U.S. DEPARTMENT OF ENERGY

Office of ENERGY EFFICIENCY & RENEWABLE ENERGY

Advanced Grid Research
OFFICE OF ELECTRICITY
US DEPARTMENT OF ENERGY

# New Technology Implications

- Technologies being considered to manage charging loads (DER, microgrids, energy management)





- Rich Scholer

Chair SAE Hybrid Communication and Interoperability Task Force

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- Managed charging
  - Price, DR, FlowReservation
- DER

# Energy Control Classifications

**RPF: Reverse Power Flow V2X**

- V2L: Vehicle-to-load
- V2H: Vehicle-to-home
- V2V: Vehicle-to-Vehicle
- **V2G**: Vehicle-to-grid

**VGI: Vehicle-Grid Integration**

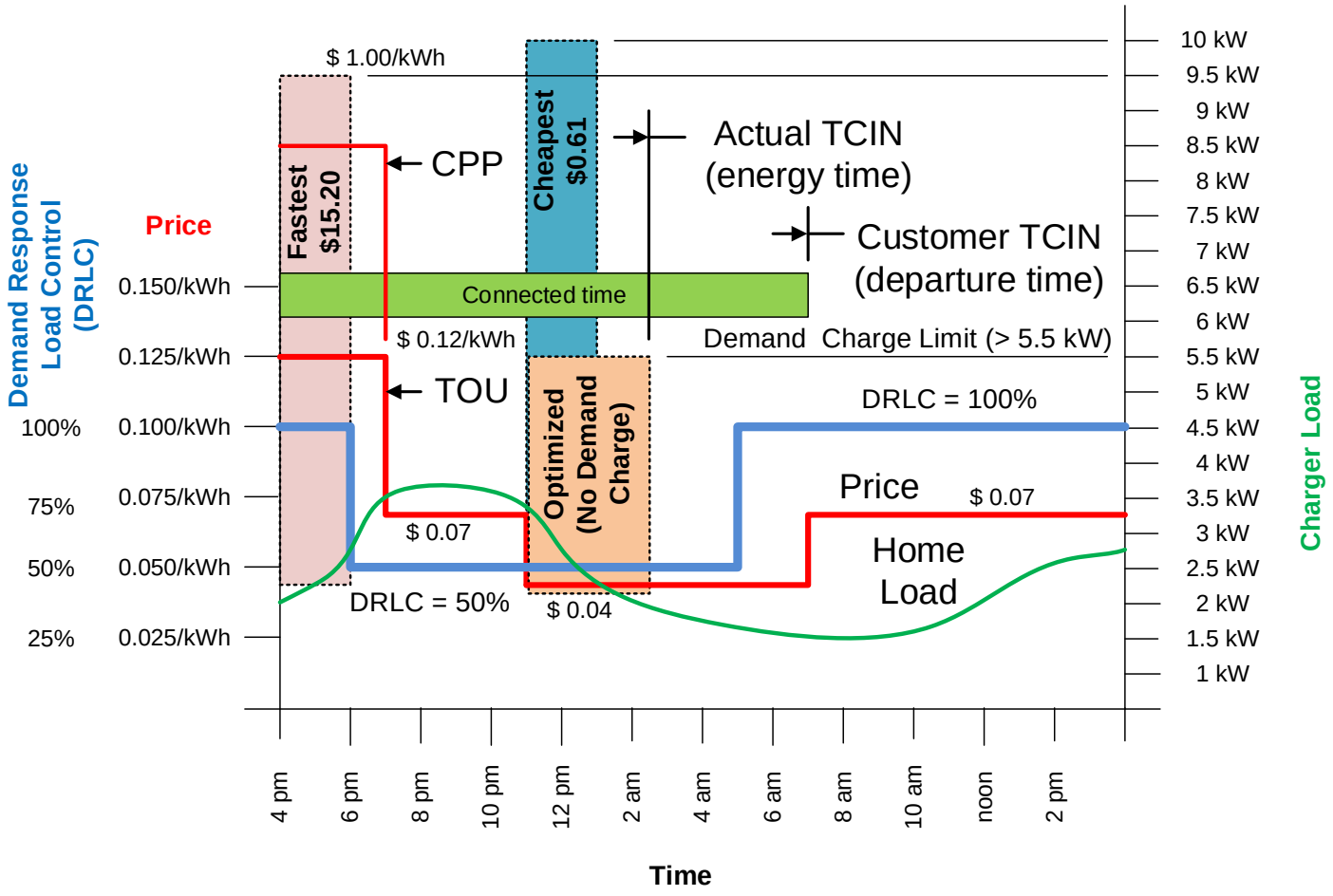
- **V1G**: (Smart/Optimized/Managed Charging)

