DTE Energy®

Managing EV Load
Workplace Charging Project
Utility Perspective

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DTE Energy is an Integrated Energy Company

Strong, Stable and Growing Utilities
Fully Regulated by Michigan Public Service Commission

~80% of total earnings

DTE Electric
- *Electric generation and distribution*
- *2.2 million customers*

DTE Gas
- *Natural gas transmission, storage and distribution*
- *1.2 million customers*

Complementary Non-Utility Businesses

~20% of total earnings

Gas Storage & Pipelines
- *Transport and store natural gas*
- *4 pipelines, 2 storage sites*

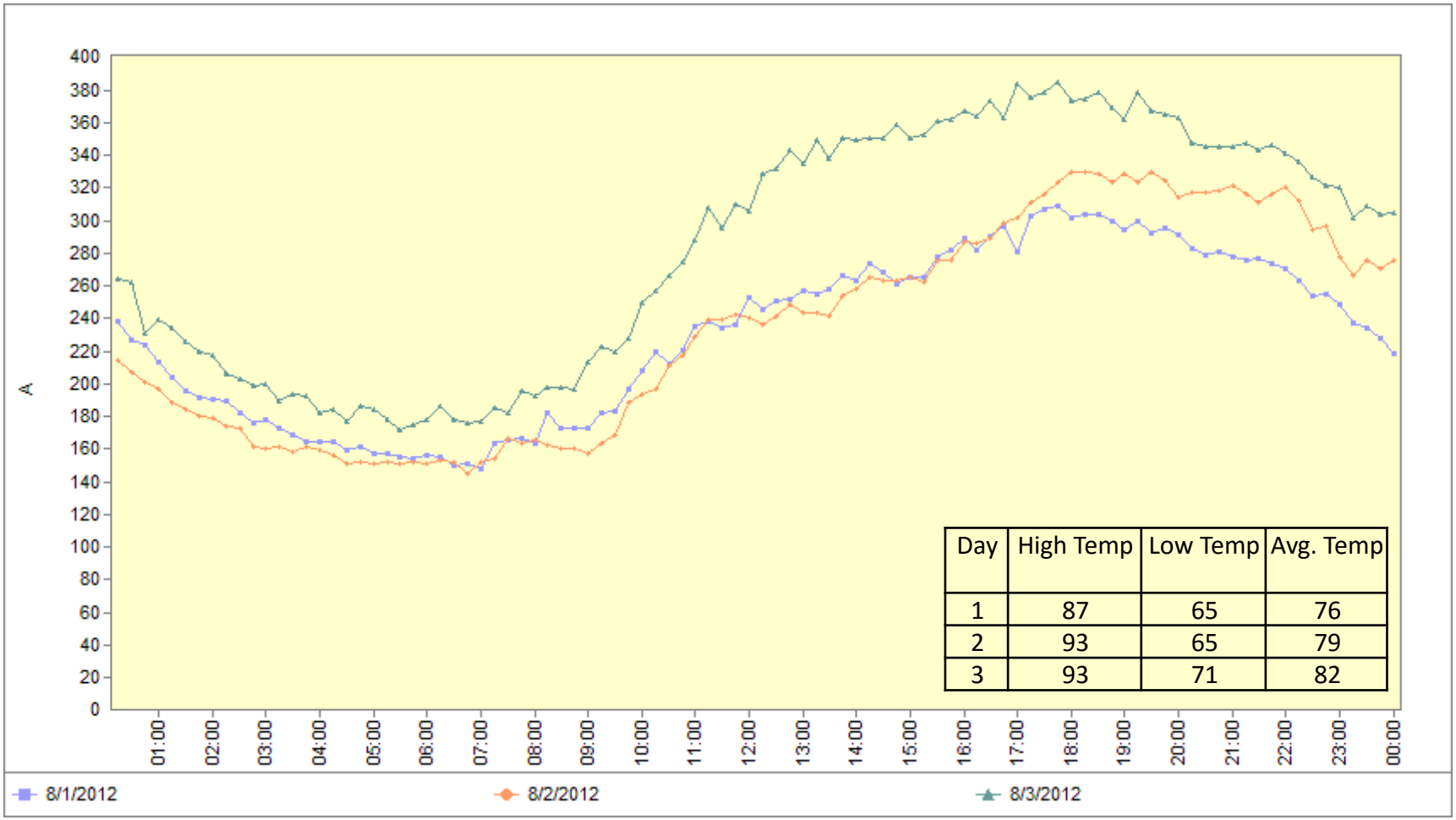
Power & Industrial Projects
- *Own and operate energy related assets*
- *66 sites, 17 states*

Energy Trading
Generates economic value and provide strategic benefits

Agenda

- Why manage EV load?
- Local level
- System level
- Renewable variability
- Workplace charging
- Interoperability & standards

Residential Distribution Circuit Load Graph
Summer 2012 high temperature days



Day	High Temp	Low Temp	Avg. Temp
1	87	65	76
2	93	65	79
3	93	71	82

Residential Experimental PEV Rate

- **PEV rate approved in August 2010 – 2,500 limit**
- **Choice of two Experimental Electric Vehicle Rate options:**
  - **Option 1- Time of Use Rate**
  - **Option 2 - A Flat Rate (250 customer cap)**
- **Both options required a separately meter service**
- **An incentive up to $2,500 was offered to offset the purchase and installation costs for a Level 2 EVSE**

Option1: Time of Use Rate Option

On-Peak: $0.18195 kWh*
Off-Peak: $0.07695 kWh*

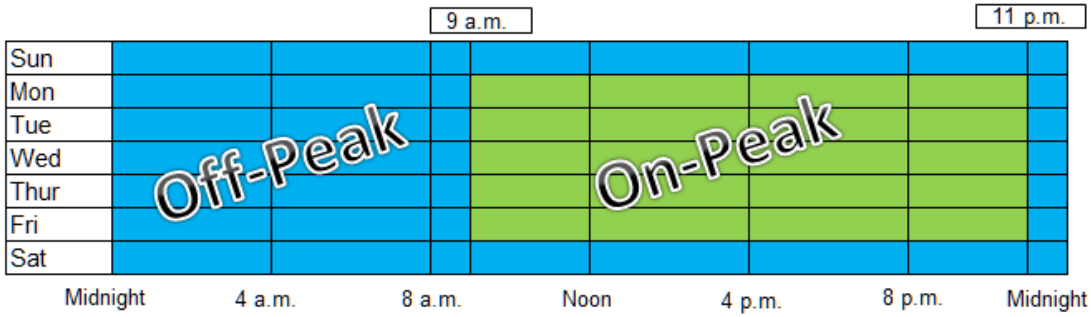
On-Peak: All kWh used between 9am and 11pm Monday- Friday
Off-Peak: All other kWh used.

