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IEPR Committee Workshop
Sacramento, California
June 22, 2011

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- **Transmission**
  - Implement project to improve speed of response to grid issues
  - Better utilization of data to proactively avoid issues
  - More efficient utilization of resources
- **Distribution**
  - Create a self-healing and resilient grid via real-time information
  - Expand communications and remote control of devices
  - Provision of balancing, storage, reliability and integration services to customers

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- Lays out the timeline for our 9 programs from 2011-2020 and their alignment to policy goals
- Shows by project, by year, and policy / value / pilot
  - Includes brief descriptions of all projects including “Enterprise” projects – those not being done because of smart grid, but including smart grid requirements.
- Total number of projects – 64
  - Enterprise – 18 (not included in costs/benefits)
- Includes 2015 and 2020 Vision statements in Program timelines for context

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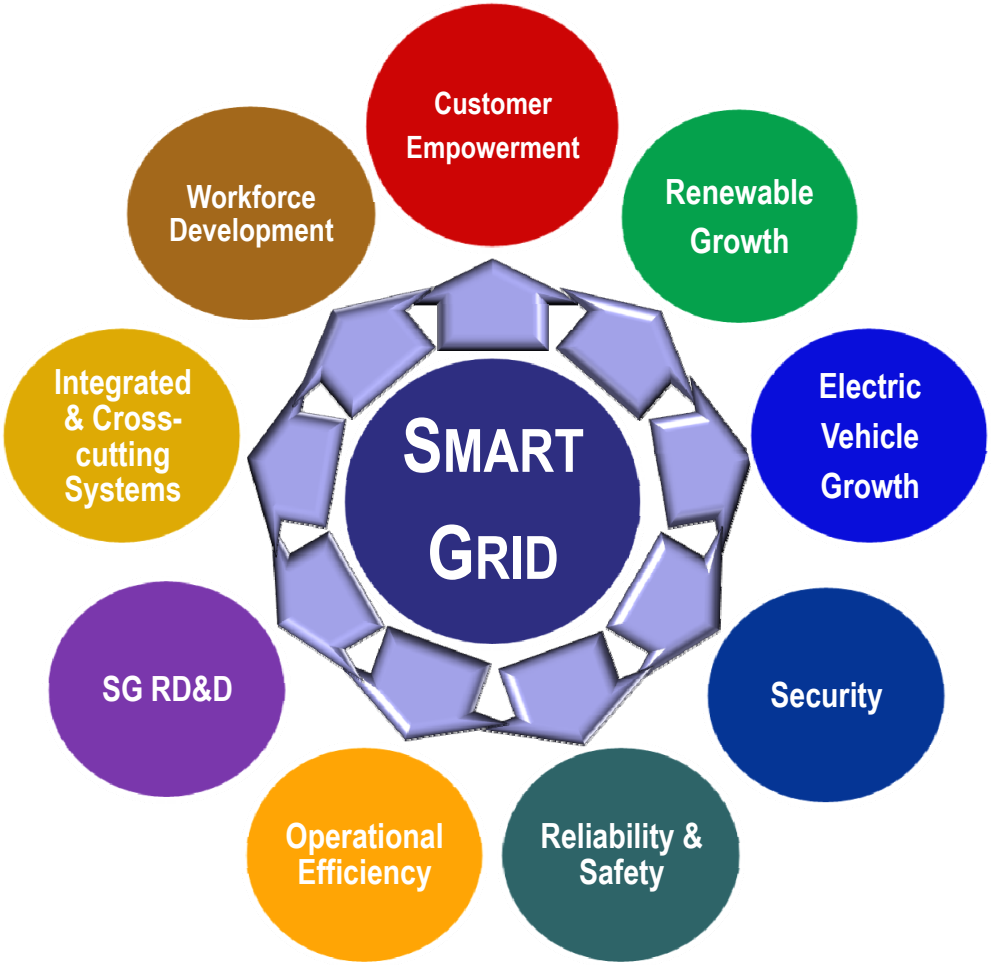
Roadmap includes smart grid investments in 9 programs:



