EVTC
Electric Vehicle Transportation Center

EVSE Technology, Deployment, and the Grid

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Topic Areas

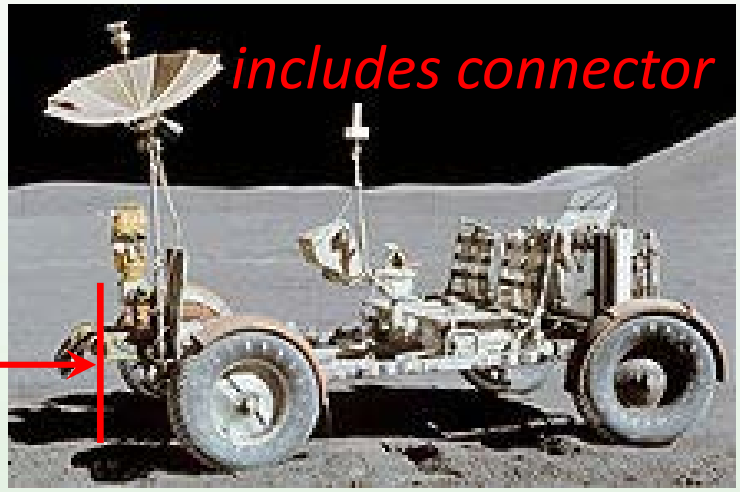
- EVSE Technology
  - Definition
  - Standards
  - Components and Options
- EVSE Deployment
  - Charge Rate and Cost
  - Utility Billing Metrics
  - Demand Management Strategies
- Utility Grid Modernization
  - Performance Monitoring
  - Two-way Communication

EVSE Technology

- **Electric Vehicle Supply Equipment (EVSE)**

*The conductors, connectors and plugs (coupler), and other devices required to deliver energy from the **premises wiring** to the **electric vehicle**.*

EVSE



EVSE Standard – SAE J1772 (2012)

"Electric Vehicle and Plug in Hybrid Electric Vehicle Conductive Charge Coupler"

- *Defines AC Level 1 and 2*
- *Specifies a **coupler and interface***
- *Includes specification for DC charging*
- *DC Level 1 coupler is identical to AC Level 1/2*
- *DC Level 2 includes 2 high current conductors.*

Electric Vehicle Supply Equipment

- SAE J1772 - Electric Vehicle and Plug in Hybrid Electric Vehicle Conductive Charge Coupler

AC Level 1	120 VAC	≤ 16 Amps
AC Level 2	208-240 VAC	≤ 80 Amps

- AC Level 3 (TBD)

DC Level 1	200-500 VDC	≤ 80 Amps
DC Level 2	200-500 VDC	≤ 200 Amps

- DC Level 3 (TBD)

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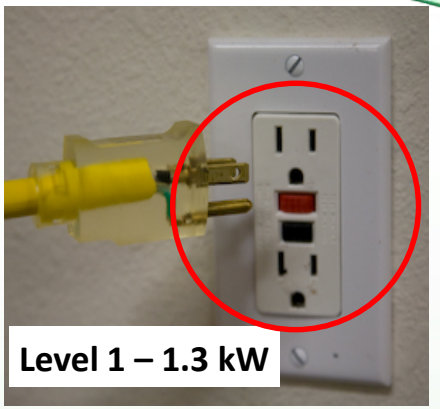
DC Charging

EVSE Technology

AC Charging

← CHAdeMO

SAE J1772 →
IEC 62196 Type 1

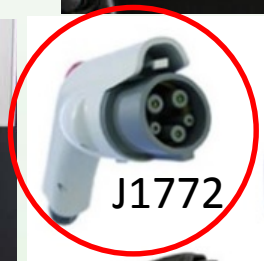


Level 1 – 1.3 kW

Level 2 – 3.5 kW

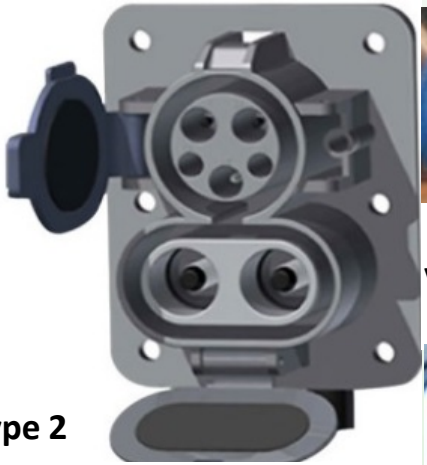
IEC approved in 2014

Kia, Nissan, Mitsubishi, Subaru, Toyota



J1772

SAE CCS Combo Type 2



Audi, BMW, Chrysler, Daimler, Ford, GM, Porsche, Volkswagen

Mennekes VDE-AR-E 2623-1 Type 2

Tesla (USA)

