



A  Sempra Energy utility®



SDG&E® Synchrophasor Initiative

Ali Yari – Director, Grid Operations

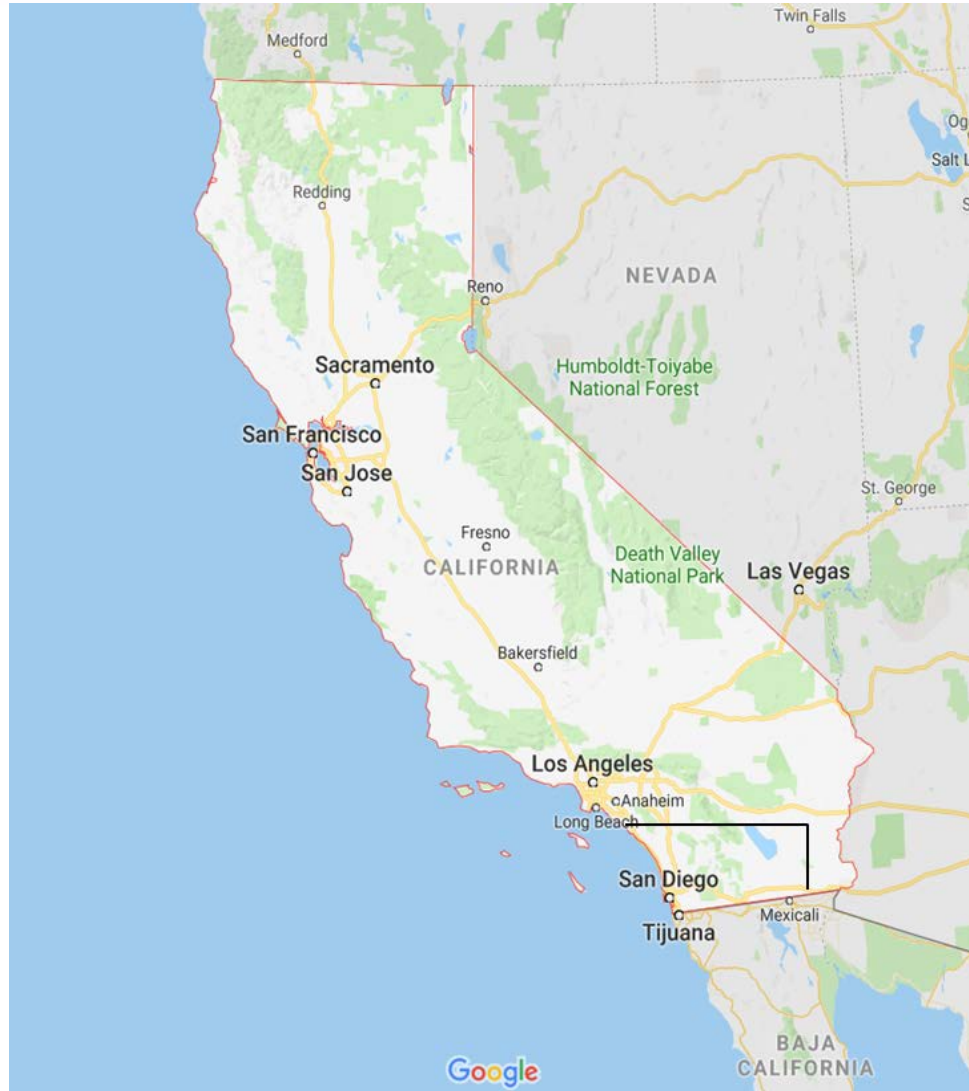
San Diego Gas & Electric®



NASPI North American
SynchroPhasor Initiative

*San Diego, California
April 15-17, 2019*

San Diego Gas & Electric®



SDG&E is a regulated public utility in southern California, U.S.A.

- Provides energy service to 3.6 million people through 1.46 million electric meters and 889,000 natural gas meters.
- System Peak = 4,890 MW (9/16/14)
- Service area span 4,100 square miles.

