Using GIS, PCS, ADMS, & Weather Forecasting to Manage Renewables & DER

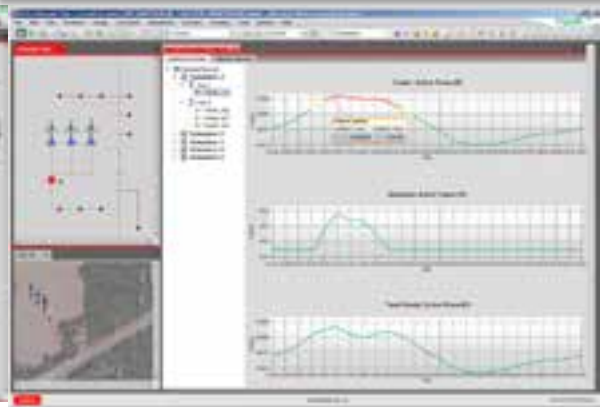
Scott Mellon
Principal Electrical Engineer/ Project Manager
Burbank Water and Power

John Dirkman, P.E.
Smart Grid Product Manager
Schneider Electric

Esri User Conference
17 July 2014

Key Learning Objectives

- Learn how renewables, microgrids and distributed energy resources can impact an electric distribution system
- Discover ways to manage and optimize renewables, microgrids, and distributed energy resources using ADMS
- Maximize benefits from renewables by leveraging integration of accurate renewable power forecasts within ADMS



Burbank Water and Power

- Services 45,000 households and 7,000 businesses in Burbank, California with water, electricity, and communications
- 20 Substations, 120 feeders, 320MW peak load

Burbank Water and Power

- Miner & Miner customer #10 of ~600
- Started in production with ArcFM v8.0 in 1999
- Long-time user of Esri and Schneider Electric products, now running version 10.0.2
  - ArcGIS
  - ArcGIS Server
  - ArcFM
  - Responder OMS
  - Conduit Manager/UFM
  - Fiber Manager
  - OASyS SCADA
  - SAGE RTU's
- Working to implement:
  - Schneider Electric's Power Control System (PCS) with integration to OASyS SCADA, DTN WeatherSentry, and OATI WebDistribute (completed)
  - Demand Response and Load Management (ongoing)
  - Schneider Electric's Advanced Distribution Management System (proposed)

BWP Smart Grid Program Overview

$60 million – 4 year Capital Program

Command and Control
- Schneider Electric OASyS SCADA and PCS
- Integrated Automated Dispatch System (IADS)
- New Power Operations Center

Security Suite
- Physical security
- Cyber security
- Policy, procedures, standards

Distribution/Station Automation
- Station Automation projects
- Feeder Automation projects
- Digital Relays / Auto-Reclosers
- Static Power Flow Model

Improved Business Systems
- ArcFM GIS
- Responder OMS
- TIBCO Enterprise Service Bus
- Customer Information System (CIS)
- Virtualized Server Environment

Customer Smart Choice
- Demand Response and Load Management Analysis
- Home Energy Reports
- Customer Web Portal
- Time of Use Rates
- Smart Appliance Demonstration

Demonstration Projects
- Electric Vehicle Chargers
- Black Start Project (Microgrid)
- Energy Storage

AMI/MDM Systems:
- Cisco powered fiber optic network
- Tropos City-wide wireless mesh network
- Trilliant AMI meter system
- eMeter Meter Data Management System (MDMS)

