Smart Grid Energy Research Center

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Smart Grid Energy Research Center (SMERC)

- **Major sponsors**
  - DOE Funded Regional Demo Grant – LADWP, UCLA, USC, JPL-Caltech
  - KIER-UCLA Smart Grid Grant
  - California Energy Commission - DR
  - DOE Funded EPRI, NESCOR Grant – EPRI + several DOE, University partners
  - SMERC IPP (Industry Partners Program): 18 industry members
  - CEC – Bi-directional EV charging
39 MW (76%)
Natural gas and landfill
16,600 tons of chilling
160,000 lb/hr of heating steam
Traditional Electricity Flow Model

Traditional Hierarchical Model

- **Generation**
- **Transmission**
- **Distribution**
- **Consumption**
New electricity flow model – the opportunity Smart Grid
# UCLA Smart Grid Energy Research Center (SMERC)

<table>
<thead>
<tr>
<th>WINSmartGrid™</th>
<th>EV Integration to the Grid</th>
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<tbody>
<tr>
<td>The UCLA WINSmartGrid™ is a network platform technology that allows electricity operated appliances such as plug-in automobile, washer, dryer, or, air conditioner to be wirelessly monitored, connected and controlled via a Smart Wireless hub.</td>
<td>California constitutes a significant automotive market - a place where demanding and energy-conscious consumers come together with creative designers from Hollywood, resulting in an environment rich in ideas on automotive innovation.</td>
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<tr>
<th>Demand Response</th>
<th>Cyber security of Communications Infrastructure</th>
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<td>Automated load control in smart buildings, smart offices, smart homes, smart appliances, renewable integration and local storage.</td>
<td>Cyber security is being studied and researched for EVSE infrastructure, HAN, and applications in residential and commercial DR.</td>
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<th>Microgrid</th>
<th>Transactive Control of Smart Grids</th>
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<td>Comm, sense and control for integrating renewables, EVs and smart loads.</td>
<td>Price based high speed control of smart loads, EVs, and storage.</td>
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WINSmartGrid™
Power and Information Flow

Utility’s Distribution Grid

WAN

WAN, NAN, LAN

UCLA Electrical Gateway

WAN, NAN, LAN

UCLA Campus

LAN, HAN

Controllable Loads

AMI

Electricity

TCP/IP

Los Angeles Districts

Co-Gen

Buildings

Labs

Residential Halls

Parking structures

Los Angeles Districts

WINSmartGrid™

Power and Information Flow

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Controllable Loads and Generators

Electricity
TCP/IP
Electric Vehicles – EVs available in today’s market

- Scion iQ EV
- Fiat 500e
- Toyota RAV4 EV
- Chevy Spark EV
- Smart Electric Drive
- BMW ActiveE
- Mitsubishi i-MiEV
- Honda Fit EV
- Ford Focus Electric
- Tesla Model S
- Nissan Leaf
- Toyota Prius Plug-in
- Chevy Volt

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EV Smart Grid Integration: Fundamental Approach

Smart Charging within a Smart Grid
The current WINSmartEV™ infrastructure at UCLA, LADWP, City of Santa Monica, and City of Pasadena consists of 150 EVSmartPlug™s.
UCLA Microgrid Integration – EVs, solar and stationary storage
Vehicle to Grid (V2G)

Phd Student, **Yubo Wang**, and SMERC Director, **Rajit Gadh**, testing vehicle to grid system with the Mitsubishi i-MIEV.
Modular Design for Interoperability with existing Technologies & Standards

Control Center in the cloud

Level 1

Level 2

Clipper Creek

Other Charging Boxes

Mobile Website

Billing

Database

Communication Language
Demand Response – Automation Network

Private fixed networks, WA/LAN

Protocols:
- Insteon
- HomePlug
- Bluetooth
- Z-Wave
- Zigbee
- 6loWPAN
- …

Wired & Wireless

Smart Meter

Gateway

Utility

Small Appliance Controls
- Refrigerators, Oven, Dryer

HVAC Controls
- ACs, heat pumps, etc.

Small Load Controls
- TVs, Comps., Lighting, Etc.

PHEV/EV Management
- Charge Mngr., billing, Etc.
HAN Device Portal Interfaces

Utility Side
- GPRS/GSM
- WiMAX
- 802.11n
- Unlicensed RF
- Ethernet TCP/IP
- POTS

Optional Modules
- Latency
- Data Capacity
- Cost
- Density
- Backhaul Connectivity

Optional Modules
- Zigbee
- Z-Wave
- 802.11x
- PLC
- M-Bus
- FlexNet
- LonWorks
- Wireless M-Bus
- RS232 / RS485

Customer

Gateway

DLMS/COSEM

ANSI 12.xx

IEEE P2030
Smart Meter

Units’ Support
Network Design
RF Drawbacks
Cost
Heterogeneity

Cost
Latency
Data Capacity
Density
Backhaul Connectivity
Heterogeneity
WINSmartGrid™ DR – Wireless Appliance Interface

HVAC BACNET

Lighting / LED

Refrigerator

Dryer