*Prices do not include applicable surcharges and taxes

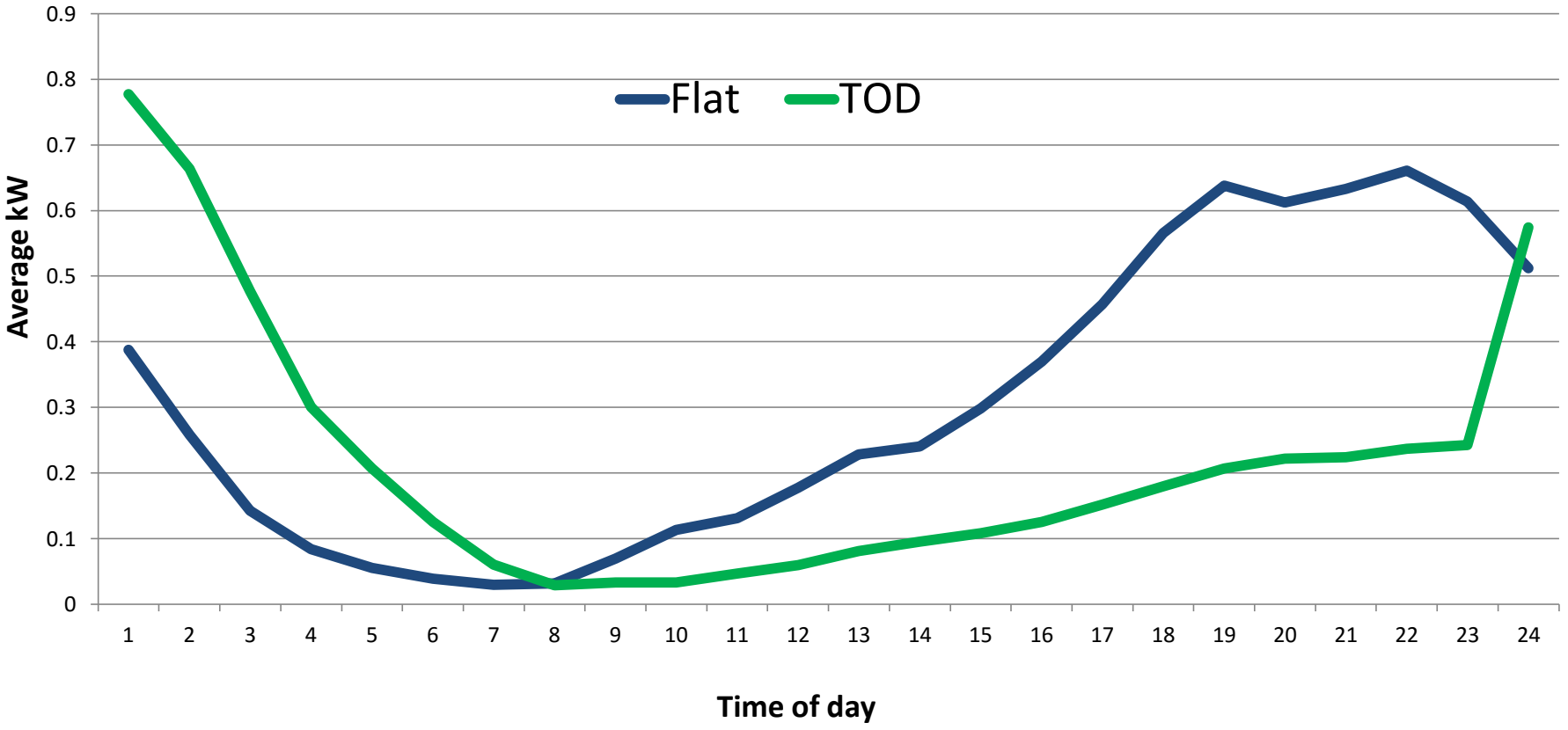
Option 2: Flat Rate Option

$40 per month + applicable surcharges and taxes.

