



# Smart Grid – Research and Technology Demonstrations in UCLA

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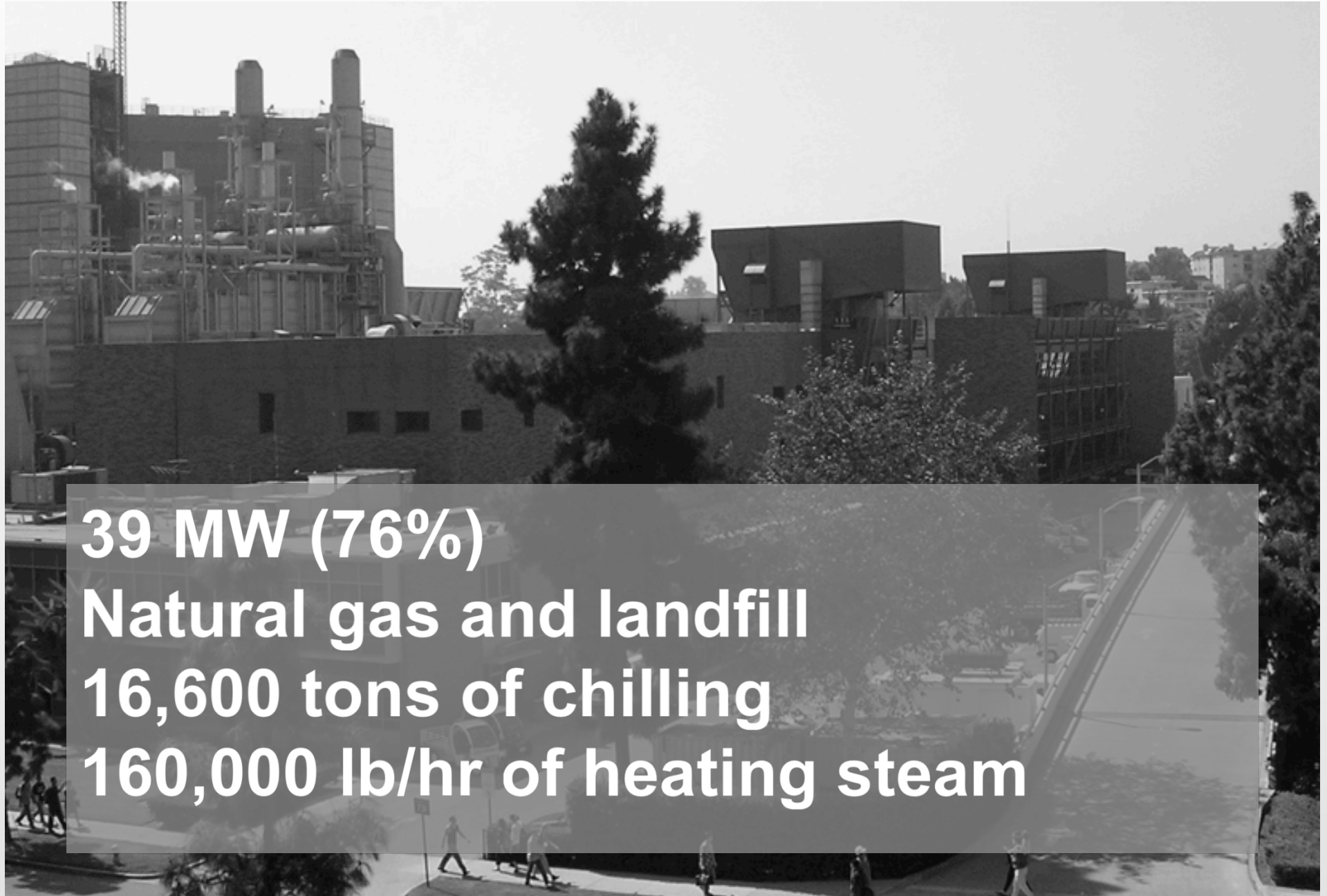
🔗 <http://smartgrid.ucla.edu>

🔗 <http://winmec.ucla.edu>

# 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
- **Industry Thought Leadership Forums – every six months, next scheduled for March 28, 2012**
- **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)**
- **Educational programs (courses, training workshops, demonstration days)**
- **Publish research papers**