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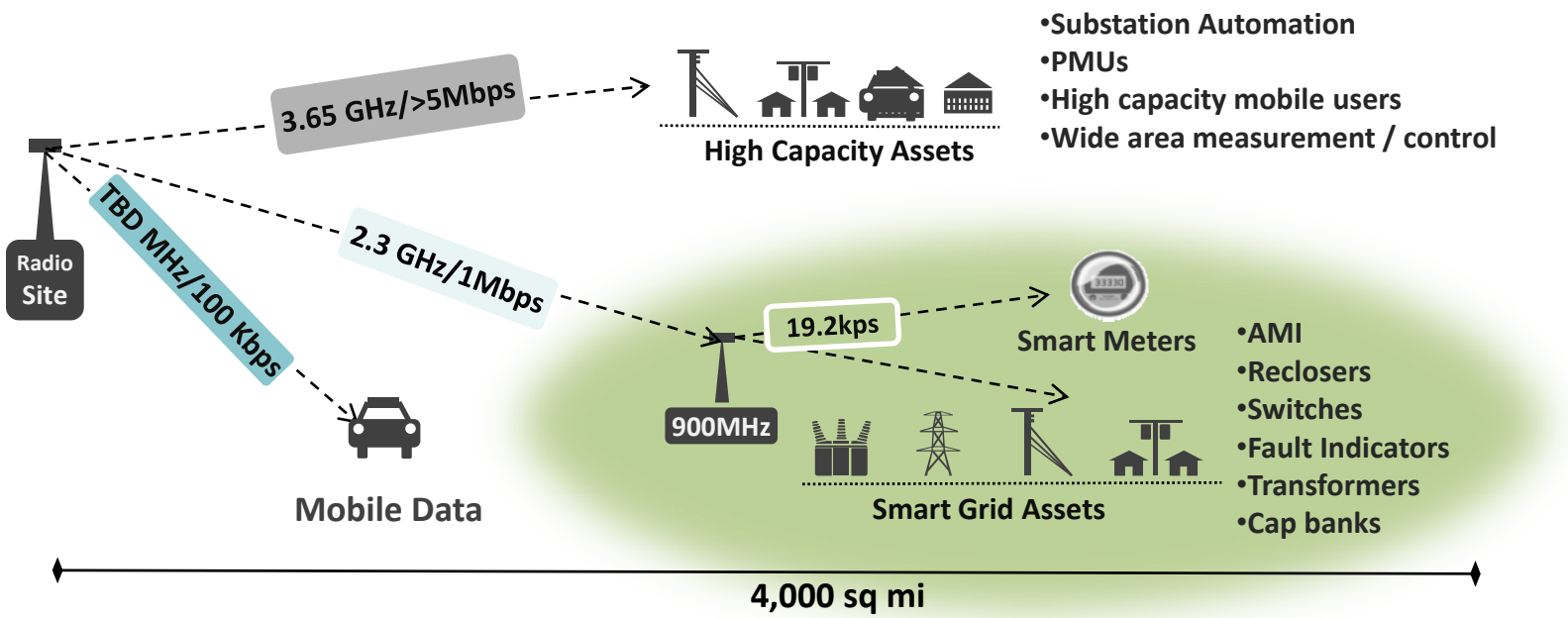
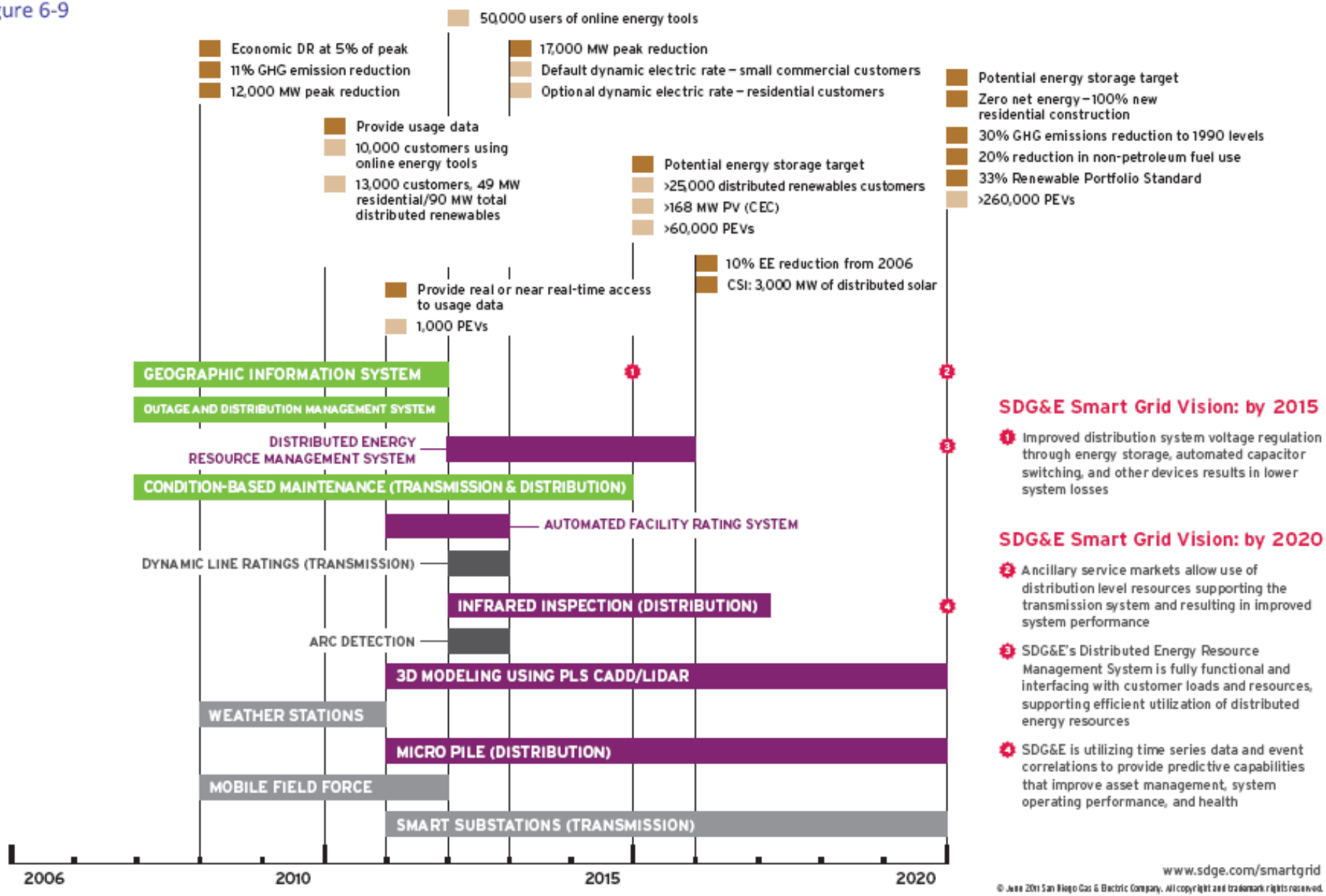