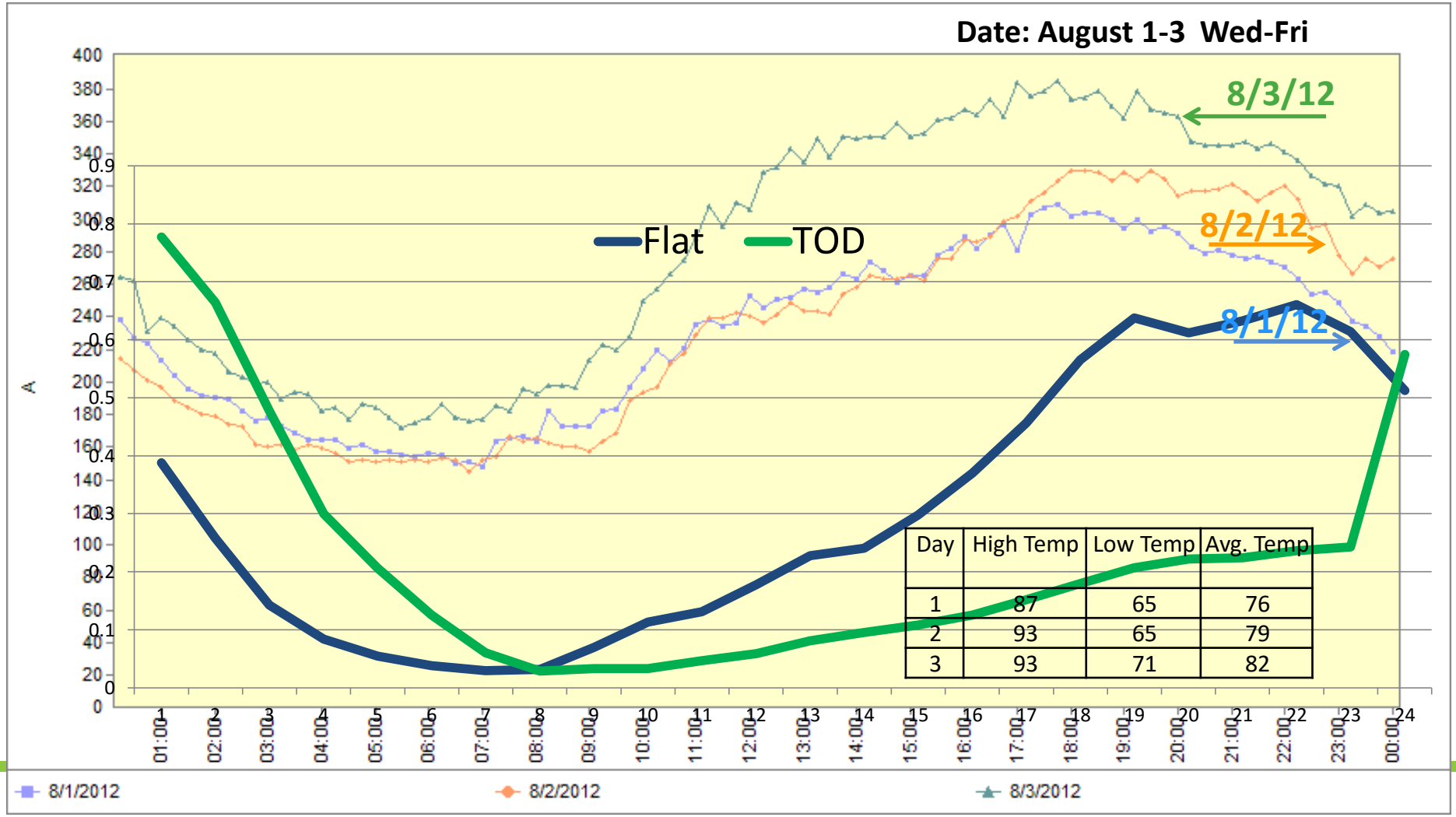
Time of Use Rate



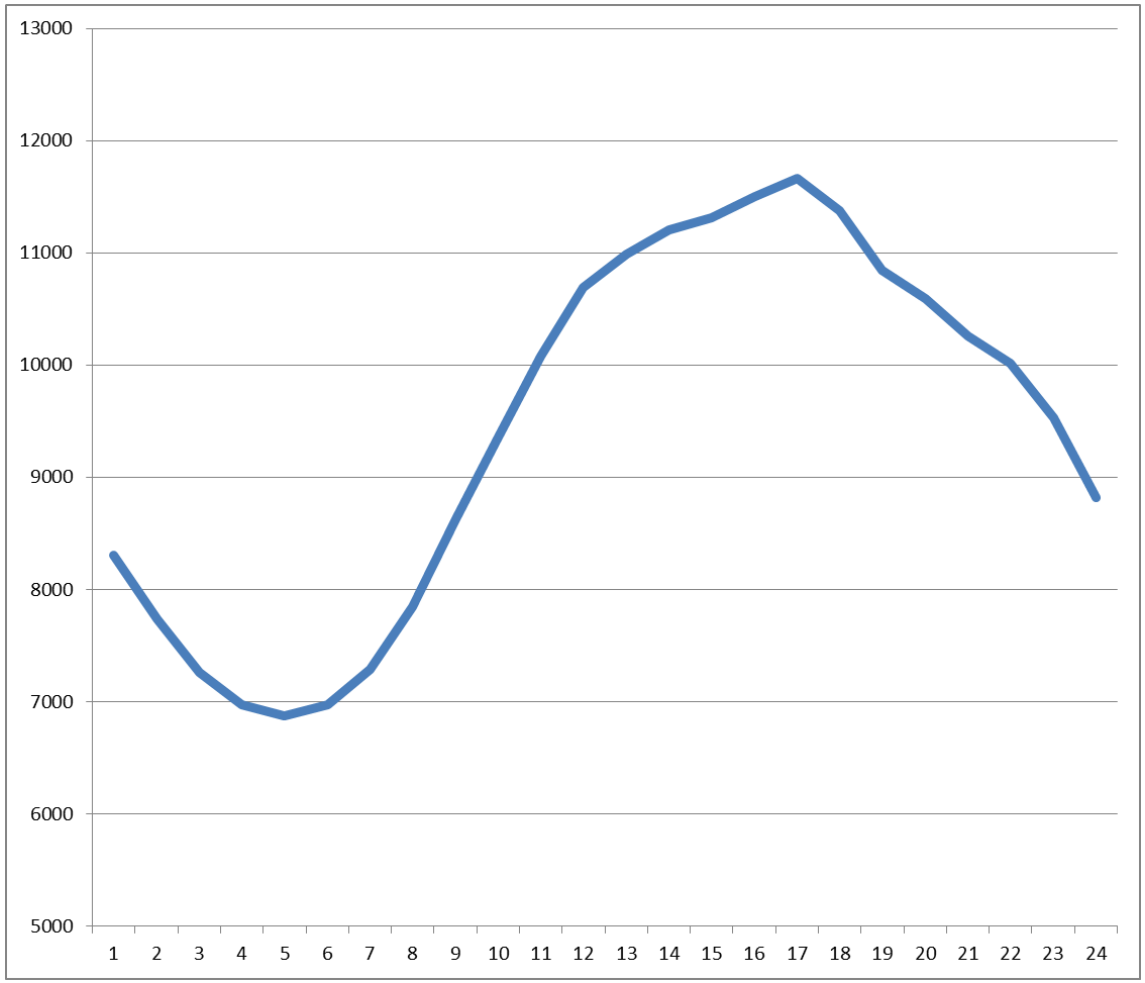
Residential Charging - Pilot PEV Rate
Average Demand - TOU vs Flat Rate



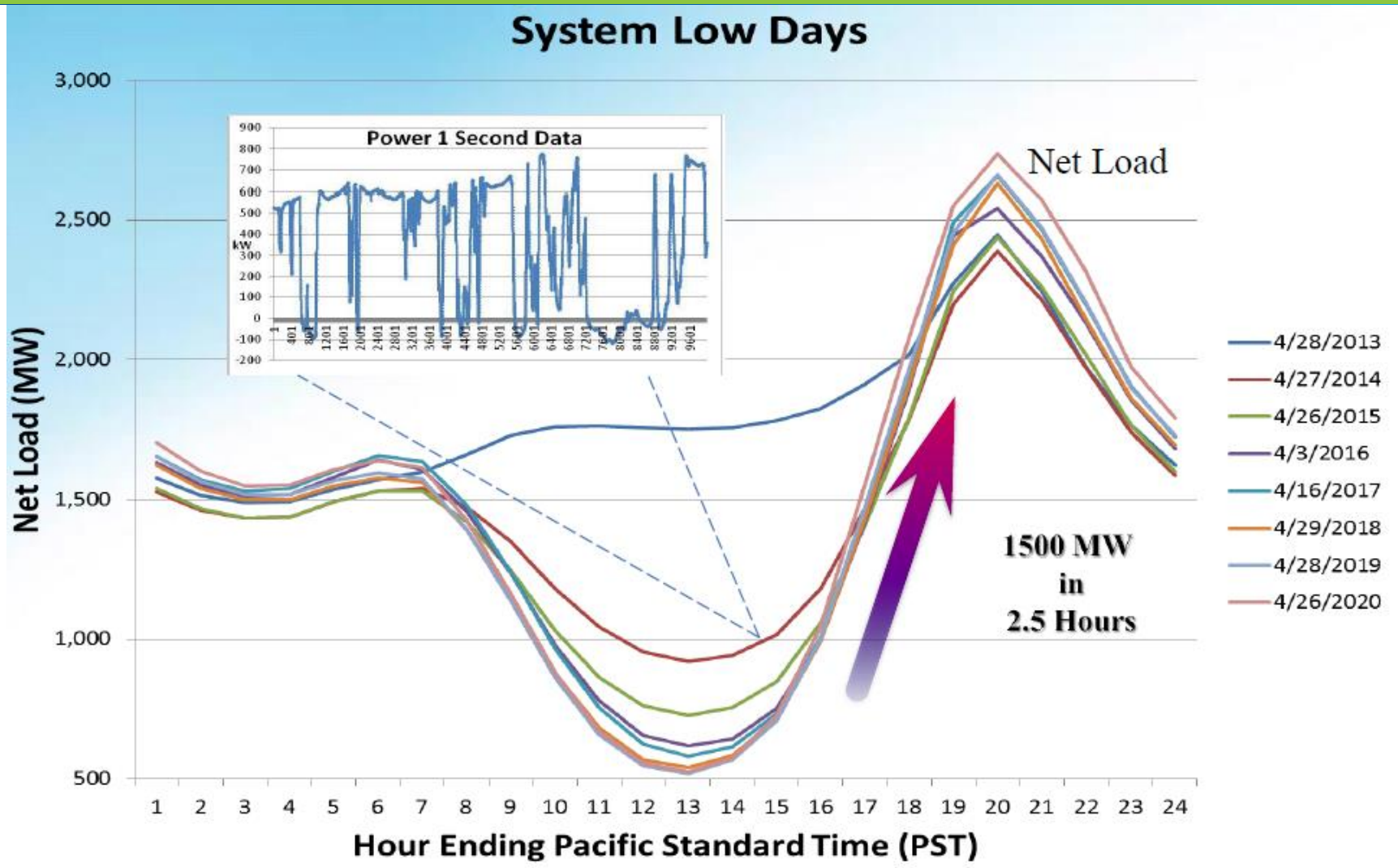
Distribution circuit load graphs
Summer 2012 high temperature days