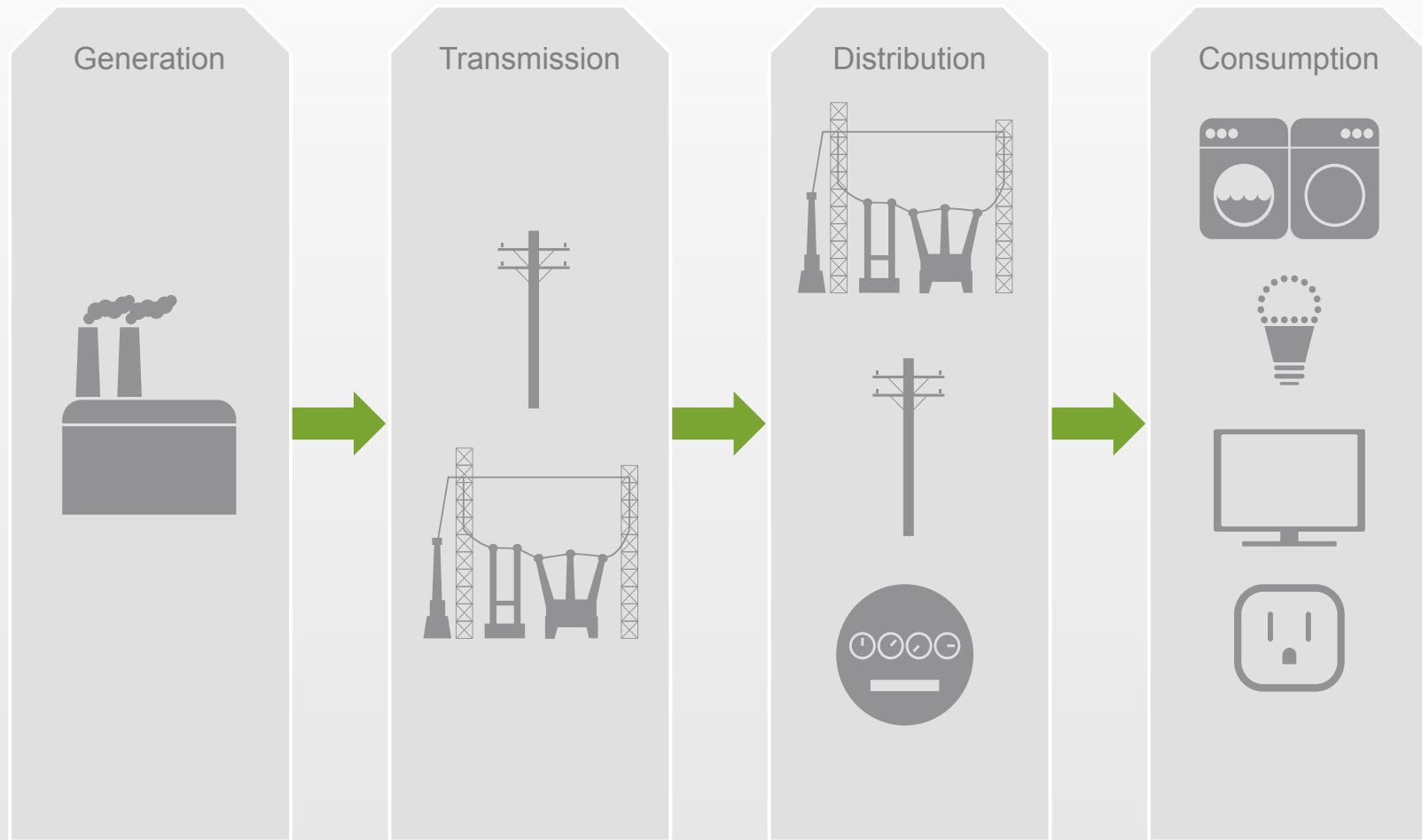
## UCLA Co-Generation Plant



**39 MW (76%)**  
**Natural gas and landfill**  
**16,600 tons of chilling**  
**160,000 lb/hr of heating steam**

# Traditional Electricity Flow Model

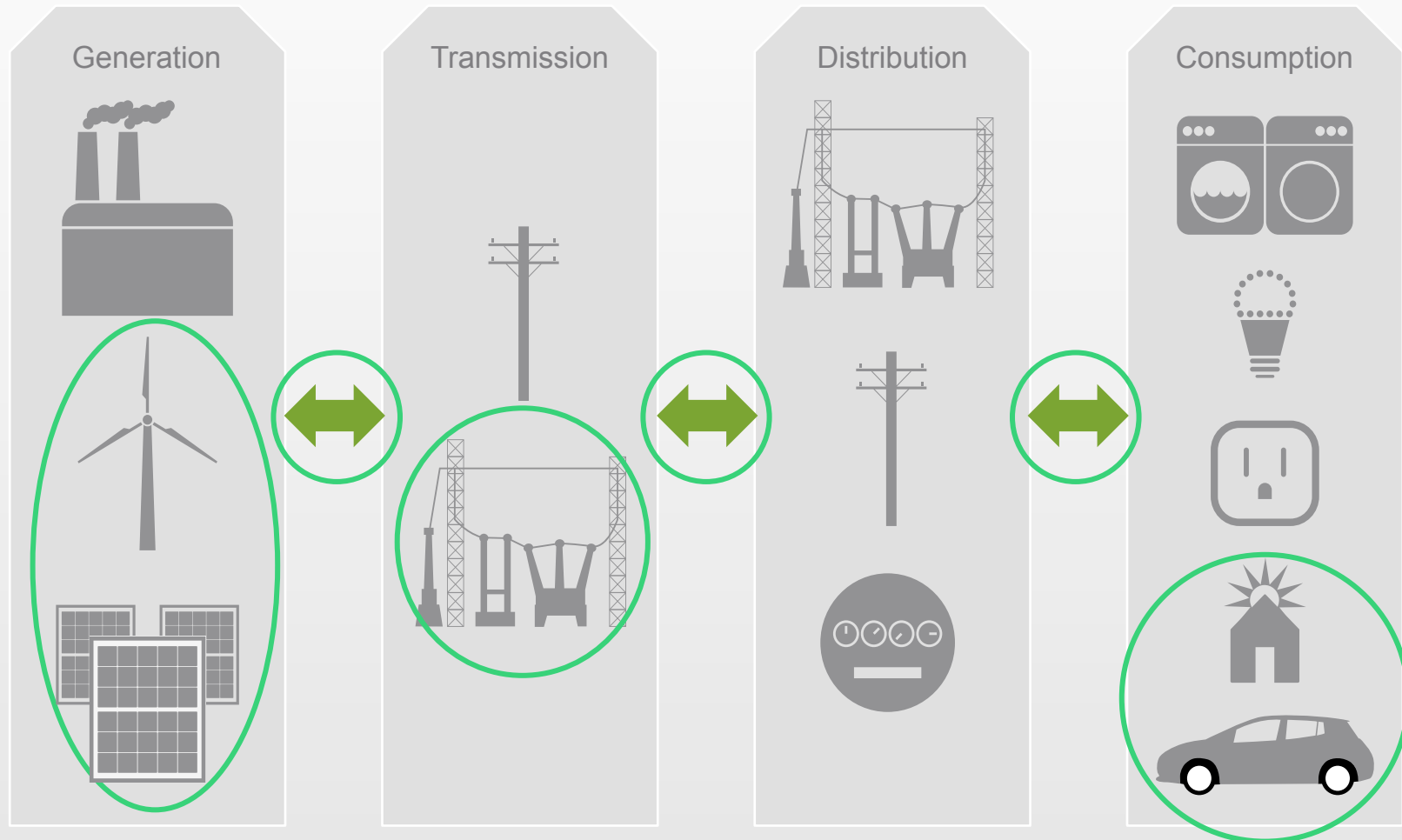
## Traditional Hierarchical Model





# New electricity flow model – the opportunity Smart Grid

## Non-Traditional Hierarchical Model



Technologies?

Cloud intelligence

Wireless/ Comm.

Sense & Control

Storage

Mobile Devices & UI

Embedded Systems

Renewables: Solar, Wind, BioM, GeoT, Hydro

# UCLA Smart Grid Energy Research Center (SMERC)



## WINSmartGrid™

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.



## EV Integration to the Grid

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.



## Demand Response

Automated load control in smart buildings, smart offices, smart homes, smart appliances, renewable integration and local storage.



## Cyber security of Communications Infrastructure

Cyber security is being studied and researched for EVSE infrastructure, HAN, and applications in residential and commercial DR.



## Microgrid

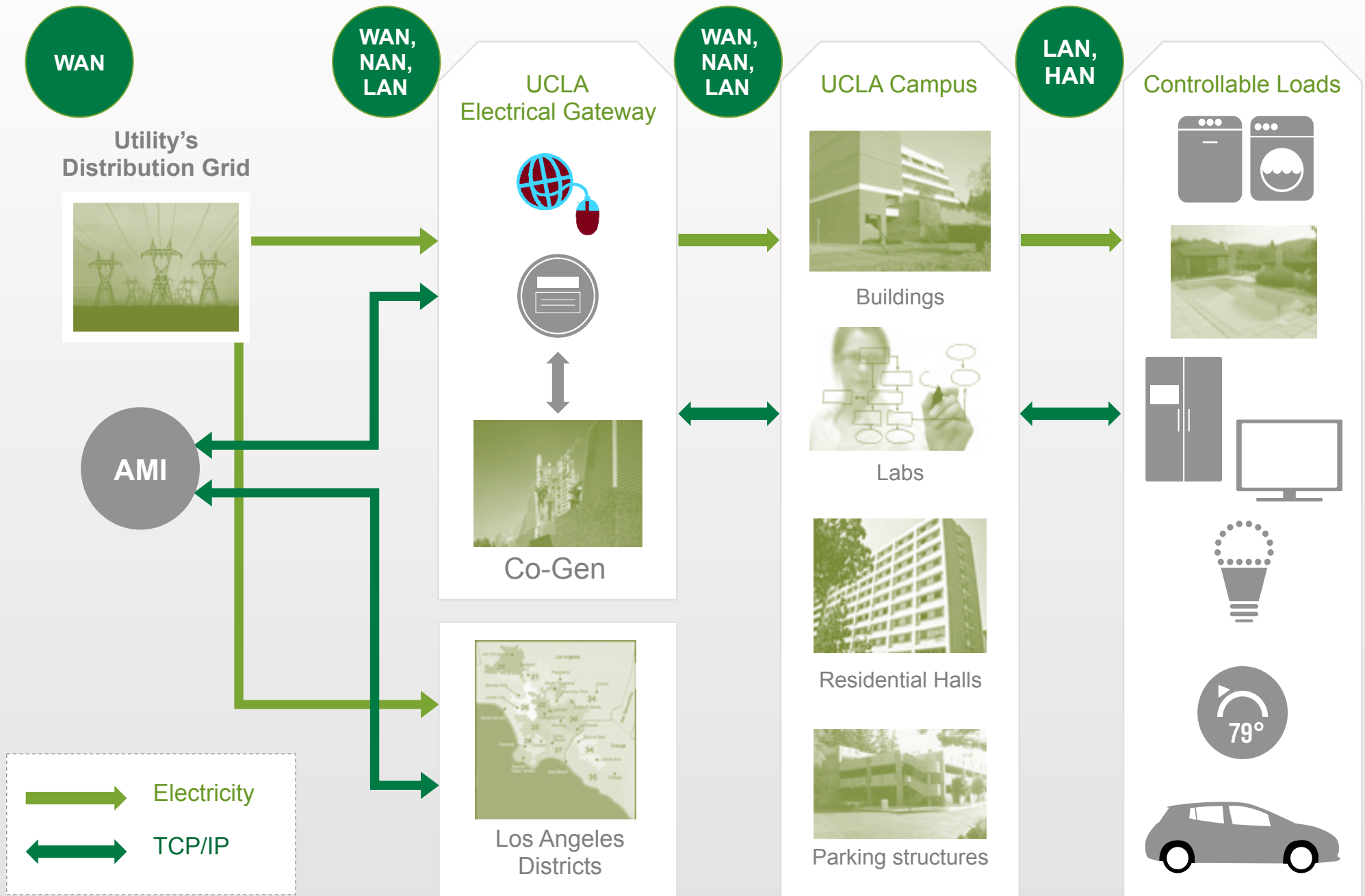
Comm, sense and control for integrating renewables, EVs and smart loads

## Transactive Control of Smart Grids

Price based high speed control of smart loads, EVs, and storage.

