

# Emerging Technology Solutions at Southern California Edison

**ADVANCED  
TECHNOLOGY**  
Transmission & Distribution Business Unit



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Minneapolis, MN  
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# Drivers for SCE's Emerging Technologies Work

- State and federal mandates for GHG reduction, energy efficiency, demand response, and renewable energy integration.
- Customer expectations for superior reliability and power quality at a reasonable cost.
- Interaction between emerging technologies to help control power delivery in an efficient, safe and reliable real-time mode.
- Development of smart transmission and substation technology solutions because of PMU technology.
- The increased speed, intelligence and computation of real-time monitoring equipment.

# SCE Smart Grid Strategy

Five key themes that will position SCE for the future in energy delivery



***Modernize the grid to improve reliability, safety, and cost effectiveness while delivering more customized solutions and environmentally-friendly energy supply to meet customer energy management needs***

# Emerging Technology Development at SCE

- Optimizing Renewable Integration
- Wide-Area Monitoring Protection and Control (WAMPAC)
- Advanced Transmission/Substation Technologies
- Advanced System Analytical Tools
- Information and Communications Technologies
- Cyber-Security and Interoperability
- Smart Customer Technologies
- Electric Vehicles
- DOE Stimulus Awarded Projects



# Optimizing Renewable Integration

- Solar Photovoltaic
  - Solar PV Inverter Studies
  - Dynamic Modeling of Solar Technologies
  - PV Integration Impact Studies
- Wind
  - Wind Integration Studies
  - WECC Steady-State and Dynamic Wind Model Validation
- Energy Storage
  - DOE Large Energy Storage Demonstration Project
  - CEC Energy Storage Contract (SCE/Quanta/Oak Creek)

# Wide-Area Monitoring Protection and Control (WAMPAC) Program

- SCE Wide-Area Situation Awareness System (WASAS)
- Centralized Remedial Action Scheme (CRAS)
- Situational Awareness and Analysis Center (SAAC)
- ARRA Project - Application of Advanced Wide-Area Early Warning Systems with Adaptive Protection
- WECC Western Interconnection Synchrophasor Program (WISP)
- Synchrophasor Application Development



# Advanced Transmission/Substation Technologies

- Fault Current Limiters
  - Superconducting Fault Current Limiter (FCL)
- Superconducting Transformers
- Transformer Online DGA Monitoring Program
- Distribution Static VAR Compensator (d-SVC ) Application
- Advanced Voltage/VAR Control (AVVC)

# Advanced Analytical System Tools

- Power System Outlook (PSO®)
- Synchronized Measurement and Analysis in Real Time (SMART®)  
Tool development to create simulated cases and files using PSLF-PSO programs
- Real-Time Digital Simulator (RTDS)
  - Renewable Energy Integration Analysis
  - Detailed simulation of T/D grid and circuit element behavior
- CYME Dist - PSCAD





# Information and Communications Technologies

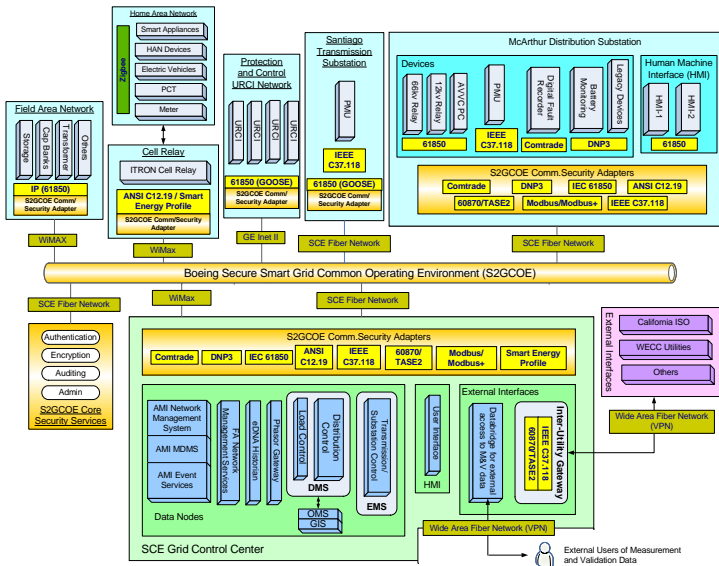
- Distribution Management System/Advanced Load Control System (DMS/ALCS)
- eDNA Historian
- Home Area Network (HAN) testing of smart appliances and thermostats
- Edison SmartConnect™ Advanced Metering Infrastructure
  - First meters installed in 2009
  - 1 million installed to date - July 2010
  - 5 million planned by 2012
  - 7500 installed each day