Schneider Electric

the global specialist
in energy management

A global company

$34 billion revenue in 2013

43% of sales in new economies

160,000+ people in 100+ countries

committed to innovation

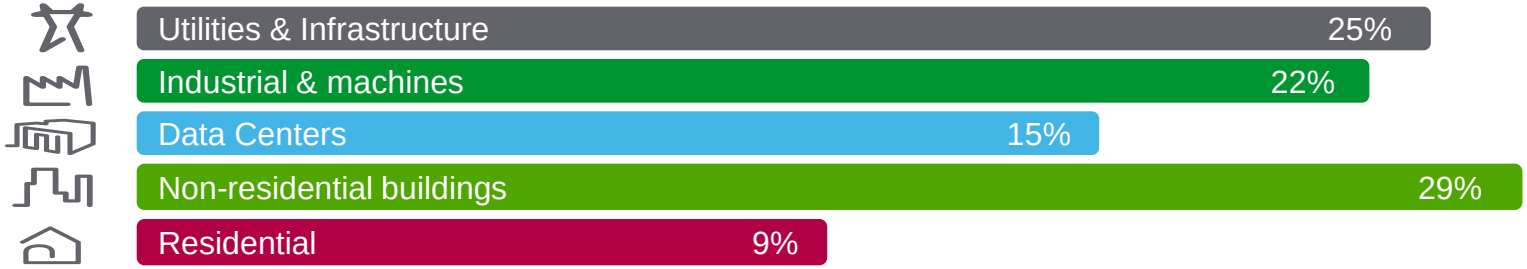
4-5% of sales devoted to R&D

~$1.5 billion devoted to R&D

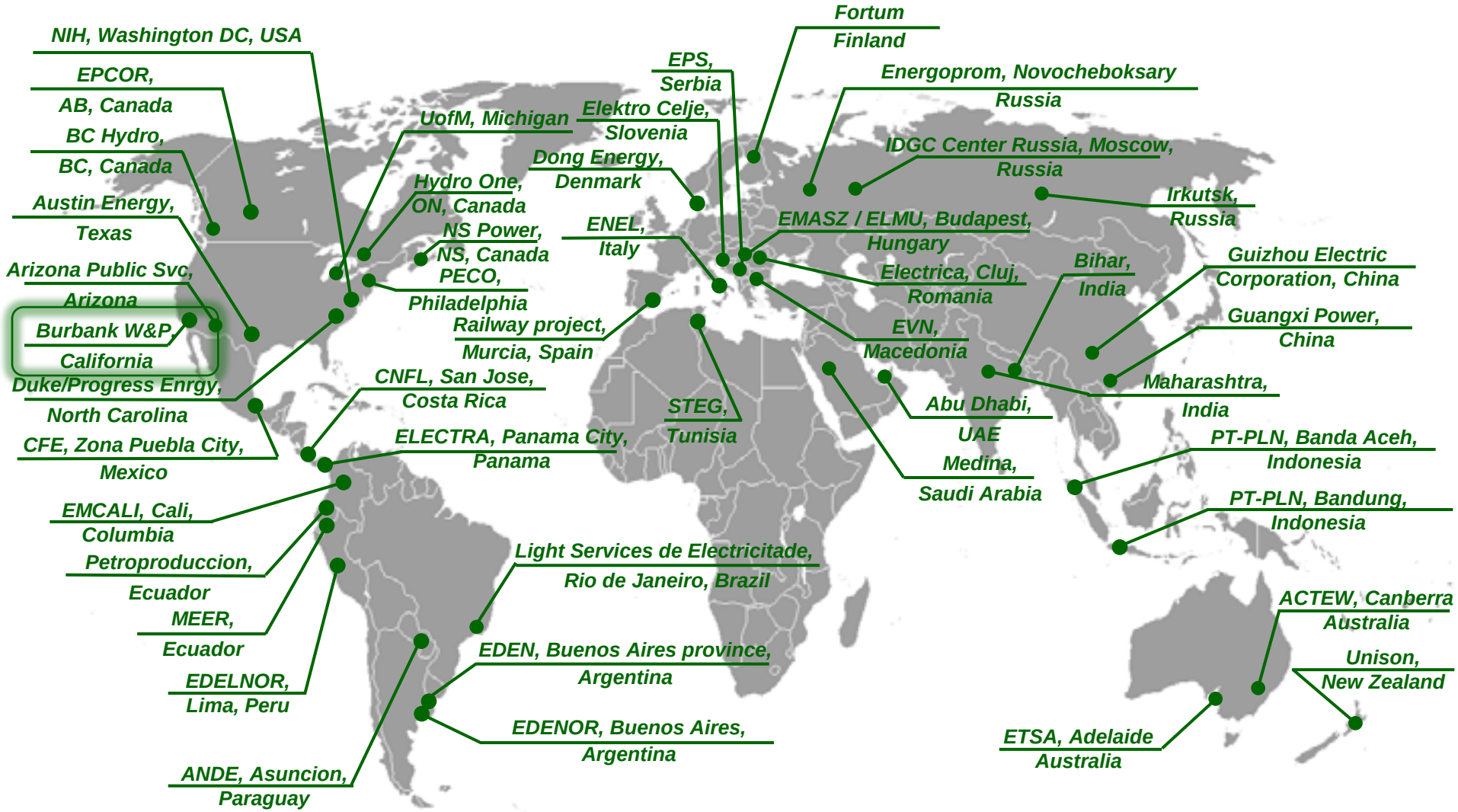
Some of the world class brands that we have built or acquired in our 175 year history