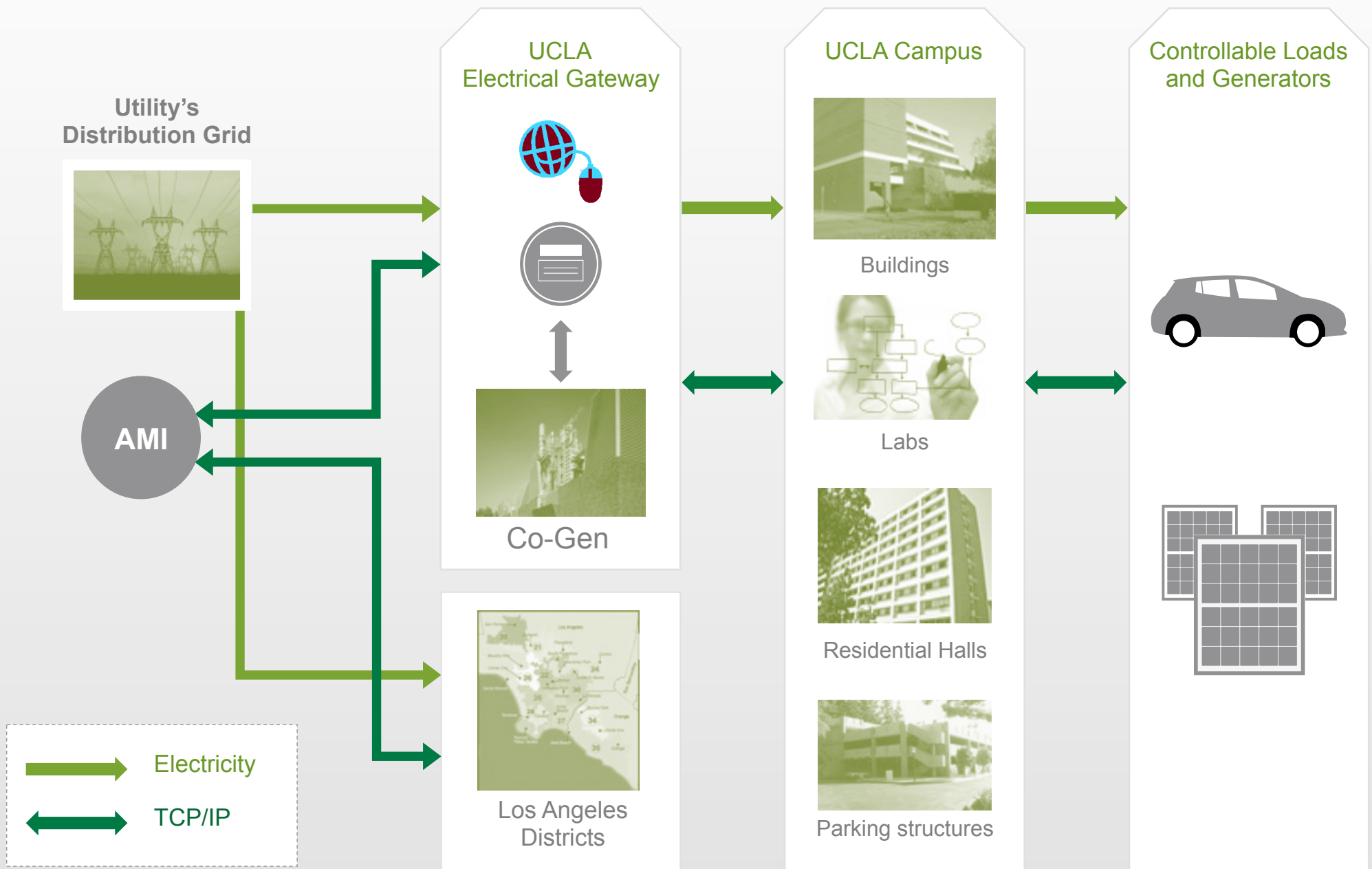
# WINSmartGrid™

## Power and Information Flow



# WINSmartGrid™

## Power and Information Flow



# Electric Vehicles – EVs available in todays 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

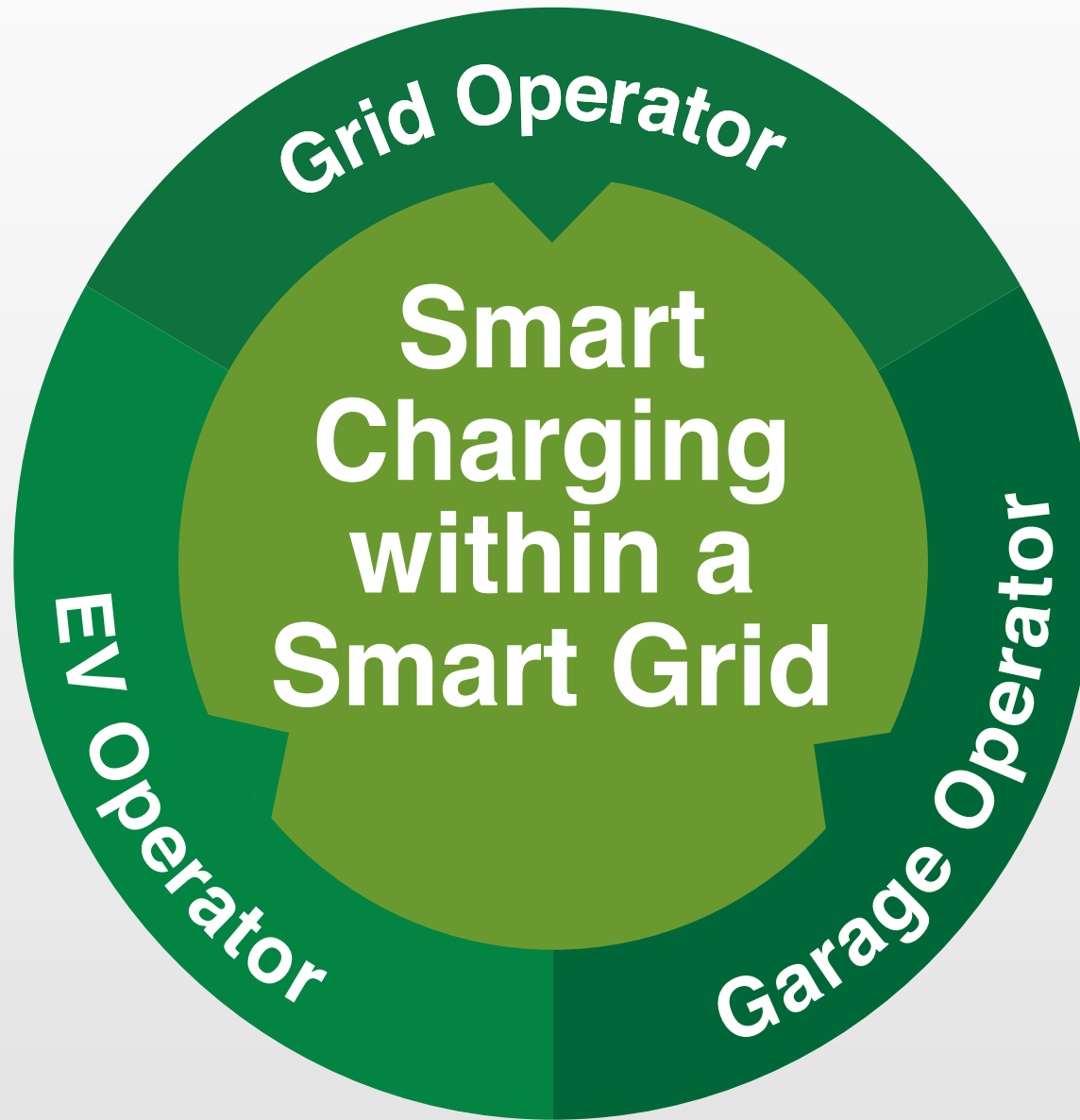


Toyota Prius Plug-in



Chevy Volt

# EV Smart Grid Integration: Fundamental Approach



# WINSmartEV™ - Mobile Web App





# SMERC Monitoring and Control Center Monitoring & Control

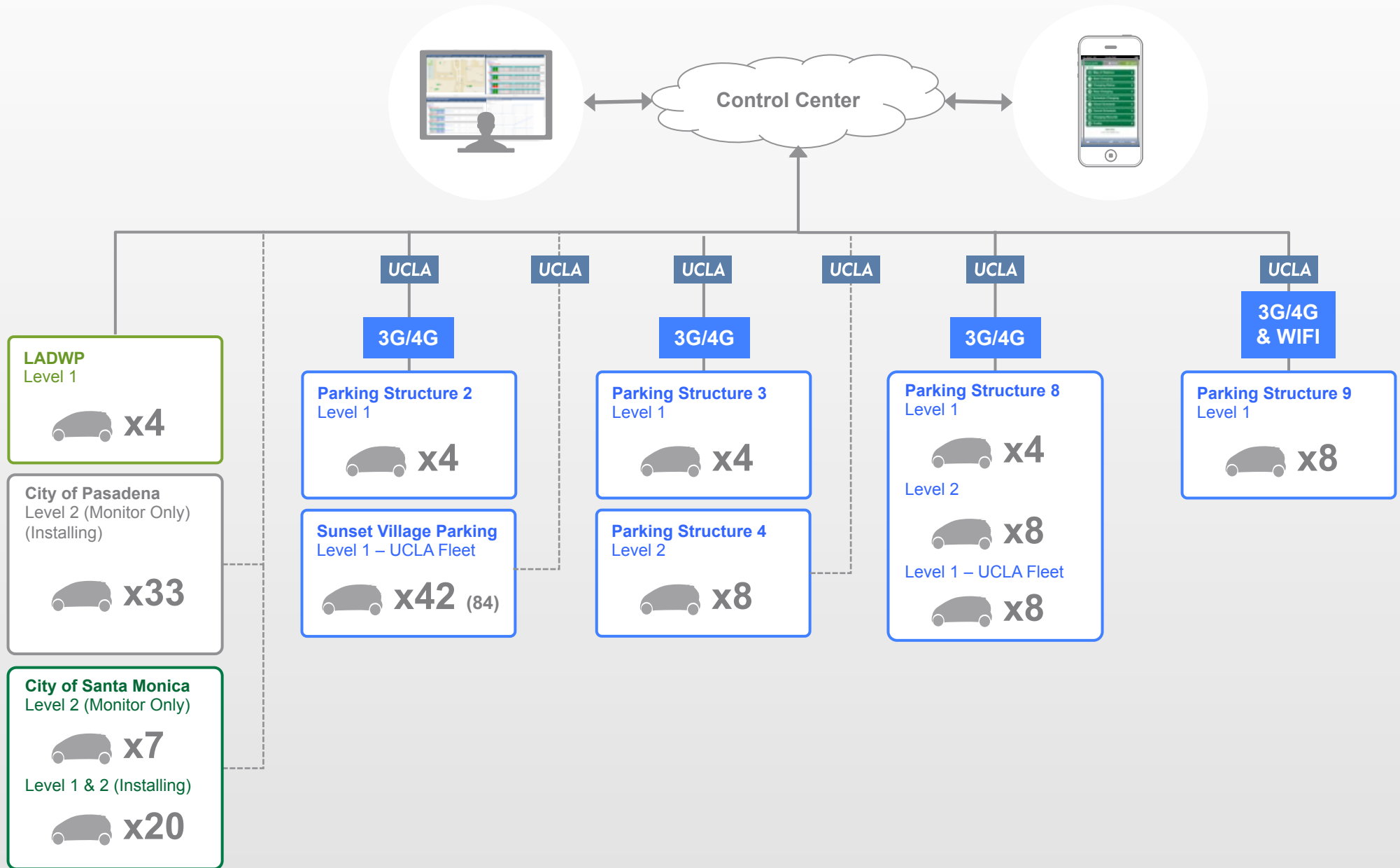
The screenshot displays a complex monitoring interface with multiple data tables. Each table represents a different system or component, with columns for status, location, and other parameters. The interface is organized into sections, likely corresponding to different parts of the facility being monitored.





# WINSmartEV™ Infrastructure

The current WINSmartEV™ infrastructure at UCLA, LADWP, City of Santa Monica, and City of Pasadena consists of 150 EVSmartPlug™s.

