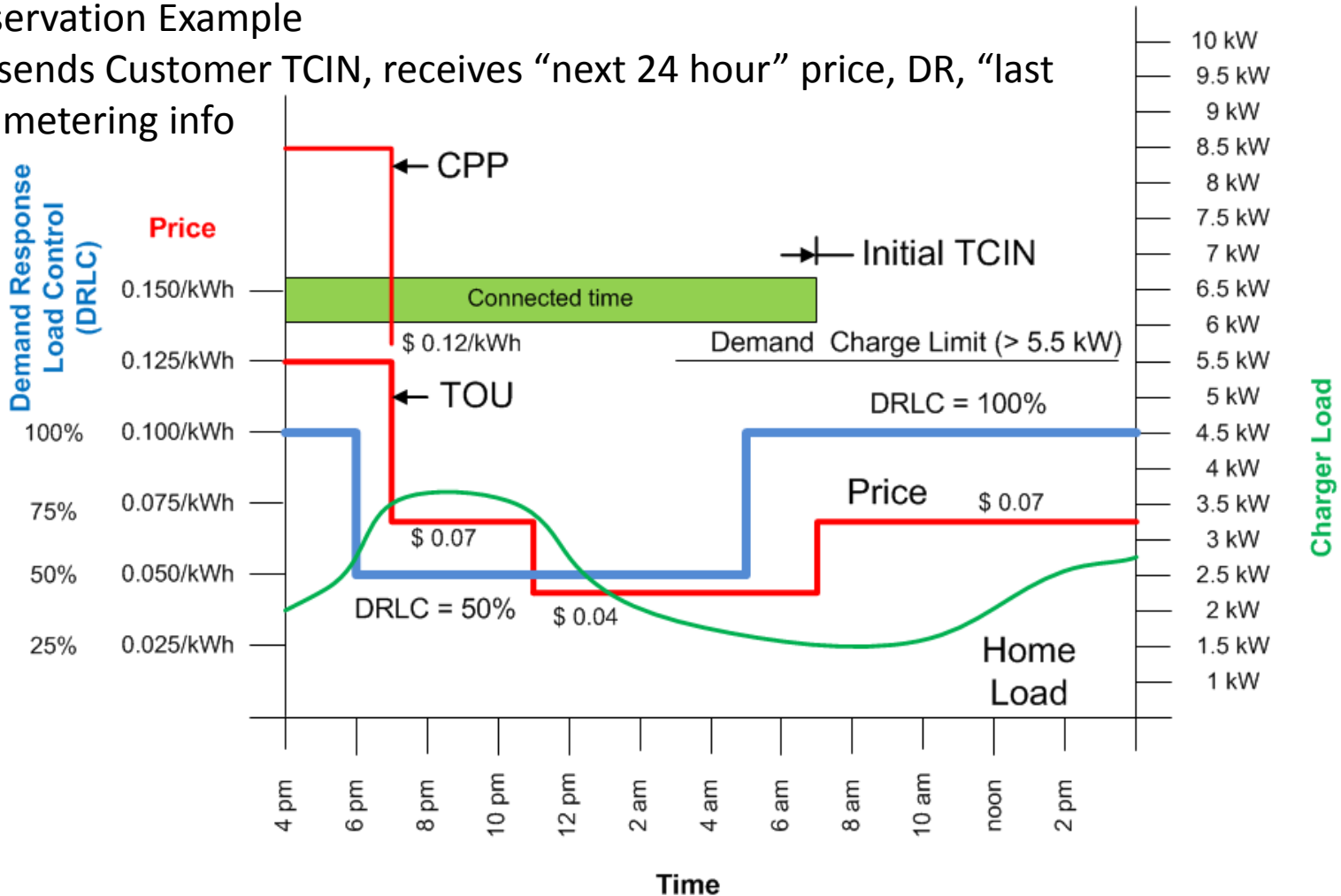
Charging and Discharging

- **Pricing (ToU, RTP, CPP)**
- **Demand Response and Load Control (DLRC)**
- **Flow Reservation**
- **Distributed Energy Resources (DER) – V2G**
 - **AC for vehicle inverter**
 - **DC for EVSE inverter**
- Confirmation
- Messaging
- End Device / Self Device
 - Registration, Device Information, Time,
 - Power Status, Function Set Assignments ,
 - Subscription
- Network Status
- Firmware Download (OTA upgrade)
- Log Events
- Pre-Payment
- Billing
- **Metering**