INTEGRATED SECURITY

INTEGRATED MANAGEMENT & RF CONTROL

OPERATIONAL EFFICIENCY

Figure 6-9



SDG&E Smart Grid Vision: by 2015

1. Improved distribution system voltage regulation through energy storage, automated capacitor switching, and other devices results in lower system losses

SDG&E Smart Grid Vision: by 2020

2. Ancillary service markets allow use of distribution level resources supporting the transmission system and resulting in improved system performance
3. SDG&E's Distributed Energy Resource Management System is fully functional and interfacing with customer loads and resources, supporting efficient utilization of distributed energy resources
4. SDG&E is utilizing time series data and event correlations to provide predictive capabilities that improve asset management, system operating performance, and health

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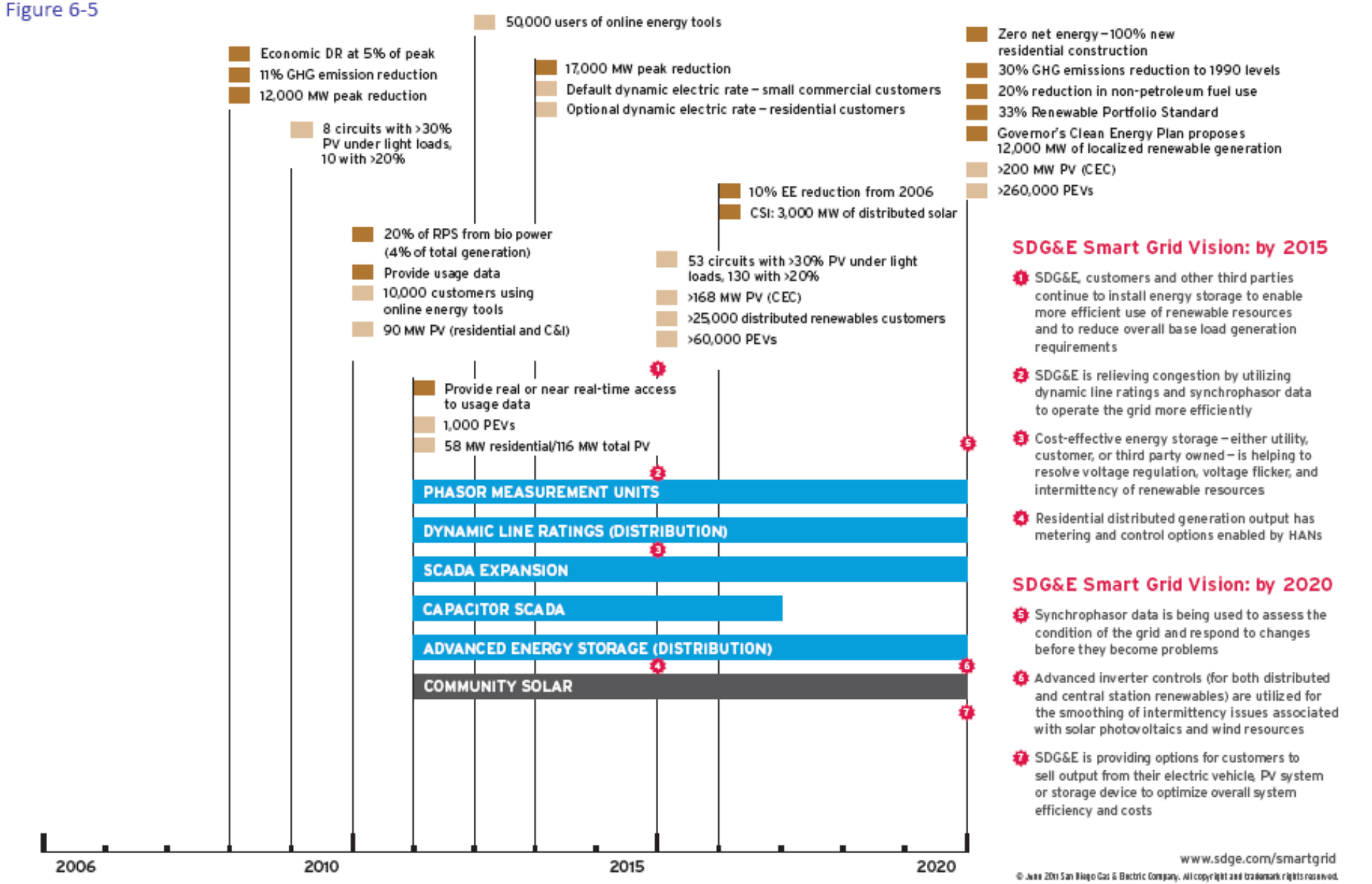
RENEWABLE GROWTH