Level 1 or Level 2

EVSE Options

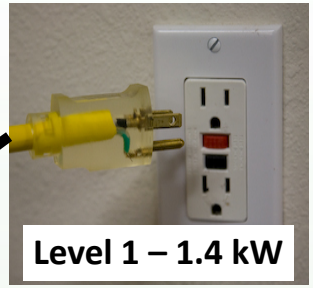
USA SAE J1772

L1 L2/N

Equip GND

120 VAC

NEMA 5-15/20



Level 1 – 1.4 kW

240 VAC

Level 2 – 3.3 kW

NEMA 14-50

208/240 VAC

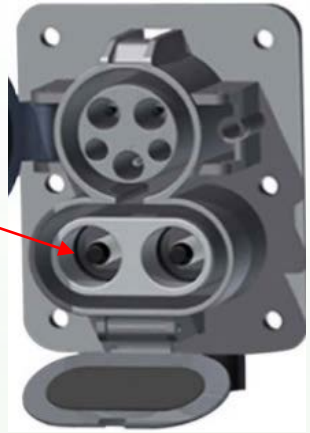
Level 2 – 6.6 kW

AC Level 1 and 2 - All Electric Vehicles

EVSE Options

USA SAE J1772

DC



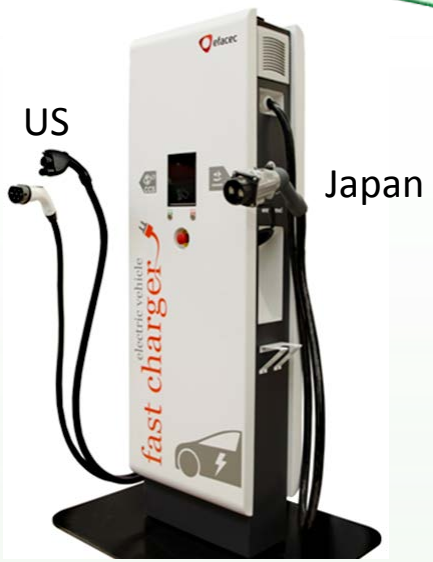
DC Charging (DCFC or DCQC)