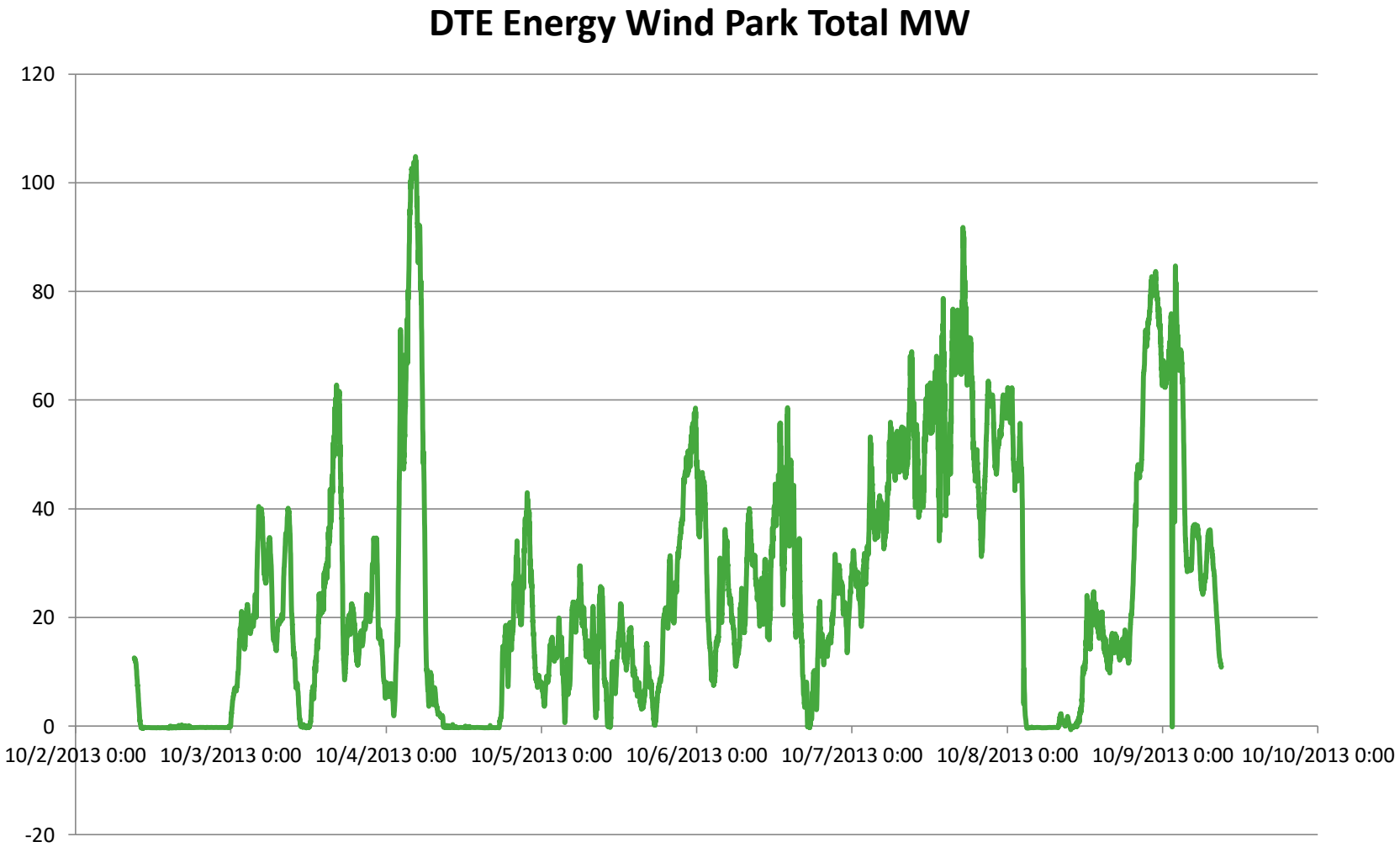
Typical system summer load curve – how to manage morning ramp rate with workplace chargers



California - SDG&E System Load



Wind production is variable



Workplace Smart Charging Project - DOE Funded

- **Install 24 charging stations in the DTE Energy HQ parking deck**
- **Utilize DTE's Tropos mesh network to communicate with head end software**
- **Upgraded existing infrastructure to support increased load from EVSEs**
- **Utility service was not upgraded – New LED lighting installed**

Delta's "smart grid-capable" Level-2 EVSE

DTE Energy

• Bi-directional communications between EVSE and energy service providers	• Zigbee bi-directional communication
• Revenue-grade metering	• 0.5% accuracy in operation range
• Advanced metering infrastructure (AMI)/Ethernet/power line communications (PLC)/Wi-Fi/cellular/ZigBee interface capable	• Zigbee interface to AMI meter / wi-fi
• Interface capable with in-home displays and home energy management systems	• Display and control through Home Energy Management System (HEMS) user interface
• Utility communication messaging	• Smart Energy Profile (SEP) 1.1 (Time synchronization, DRLC, Price information)
• Controls including direct load control at fixed percentage of EV load reduction, remote disconnect, etc.	• Charging current control through J1772 interface

Workplace Charging

DOE Project Task #1:

Workplace Charging EVSE Installations, 24 units

Includes the build and installation of 24 units of the EVSE, for installation and evaluation at DTEs downtown Detroit site

- 24 units are in operation

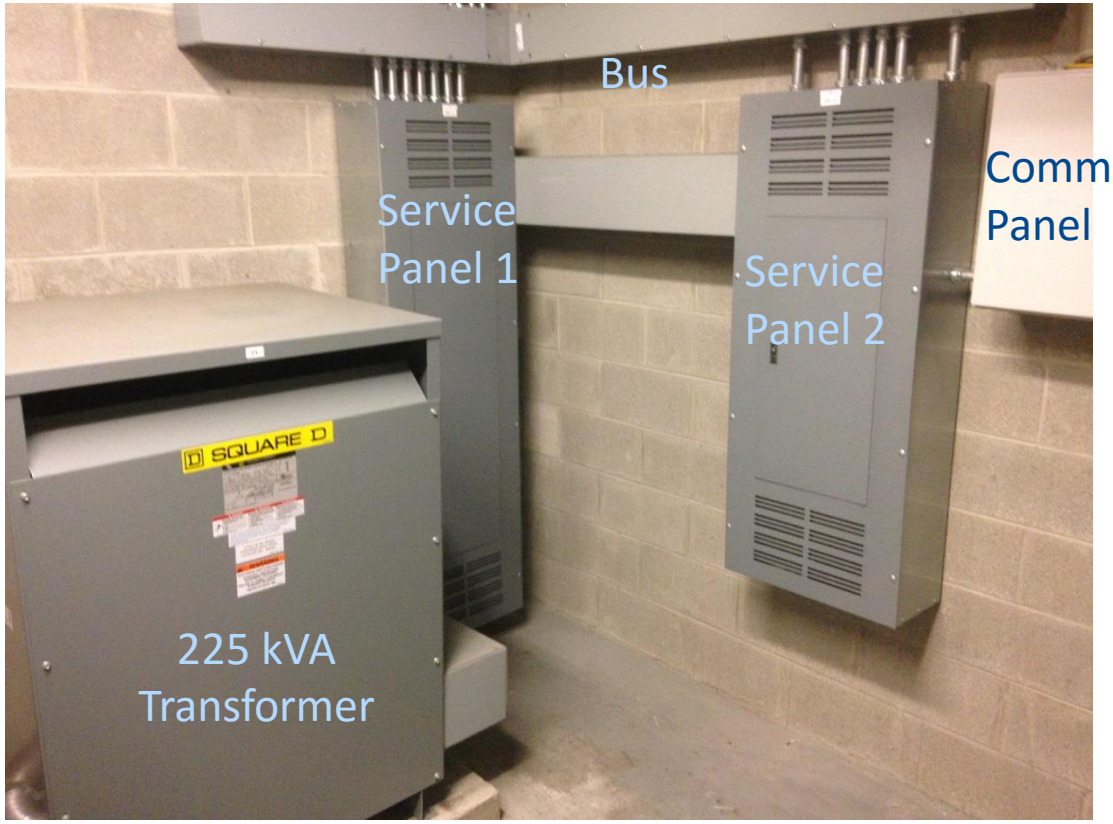
DOE Project Task #2

Monitoring and Network Software Installation.

This includes monitoring and evaluation of the EVSE performance in various scenarios anticipated by power company management, using the smart grid functions of the EVSEs, and network management software installed for this purpose.