Initial TCIN and price and DR & metering (home load) info

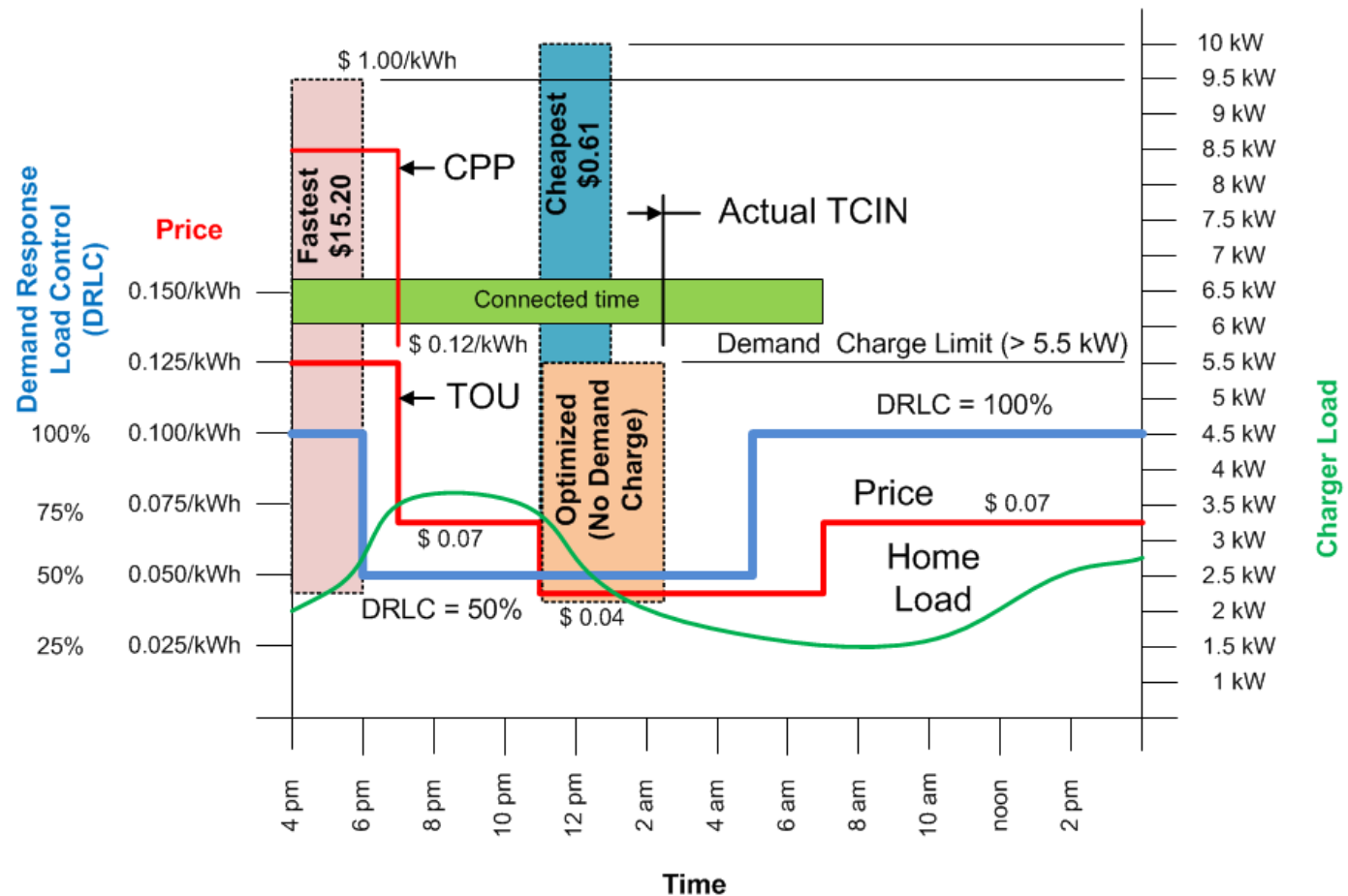
FlowReservation Example

Vehicle sends Customer TCIN, receives “next 24 hour” price, DR, “last period” metering info



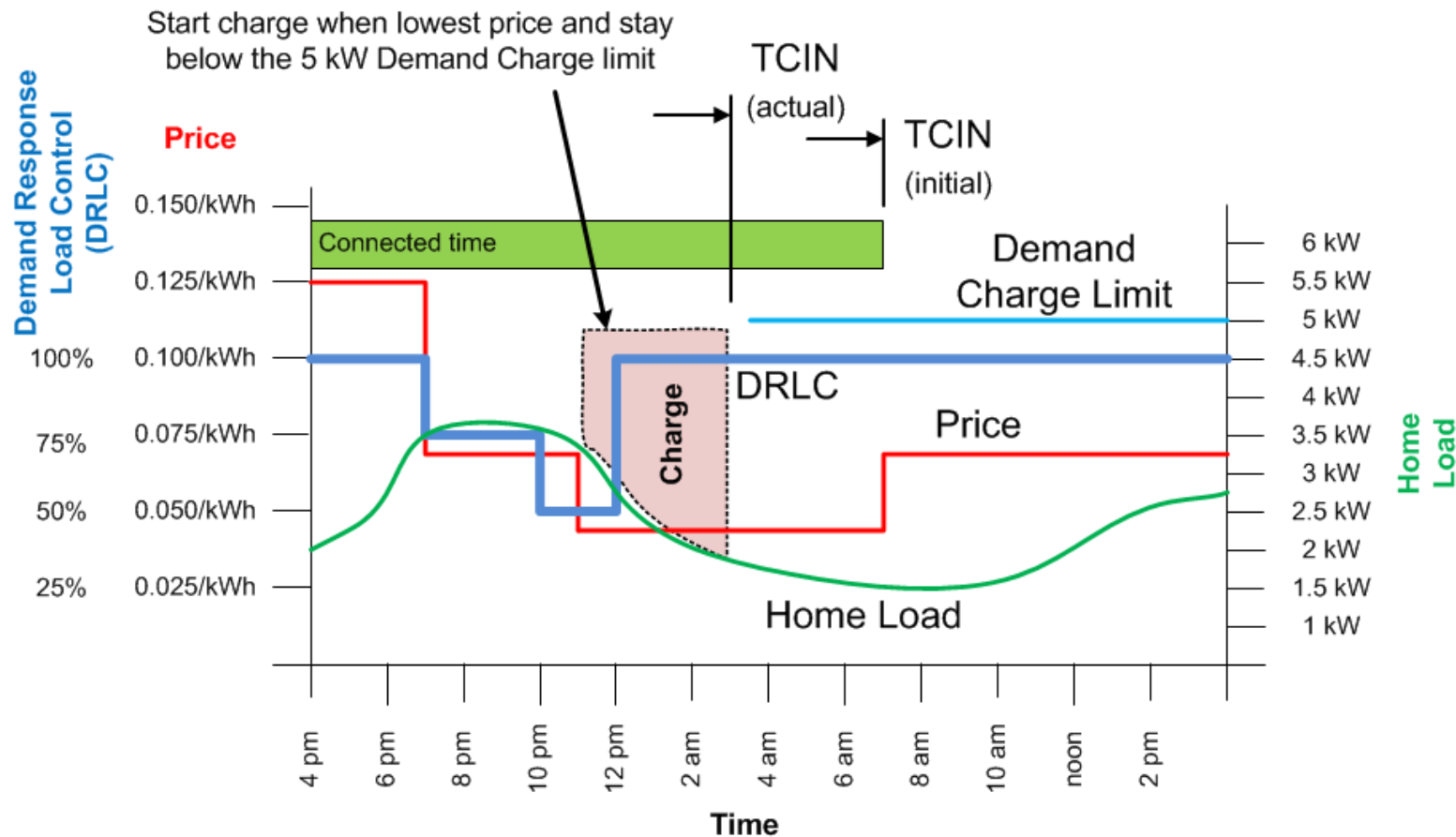
Confirmed TCIN and selection of Fastest, Cheapest or Optimized