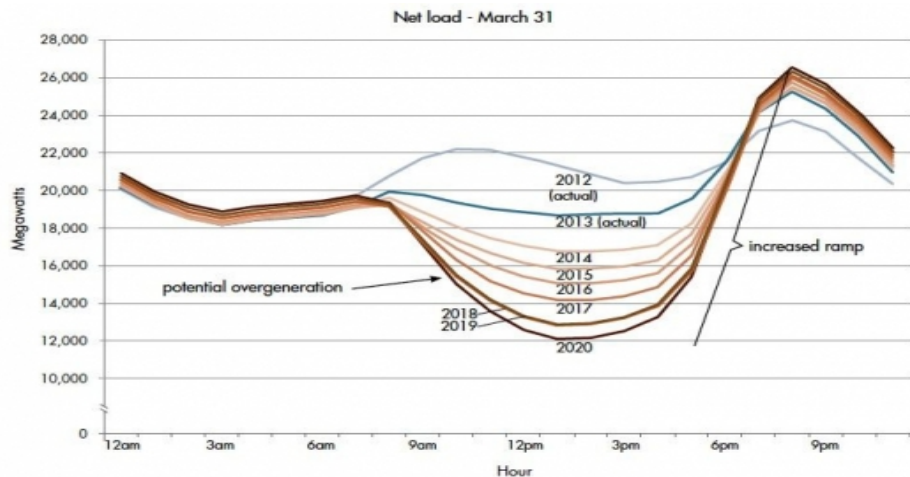
SDG&E strives to be the Cleanest, Safest, and Most Reliable energy service provider

- Named “Best in the West” for electric reliability for thirteen years.
- 2018 National Reliability Award Winner.

Moving Towards a Low-Carbon Future Grid



- Approx. 45% electric load are supplied by renewable energy resources today – well ahead of the current target
- California targets driven by the overall positive economic and environmental impacts
 - 60% load served by renewable energy resources by 2030, and 100% by 2045

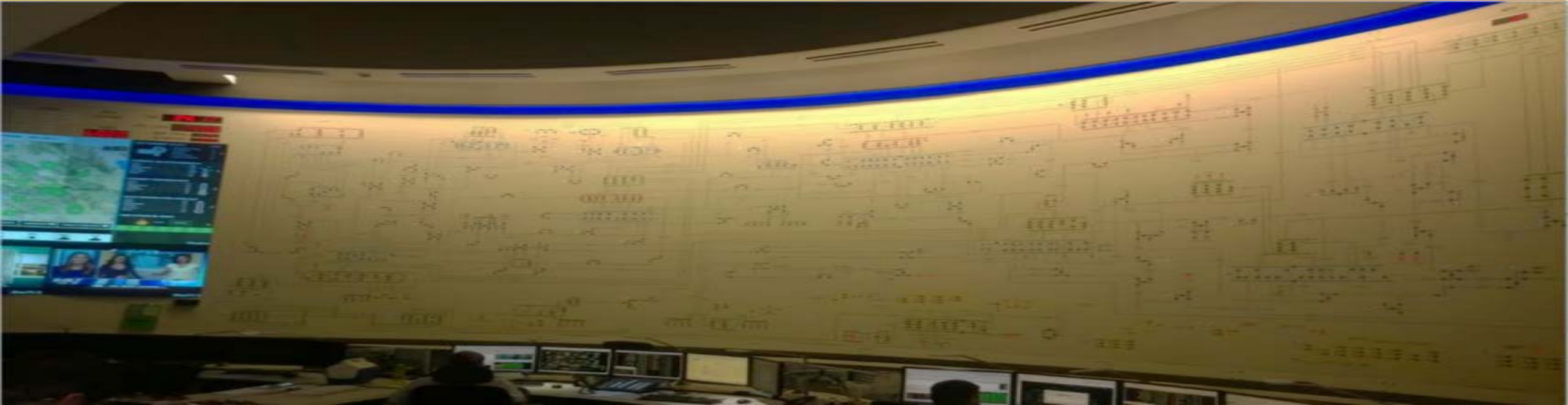


Modernize SDG&E's Grid for Future Grid Operations



- Replace baseload power plant with quick-start gas turbines
- Build new transmission lines
- Re-configure systems
- Adding new substations
- Add synchronous condensers
- Use phase shifting transformers
- Install battery storage
- **Improve and enhance control room operations**

Old Map Board Replaced



- Replace control room map board with a state-of-the-art digital video wall
 - Improve operational situational awareness with the aggregation of data visualization tools
 - Allow information to be seamlessly reconfigured based upon operational intel needs
 - Facilitate operational readiness by increasing work surface area, computer screen area, and work-flow management process improvements