- Software Installed:
  - Demand Response
  - Real-time monitoring
  - Charge Profiling
  - Data History

Infrastructure Upgrades



- 50kVA Transformer upgraded to 225 kVA
- Main breaker upgraded to 600 Amp
- 480/208 Volt transformer
- Upgraded existing service panel and added second service panel and bus
- Utility service was not upgraded – New LED lighting installed

EVSE Site

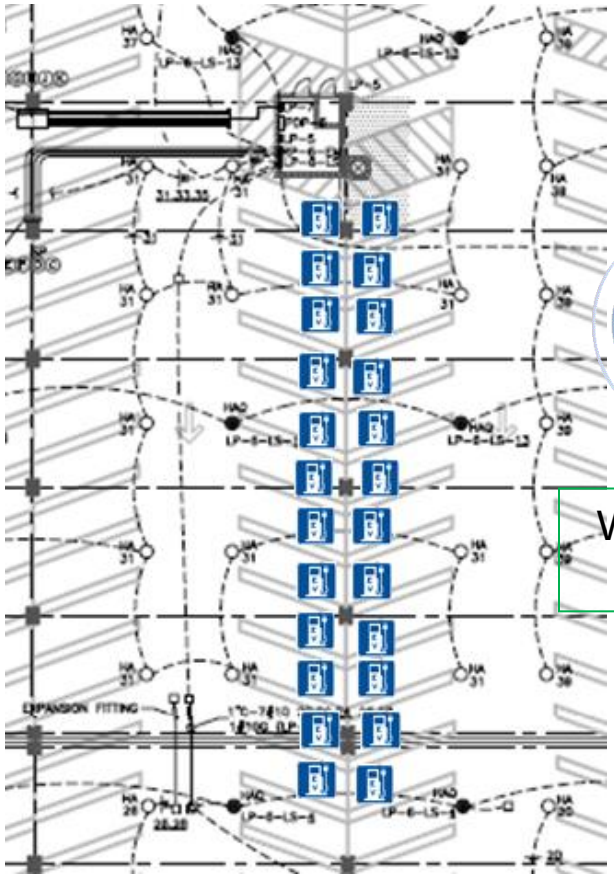
Total of 24 EVSEs
Four or five EVSEs around each column

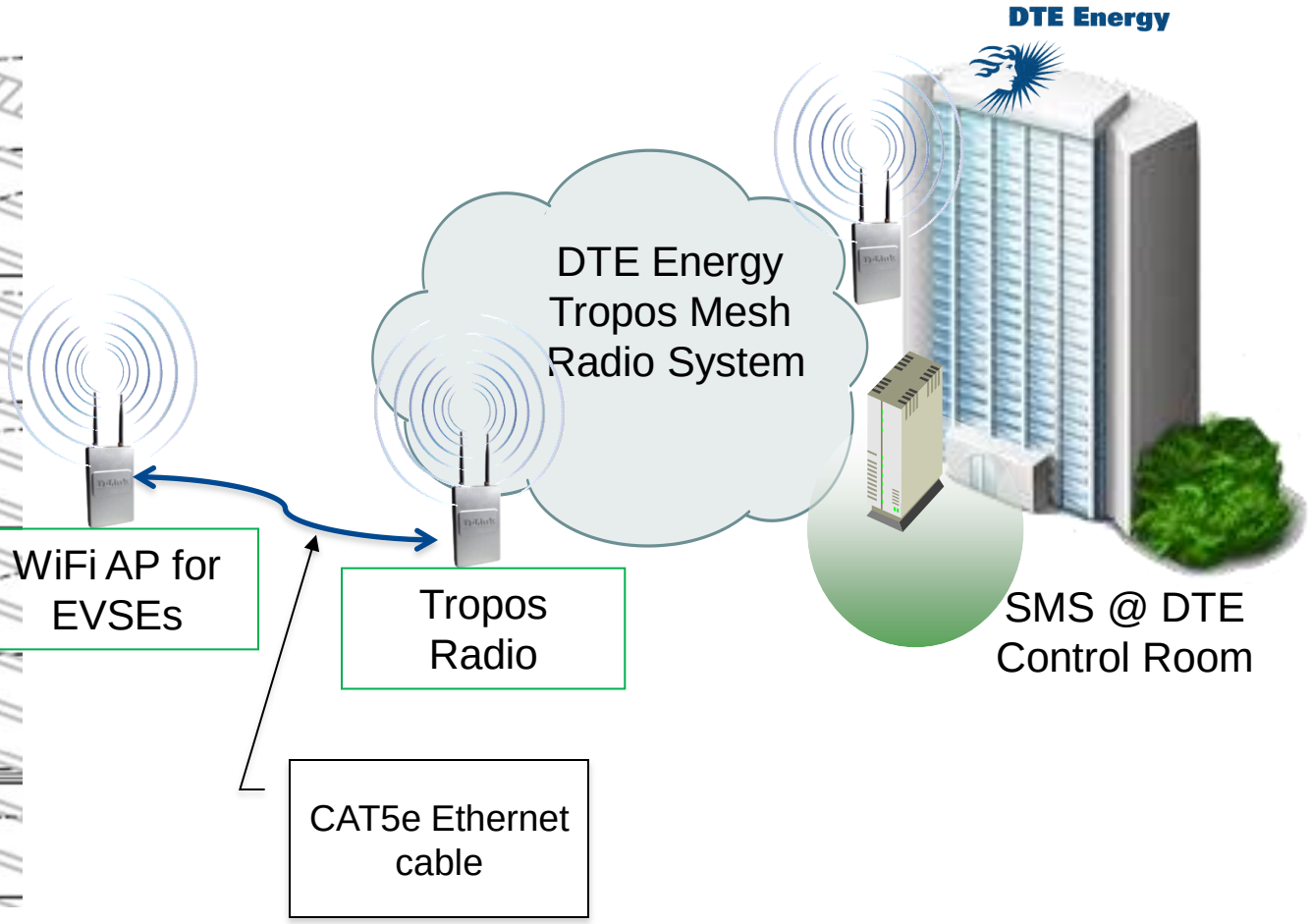
EVSE Site

Photo of the 2nd generation EVSE Prototype installed and under field trial at DTE's parking garage in downtown Detroit, MI.

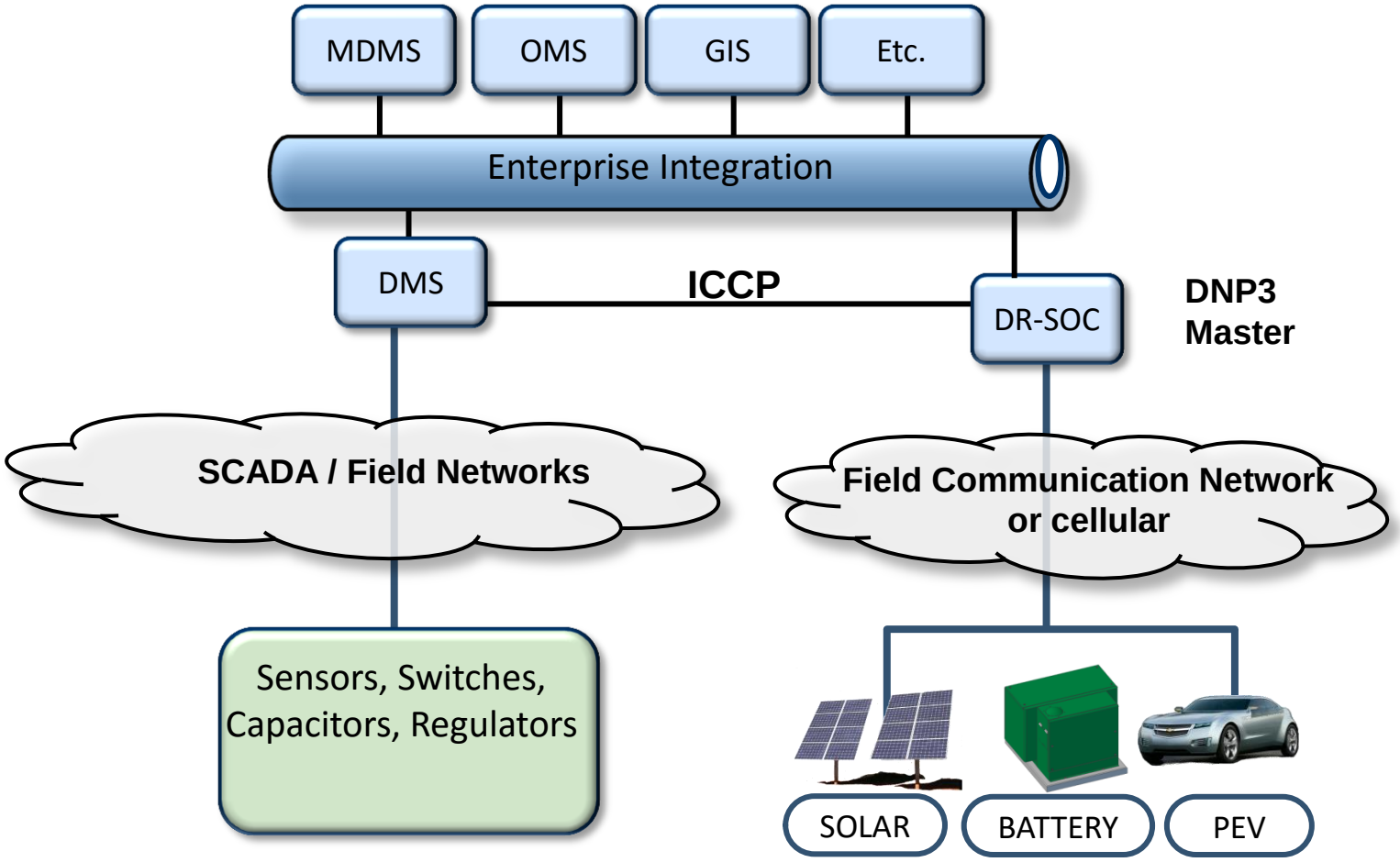
Guests viewing charging of Daimler Smart EV at the October 2014 demonstration event.