SQUARE D by Schneider Electric
TELVENT
dtn
AREVA
invensys
APC by Schneider Electric
xantrex Smart choice for power
SummitEnergy
PELCO by Schneider Electric
PowerLogic
NU-LEC INDUSTRIES
Modicon

Delivering Solutions for End Users



ADMS/PCS Projects Worldwide



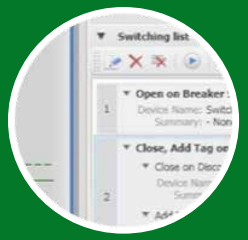
Over 180 control centers and 88M meters

Only ADMS to be awarded Gartner's highest rating in 2012, 2013, 2014

The Advanced DMS

DMS

Network automation, FLISR, VVO, Energy Losses, Relay Protection

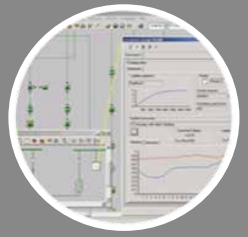


SCADA

Alarming, Tagging, Trending, Switching Validation

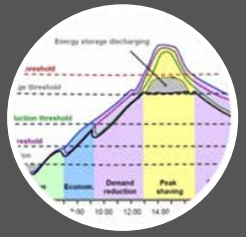
OMS

Incident, Fault, Customer Call, Switching, and Crew Mgmt and Reporting



EMS

State Estimation, AGC, Economic Dispatch, Unit Commitment



DSM

Load Forecast, Distributed Energy Mgmt, Demand Response

Common Platform, Database, Infrastructure, Security, History, and User Interface

Common User Experience, Integrated Components

Data, Performance, Calculation

Security, Scalability, Integration, Availability

Applications

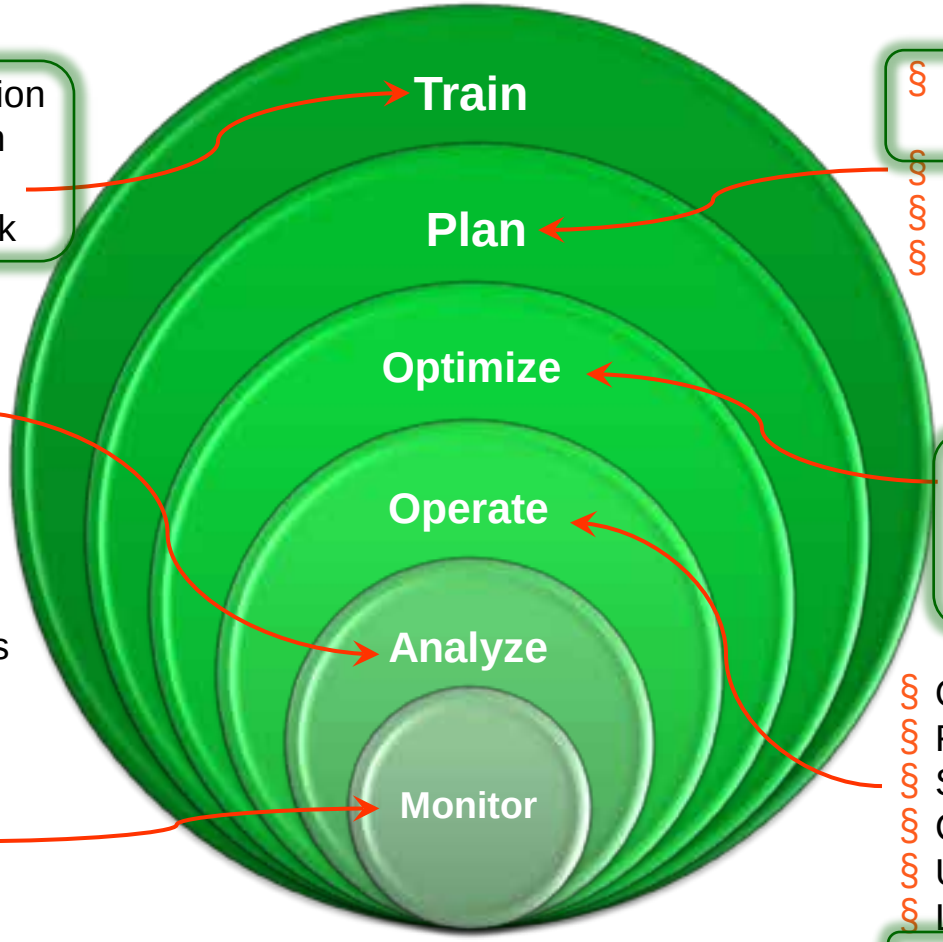
DMS | SCADA | OMS | EMS | DSM

Network Model Management

Realtime Infrastructure

ADMS Functionality

ADMS Benefits
- **Safety**
- **Reliability**
- **Efficiency**
- **Standardized Training**
- **Unified Interface**
- **Advanced Analytics**



- Real-time Simulation
- Off-line Simulation
- What-if Analysis
- Historical Playback

- Medium and Long-term Load Forecasting
- Network Automation
- Network Reinforcement
- Optimal Device Placement

- Load Flow
- State Estimation
- Energy Losses
- Fault Calculation
- Reliability Analysis
- Relay Protection
- Device Capability
- Contingency Analysis