Figure 6-5



SDG&E Smart Grid Vision: by 2015

1. SDG&E, customers and other third parties continue to install energy storage to enable more efficient use of renewable resources and to reduce overall base load generation requirements
2. SDG&E is relieving congestion by utilizing dynamic line ratings and synchrophasor data to operate the grid more efficiently
3. Cost-effective energy storage – either utility, customer, or third party owned – is helping to resolve voltage regulation, voltage flicker, and intermittency of renewable resources
4. Residential distributed generation output has metering and control options enabled by HANs

SDG&E Smart Grid Vision: by 2020

5. Synchrophasor data is being used to assess the condition of the grid and respond to changes before they become problems
6. Advanced inverter controls (for both distributed and central station renewables) are utilized for the smoothing of intermittency issues associated with solar photovoltaics and wind resources
7. SDG&E is providing options for customers to sell output from their electric vehicle, PV system or storage device to optimize overall system efficiency and costs

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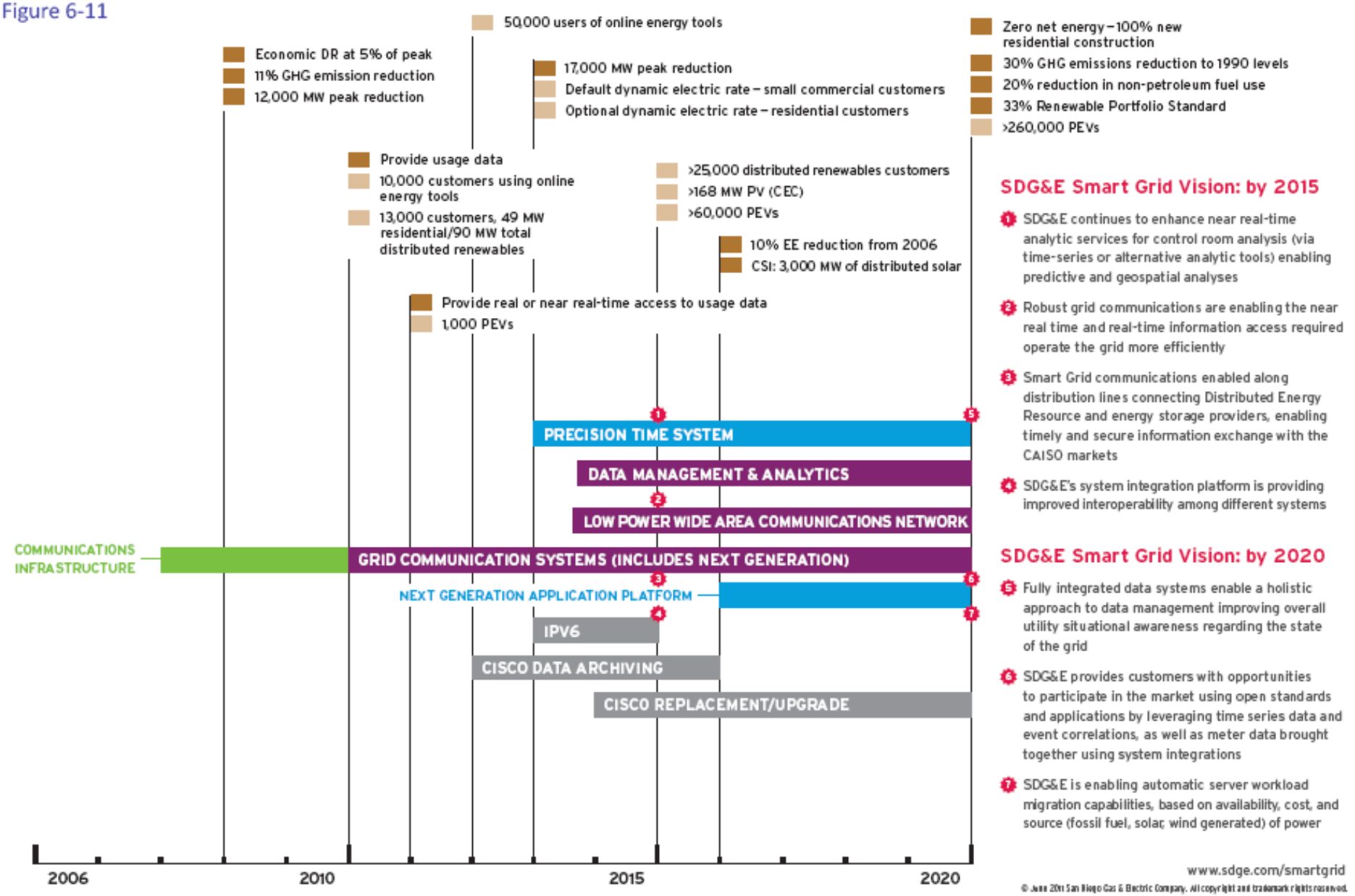
INTEGRATED AND CROSS-CUTTING SYSTEMS