SAE CCS Combo Type 2

US

EU

Japan



Audi, BMW, Chrysler, Daimler, Ford, GM, Porsche, Volkswagen

Japan - CHAdeMO

DC

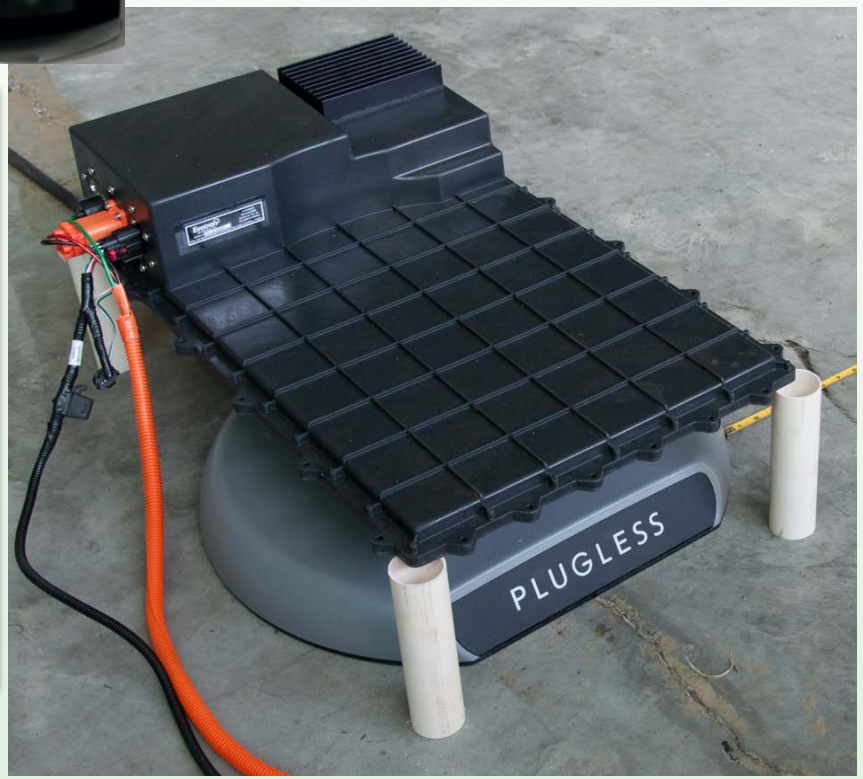
IEC approved in 2014

Kia, Nissan, Mitsubishi, Subaru, Toyota

EV Wireless Charging Station

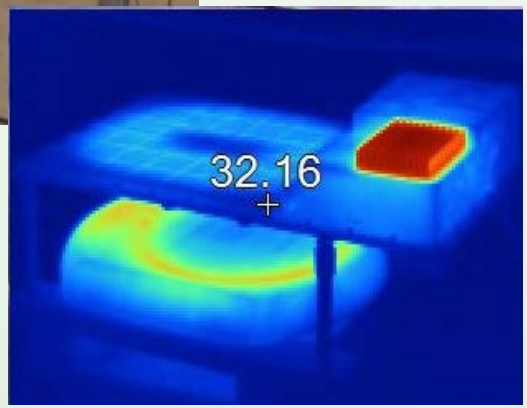
- Drive up and charge
- No cord to plug in or unplug
- Self-guiding alignment

Wall-mount Controller
Transmitter (grey)
Receiver (black)
20 kHz resonant frequency



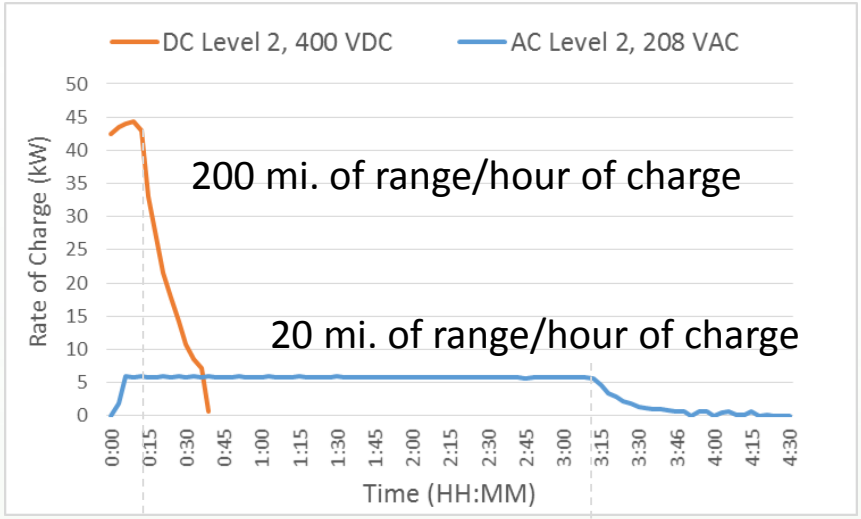
EV Wireless Laboratory

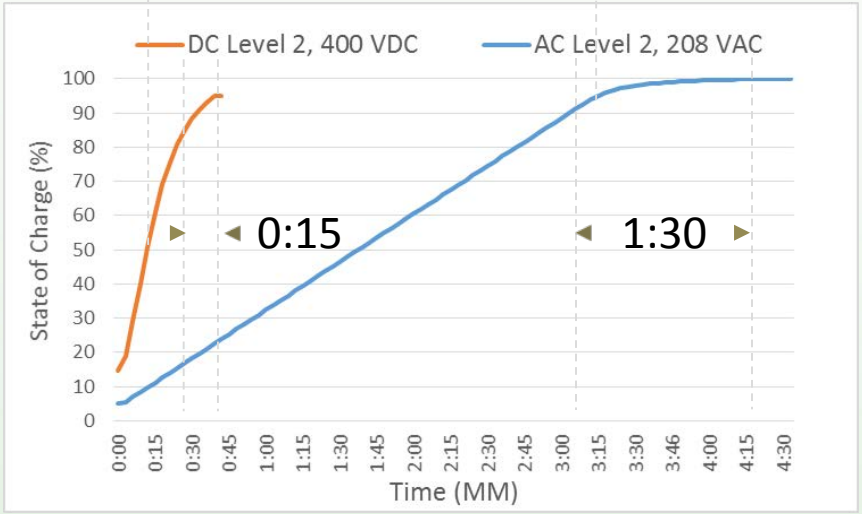
3.3 kW



- Electric and Magnetic Field (X, Y, Z) Measurements
- Spacing and Alignment Testing
- Infrared Imaging
- Application Assessment

EV Charging Rates





Nissan Leaf: 24 kWh Traction Battery

Level 2:

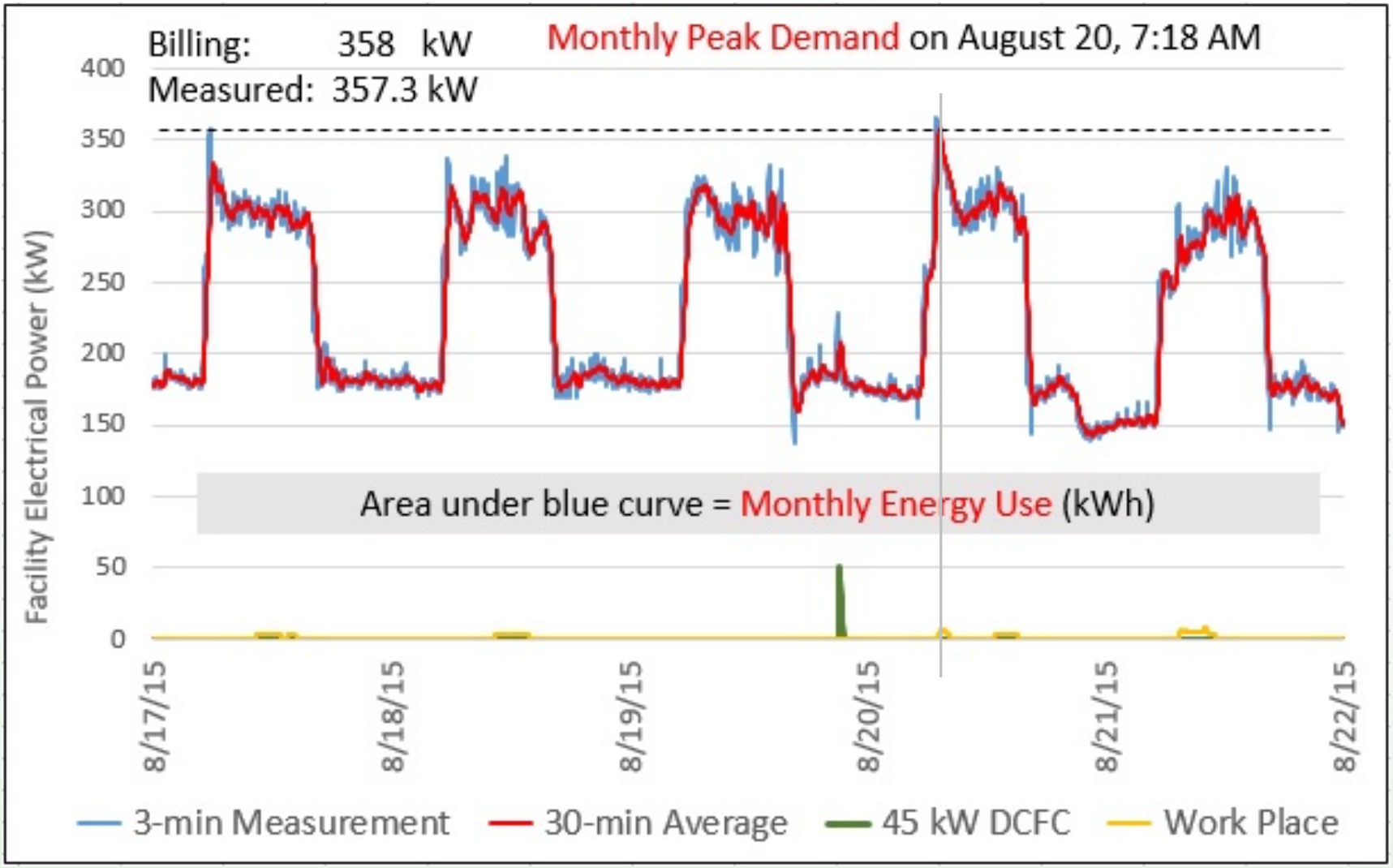
- Slow rate of charge (0.25C)
- Continuous charge rate up to 95% SOC
- Last 10% of charge takes 1 hour 30 min

DCFC:

- High rate of charge (2C)
- Continuous charge rate up to 50% SOC
- Last 10% of charge takes 15 min

Demand reading	1.49
kW constant	x 240.00
Demand kW	358

Utility Billing Metrics



September 2015 Electric Billing – Week of Monthly Peak Demand, Aug 17-21

Utility Cost

FPL Rate Class - Sep 2015	Customer Charge	Demand	On-Peak Energy	Off-Peak Energy
	$/mo	$/kW	¢/kWh	
Residential (> 1000 kWh/mo)	7.57		10.12	
General Service Non-Demand	7.46		9.347	
General Service Demand	19.48	9.94	5.901	
To Fully Charge a Nissan Leaf:				
Residential (> 1000 kWh/mo)			$2.02	
General Service Non-Demand			$1.87	
General Service Demand		???	$1.18	