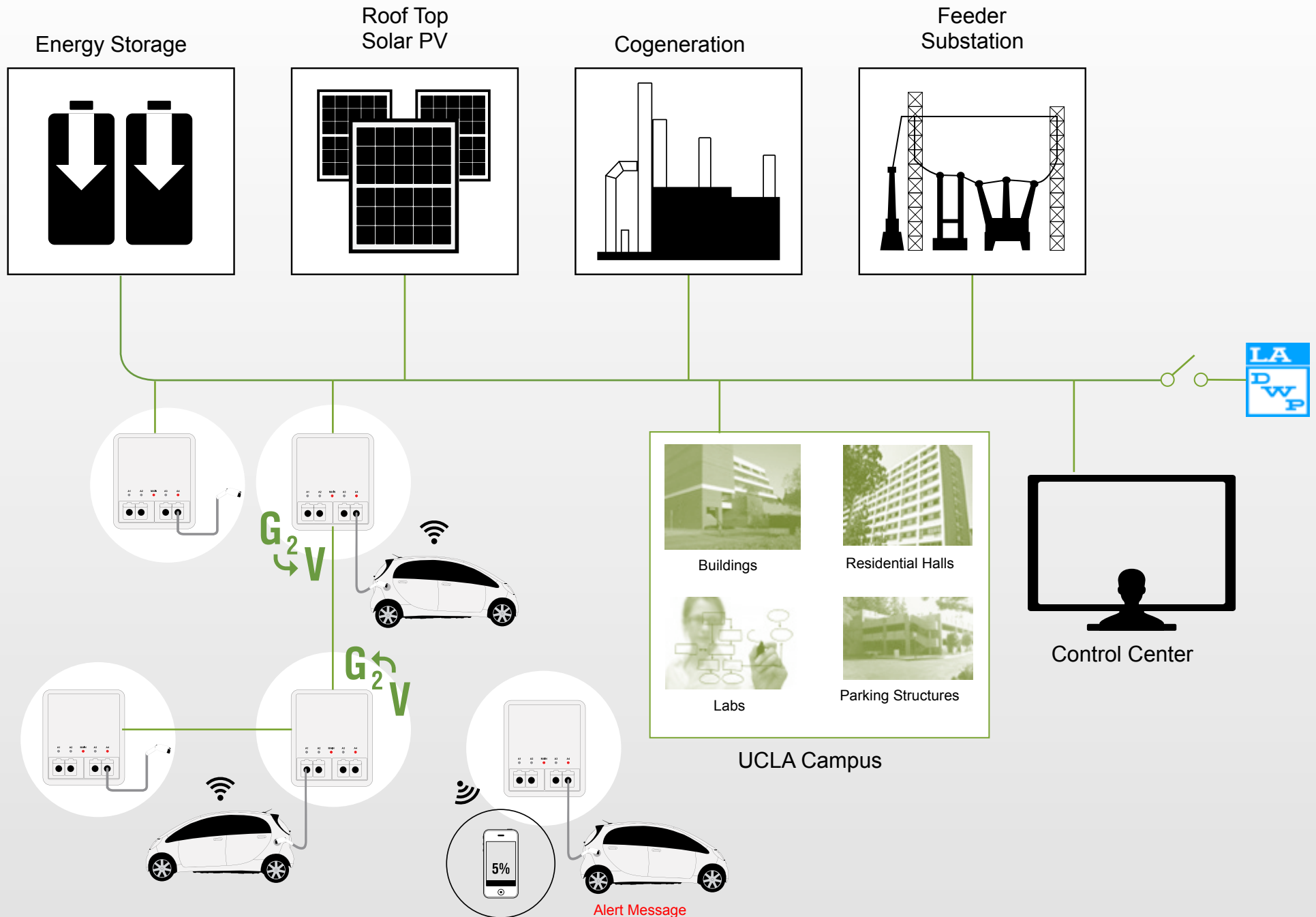




# Installation of 42 EVSmartPlugs: Sunset Village Parking

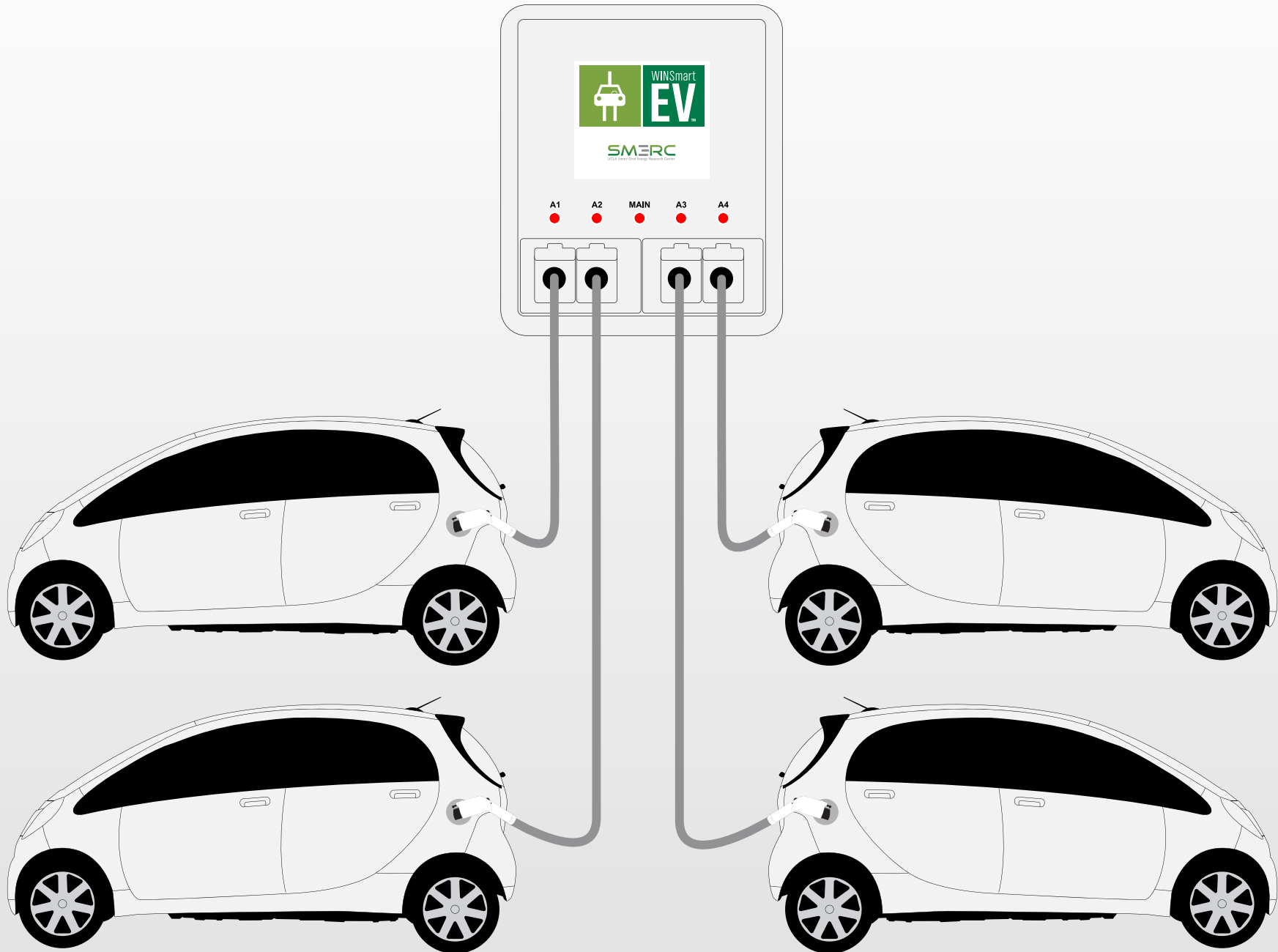


# UCLA Microgrid Intergration

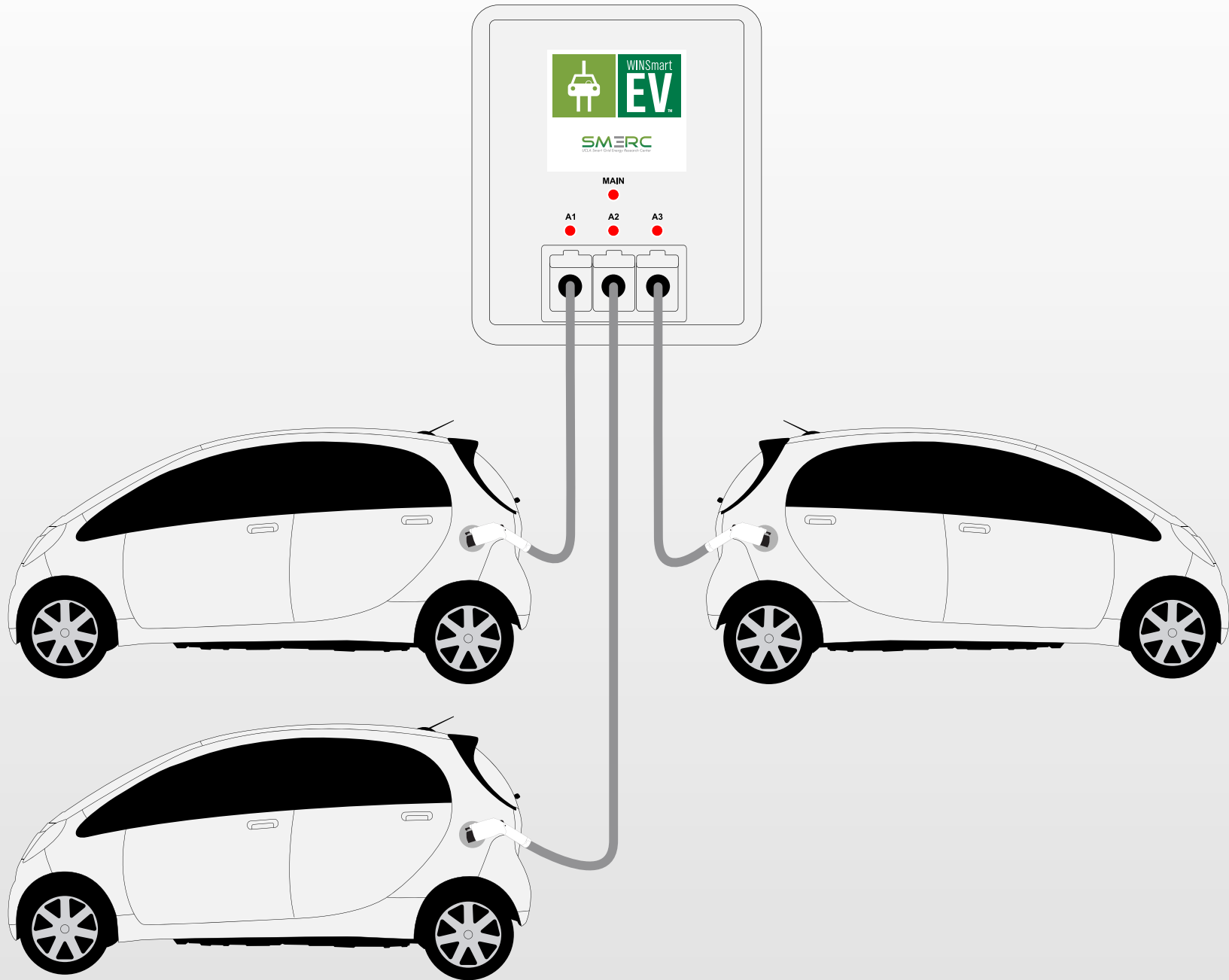




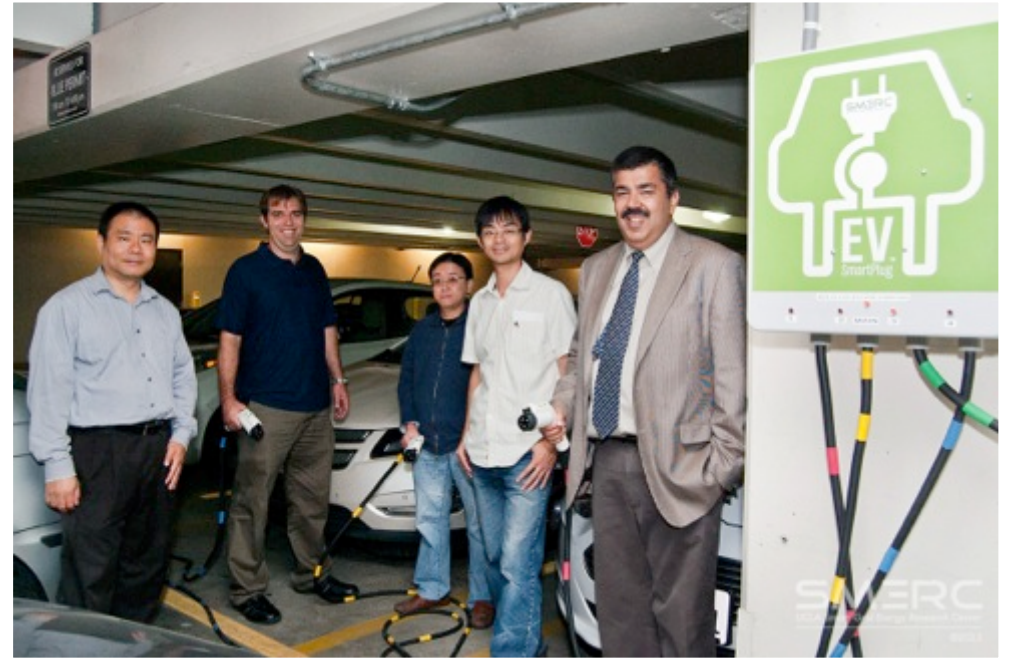
# WINSmartEV™ - The Multiplexor – 4 EVs



# WINSmartEV™ - The Multiplexor – 3 EVs

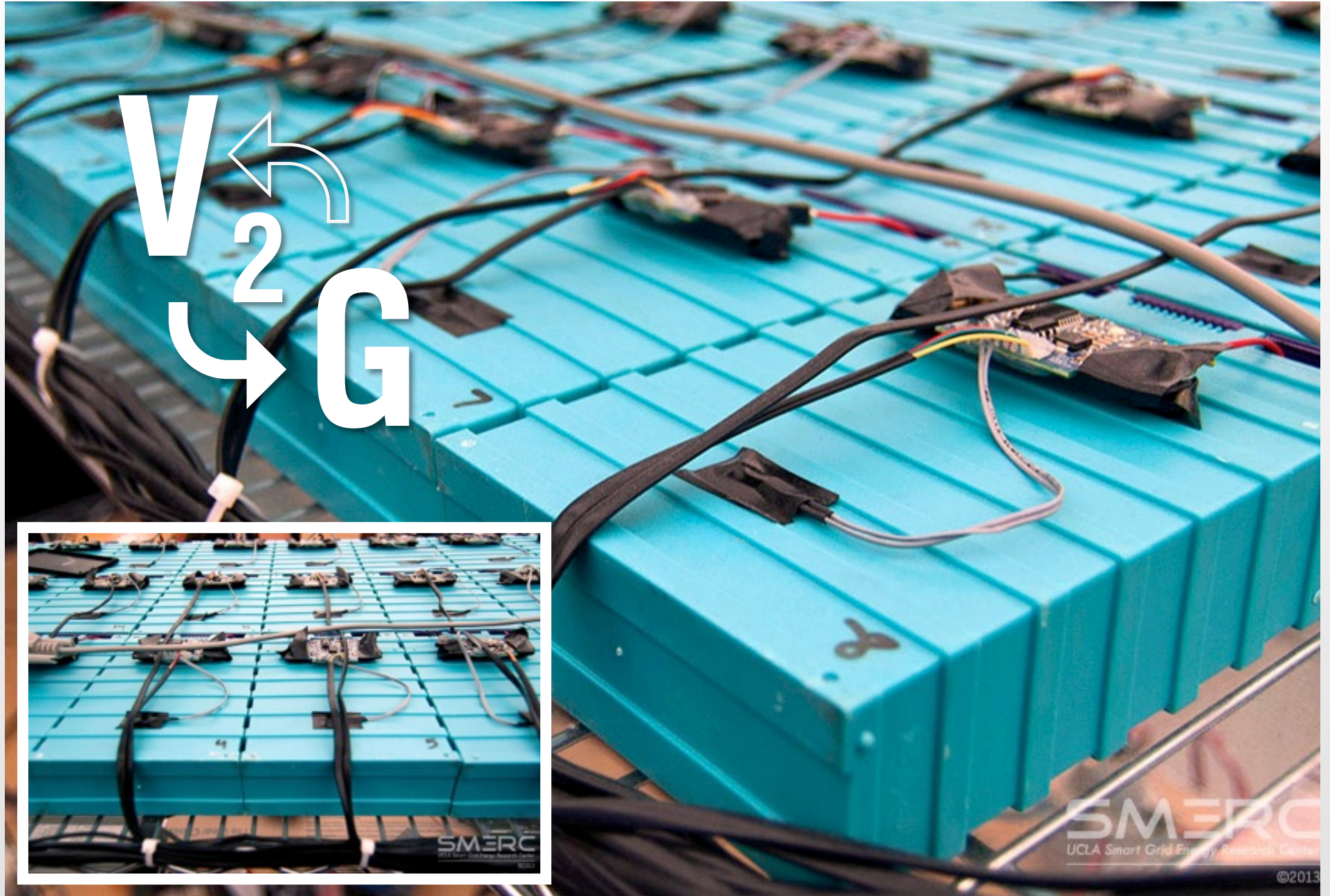