Figure 6-11



SDG&E Smart Grid Vision: by 2015

1. SDG&E continues to enhance near real-time analytic services for control room analysis (via time-series or alternative analytic tools) enabling predictive and geospatial analyses
2. Robust grid communications are enabling the near real time and real-time information access required operate the grid more efficiently
3. Smart Grid communications enabled along distribution lines connecting Distributed Energy Resource and energy storage providers, enabling timely and secure information exchange with the CAISO markets
4. SDG&E's system integration platform is providing improved interoperability among different systems

SDG&E Smart Grid Vision: by 2020

5. Fully integrated data systems enable a holistic approach to data management improving overall utility situational awareness regarding the state of the grid
6. SDG&E provides customers with opportunities to participate in the market using open standards and applications by leveraging time series data and event correlations, as well as meter data brought together using system integrations
7. SDG&E is enabling automatic server workload migration capabilities, based on availability, cost, and source (fossil fuel, solar, wind generated) of power

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Category	Cost Estimates 2006 - 2020	Benefits Estimates 2011 – 2020 and Terminal Values
Previously authorized investments (Smart Meter, OpEx 20/20 Smart Grid projects)	$1,042 MM	$1,378 MM
2012 Test Year General Rate Case	$1,424 MM	$966 MM - $2,263 MM
Other active applications (Demand Response, Dynamic Pricing)	$237 MM	$29 MM - $139 MM
Estimated incremental investments – CPUC	$299 MM - $364 MM	$253 MM - $491 MM
Estimated incremental investments – FERC	$466 MM - $555 MM	$434 MM - $906 MM
Societal and Environmental Benefits (see following slide for details)		$760 MM - $1,939 MM
Totals	$3,468 MM - $3,622 MM	$3,820 MM - $7,116 MM

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Societal / Environmental Benefit Source	Societal / Environmental Benefit Range	Estimated tons of CO_2e Avoided
Estimated Avoided Emissions from Energy Reductions and Peak Load Shifting	$12 MM - $83 MM	~ 0.7 million
Estimated Avoided Emissions Reduction by Integrating Centralized Renewable Energy	$85 MM - $612 MM	~ 5.4 million
Estimated Avoided Emissions Reduction by Integrating Distributed Generation	$10 MM - $79 MM	~ 0.7 million
Estimated Avoided Net Emissions Reduc		illion

Benefit Source	Benefit Range	Purchased Gallons of Gasoline Avoided
Estimated Avoided Fuel Cost by Integrating Electric Vehicles	$369 MM - $615 MM	~ 207 million

Total Societal & Environmental Benefits	$760 MM - $1,939 MM

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- **Operational Concerns (PV Power Variability)**
  - Monitoring and ensuring resource adequacy
  - Frequency regulation
  - Voltage regulation
  - Impact is highly location dependent (urban vs rural)
  - O&M impacts
- **Engineering / Planning**
  - Capacity planning (size, location, time, guaranteed production)
  - Volt/ VAr planning
  - Conservation Voltage Reduction impacts
  - Electrical models
  - Transient analysis tools
- **Regulatory**
  - Rule 21
  - Rule 2
  - Cost causation

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- **General Rate Case Smart Grid Projects ($ 54 Million* – Yr 2012)**
  - Distributed Energy Storage ($ 34 Million*)
  - Dynamic Line Ratings for distribution ($ 4 Million*)
  - Synchrophasors for distribution ($ 8 Million*)
  - Dynamic Voltage support ($ 3 Million*)
  - Distributed Energy Resource Management System ($ 5 Million*)
- **Smart Grid Deployment Plan**

* Costs shown in 2009 dollars, unloaded. Cost to mitigate 120 – 130 MW of PV on SDG&E system in yr 2012, does not include T&D costs of meeting 12,000 MW PV goal by 2020.