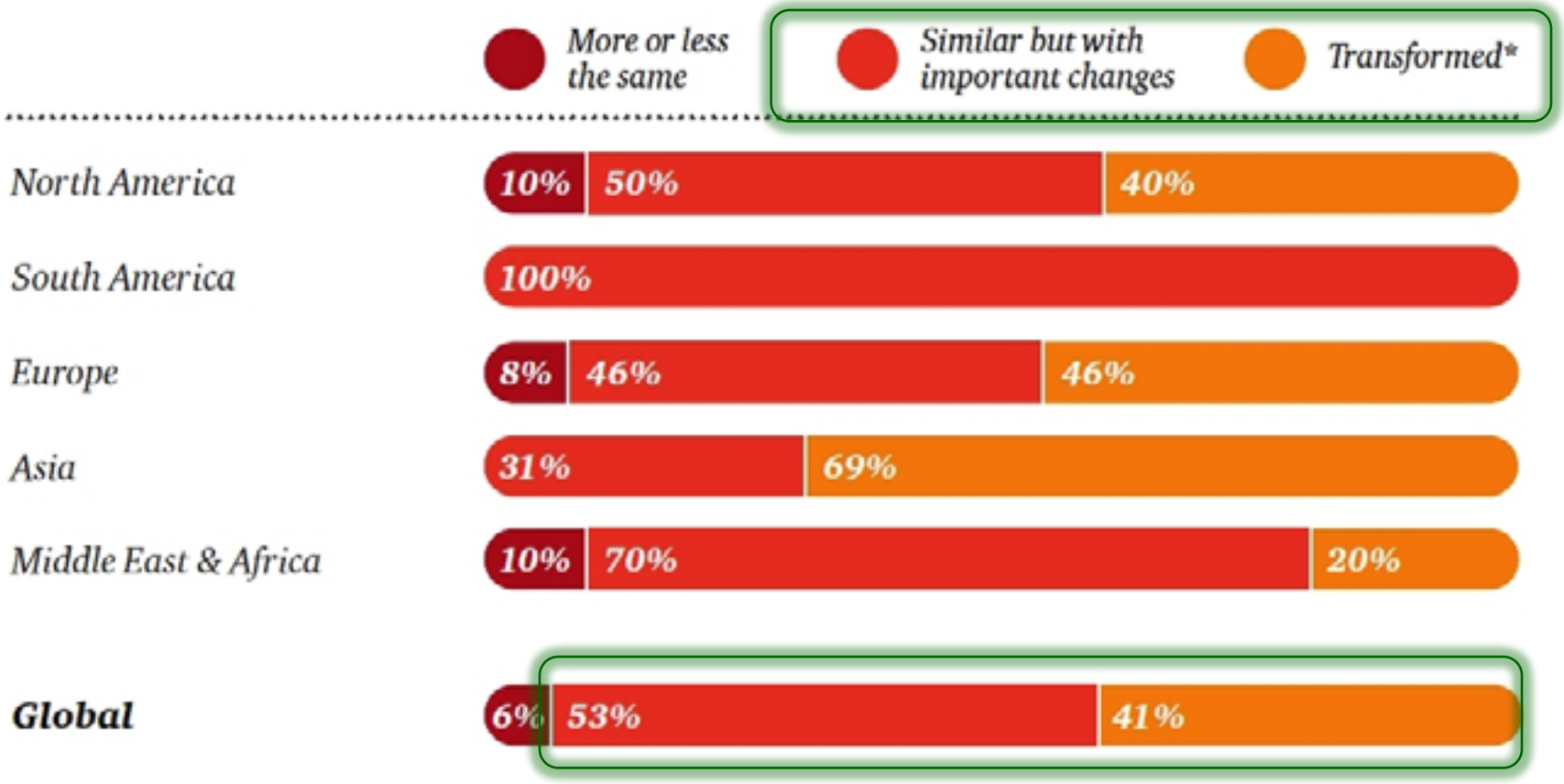
- Volt/VAR Optimization
- Network Reconfiguration
- Near and Short-term Load Forecasting
- Demand Response
- Distributed Energy Mgmt.

- Telemetry
- Alarming
- Tagging
- Trending
- Reporting

- Outage Management
- Fault Management
- Switch Management
- Crew Management
- Under-load Switching
- Large Area Restoration
- Load Shedding