Network Architecture



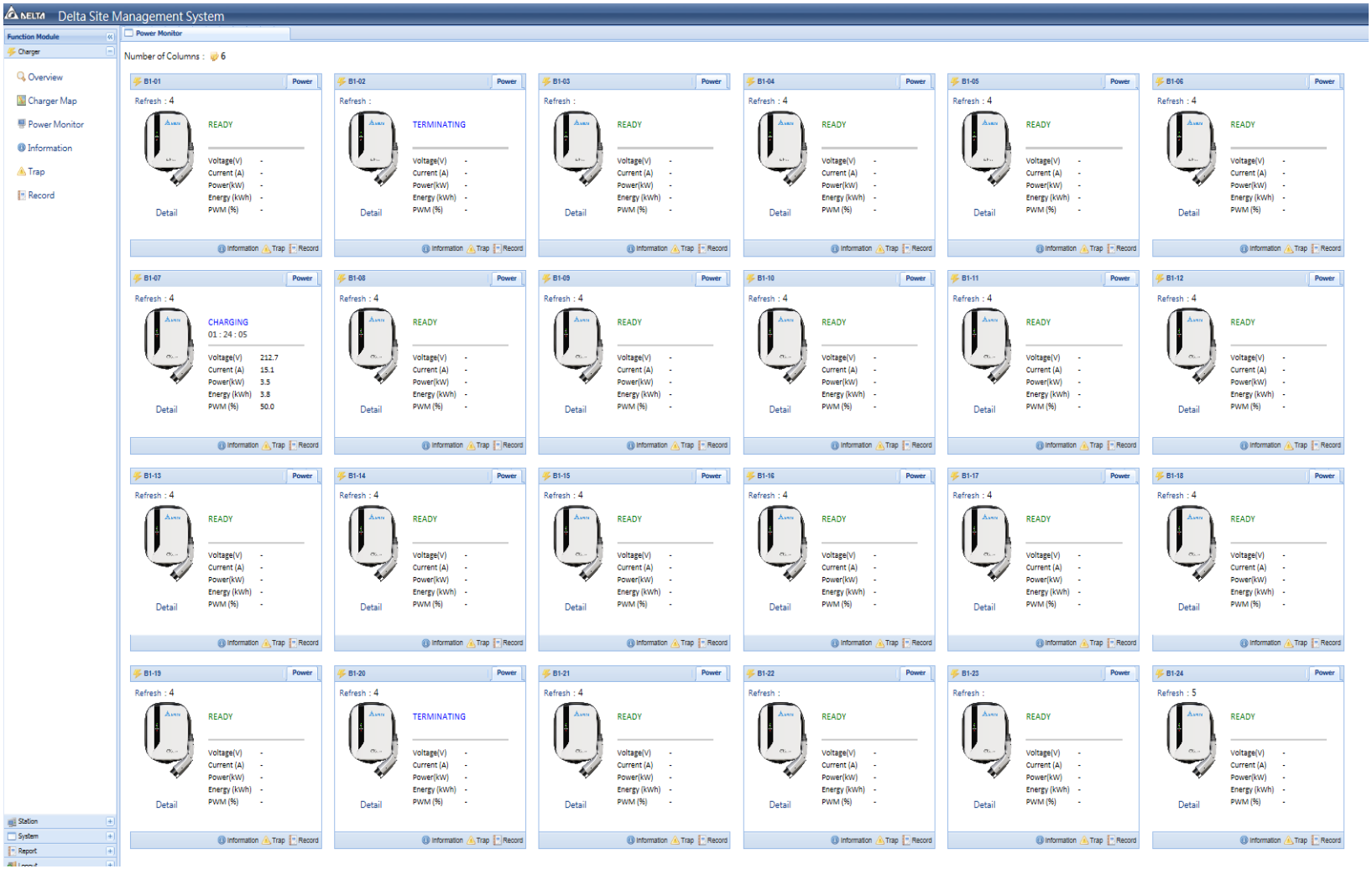


DTE Energy DR-SOC (DERMS)