New Digital Video Wall



- Integrate new technologies and additional information into real-time grid operations
 - **Synchrophasor technology**
 - GIS, Real-time weather & Fire conditions
 - Dynamic and scalable high-visibility EMS map board display
 - Provides ability to display SOP's on digital video wall for operational coordination and training

Synchrophasor Technology Integration – Grid Operation’s Perspective



Augment existing tools (EMS/SCADA) capabilities

- High resolution trending
- Three-phase information
- Geospatial multi-layer overlay displays
- EMS/SCADA failure backup
- Relay fault records

Implement advanced grid operation applications

- Oscillation monitoring and alarming
- Voltage instability monitoring and alarming
- Intelligent event detection and alarm management
- Big data analytics, artificial intelligence and machine learning based applications

Synchrophasor Technology Integration

Enable wide-area system condition visibility

- Western Interconnection
- California grid
- Mexico grid
- Neighboring utilities grids

Provide extended situational awareness capability

- Weather conditions
- Fire conditions
- System recovery activities



Transmission Wide-Area Situational Awareness (WASA) System

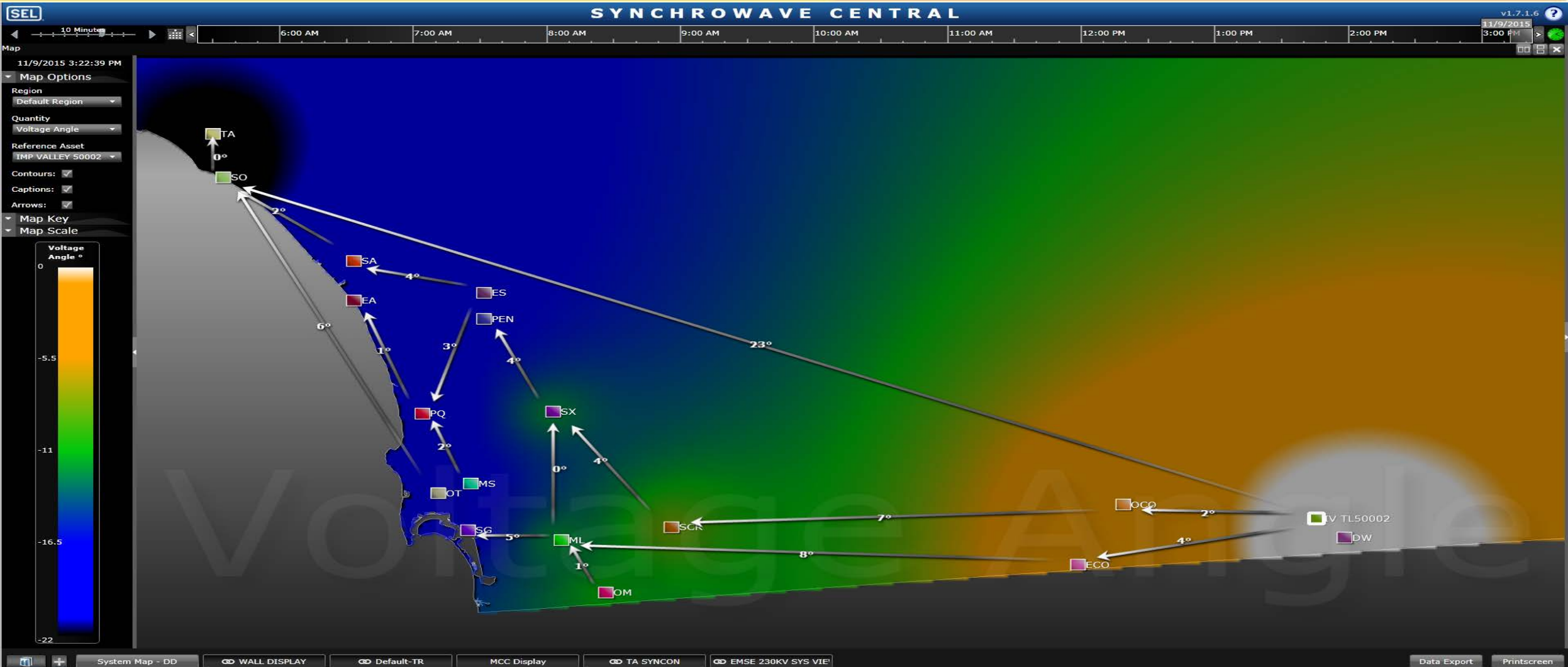
- Phase 1 (WASA1)
 - Using commercial off-the-shelf products
 - Deployment completed in 2016
 - Has been well accepted by system operators
- Phase 2 (WASA2)
 - A next generation WASA system based on platform concept
 - Multi layer geospatial displays
 - Fully integrated with existing systems
 - Event detection, Artificial Intelligence, Machine Learning, and Rule Based Expert Systems
 - Visualization software system platform to be deployed by the end of 2020