Energy charge includes storm, conservation, environmental, and fuel charges

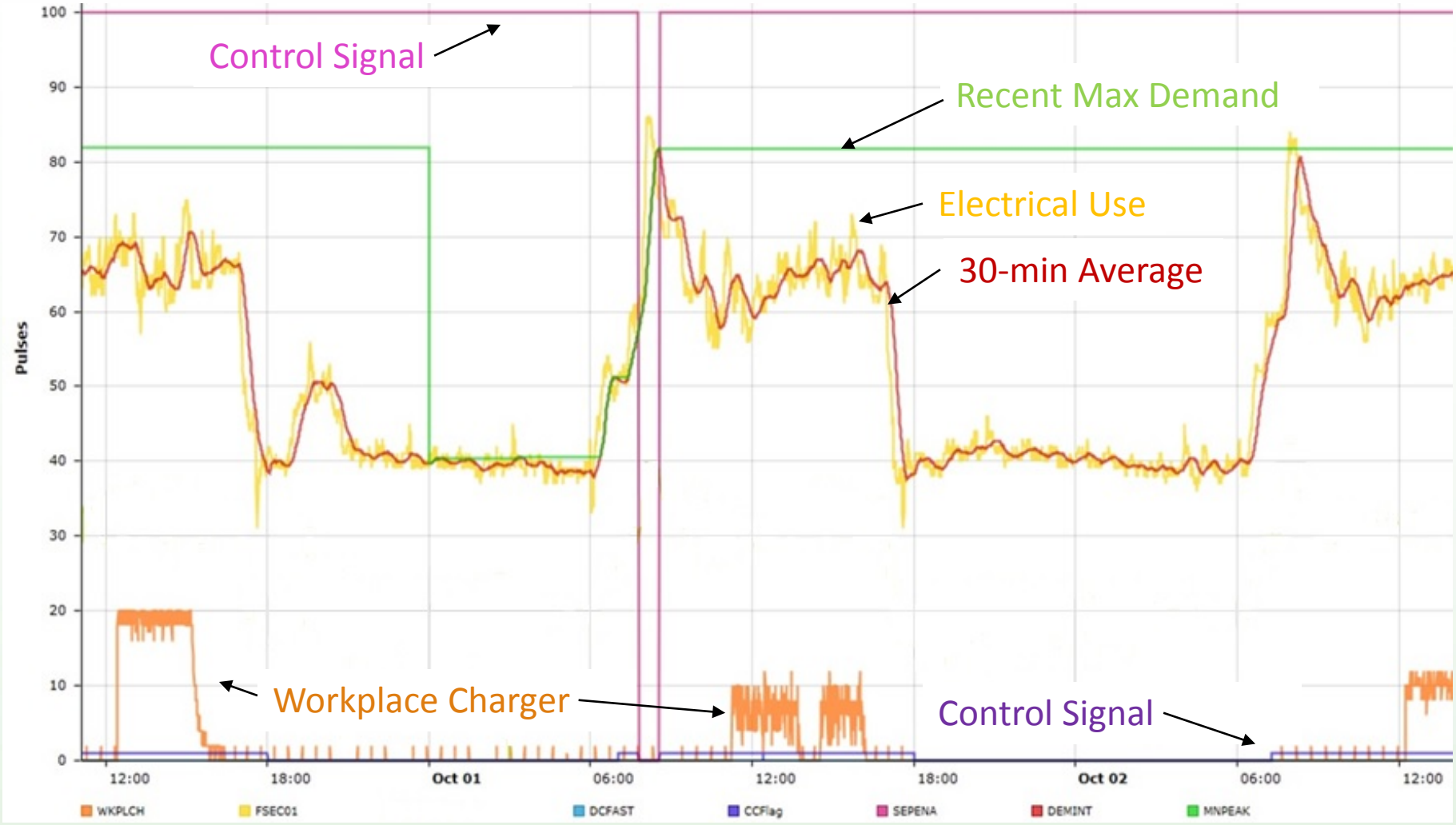
Impact of Monthly Demand

Month (2015)	Billing kW	No DCFC kW	Diff kW	Cost $	No WkPlc kW	Diff kW	Cost $
Feb	278.4	255.0	23.4	248	253.1	1.9	20
Mar	285.8	283.7	2.1	22	283.7	0.0	0
Apr	322.4	322.4	0.0	0	316.5	5.9	63
May	331.6	331.6	0.0	0	331.6	0.0	0
June	339.8	339.8	0.0	0	339.8	0.0	0
July	368.2	368.2	0.0	0	368.2	0.0	0
Aug	357.3	357.3	0.0	0	356.0	1.3	14
Sep	354.24	354.24	0.0	0	354.2	0.0	0

Monthly electric billing impact of public DCFC and workplace chargers

- Prior to Sep 2015, monthly demand chargers were $10.61/kW
- FSEC workplace chargers include 2 Level 2 J1772 @ 6 kW each

Building Demand Management



EVSE Deployment

Electric Vehicle Charging Station Locations

Find electric vehicle charging stations near an address or ZIP code or along a route in the United States. For more alternative fueling stations, use the Alternative Fueling Station Locator.

