

**EPRI**

ELECTRIC POWER  
RESEARCH INSTITUTE

## **Power Engineering Workforce Needed for the Smart Grid**

**Clark W. Gellings**

EPRI Fellow

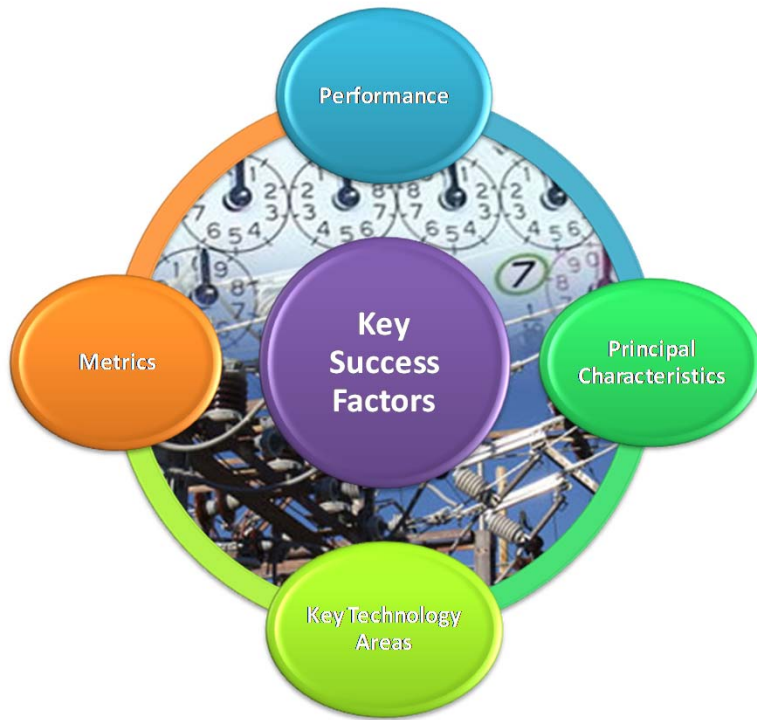
**University of Minnesota, Reforming  
Electrical Systems Curriculum  
Napa, CA**

February 5, 2011

# Estimated Cost & Benefits of the Smart Grid

	<b>20-Year Total (\$billion)</b>
Net Investment Required	338 – 476
Net Benefit	1,294 – 2,028
Benefit-to-Cost Ratio	2.8 – 6.0

# Smart Grid System Vision for Measuring Success



- Enable active participation by consumers
- Accommodate all generation and storage options
- Enable new products, services, and markets
- Provide power quality for the digital economy
- Optimize asset utilization and operate efficiently
- Anticipate and respond to system disturbances (self-heal)
- Operate resiliently against attack and natural disaster