**FPF: Forward Power Flow**

- Price Based charging
  - Choose lowest price period to charge while connected
- Demand Response Load Control
  - Delay and/or Reduce charging power
- FlowReservation
  - Exchange Power, Energy, Time Charge Is Needed (TCIN) between vehicle and management system
- Demand Charge Limits
  - Stay below limits on vehicle charging power – include other site loads

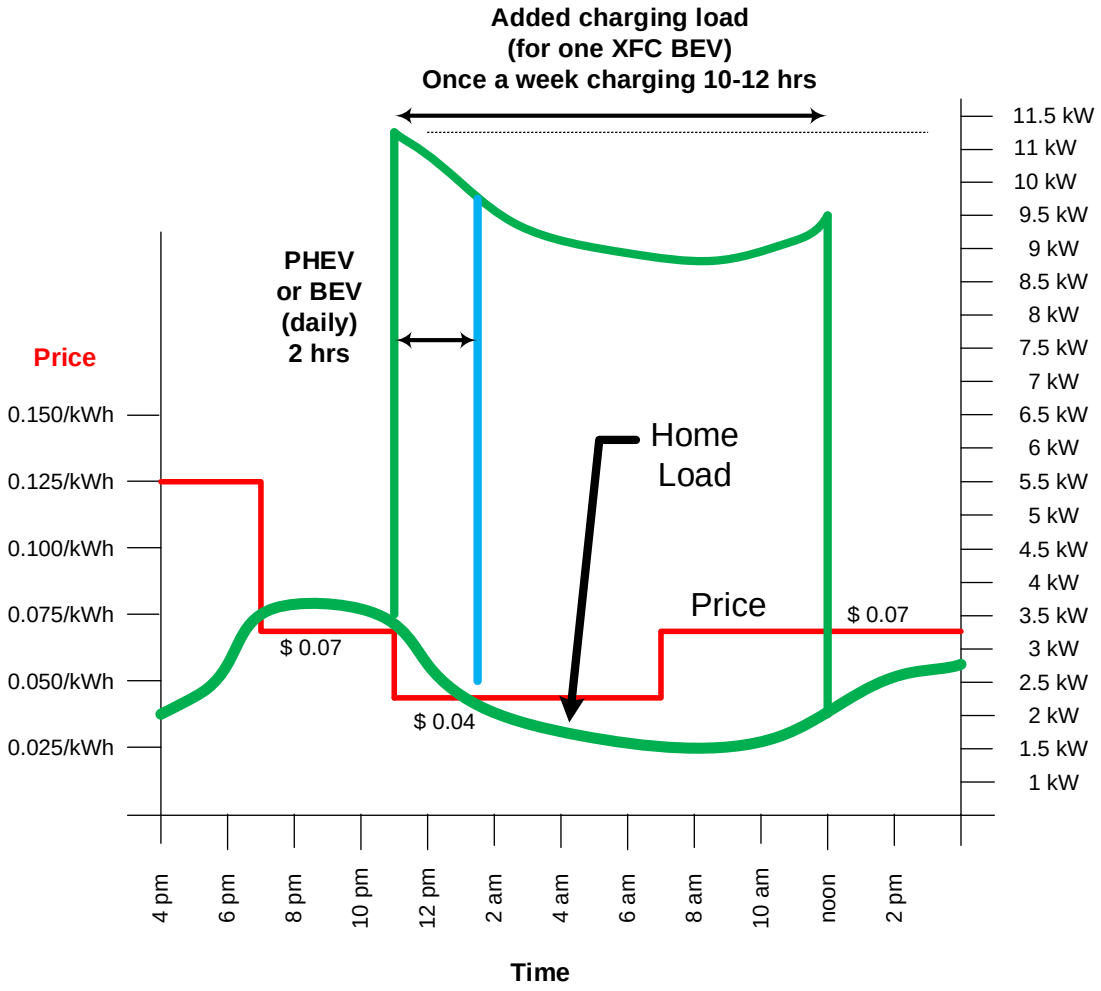
# Scheduled charging

## Bulk Charging – shifts start time (Price based)



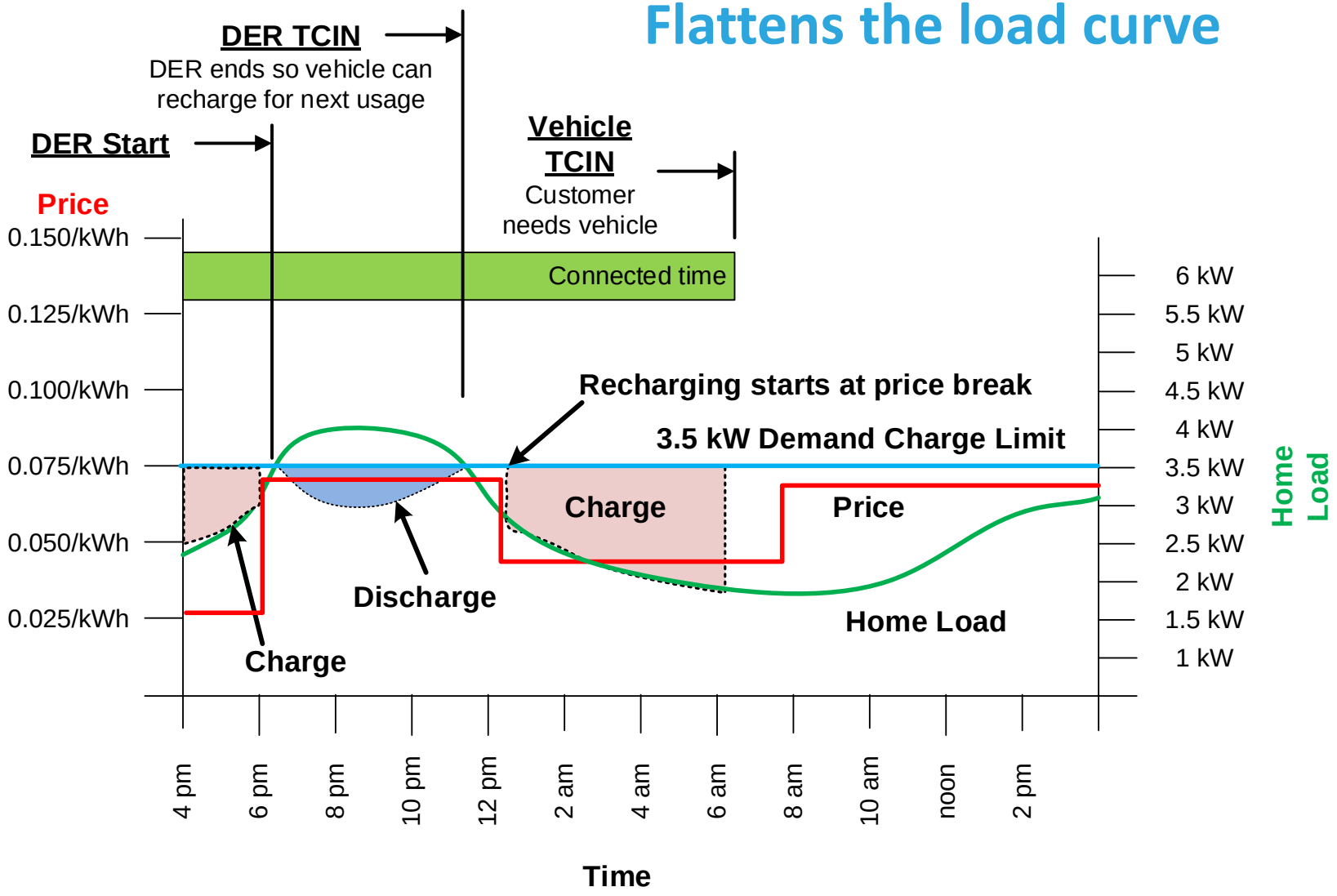
# Add Extended range BEVs

## Occurrence: once or twice a week



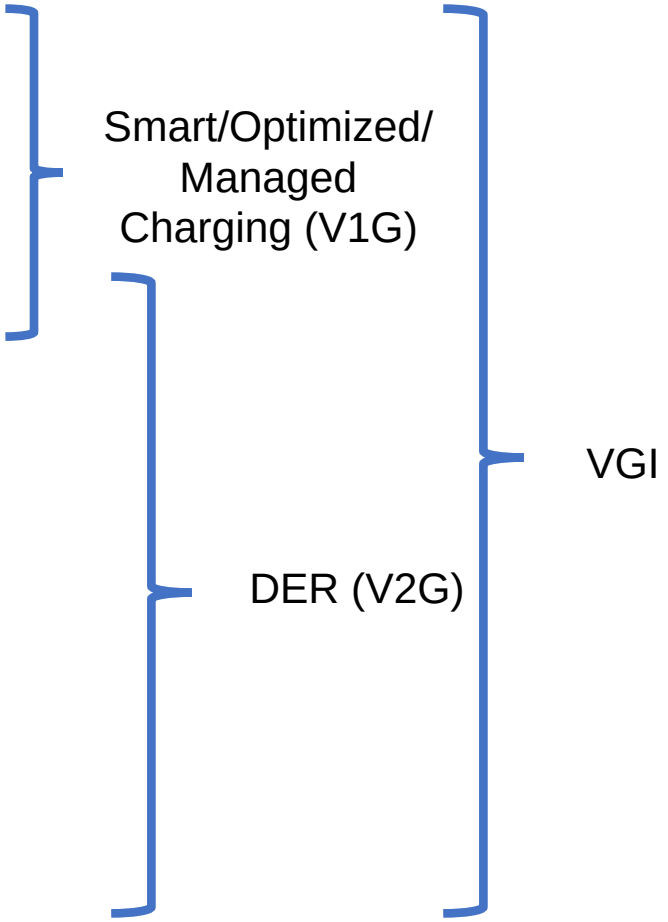
# Managed charging and DER

## Flattens the load curve



# VGI Use Cases/Functions

| SAE Use Case | | VAR | Purpose |
|---|---|---|---|
| U1 | Time of Use (Seasonal Price) | | V1G |