Customer selects (or preset choice) for desired option,
Actual TCIN acknowledged to utility along with Power and energy



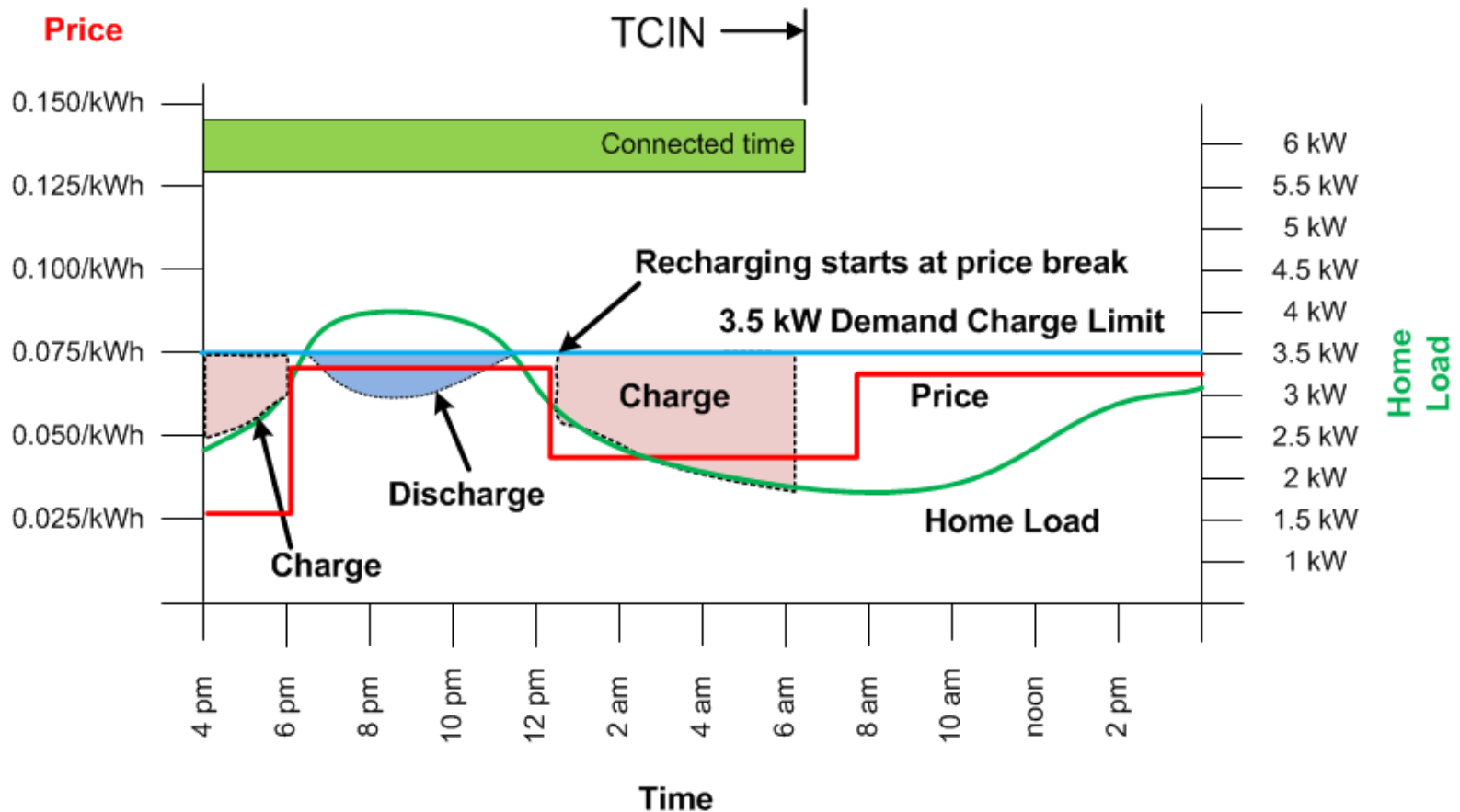
Dynamic FlowReservation - Charging (Transactive Charging)

Compare previous day of week meter loads (predictive or historical data) with current (or actual) to contain the vehicle charging power below any Demand Charge limits.