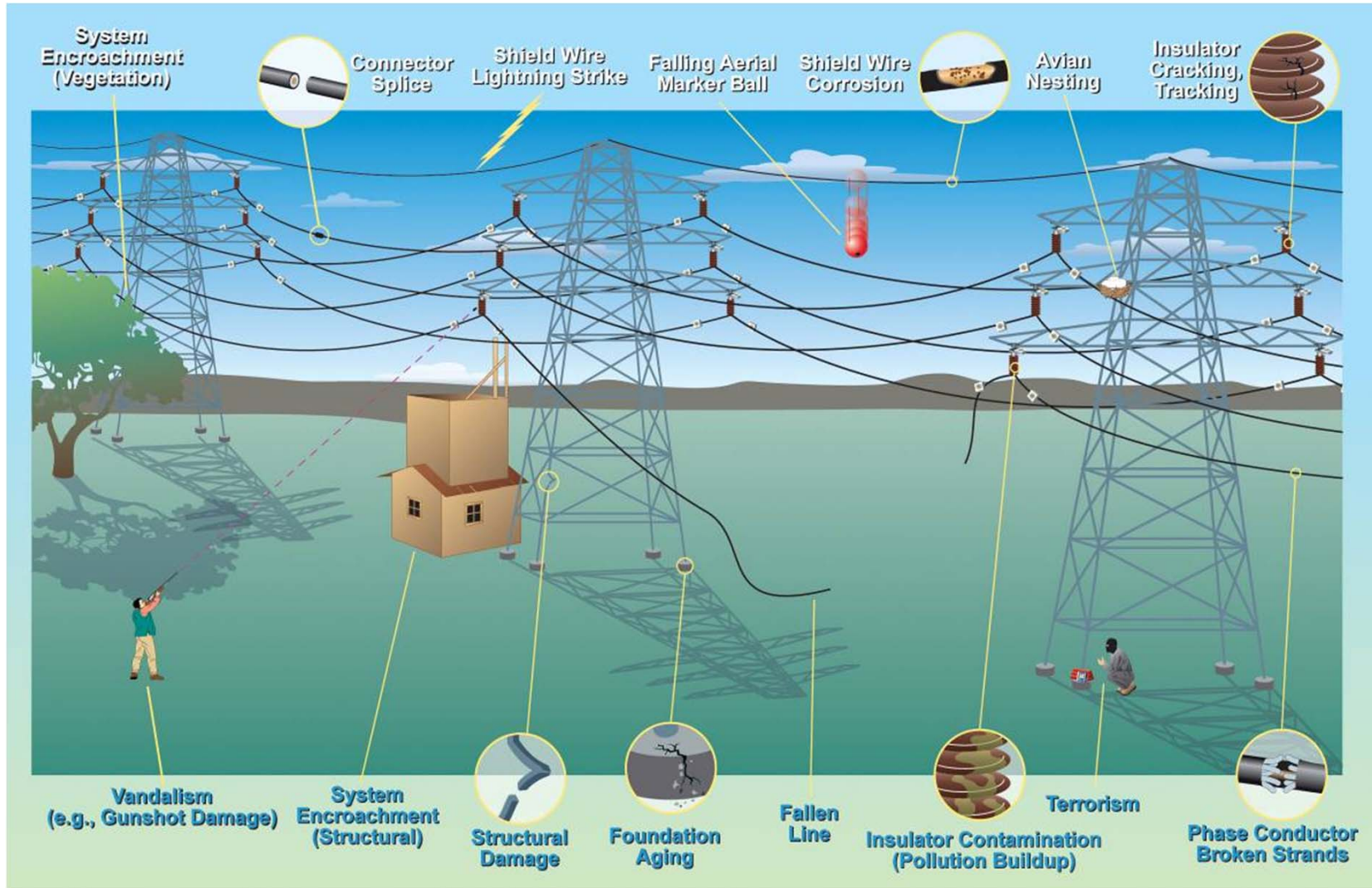
Source: EPRI Report to NIST, 2009

CWG/9379P

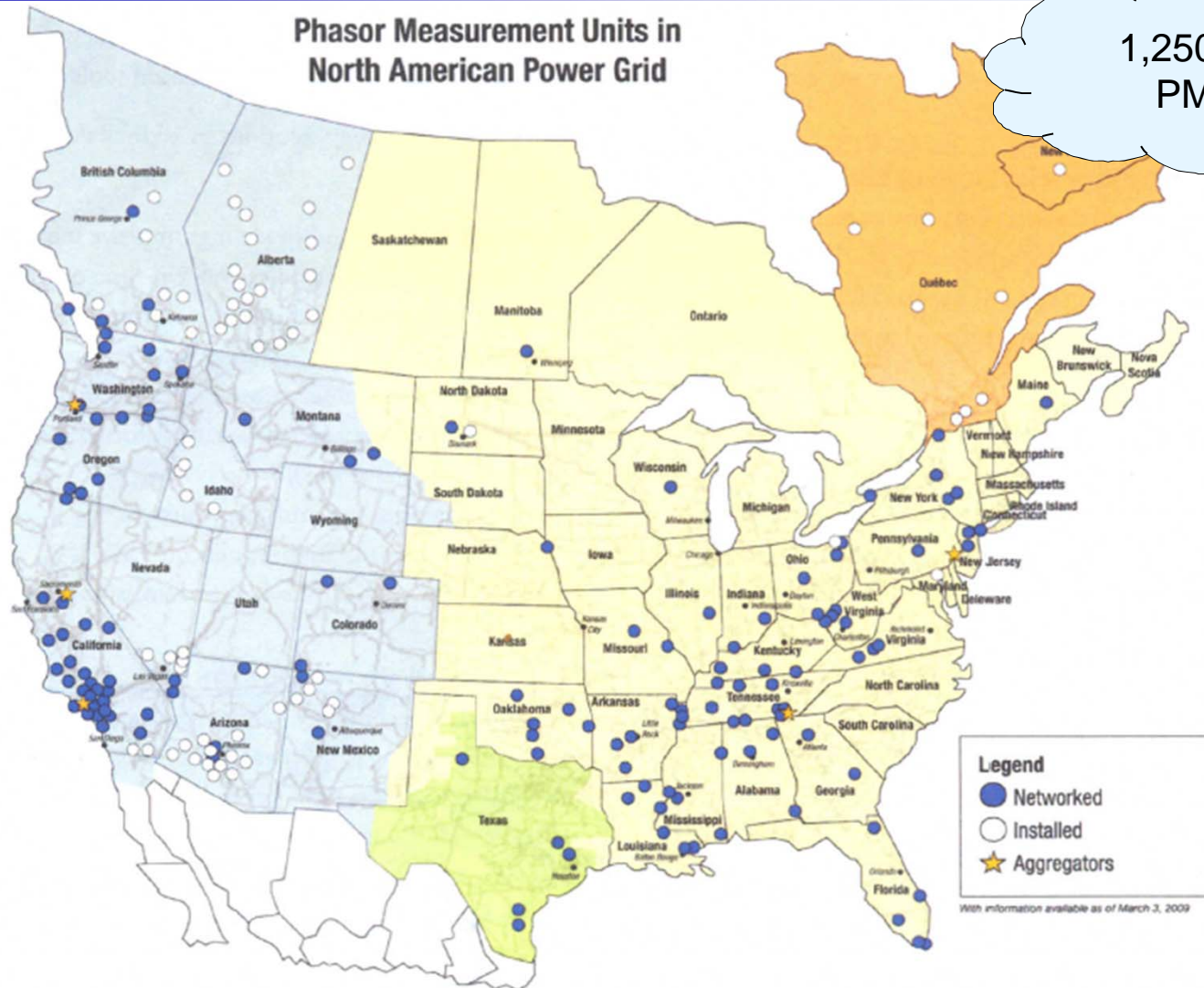
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# Sensor Needs for Transmission Lines & Towers