Utility Transformation

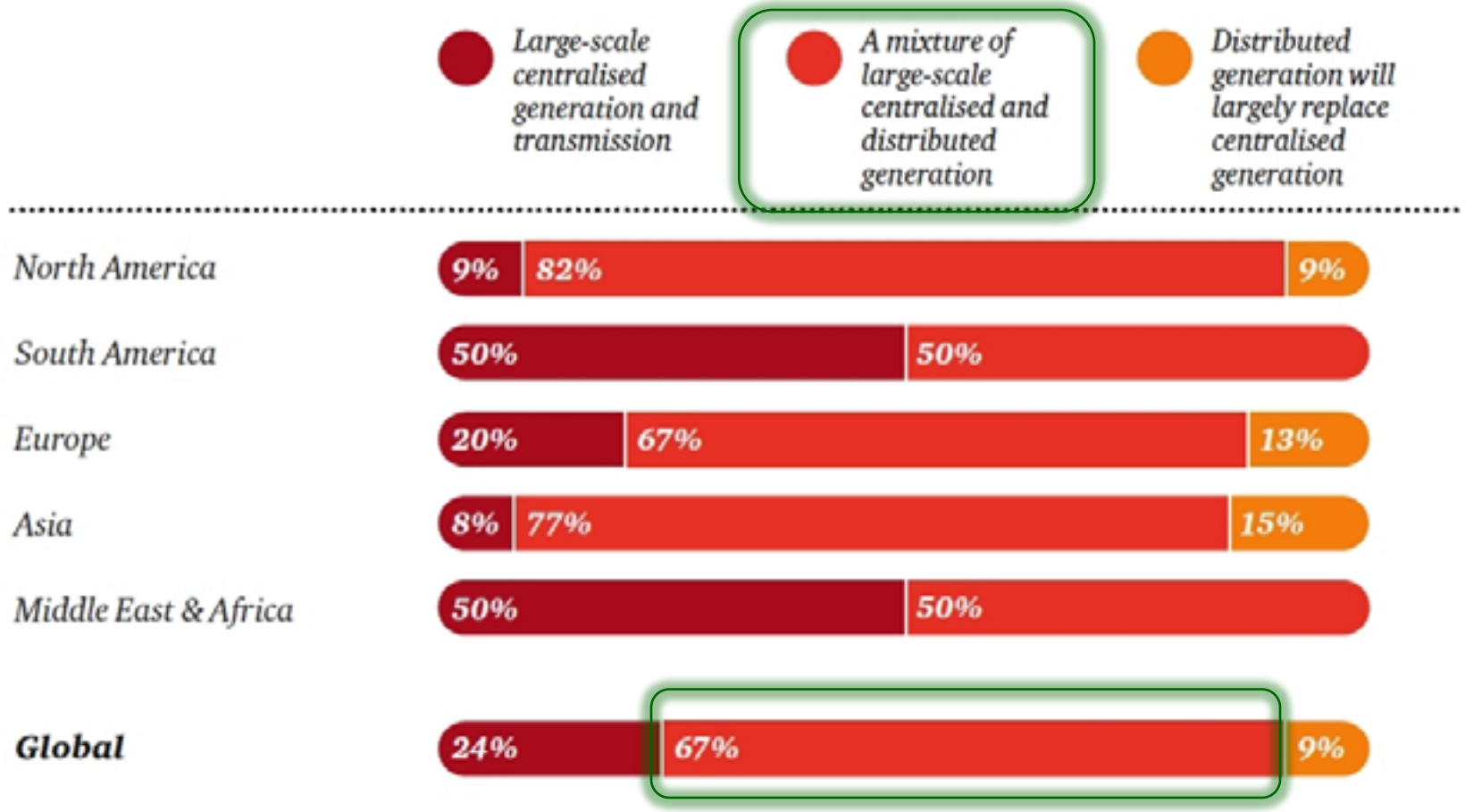
How do you expect utility business models to be in 2030 compared to today?



* of which 'unrecognisable transformation' – North America 0%, Europe 8%, Asia 8% and Global 4%.
Source: 13th PwC Annual Global Power & Utilities Survey