Find Stations | Plan a Route

32922 Go

Electric

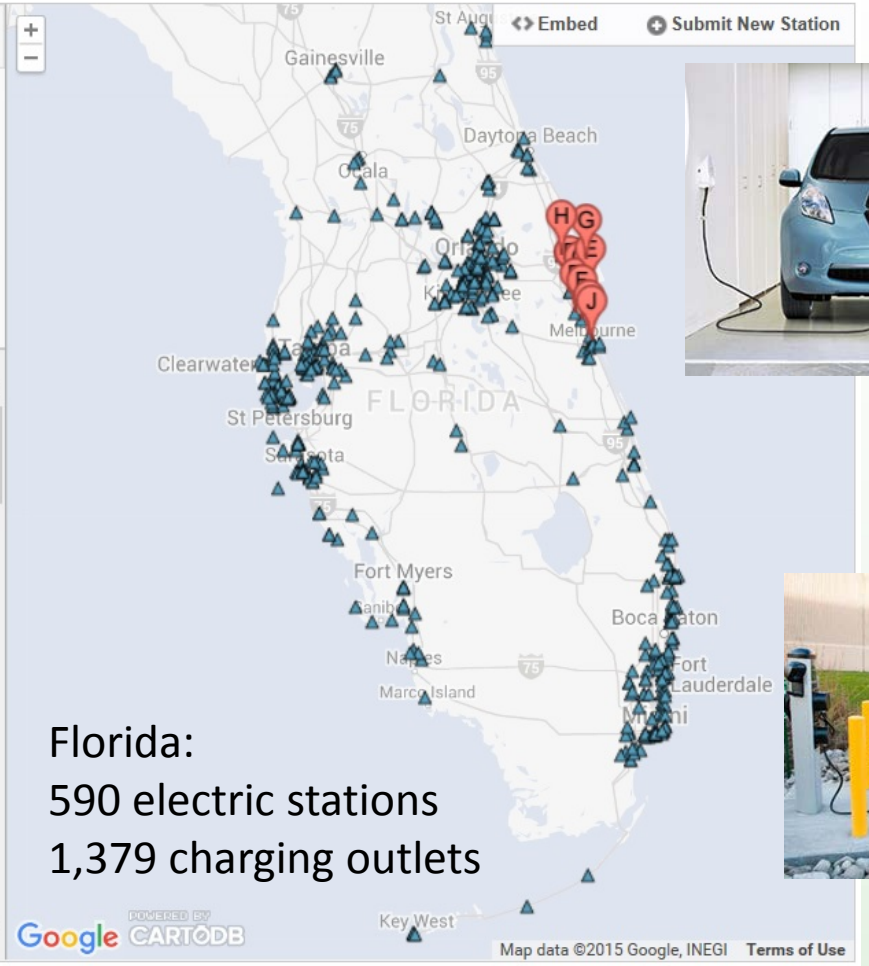
more search options

Electric stations near 32922

Excluding private stations

A Florida Solar Energy Center
1679 Clearlake Rd
Cocoa, FL 32922
Phone: 855-900-7584
Fuel: Electric
Electric charging types: Level 2, DC Fast
Distance: 1.3 mi

B FSEC
1679 Clearlake Rd
Cocoa, FL 32926
Phone: 888-758-4389
Fuel: Electric
Electric charging types: Level 2
Distance: 1.4 mi



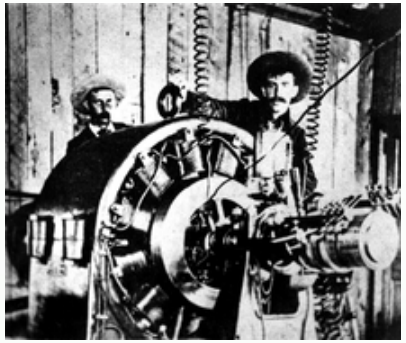
Florida:
590 electric stations
1,379 charging outlets