# SMERC EV Team & Level 2 Charging Box (MP-201)



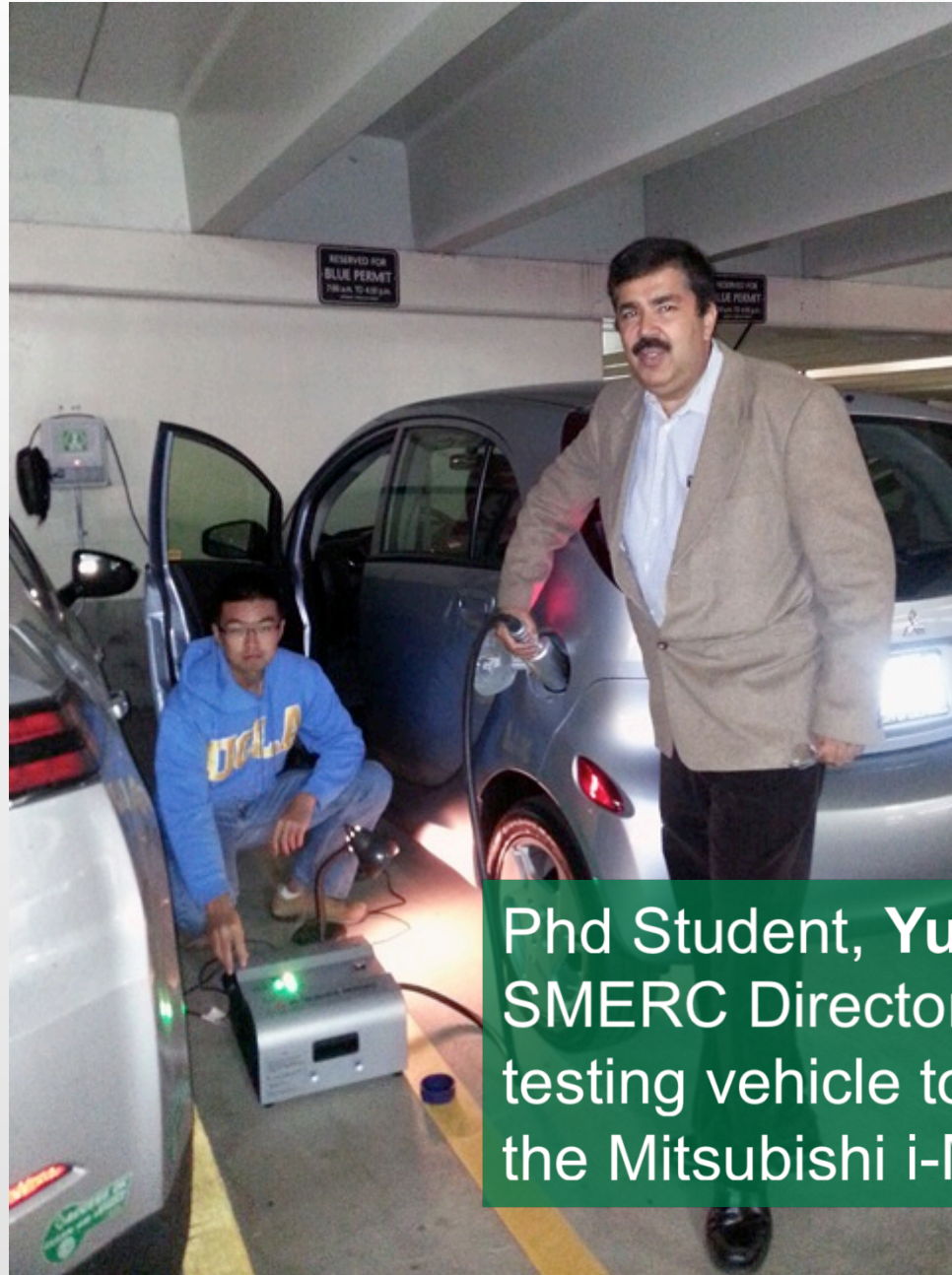


## Vehicle to Grid Testing in lab: V2G





## Vehicle to Grid (V2G)



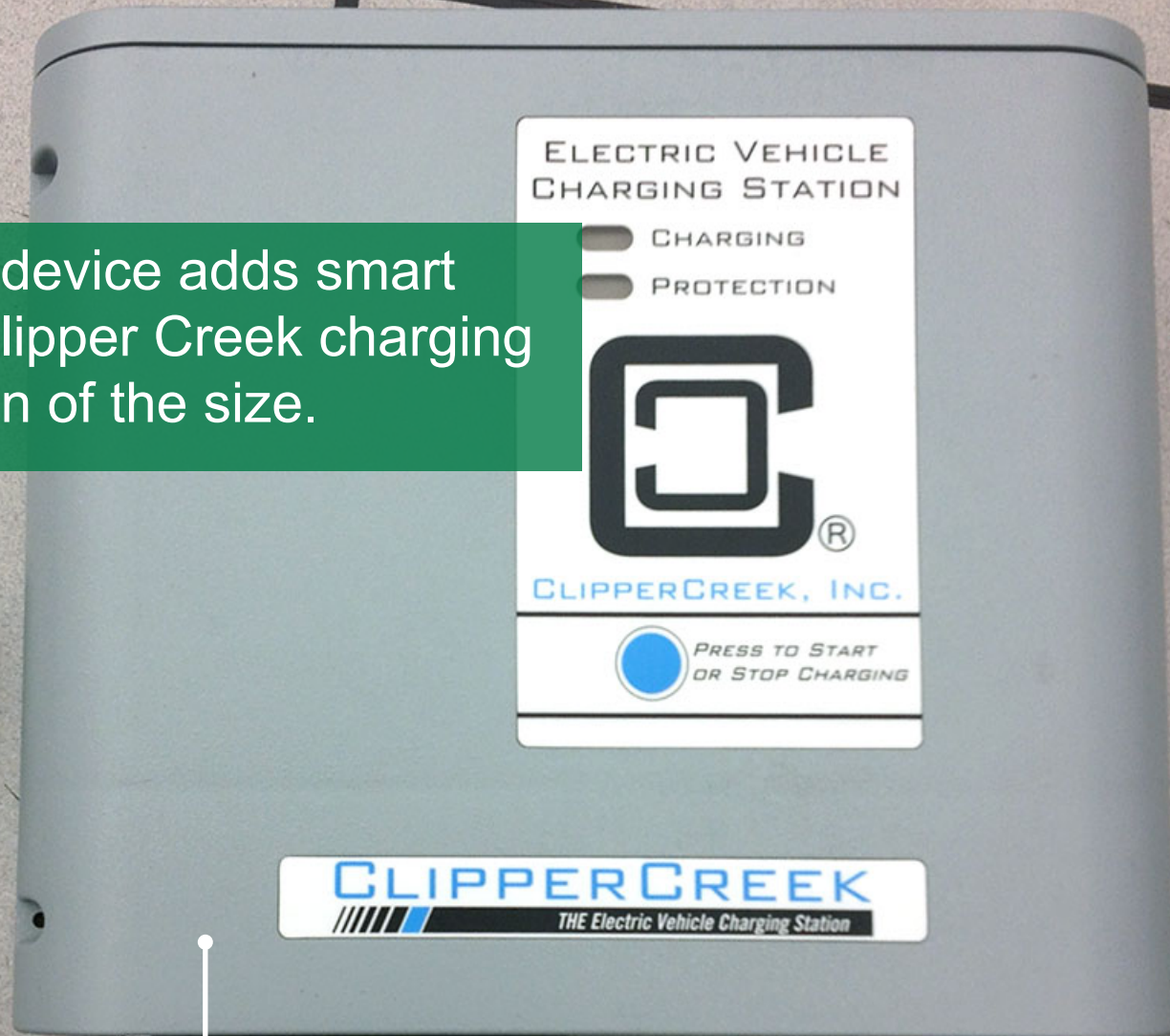
Phd Student, Yubo Wang, and SMERC Director, Rajit Gadh, testing vehicle to grid sytem with the Mitsubishi i-MIEV.

## Solar Testing in Lab





**WINSmartEV™** device adds smart functionality to Clipper Creek charging box and a fraction of the size.



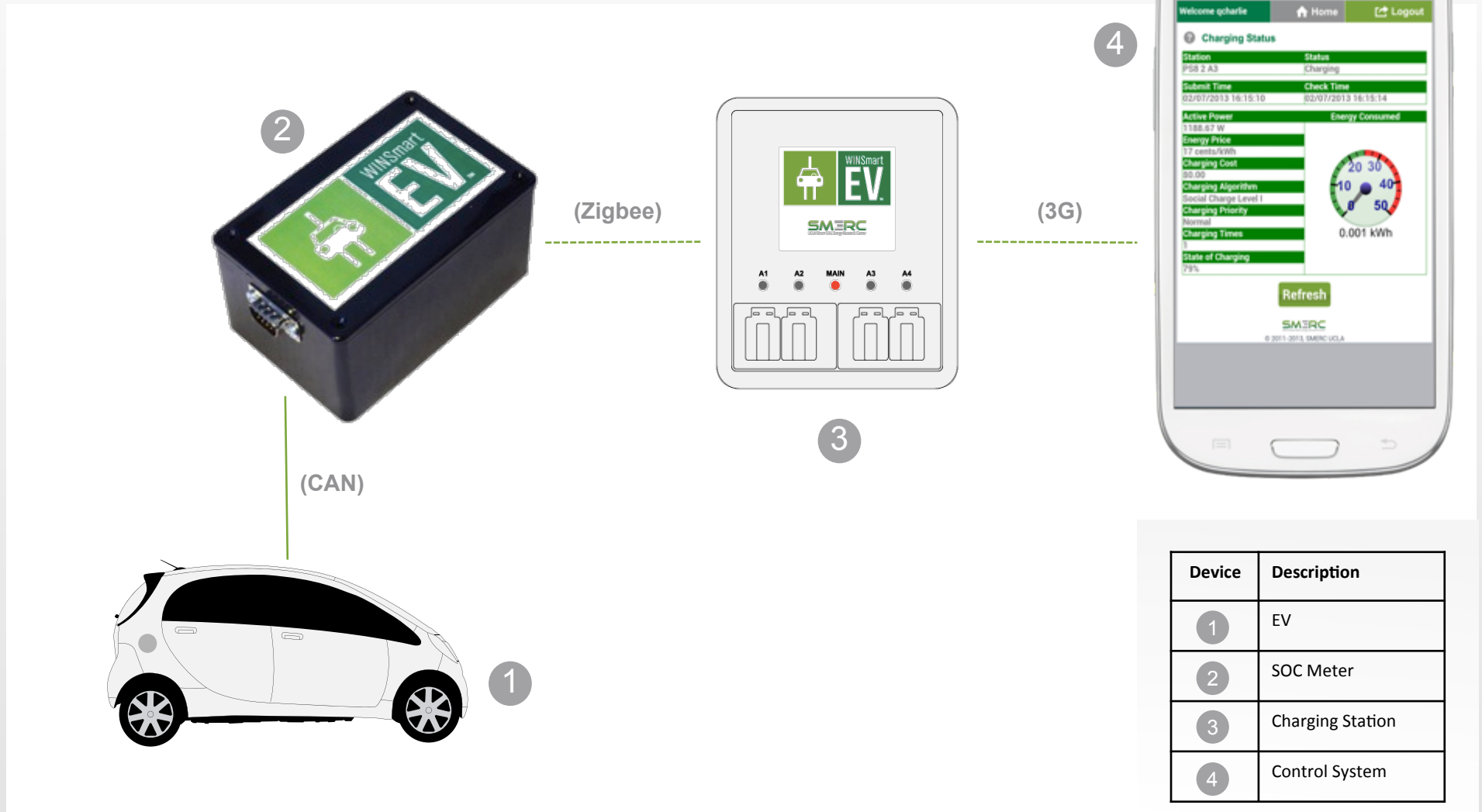