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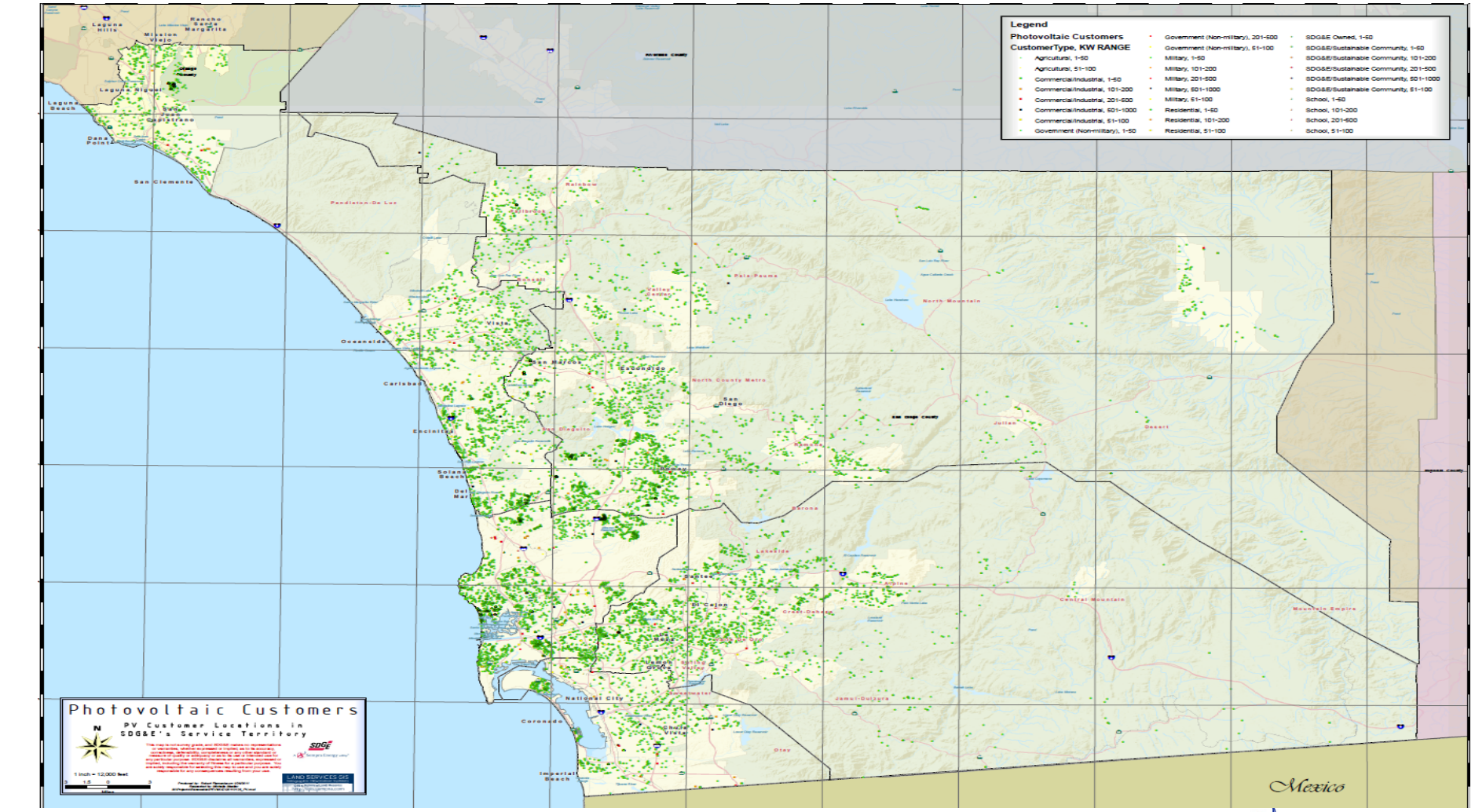