Data Download | Developer Tools

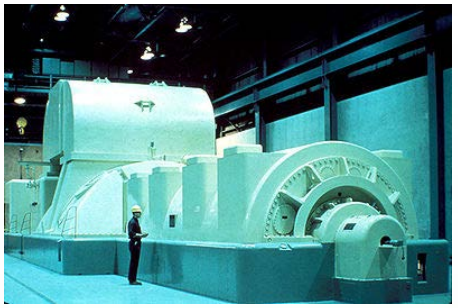
afdc.energy.gov

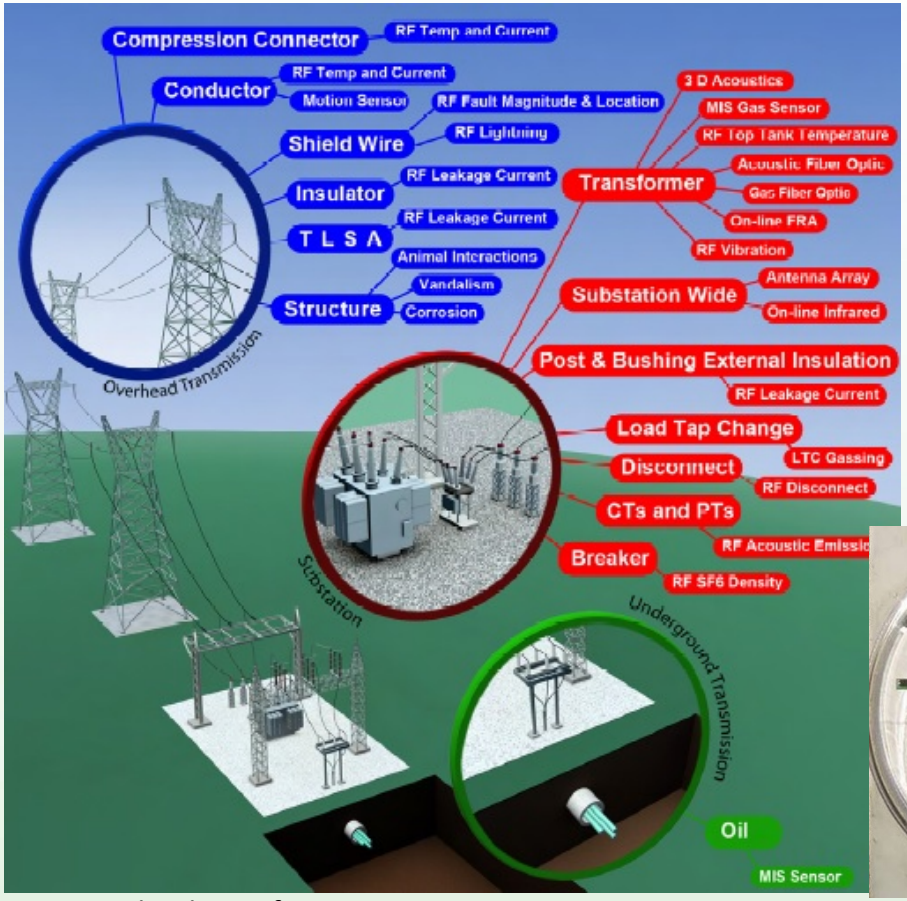
Utility Grid

How far we've come:



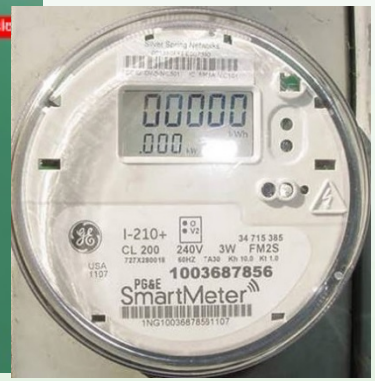
Steam Turbine





Sensors

Smart Meter



Sensor Technologies for a Smart Transmission System, EPRI, 2009

Utility Grid Sensors

Overhead Transmission Sensors	
Compression Connector	RF Temperature and Current
Conductor	RF Temperature and Current
	Motion Sensor
Shield Wire	RF Lightning
Insulator	RF Leakage Current
TL Surge Arrestor	RF Leakage Current
Structure	Animal Interactions
	Vandalism
	Corrosion

Utility Grid Sensors

Substation Sensors	
Transformer	3D Acoustics
	Metal-Insulator-Semiconductor Gas Sensor
	RF Top Tank Temperature
	On-line Frequency Response Analysis
	RF Vibration
Substation Wide	Antenna Array
	On-line Infrared
Post & Bushing Insul.	RF Leakage Current
Load Tap Change	LTC Gassing
Disconnect	RF Disconnect
CT's and PT's	RF Acoustic Emissions
Breaker	RF Sulfur Hexafluoride (SF6) Density