Distributed Energy Resources (DER) (Transactive Energy – charge/discharge)

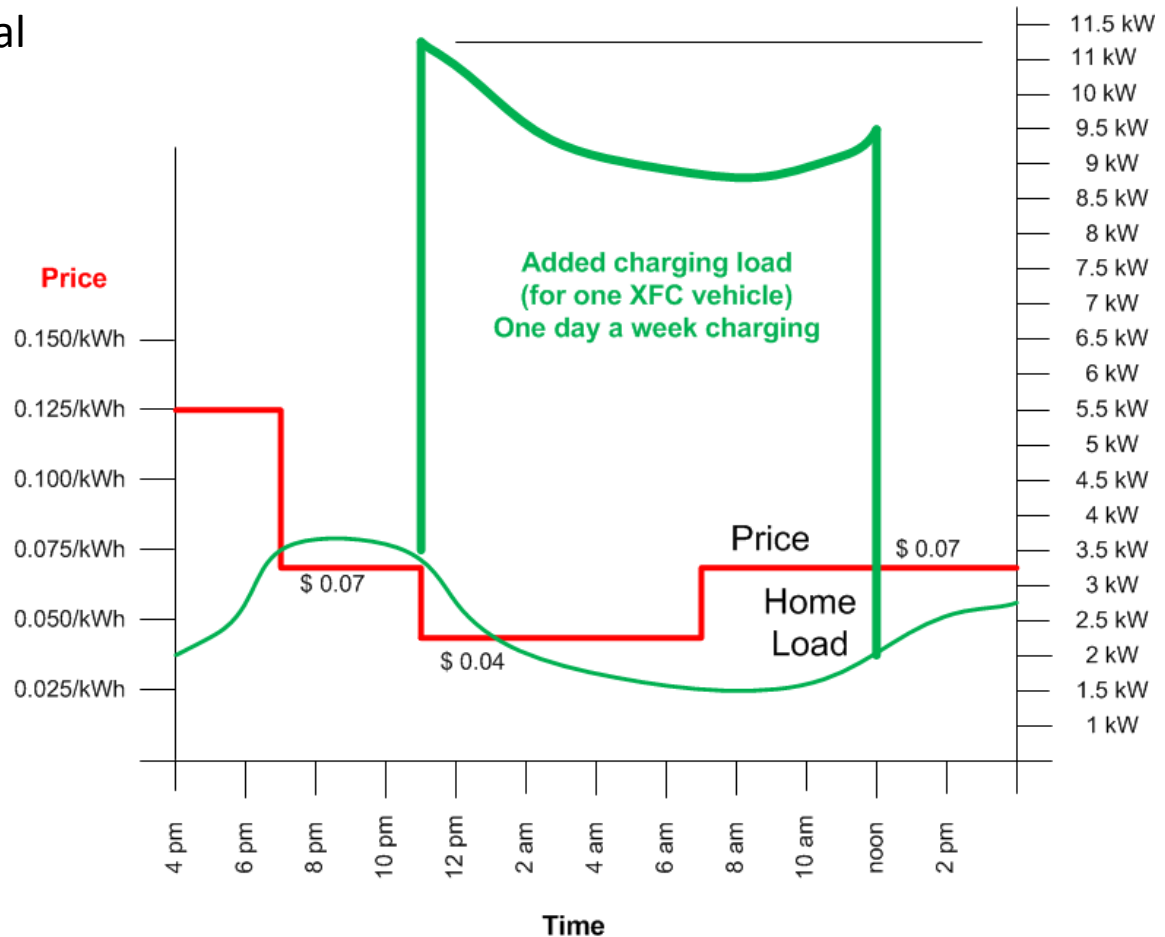
Discharge to shave peak (keep it below a Demand Charge limit), then recharge when home peak is lower, at lower cost.