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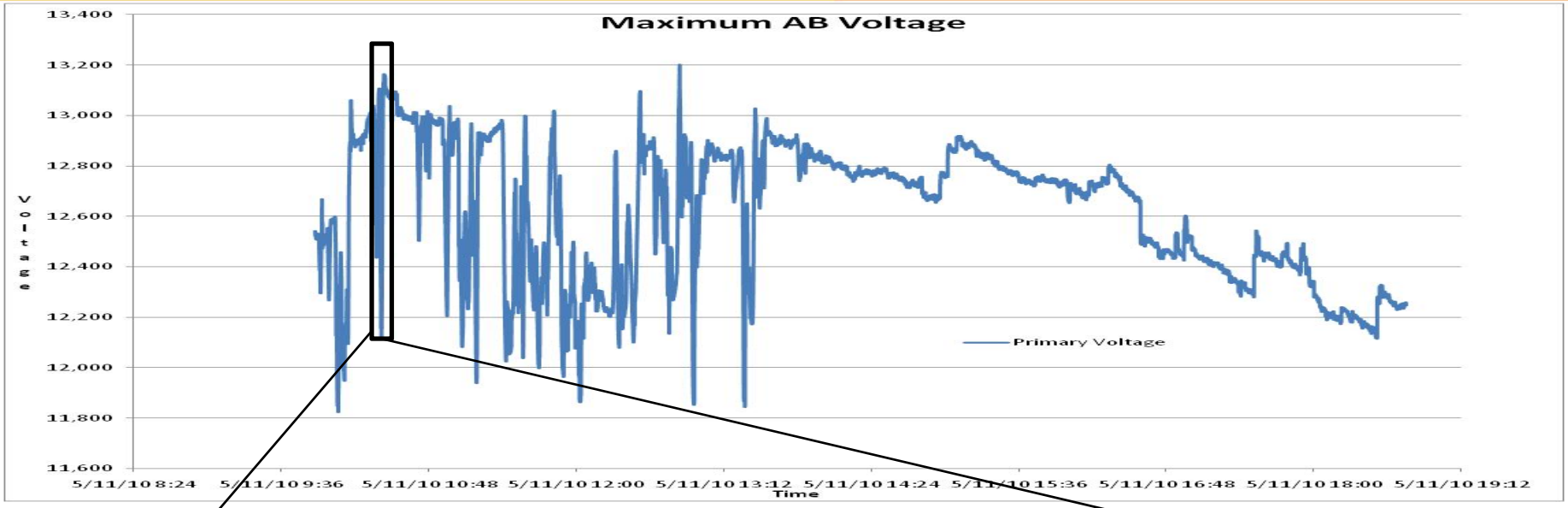
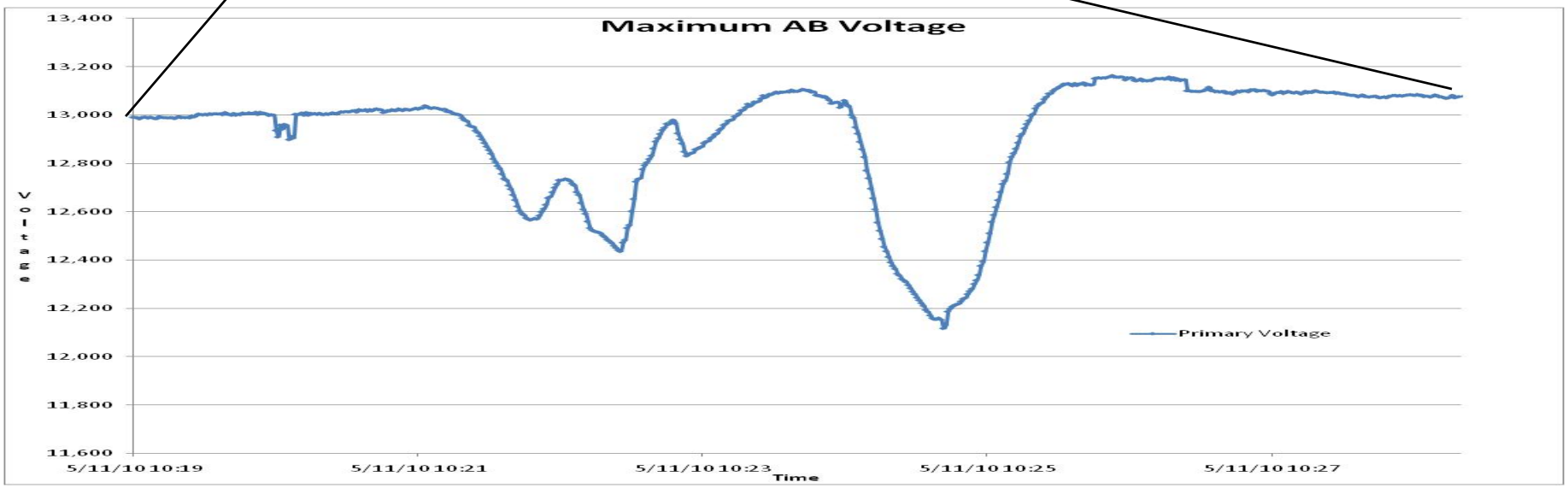

