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“The intention is to keep consumers in the driver’s seat.“
“Eventually, two-way interfaces between EVs and the bulk power network ...”
“... to lead to EV charging behavior that is beneficial or at least not adverse to grid reliability.”
“...aggregation of EV resources that can be bid into the ISO’s wholesale market ...”
“... to contribute to reliable management of the electricity grid.”
“At a minimum... do not increase peak load, requiring additional generation or capacity expansions.”
“Ideally, charging is coordinated with grid conditions and the ability for aggregation of EVs to respond to grid operator signals”
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
  - LAEDC / CEC partnership

- **Industry Thought Leadership Forums** – every six months
- **Smart Grid Living Lab (SMERC LL)**
  - UCLA has its own natural gas cogeneration power plant
  - UCLA gets a fraction of its power from LADWP, the local utility

- **External Leadership Council (SMERC LC)**
- **Publish research papers** (> 20 publications on EV – Grid research)
- **Educational programs** (courses, training workshops, demonstration days)
$60 million LADWP smart grid project to be tested at UCLA, USC

December 8, 2009

Rajit Gadhi

Excerpted from the Los Angeles Times.

The federal government today awarded Los Angeles a $60-million grant to help modernize the city's electrical power system.

The money will be used for "smart grid" demonstration projects at USC and UCLA. The projects will allow the city's Department of Water and Power, the largest municipal utility in the nation, to use advanced meters and other technology at the universities to chart how power is being consumed, forecast demand and potential outages, and seek ways to reduce energy use.

Please read the full Los Angeles Times article here.

Also, please read the article at www.engineer.ucla.edu.

UPDATE: On 1/14/10, UCLA Today published an in-depth article on Smart Grid.
<table>
<thead>
<tr>
<th><strong>WINSmartGrid™ - Two-way communications</strong></th>
<th><strong>EV Integration to the Grid – V1G, V2G</strong></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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<thead>
<tr>
<th><strong>Demand Response</strong></th>
<th><strong>EV+ Used EV battery : Peak reduction, V2B</strong></th>
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<tbody>
<tr>
<td>Automated load control in smart buildings, smart offices, smart homes, smart appliances, renewable integration and local storage.</td>
<td>Using battery energy storage to reduce demand charges due to peaky loads such as Fast EV charge such as Chademo.</td>
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<th><strong>Microgrids</strong></th>
<th><strong>Transactive Control of Smart Grids</strong></th>
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<tbody>
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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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Electric Vehicles – EVs available in today's market

- Scion iQ EV
- Fiat 500e
- Toyota RAV4 EV
- Chevy Spark EV
- Smart Electric Drive
- BMW ActiveE
- uubishi i-MiEV
- Honda Fit EV
- Ford Focus Electric
- Tesla Model S
- Nissan Leaf
- Toyota Prius Plug-in
- Chevy Volt
EV Smart Grid Integration:
Fundamental Approach
Level 2 technology – bidirectional communications and smart scheduling, price-bids and controls for V1G
WINSmartEV™ Mobile Web App – EV driver engagement and education
Real Time Monitoring & Control Center FOR Grid operator and aggregator

Postdoc Researcher Ching-Yen Chung and Prof. Rajit Gadh monitor several EVs charging at SMERCs monitoring and control center.
WINSmartEV™ Infrastructure: Los Angeles / UPDATE
Modular Design for Interoperability with existing Technologies & Standards

Control Center in the cloud

Level 1
Level 2
Clipper Creek
Mobile Website
Billing
Other Charging Boxes
Database

Communication Language

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Vehicle to Grid (V2G)

Phd Student, Yubo Wang, and SMERC Director, Rajit Gadh, testing vehicle to grid system with the Mitsubishi i-MiEV.
Prototype system designed at 1.5 kW, targeting at 5 kW for next version

Research on discharging protocol, once fully understood, power pumping can go up to 50 kW

Controller objectives - active and reactive power control

The output of Power Box is 100 VAC 60Hz. The reason to go through AC-DC and DC-AC is to have full control of the power
Energy Storage to reduce peak load during rapid charging

CHADemo Installation in UCLA Parking Lot 4
Problem Description:
EVs become more and more popular
- Charging of EVs increases peak demand
- Charging of EVs may cause electric power shortage
- Waiting time for charging might be another issue.

Solution
Integration of Battery storage system to the grid
- Cutting the peak demand
- Providing backup for the system
- Shifting the power demand profile
- Improving loading factors, voltage and frequency control
- Improving the reliability of supplies.
Renewable Integration in Microgrids with EV - technology demonstration

Electric Vehicles Supporting Microgrid

Control Center

Electric Grid

50 kW PV

75kWhr Storage
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THANK YOU