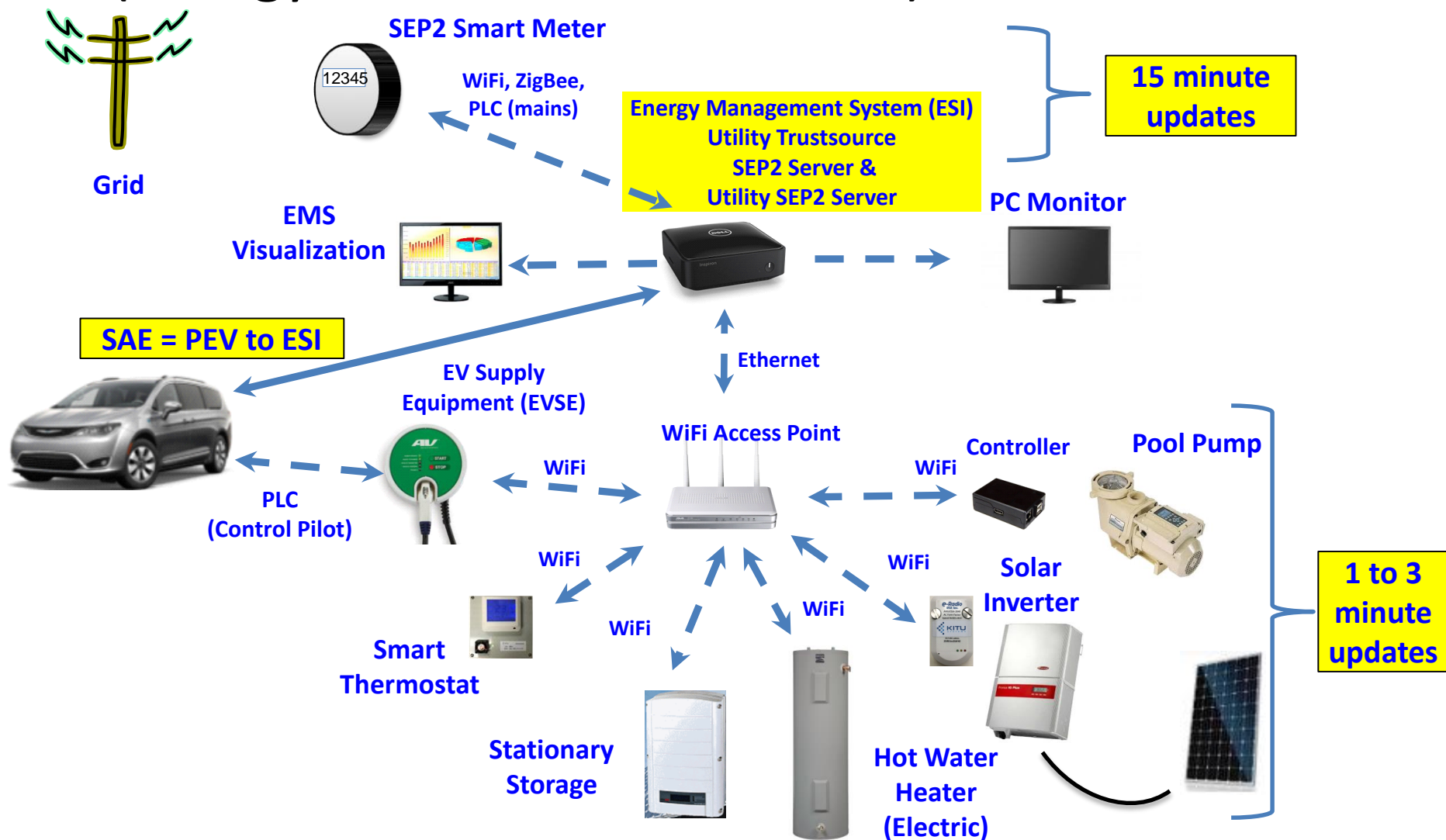
High Power Charging – home effects

(one vehicle) - It's not just about 150-400 kW DC charging

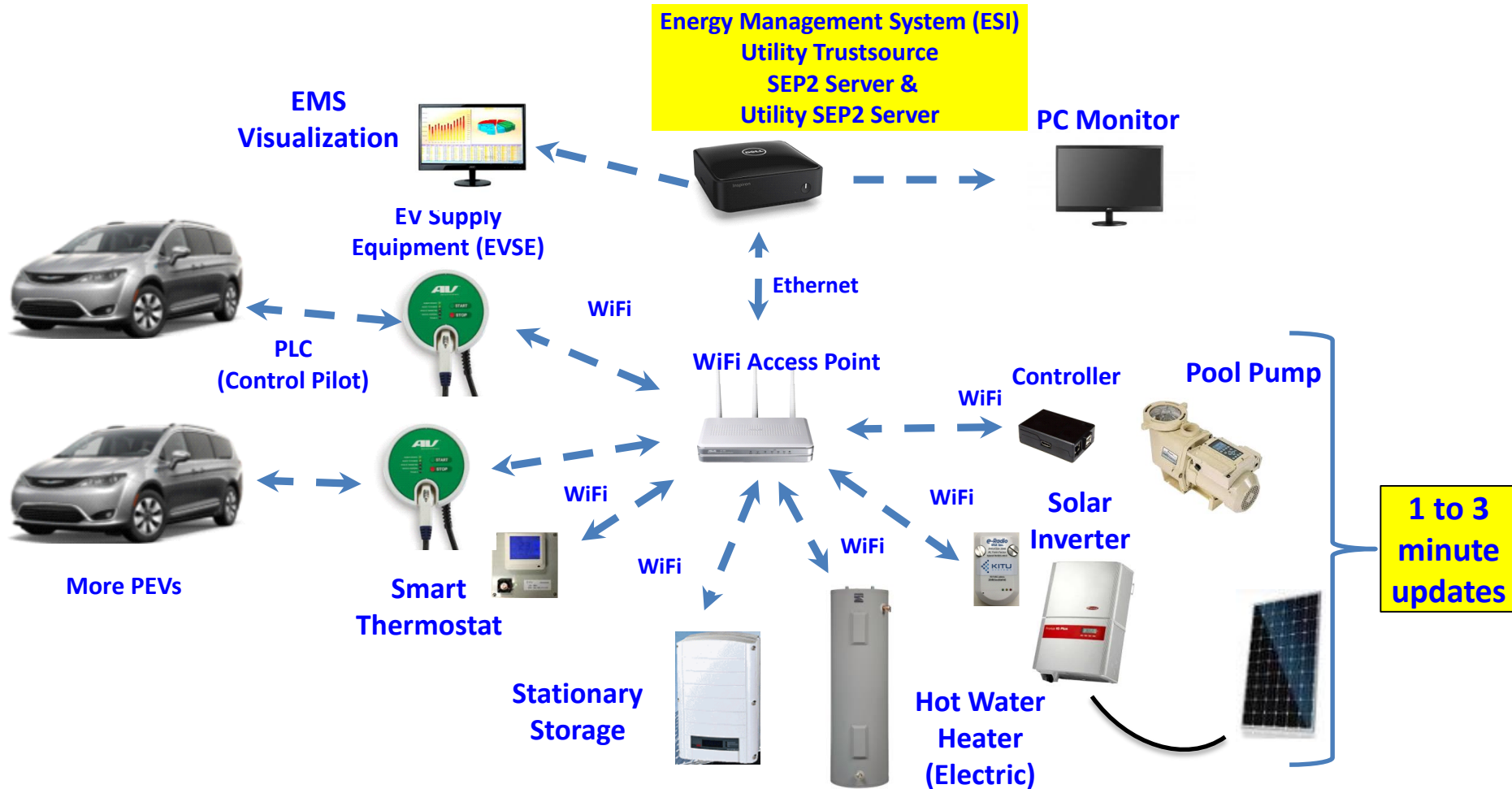
- One 12 hour charge/week, vs. several daily 2 hour charges
- Amplifies the need for Home Energy Management