Viewing Events with WASA1 High-Resolution Trending



Display showing most recent detected disturbances, the list is updated in real-time.

WASA1 Voltage Angle Heatmaps



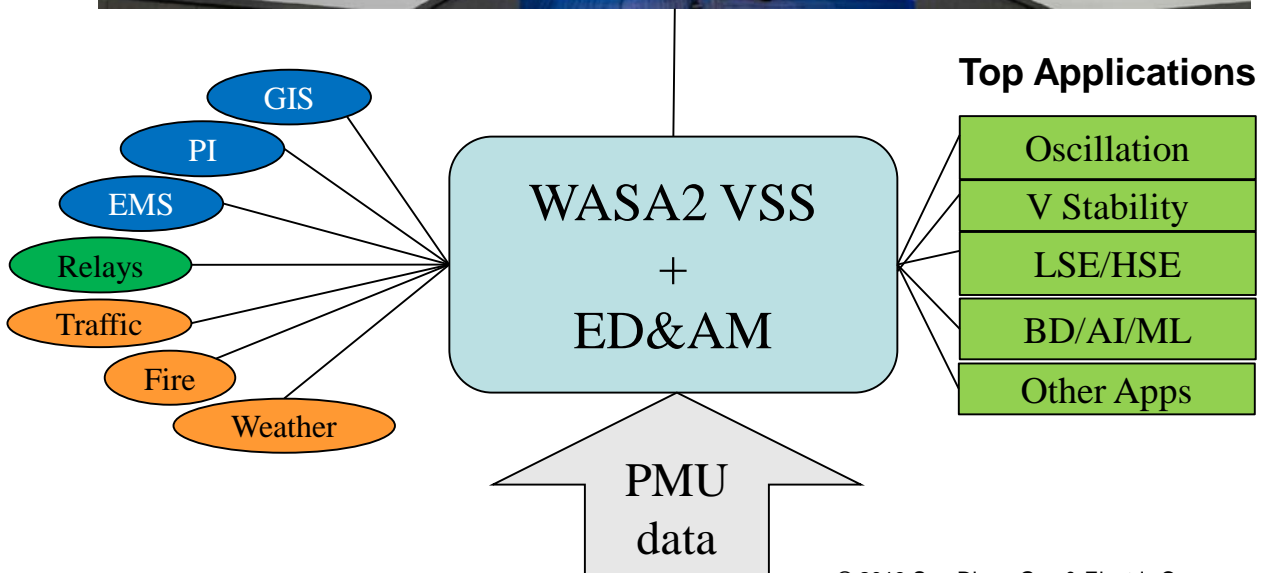
WASA System Phase 2 (WASA2) – A next generation WASA system



A visualization software system (VSS) platform base system

- Single information visualization and navigation HMI for all applications including multi-layer geospatial displays
- Centralized intelligent event detection and alarm management (ED&AM)
- Platform handle all system integrations with other systems and various data sources
- Open API for integrating all types of applications

Provide greatly enhanced and extended WASA capabilities to system operators!



Concluding Remarks



- Integrating synchrophasor into real-time grid operations has been and will continue to be a critical part of SDG&E's overall grid modernization effort
- It will take a persistent effort to fully integrate the synchrophasor technology into our grid operation
 - A lot has been accomplished but more work needs to be done
- SDG&E is committed to bring the synchrophasor technology into real-time grid operations
 - We have already seen the benefits of the technology, and will continue our efforts to fully adopt it – if we can prevent just one blackout in the future, it will be worth all the efforts and investments



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