**Clipper Creek – basic EV charging box**

# Modular Design for Interoperability with existing Technologies & Standards



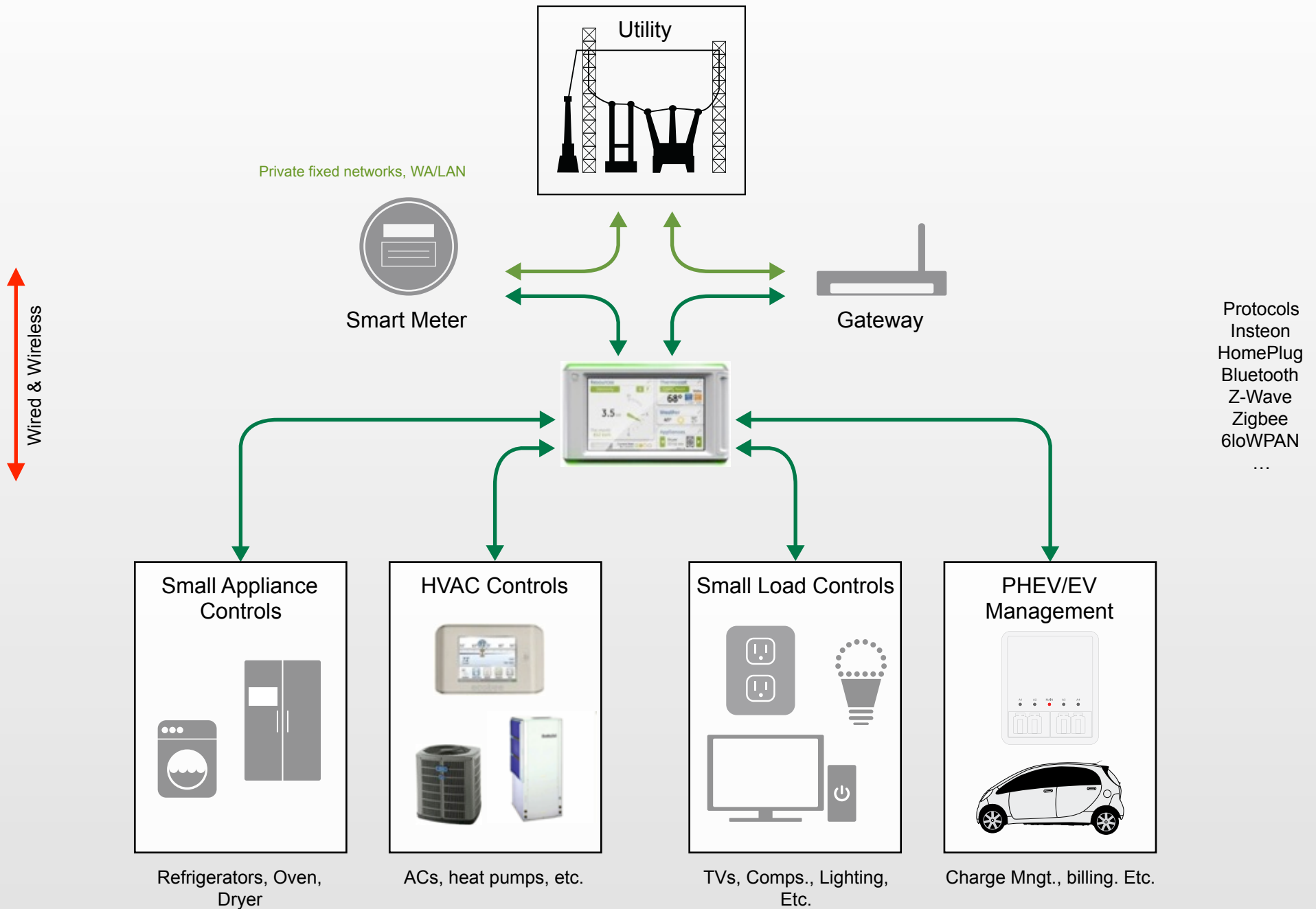
# Zigbee-Enabled Electric Vehicle State of Charge Remote Meter

Reads an EV's CAN bus, retrieves state of charge and other important data, and wirelessly transmits the data to the EVSE for subsequent charging control and charge scheduling.