Home Area Network – AC charging/DER (Energy Service Interface - ESI) PEV to ESI com

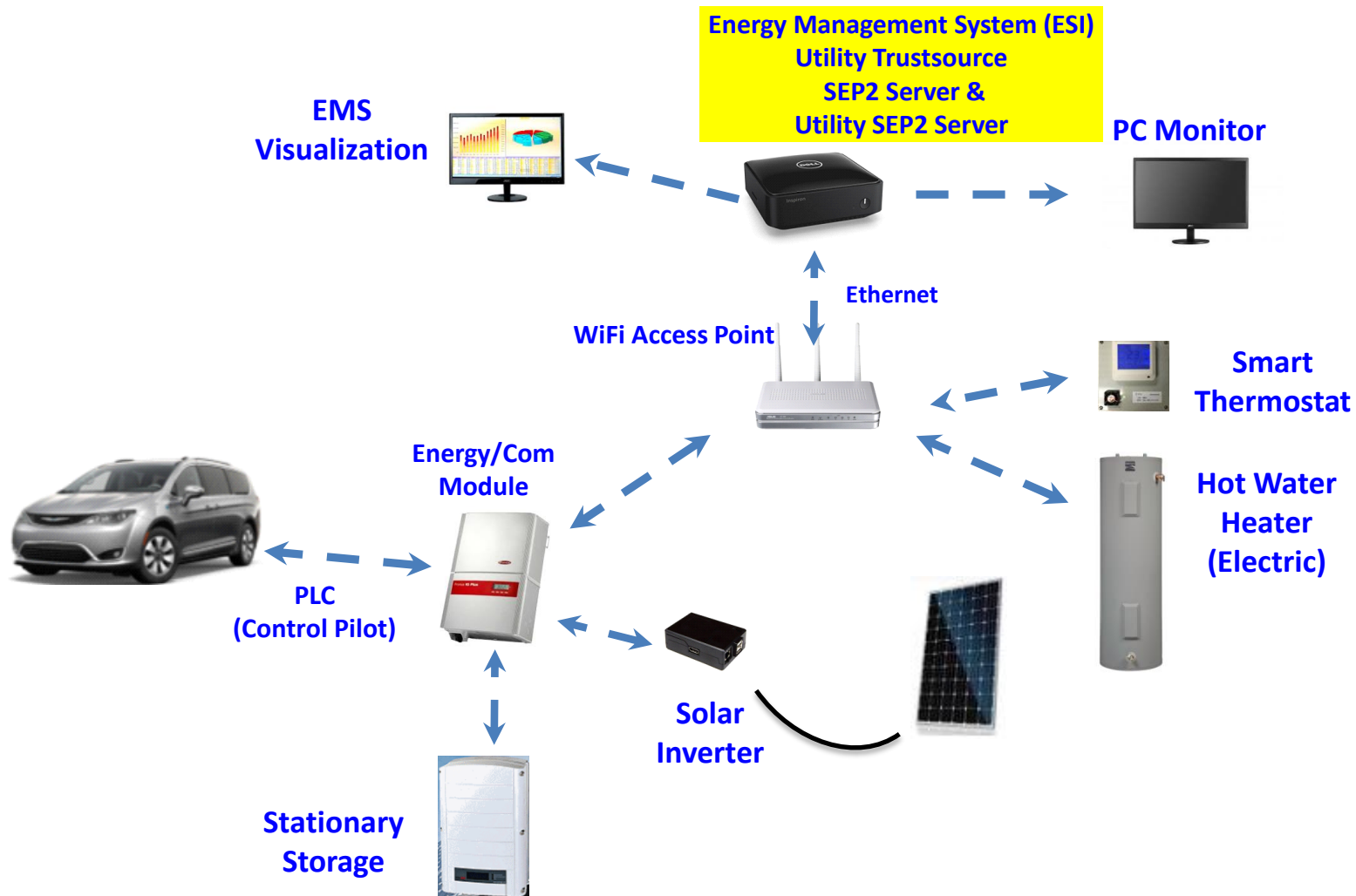


Home/fleet/public Area Network (Local EMS option – no Utility signals provided)