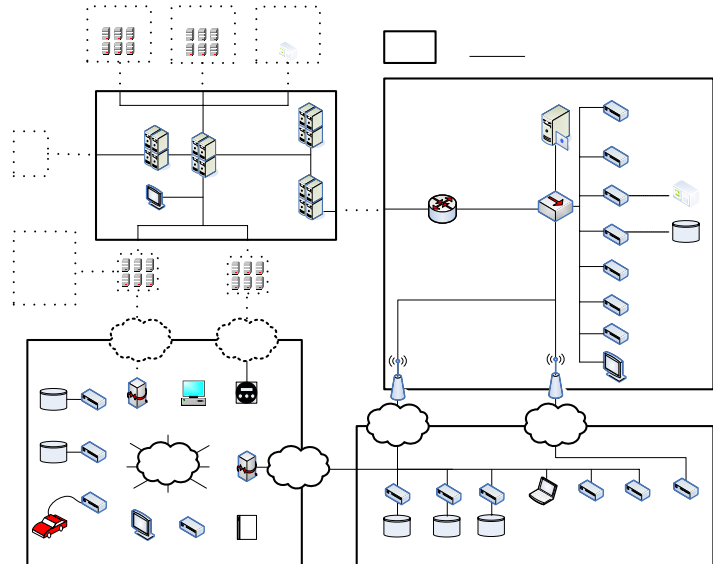
# End-to-End Cyber-Security and Interoperability

- Architect a telecommunications backbone for a smart grid called Secure Energy Network (SENet)
- SCE's objective is to create a cyber-secure smart grid communications network utilizing open standards and protocols

## Cyber-Security



## Interoperability

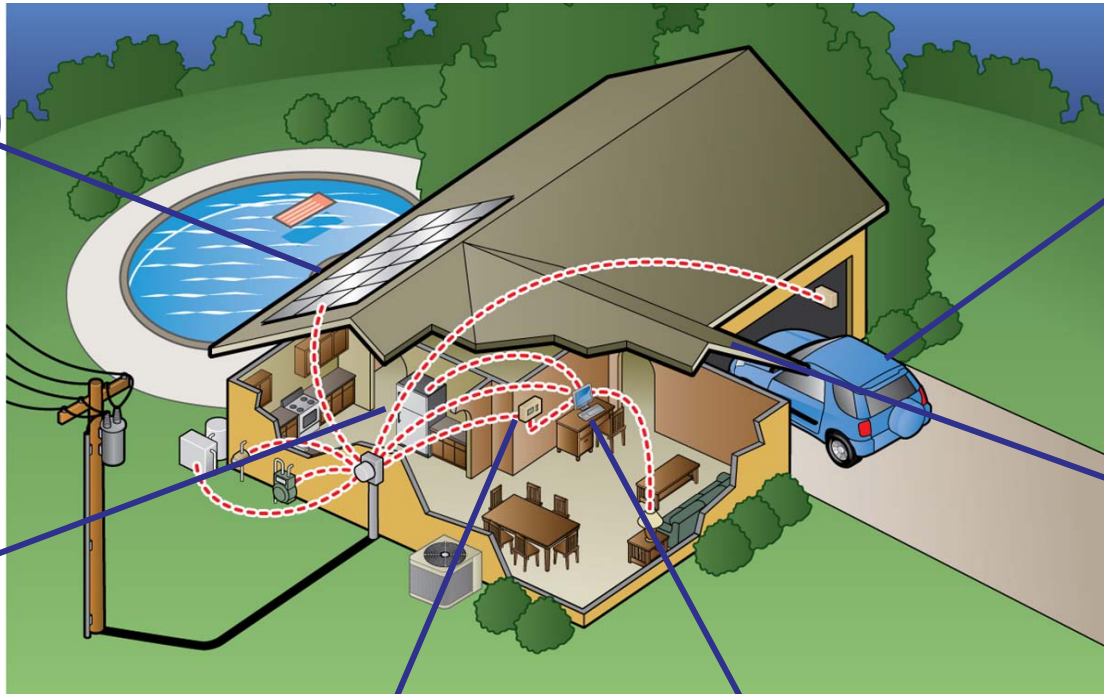


# Smart Customer Solutions

## Empowering Customers



**Customer Enabled Automated Response through Energy-Smart Appliances**



**Improved Load Management through Edison Smart Connect™**



**Energy Information Drives Energy Conservation and GHG Reductions**



# Types of Electric Vehicles (EVs)

- Hybrids (EV)

- Ford Escape, Prius, etc.

- 10 – 20 miles equivalent EV range
    - Blend electric-only and hybrid operation
    - Engine is often on, but mpg can be 100+ for urban driving



- Plug-In Electric Vehicles (PEVs)

- Nissan, Tesla, Mitsubishi, Subaru

- 100 – 200 mile EV range
    - Large battery, high charge power
    - There is no engine – home-based and public charging of the batteries is needed



- Extended Range EV (EREV)

- Chevy Volt

- 20 – 40 miles of EV range
    - Distinct electric-only operation until battery is depleted
    - Engine is rarely on – even on the freeway except on longer trips



# SCE Stimulus Projects and Collaborations

## **Irvine Smart Grid Demonstration:**

Demonstrate an integrated, scalable Smart Grid with all the interlocking pieces of an end-to-end system from the transmission and distribution systems to consumer applications such as smart appliances and electric vehicles.