Site Management System
Charger Status

DTE Energy®



Site Management System
Charger Details

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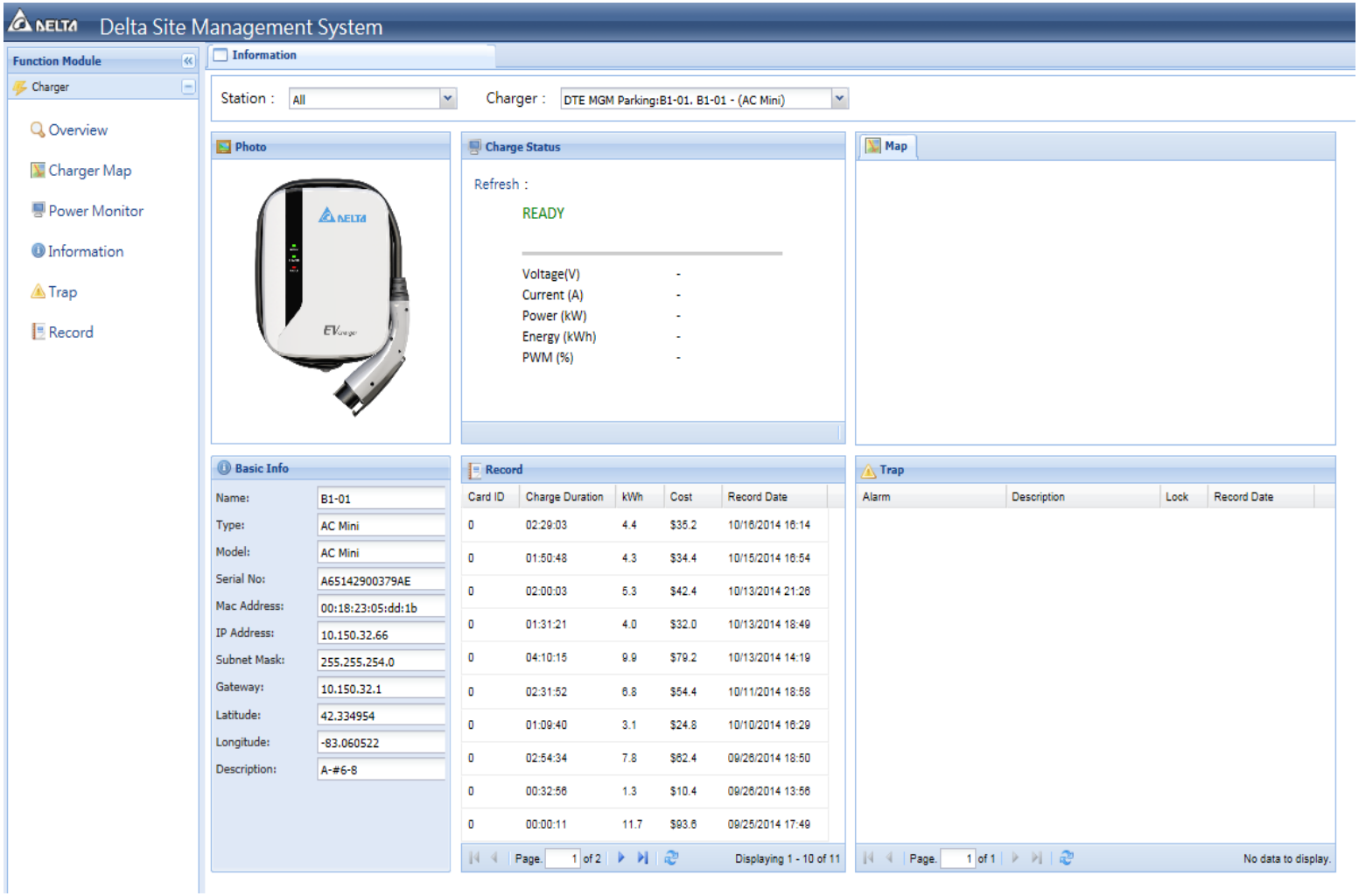
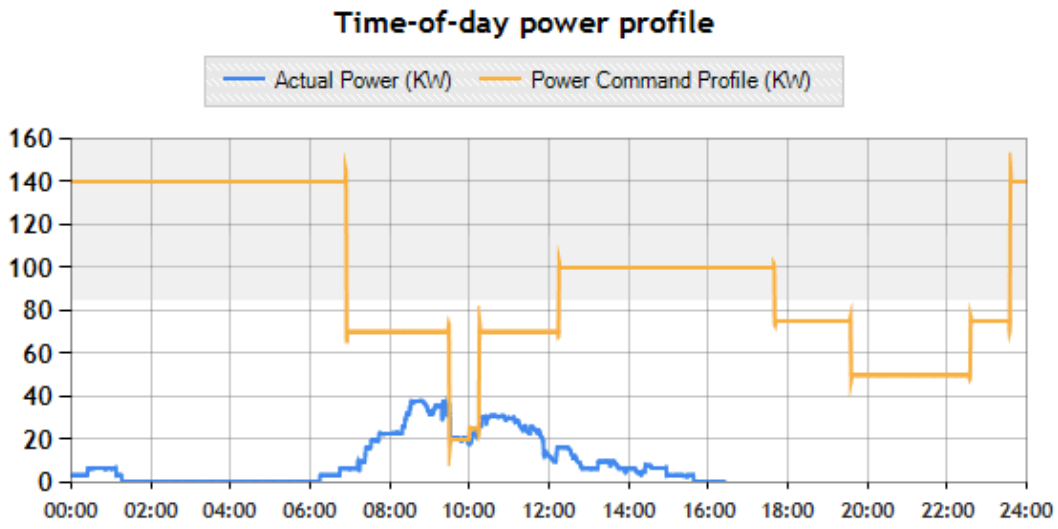


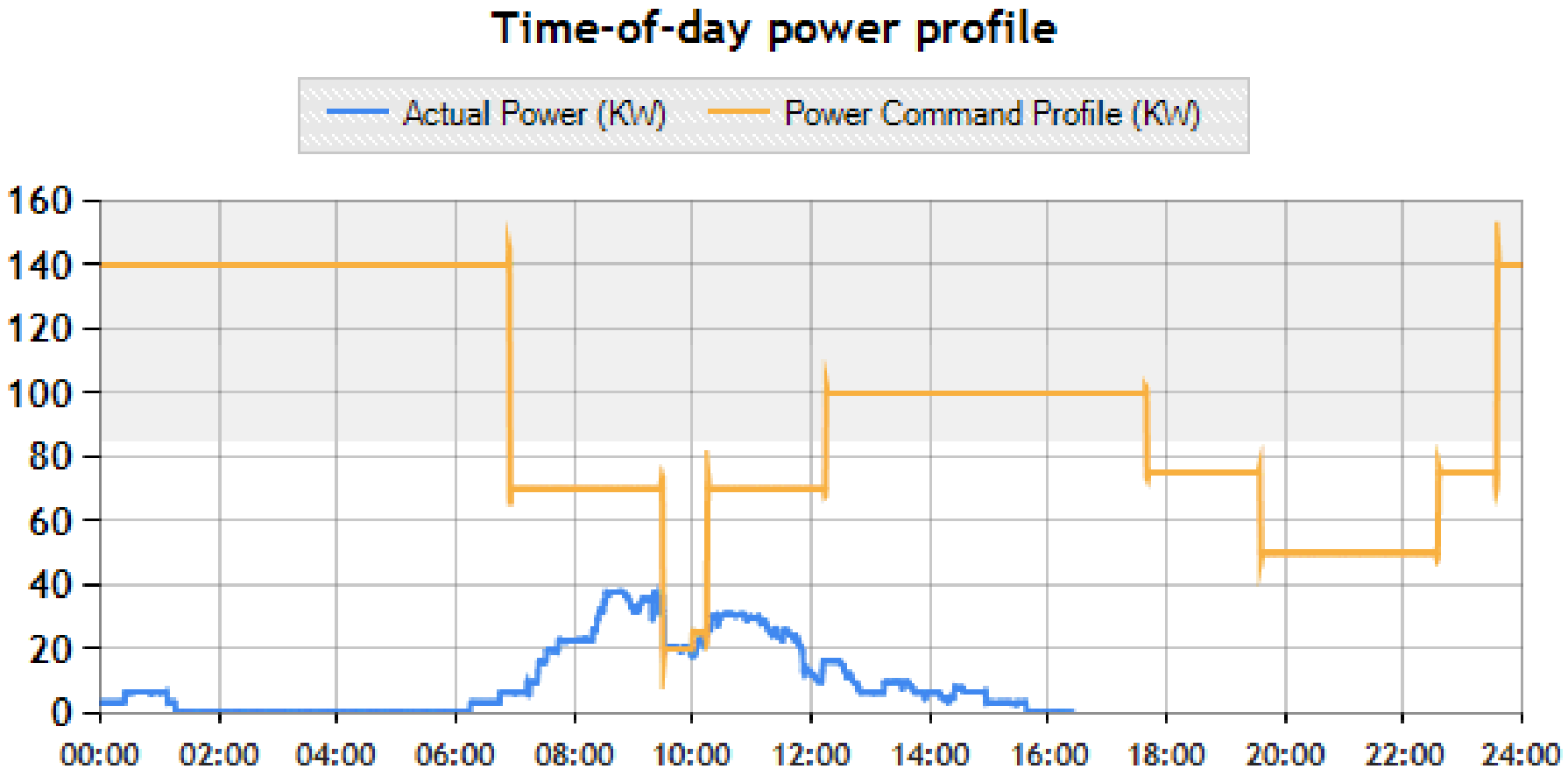
Site Management System
Charger Power Profile