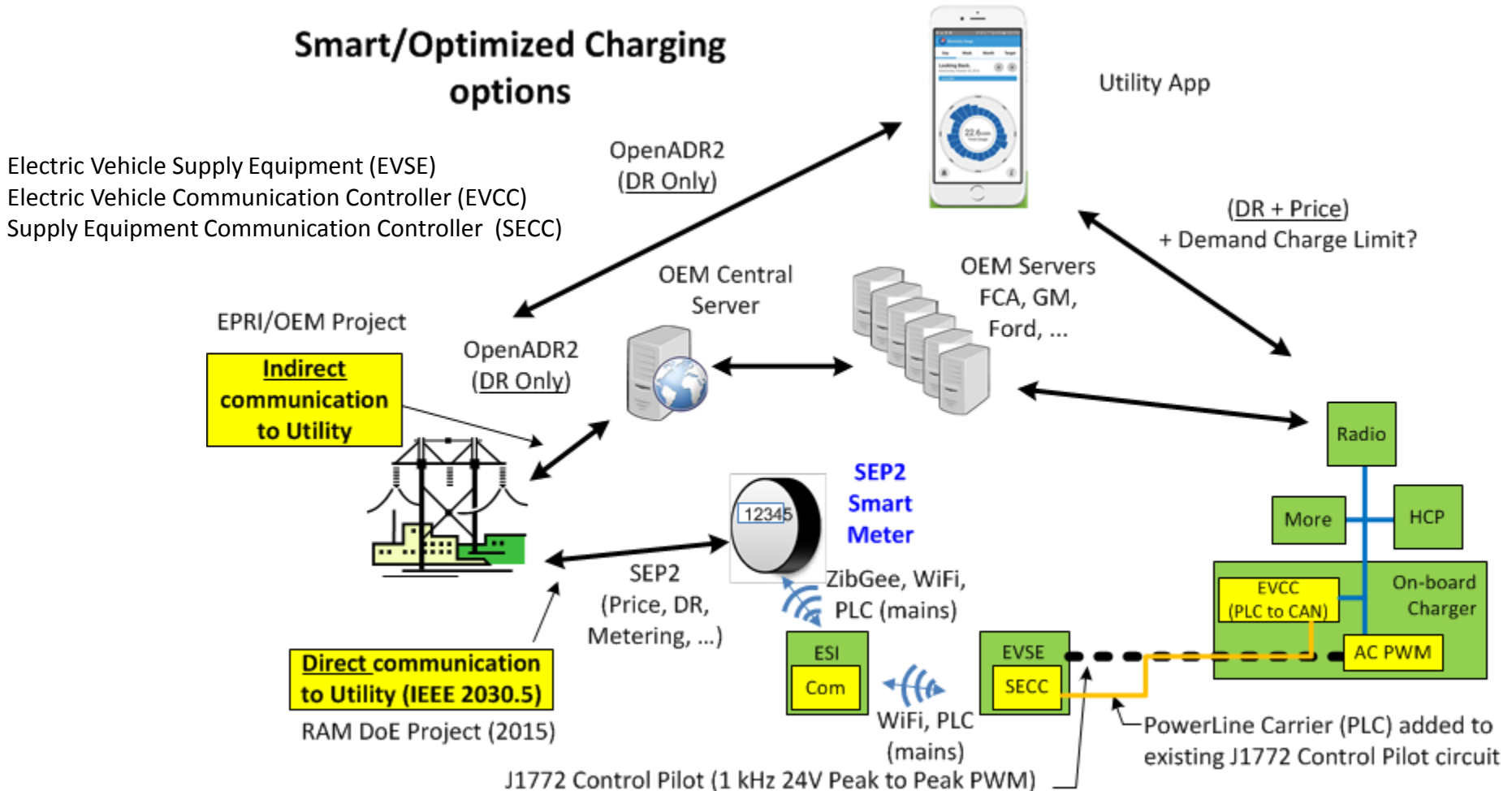
Customer or site owner knows price, Demand Response limits, etc.