| U2 | Demand Response (Stop, curtail) | | V1G |
| U3 | Real Time Pricing (5 min Price) | | V1G |
| U4 | Critical Peak Pricing (day ahead price) | | V1G |
| U5 | Flow Reservation | | V1G/V2G |
| U6 | Coordinated Charge/Discharge | | V1G/V2G |
| U7 | Constant Power Factor Mode | YES | IEEE 1547 |
| U7 | Constant Reactive Power Mode | YES | IEEE 1547 |
| U7 | Voltage - Reactive Power Mode | YES | IEEE 1547 |
| U7 | Active Power-Reactive Power Mode | YES | IEEE 1547 |
| U7 | Voltage – Active Power Mode | | IEEE 1547 |
| U7 | Frequency Droop Mode | | IEEE 1547 |
| U7 | Voltage Trip | | IEEE 1547 |
| U7 | Frequency Trip | | IEEE 1547 |



# Framing questions

1. What new technologies are needed at the customer end to manage loads and charging costs with EVs at scale (DER, microgrids, energy management)?
    a) What utility involvement is needed?

Need to apply existing technology for HAN/EMS to manage loads at homes.

Include DC charger with solar and/or stationary storage inverters for bidirectional capabilities.

DC/DC is more efficient than DC/AC/DC (vehicle charging), use common resources (single package).

2. What new approaches, strategies, or technologies are needed to manage charging so that curtailed renewable resources (e.g., PV, wind) can be better utilized?
    a) What are effective grid integration techniques for managing charging load (like price signaling)?

Insure the customer knows the value for managed charging and DER functions. Price and DR signals used alone, are not sufficient for this.

3. What are the foundational grid technologies needed for wide scale EV adoption?

Planning tools need to be implemented for anticipated grid events to match vehicle availability for charging and DER functions.