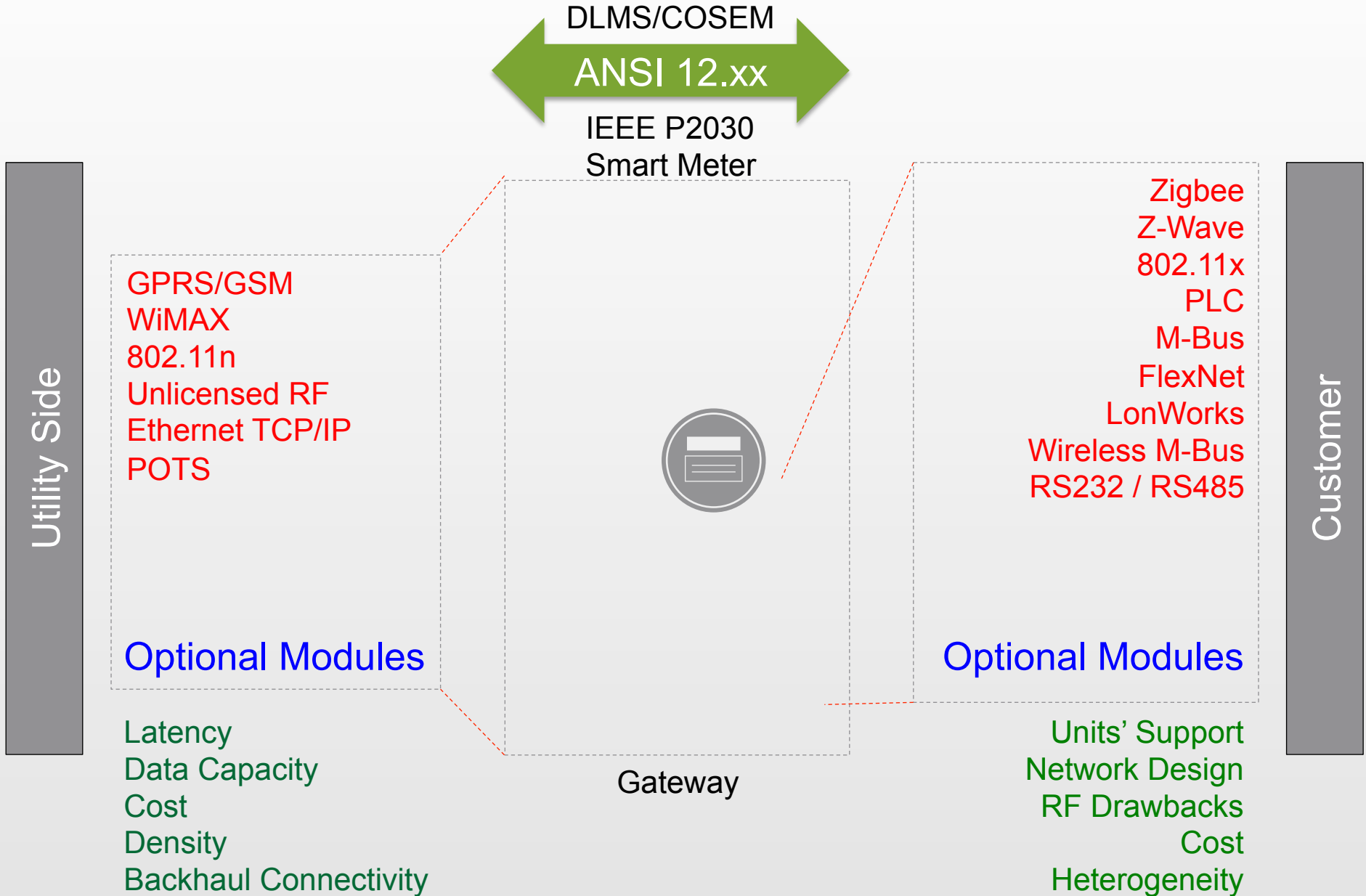


Device	Description
1	EV
2	SOC Meter
3	Charging Station
4	Control System

# Demand Response – Automation Network



# HAN Device Portal Interfaces



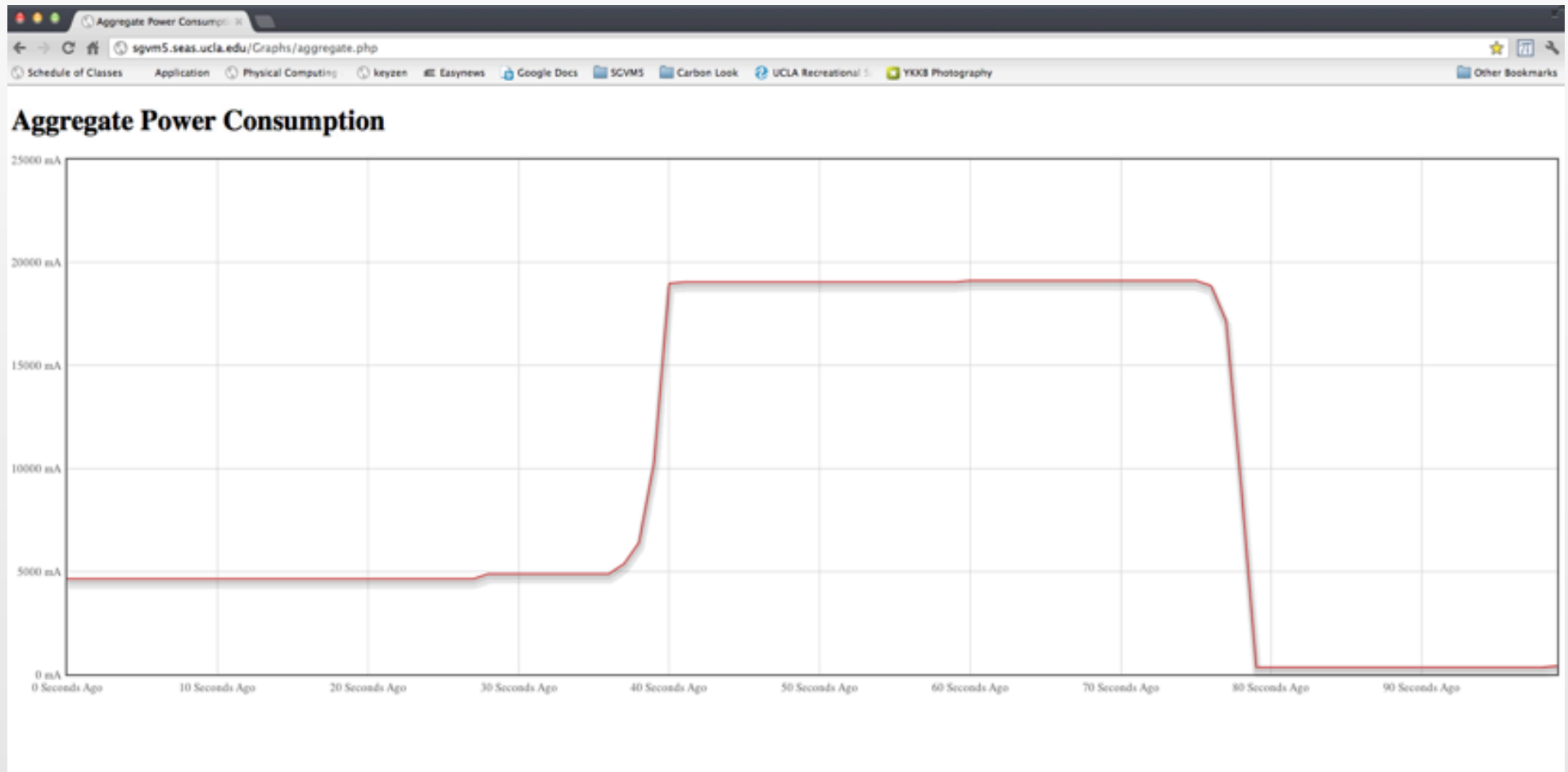


# WINSmartGrid™ DR UI – Appliance Control





# Aggregate Power Consumption



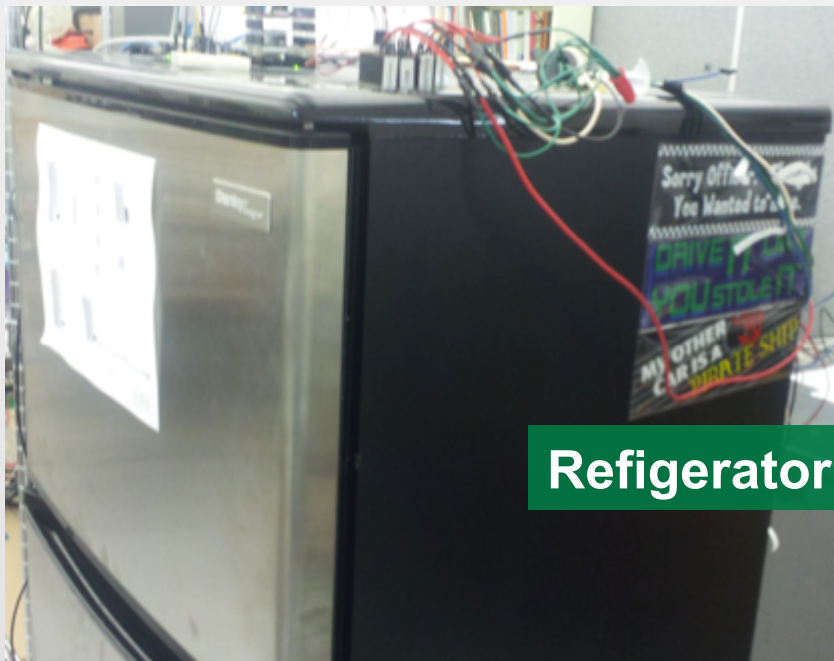
# WINSmartGrid™ DR – Wireless Appliance Interface