Home Area Network – DC charging/DER

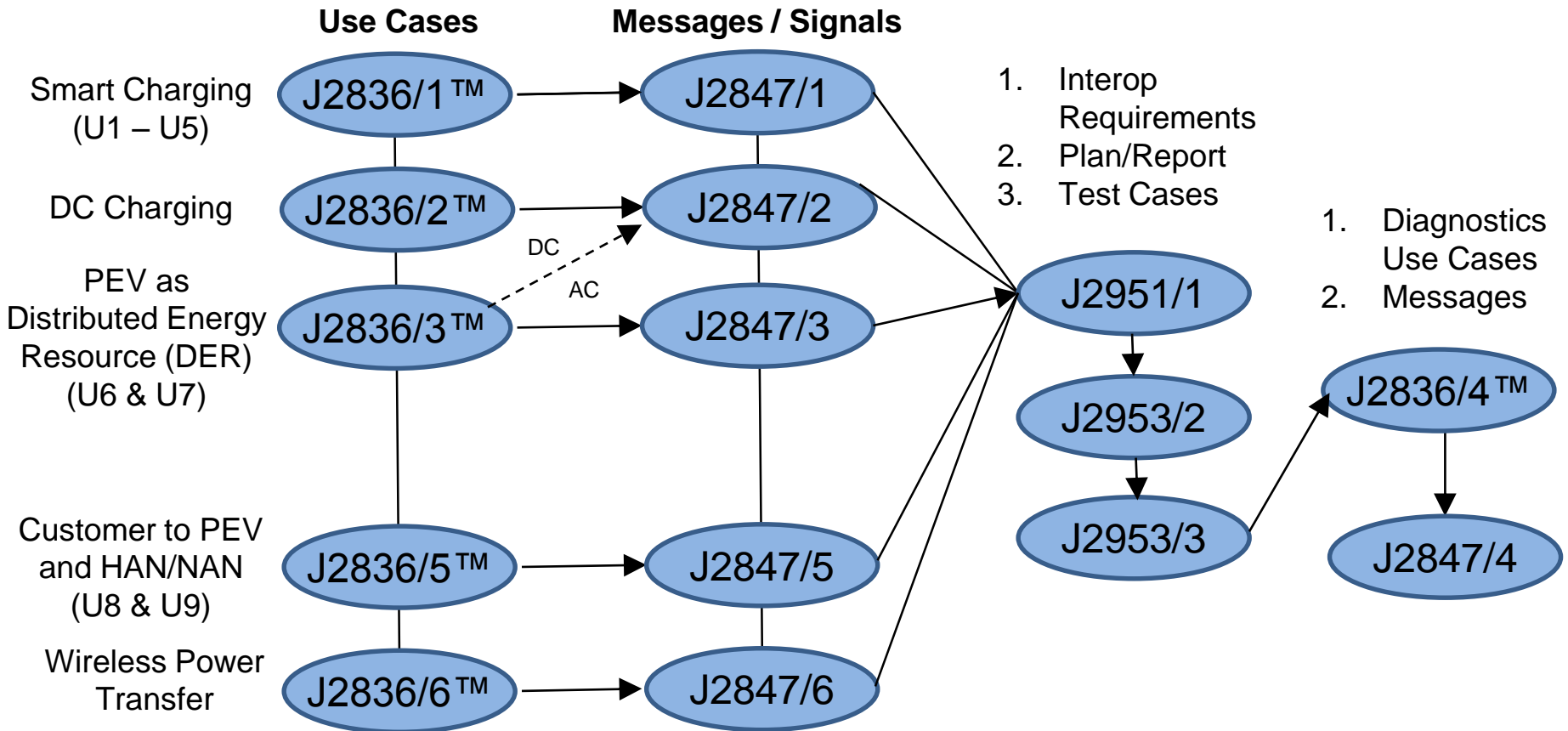


Direct vs. Indirect

- Indirect is Charging and applying DR only, potentially adding price (thru utility app)
- Direct is Charging & DER



Interoperability & Diagnostics Flow



Conformance:

- ISO 15118-4 Ed.1: Road vehicles — Vehicle to grid communication interface
 - Part 4: Network and application protocol conformance test (J2953 is Interoperability)
- ISO 15118-5 Ed.1: Road vehicles - Vehicle to grid communication interface
 - Part 5: Physical and data link layer conformance test (J2953 is Interoperability)
- DIN Spec 70122 – Conformance for DIN SPEC 70121:2014

Summary

- Older neighborhoods may have limits on distribution circuits and transformers.
 - Most 25 kVA transformers feed 5-10 homes.
 - These transformers can be overloaded 150-200% for hours but need to cool at night. This will not occur if vehicles start charging at night, providing further stress on these (reduces reliability).
- Smart Energy Profile 1.x has been used for decades for Price and DR programs in areas that require more control of loads to stabilize the grid.
- SEP2 continues SEP1.x function sets and adds more including Optimized charging & DER for PEVs.
- Price and DR Utility programs are used since most homes have A/C and electric hot water heaters that cycle periodically and are generally predictable. Once more homes install an EVSE (or more than one), Home Energy Management is required since PEV charging will never be predictable. It is always different times and amounts each day.
- HPC adds further extended loads (10-12 hours continuous but not every day vs. 2 hour periods each day).

Conclusion

Education and Awareness suggestions

Customers:

- Overnight charging could be at lower charge rates (3.3 kW vs. 6.6) for less impact to the grid and still meet TCIN.
- If a weekend trip is planned, don't wait until Friday evening and expect a 12 hour interrupted charge. Keep the vehicle charged or use a Fast Charge station as options prior to the trip.
- Consider adding stationary storage as a potential less expensive option to solar. Not a generating source, but still balances loads and a source for PEV charging that may not be preplanned.

Utilities:

- Expect to manage loads downstream from transformer, not only within each home.
 - One neighbor's solar can charge another's stationary storage. Balances energy downstream of transformer.
 - Allow more for homes that "need it" when neighbors are "gone for a week, or the season"