## **Tehachapi Wind Energy Storage Project:**

Deploy and evaluate an 32 MWh utility-scale lithium-ion battery technology to improve grid performance and aid the integration of wind generation into the electric supply.

## **Superconducting Transformer Project:**

Waukesha Electric Systems project in collaboration with SCE to design and develop a prototype superconducting transformer with fault current limiting capabilities to reduce the cost and size of substation equipment.

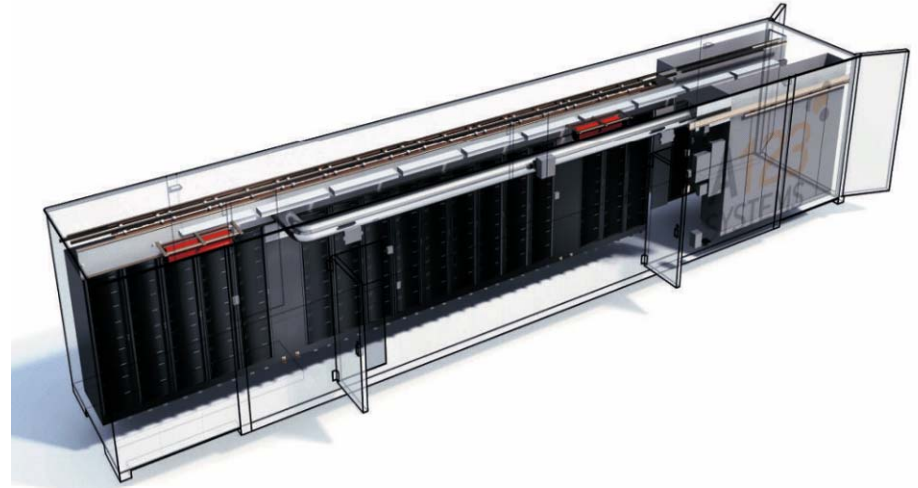
# Irvine Smart Grid Demonstration Project

- **Energy Smart Customer Devices**
  - Evaluating Zero Net Energy (ZNE) Home on the grid
  - Plug-in Electric Vehicle (PEV) charging at work
- **Y2020 Distribution System**
  - Distribution circuit constraint management using energy storage
  - Enhanced circuit efficiency and power quality with Volt/VAR control
  - Self-healing distribution circuits
  - Deep grid situational awareness for transmission operators using phasor technology
- **Secure Energy Network (SENet)**
  - Demonstrating end-to-end cyber-security and interoperability of 3 primary networks (inter-utility, intra-utility and field area)
- **Workforce of the Future**
  - Identify the organizational impacts and educational curriculum development to produce the next generation utility worker

# Tehachapi Wind Energy Storage Project

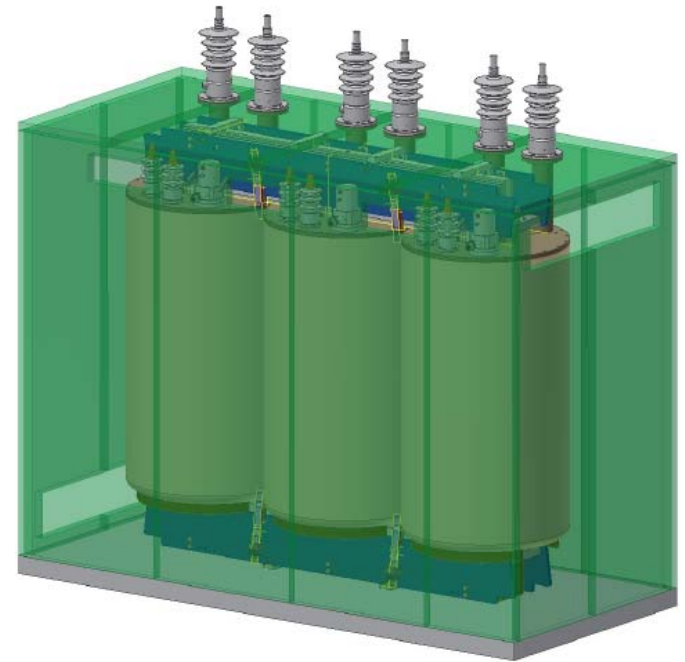
## Lithium Ion (A123 System)

- 8 MW/ 32 MWh of storage from auto-derivative batteries
- Modular rack based battery design
- Housed in 8,000 sq ft building
- Smart inverter technology
- Interoperability & security included



# Superconducting Transformer Project

- This project involves a superconducting transformer that Waukesha Electric Systems is developing under its SGD award as the prime recipient
- The transformer coils will be cryogenically cooled to eliminate line loss due to overheating
- ISGD is a test bed to demonstrate this new technology
- Inherent low impedance giving higher duty at the bus
- Inherent fault current minimization that may affect equipment duty at the substation





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For more information on SCE's Smart Grid strategy,  
news, and updates, go to: [www.sce.com/smartgrid](http://www.sce.com/smartgrid)