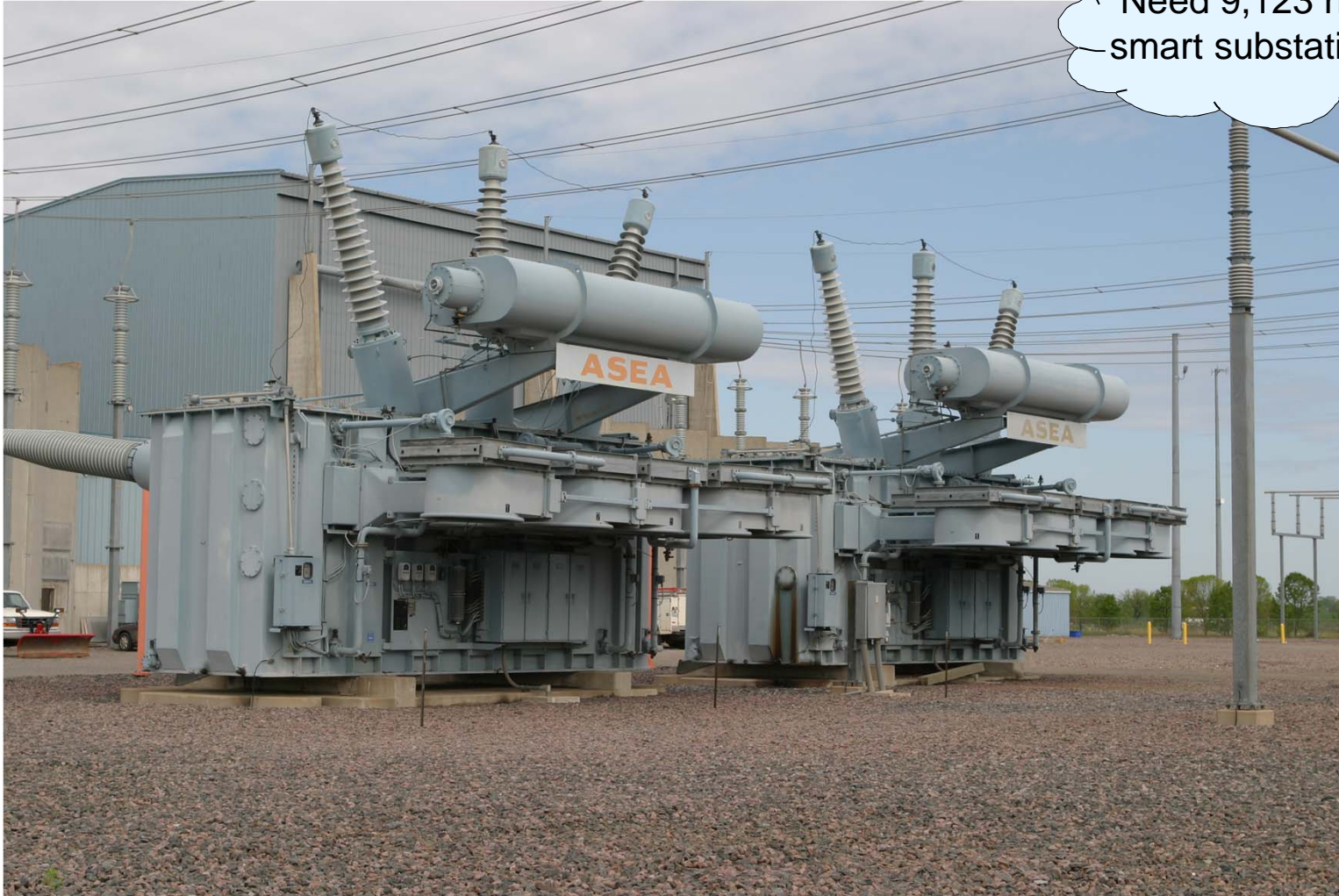
# Phasor Measurement Units



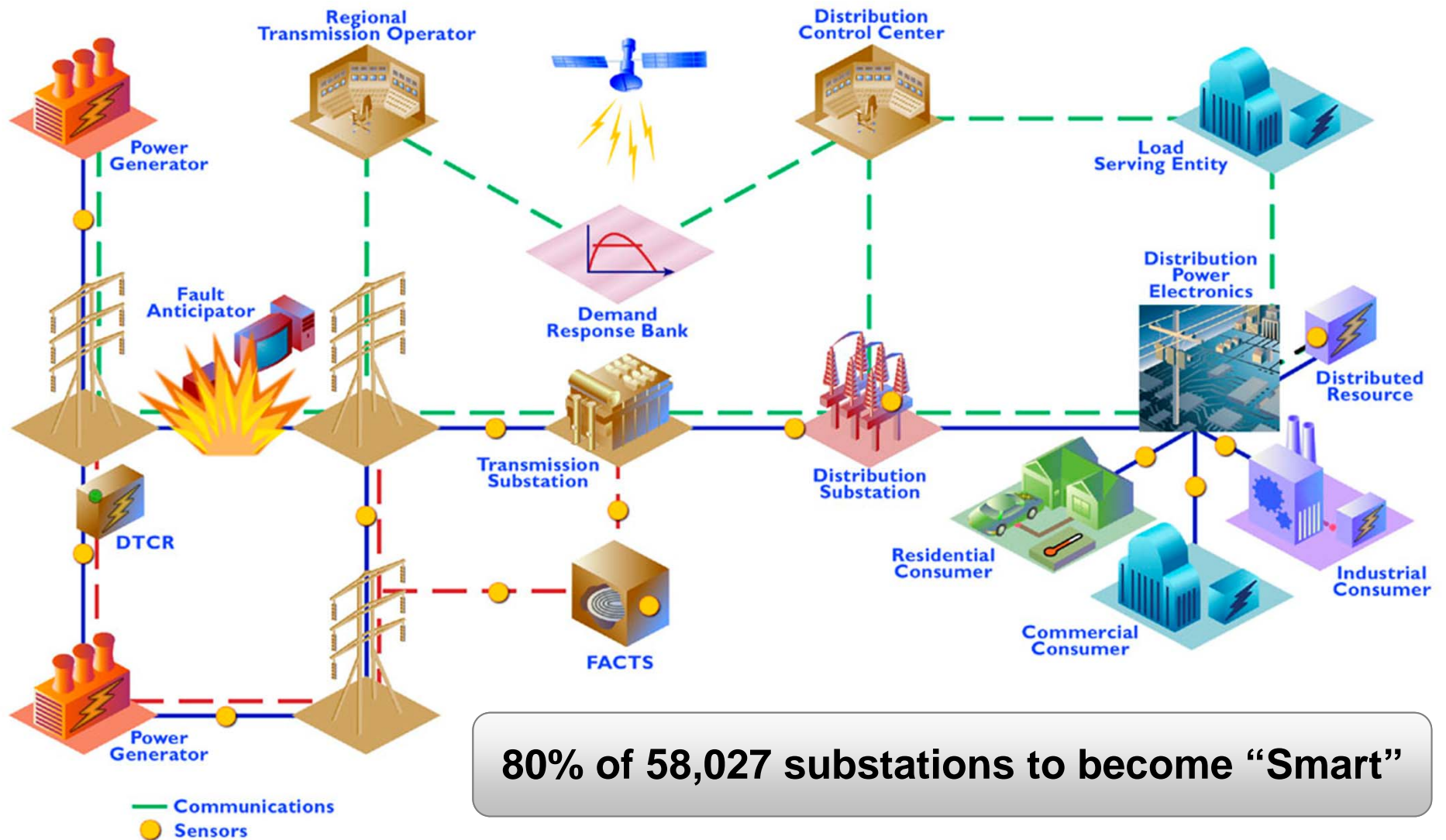


# Substations

Need 9,123 new smart substations



# Smart Grid





# Storage

10 GW of distributed storage

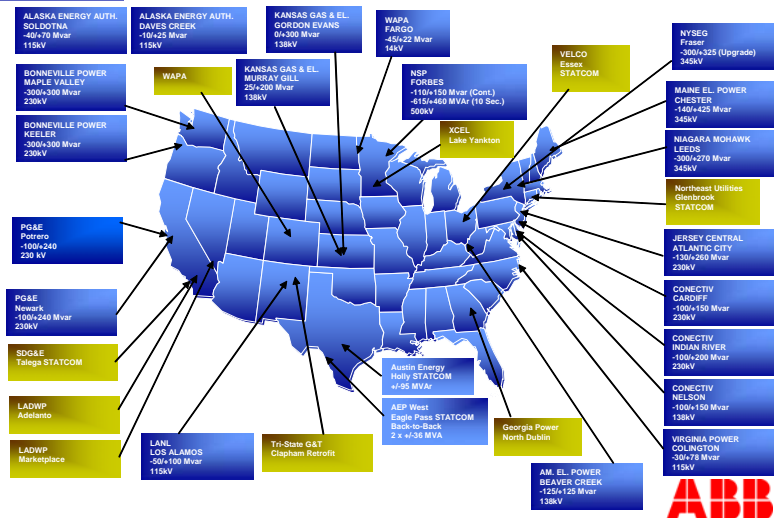




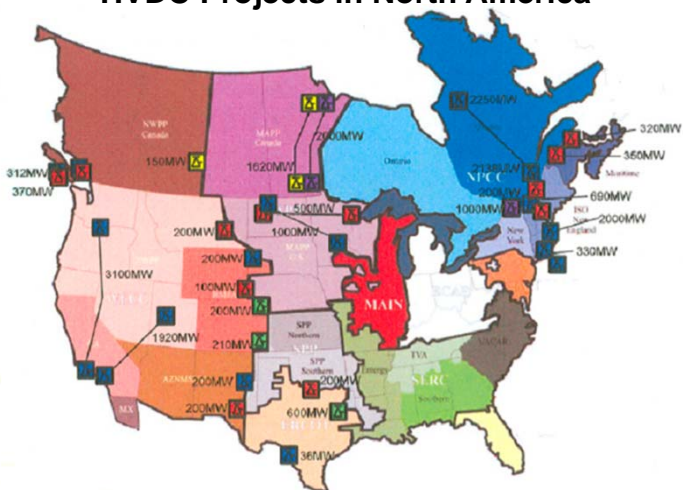
# FACTS Devices

**ROLE OF FACTS**

**Role of FACTS – SVC & STATCOM**



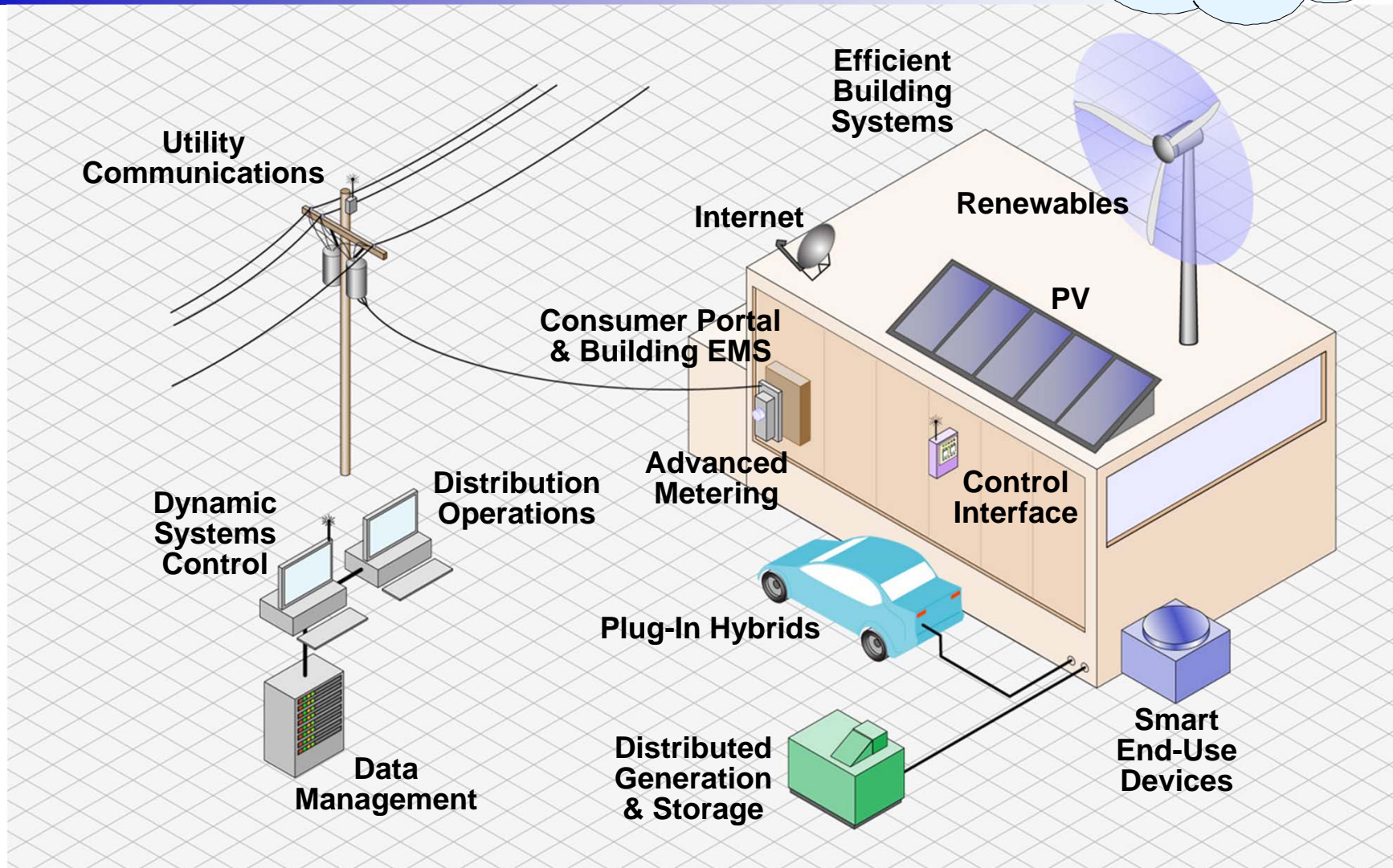
**HVDC Projects in North America**



FACTS Devices	# of Units