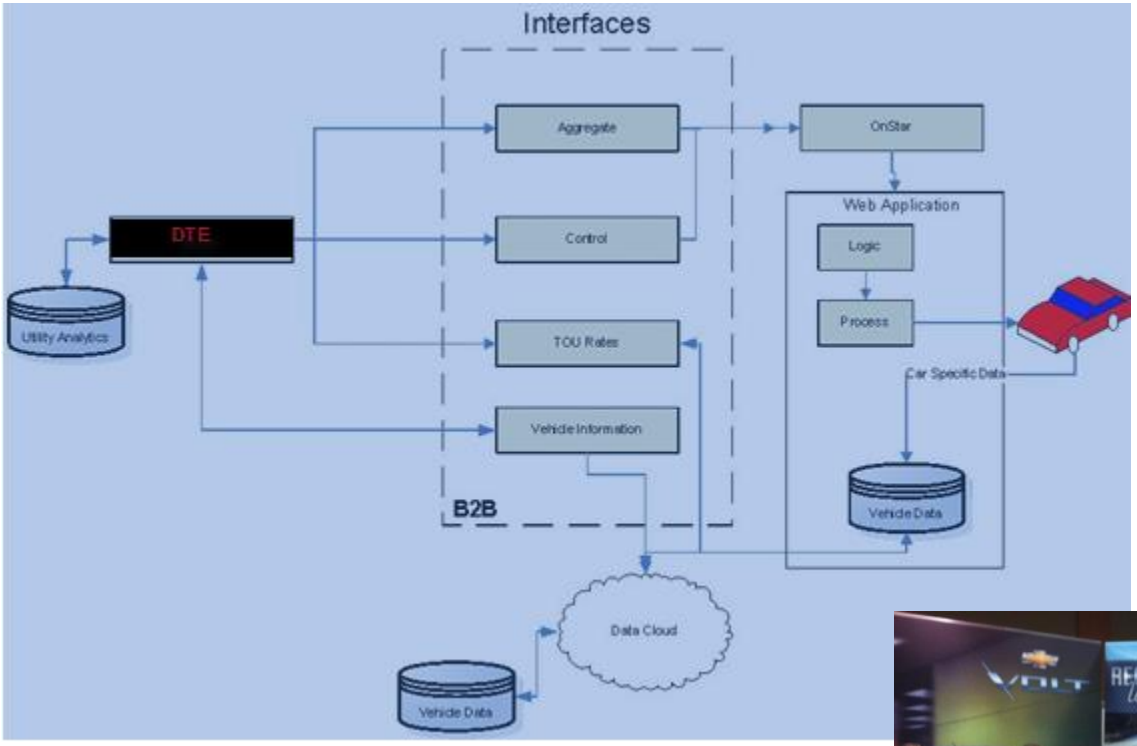
- **Power Profile display in 24 hr overview and close up view.**
- **Orange trace – max power setting**
- **Blue trace – real-time power**
- **Any profile curve can be entered into software**

✓ **Control Strategy - Based on Power Command Profile, distribute available capacity equally to those EVSEs in charging**

Site Management System
Charger Power Profile



DTE Energy – OnStar Demonstration

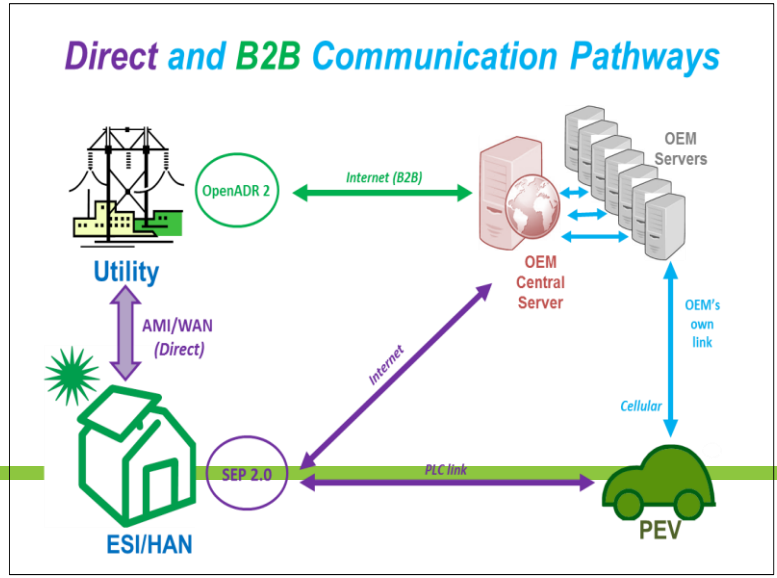


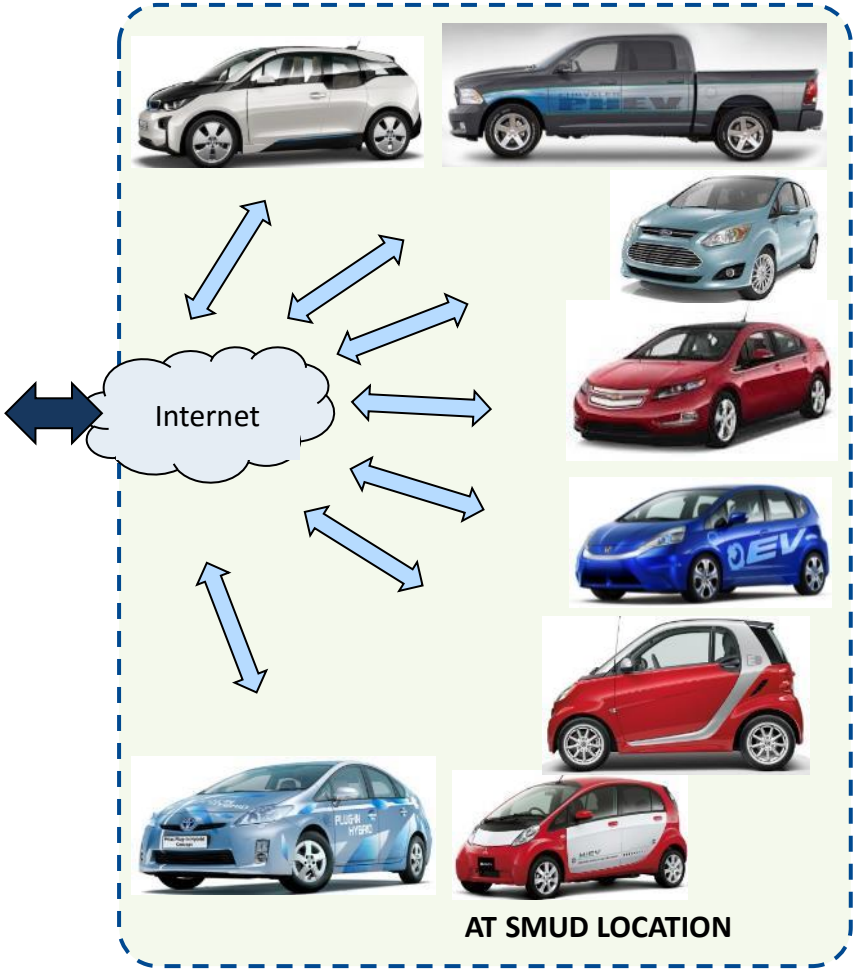
- **From DTE HQ, uploaded DTE Energy PEV rate schedule to Volts through OnStar telematics**

OEM Central Server Proof of Concept
EPRI-Utility-Auto Demonstration

DTE Energy

- ***Use Case 1*** **is the B2B internet connection**
  - **From the Utility Demand Response Management System to the Central Server utilizing the OpenADR 2b protocol.**
  - **Implements DR Events and TOU Rate Tariff Schedules communicated via the B2B internet connection to the Central Server to the individual OEM servers to the PEVs.**





VTO Systems Research Supporting Standards and Interoperability

- Vehicle to Building Integration Pathway
- Systems Research Supporting Standards and Interoperability
- Modeling and Control Software to Support V2G Integration
- Diagnostic Security Modules for Electric Vehicles to Building Integration

Multi-Lab EV Smart Grid Working Group

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Thank you!