**HVAC BACNET**



**Lighting / LED**

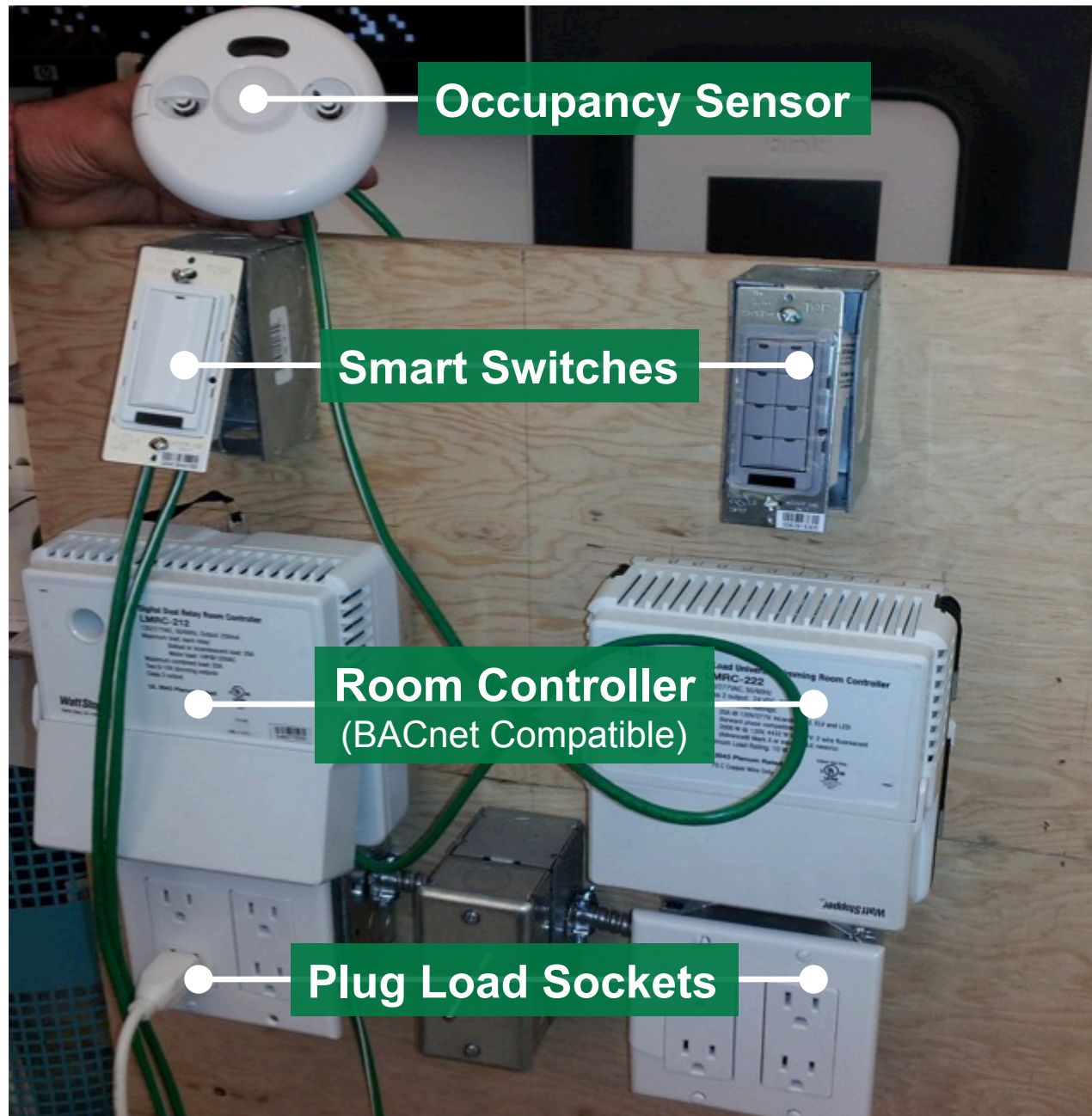


**Refrigerator**



**Dryer**

# HVAC BACNET





## Smart Appliances in Support of DR



Smart Thermostat



# Appendix

Recent SMERC News & Meetings



# Sec. of Energy, Dr. Steven Chu, meeting with UCLA Faculty & Staff at LA Science Center

(including Smart Grid Energy Research Center – SMERC)



May 13, 2011  
**Dr. Steven Chu**  
Secretary of Energy



**SMERC**  
UCLA Smart Grid Energy Research Center  
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# Michael Peevey, President of California Public Utilities Commission (CPUC), gets a tour and demonstration of the EVSmartPlug™ installation in Parking Lot 8 in UCLA.



May 2, 2013

**Michael Peevey**

President, California Public  
Utilities Commission (CPUC)

**SMERC**  
UCLA Smart Grid Energy Research Center

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# Discussing “Innovation” at UCLA

February 6, 2013



**Roy Doumani (UCLA), Ratan Tata (Chairman Emeritus, The Tata Group) and Rajit Gadhi (UCLA SMERC) discuss "Innovation" at UCLA**



# Frank Gehry & Team visit SMERC Lab

Hosted by Prof. Rajit Gadh



# City of Los Angeles

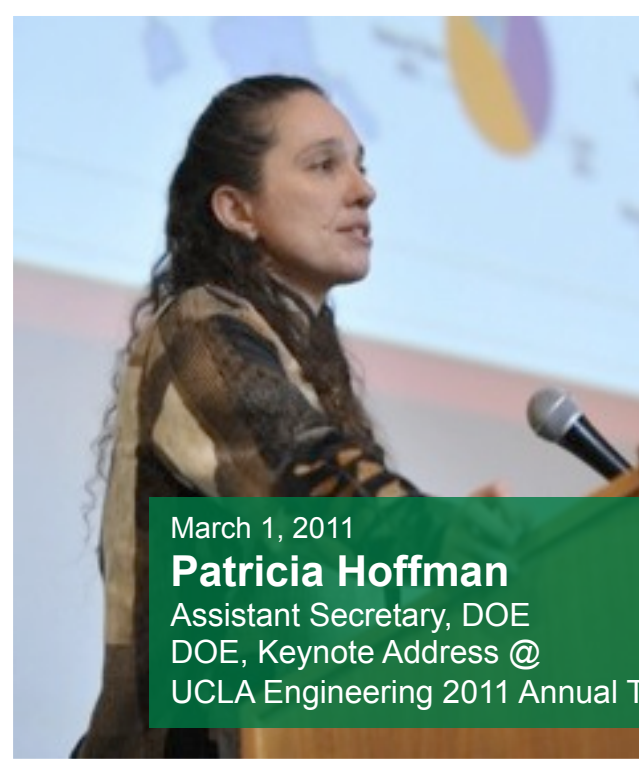
## Mayor Villaraigosa leads Electric Vehicle 101 Workshop

The screenshot shows a web browser window with the address bar displaying "mayor.lacity.org/PressRoom/LACITYP\_012264". The page header includes the City of Los Angeles logo and Mayor Antonio Villaraigosa's name. A navigation menu contains links for HOME, MEET THE MAYOR, ISSUES, PRESS ROOM, SERVICES, and OUR CITY. Below the menu is a breadcrumb trail: HOME > PRESS ROOM. The main content area features a yellow banner with social media icons (email, Twitter, Facebook, and a "More" link) and a "Sign Up to see what your friends like." button. The article title is "MAYOR VILLARAIGOSA LEADS ELECTRIC VEHICLE 101 WORKSHOP". The sub-headline reads: "Hosted by the City of Los Angeles, the SoCal EV 101 workshop was created to bring together local cities, utilities and environmental agencies to discuss regional electric vehicle readiness." The article text begins with "LOS ANGELES – Mayor Antonio Villaraigosa hosted the first SoCal EV Electric Vehicle 101 Workshop at UCLA today to bring together local cities, utilities and environmental agencies to discuss how Los Angeles will lead the region in electric vehicle readiness." It continues with a quote from Mayor Villaraigosa: "As the car capital of the world, Los Angeles has a responsibility -- both civic and economic -- to prepare itself to be the electric car capital of the world," Mayor Villaraigosa said. "And by leveraging our unparalleled resources --- our world class universities and growing clean tech economy --- Los Angeles will lead the charge for preparing for electric vehicles." The text then states: "The EV Workshop is one benchmark deliverable of Los Angeles' Electric Vehicle strategy that was announced in 2009. It is one of the many initiatives included in the collaboration between the Southern California region on EV readiness. In this announcement, the Mayor also pledged that Los Angeles would be the regional leader in this collaborative." A quote from Judith Mitchell follows: "We need a region-wide network of charging stations if we hope to see large-scale deployment of, and resulting environmental benefits from, electric vehicles," said Judith Mitchell, Rolling Hills Estates Councilwoman and AQMD Governing Board Member. The text then describes the event: "The day-long event, designed to foster regional collaboration and preparation for plug-in vehicles, was co-hosted by the Mayor's Office, the Los Angeles Department of Water and Power, Southern California Edison, South Coast Air Quality Management District, the County of Los Angeles, and the UCLA Office of the Vice Chancellor for Research." Another quote from Rajit Gadh is provided: "The SoCal EV Consortium is an important new endeavor for Southern California," said Rajit Gadh, director of UCLA's new Smart Grid Energy Research Center and its affiliated UCLA SG-EV Technology Program. "With a new generation of electric vehicles coming online soon, the consortium will provide to be a significant development in a region that brings complementary capabilities to technology programs such as ours in helping us as a community to prepare for an exciting new market." A final quote from Mayor Villaraigosa concludes the article: "By acting regionally, we are also acting strategically. Because as well all know, we are all neighbors in the Southern California region, connected by a vast network of freeways and roads," Mayor Villaraigosa said. "By working together as a region, we are leading the charge for EV owners to be able to drive and plug-in seamlessly throughout the region." The article ends with the contact information: "Contact: Rachel Kruer 213-978-0741". On the right side of the page, there is a search bar and a "HAVE A BETTER IDEA?" graphic with the text "let us know about it". Below this is a "Proud supporter of..." section featuring the Homeboy Industries logo. At the bottom right, there is an "OTHER HIGHLIGHTS" section with links for "Popular Services", "All Services", and "Stop Abuse From Existing (S.A.F.E)".

# Recent Visitors to UCLA



October 2011  
**Ron Nichols**  
General Manager, LADWP  
With Kathryn Atchison and Rajit Gadh



March 1, 2011  
**Patricia Hoffman**  
Assistant Secretary, DOE  
DOE, Keynote Address @  
UCLA Engineering 2011 Annual Tech Forum