STATCON & UPFC	20
TCSC	100
HVDC Terminals	60
Power Electronics Transformers	25
Geomagnetic Controllers	25
<b>Total</b>	<b>230</b>

# Dynamic Systems Infrastructure

140 million buildings



# Distribution

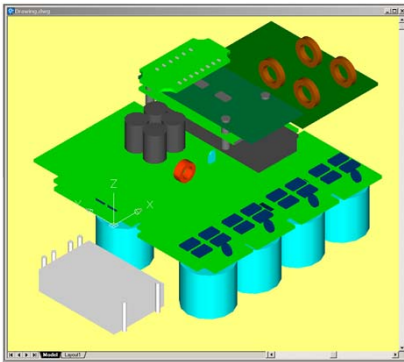
Need 67,384 new smart feeders





# Feeder & Consumer Automation

## Intelligent Universal Transformers



## Automated Metering Infrastructure



55% of 464,216 feeders to become automated

+

100 % of 67,384 new feeders

## PV Integration



## Consumer Displays

**SOUTHERN CALIFORNIA EDISON**  
An EDISON INTERNATIONAL Company

**Flex Your Power NOW!**

### SCE Energy Orb

Congratulations on your new Energy Orb!  
The Energy Orb is a new feature for your Smart Shift and Save Pricing Plan. The color of the Energy Orb tells you what pricing period we are currently in: Blue for Off-Peak, Green for On-Peak, and Red for Super Peak. The Energy Orb will flash red 4 hours prior to a Super Peak event and remain solid red through the event.

- Blue: Off Peak - 6pm to Noon - Lowest Price Period
- Green: On Peak - Noon to 6pm on Weekdays - Higher Price Period - Try to limit electricity usage
- Red: Super Peak - A 2 to 5 hour period from Noon to 6pm during Super Peak events only - Highest Prices - Reduce electricity usage

If you have any questions about your new Energy Orb, please give us a call at 877-823-8716

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80% of 123M meters to be automated