Modern Utility Grid

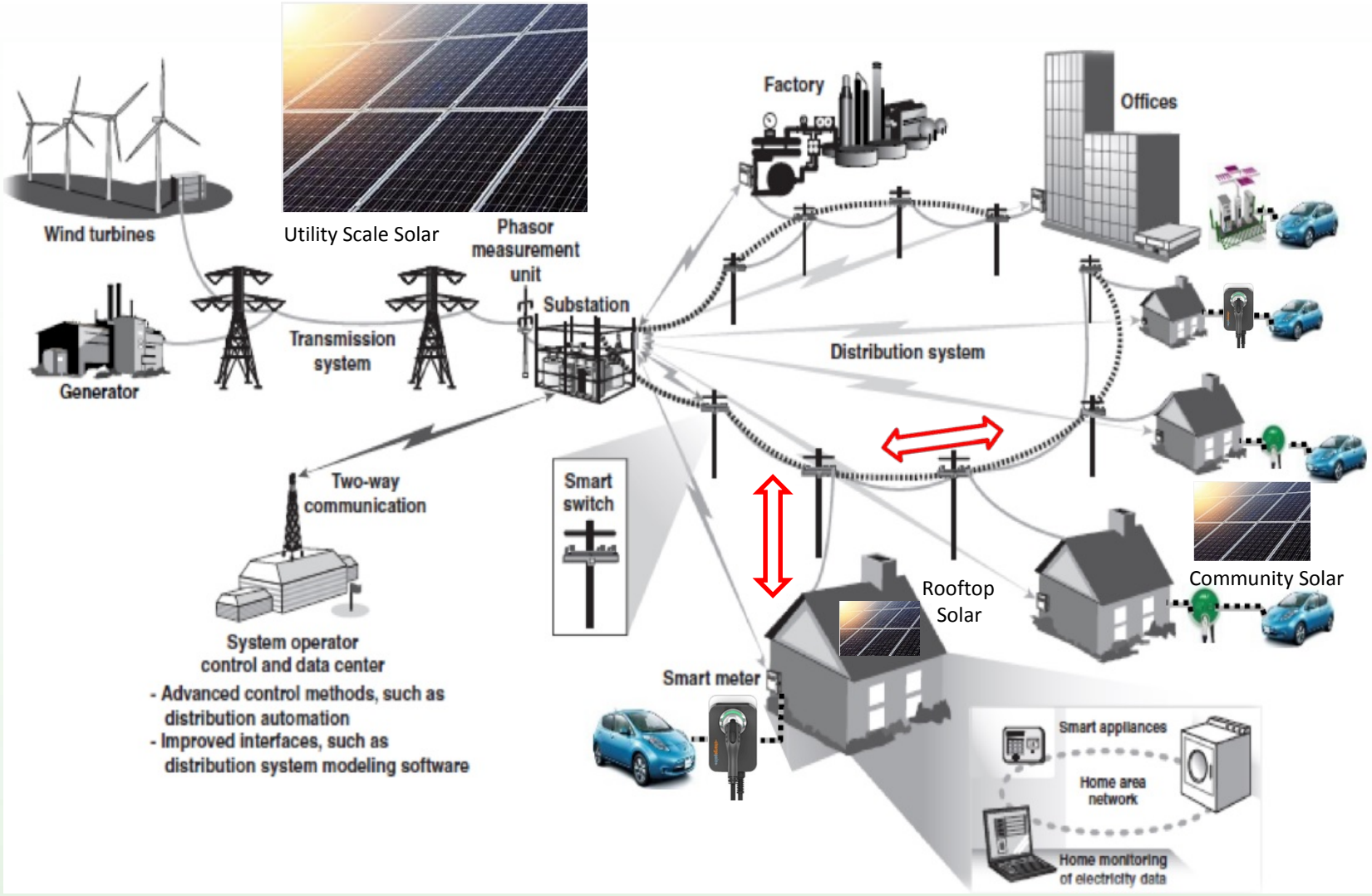
Real Time Transmission System Performance Measurement

- Voltage and Current
- Power Factor
- Harmonic Distortion
- Real and Reactive Power
- Real and Reactive Energy

Distribution System,
e.g., QinetiQ North America

Transmission System,
e.g., QinetiQ North America

Modern Utility Grid



EV's in the Future Utility Grid

Real Time Control of Distributed Resources

Ancillary Services Market (50 EV's = 1 MW)

- Load Regulation
  Frequency control (minimal impact on EV battery)
- Spinning Reserves
  Offsets intermittent generation (wind and solar)

Localized Load

- Store on-site PV/Wind production
- Eliminates distribution system reverse power flow

Second Use Traction Battery Market

- Same as Distributed Energy Storage
- Lowers cost of EV

DOE's EV Everywhere Grand Challenge

- Batteries
- Electric Drive Systems
- Vehicle Lightweighting
- Efficient Climate Control
- Charging Infrastructure

DOT's EVTC Research - Labs

- Electric Vehicle Lab
- Wireless Lab
- HI Battery Durability Lab
- TU Battery Performance Lab
- EV Charger Measurements

DOT's EVTC Research - Modeling

- Life Cycle Cost Analysis
- Electric Grid Interactions
- Peak Demand Mitigation
- EV Queueing Models
- FC Range Extender and Power Supply
- Societal Benefits

DOT's EVTC Research - Planning

- Charger Deployment
- Standards and Policy
- EV Forecasting
- Fleet Vehicle Analysis
- Traffic Databases

Thank You

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