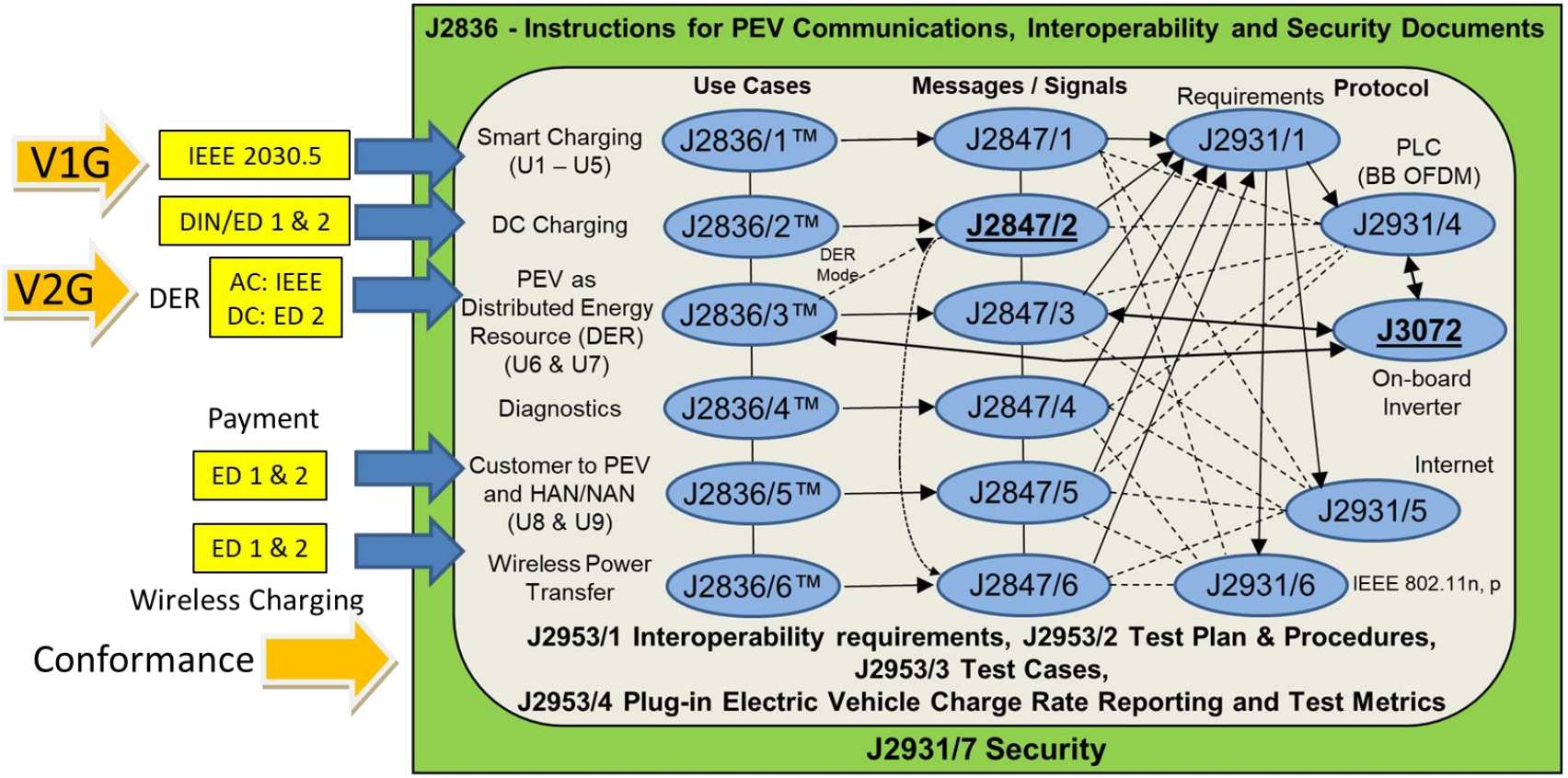
4. What are the gaps in data, communication, and controls capabilities and requirements that need to be filled (standards, protocols, coordination)?

Coordination between utilities, OEMs and customers to implement effective programs to match locations.

# Backup

# SAE VGI Documents

## SAE/IEEE/ISO/DIN common material




DIN/ISO: DIN 70121:2014, :2020, ISO 15118 ED 1, ED 2

DER: J2847/2 for DC DER using ISO ED 2 (BPT), J2847/3 for AC DER using IEEE 2030.5, 1547-1, .1