Maximum AB Voltage
13,400
13,200
13,000
12,800
12,600
12,400
12,200
12,000
11,800
11,600
Voltage
5/11/10 8:24
5/11/10 9:36
5/11/10 10:48
5/11/10 12:00
5/11/10 13:12
5/11/10 14:24
5/11/10 15:36
5/11/10 16:48
5/11/10 18:00
5/11/10 19:12
Time
Primary Voltage


Maximum AB Voltage
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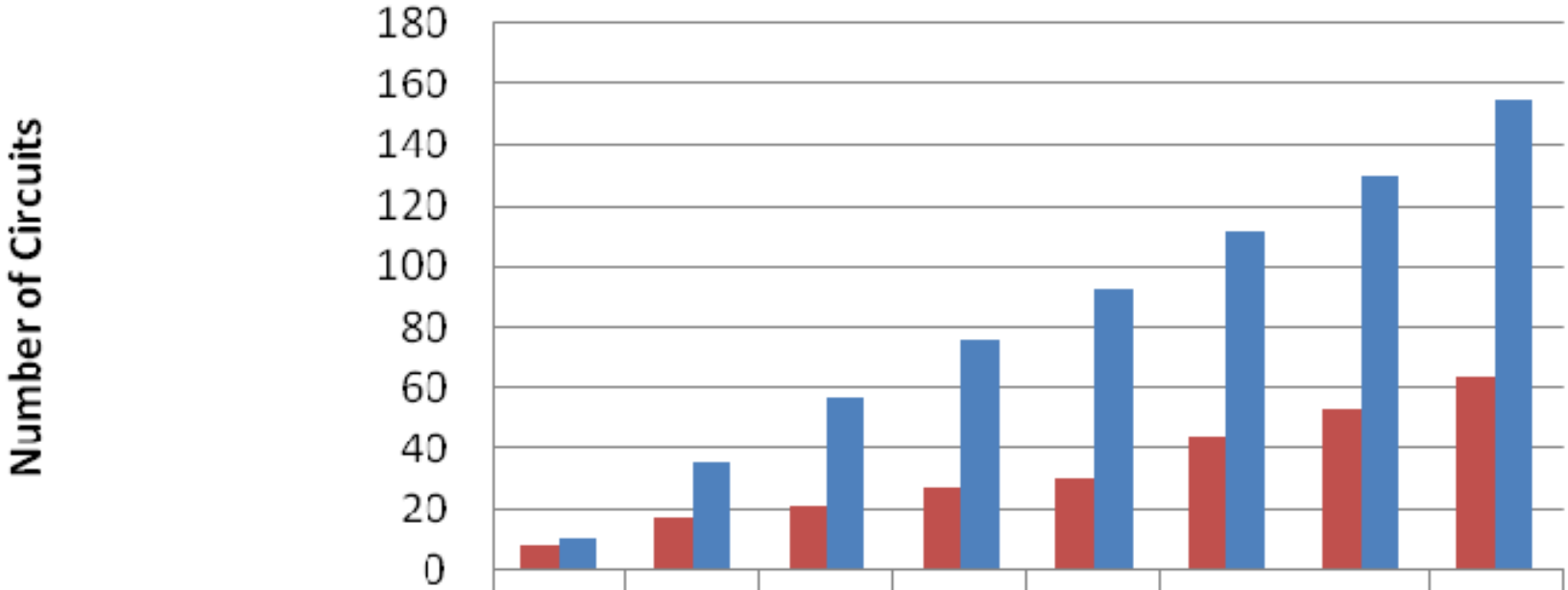
12,400
12,200
12,000
11,800
11,600
Voltage
5/11/10 10:19
5/11/10 10:21
5/11/10 10:23
5/11/10 10:25
5/11/10 10:27
Time
Primary Voltage

%PV per Circuit - Light Load



	2009	2010	2011	2012	2013	2014	2015	2016
Circuits with >30% PV	8	17	21	27	30	44	53	63
Circuits with >20% PV	10	35	57	76	93	111	130	155

Values are for illustration only and do not represent forecasts

- **Regulatory**
  - Interconnection Tariffs (Rule 21, WDAT) modification
    - Threshold for periods of low load high PV output
    - Low voltage ride through
    - Frequency droop requirements
  - **Rule 2 modification**
    - Harmonics
    - Voltage
  - **Cost Causation**
    - Rates & incentives
  - **Smart Inverters**
    - IEEE 1547.8
    - Modify WDAT to accept smart inverters

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- Increased DG Levels are expected to have significant impacts and resulting costs for the Electric T&D System
- Technical studies and demonstration projects are underway to quantify impacts of additional DG, and help design mitigation of impacts
- Actual field measurements indicate significant impacts to system performance on distribution circuits with high levels of conventional DG
- Changes in Regulatory and Technical standards are also required to accommodate increased levels of DG
- Adopt lessons learned in European countries

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Thank you.

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