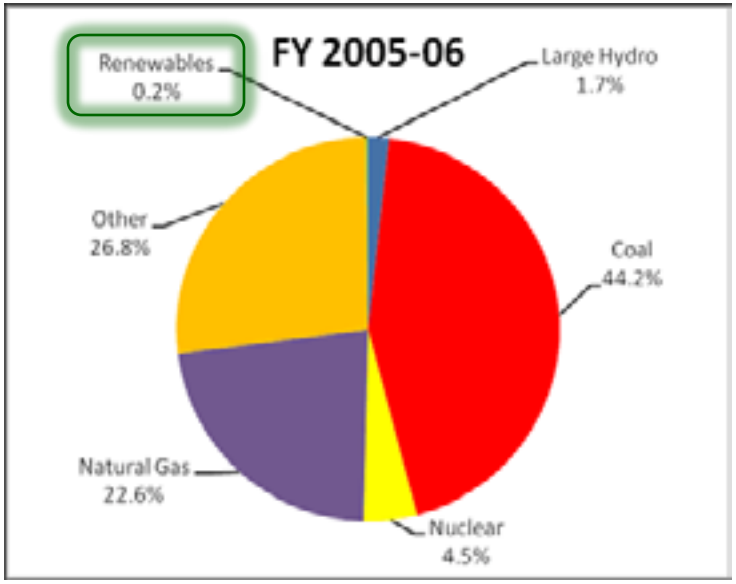
Utility Transformation

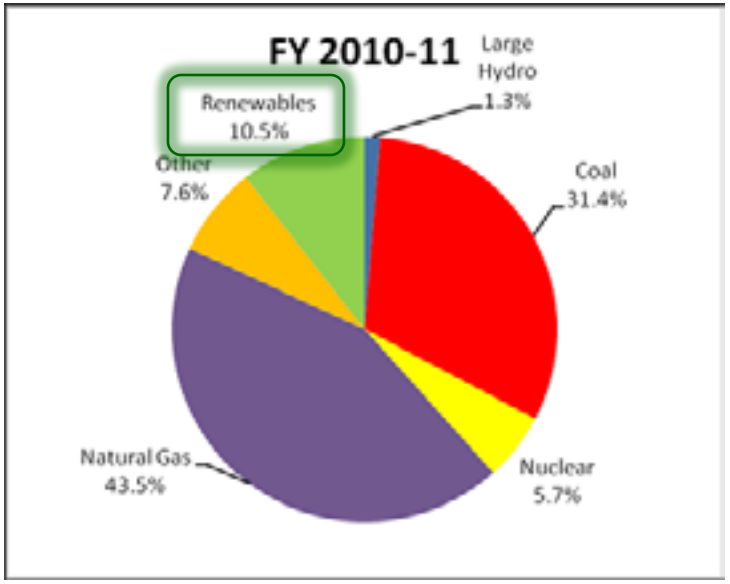
Which energy market transformation vision most closely matches your expectations of your market?



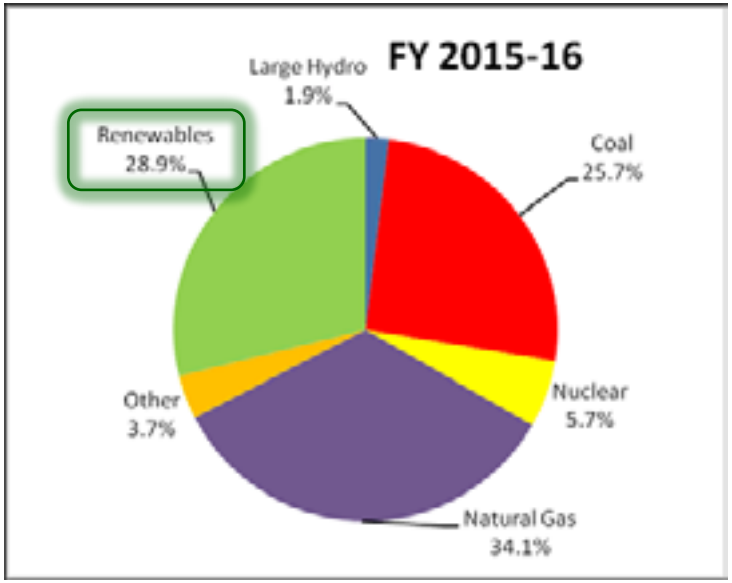
Source: 13th PwC Annual Global Power & Utilities Survey

Renewable Resource Commitment

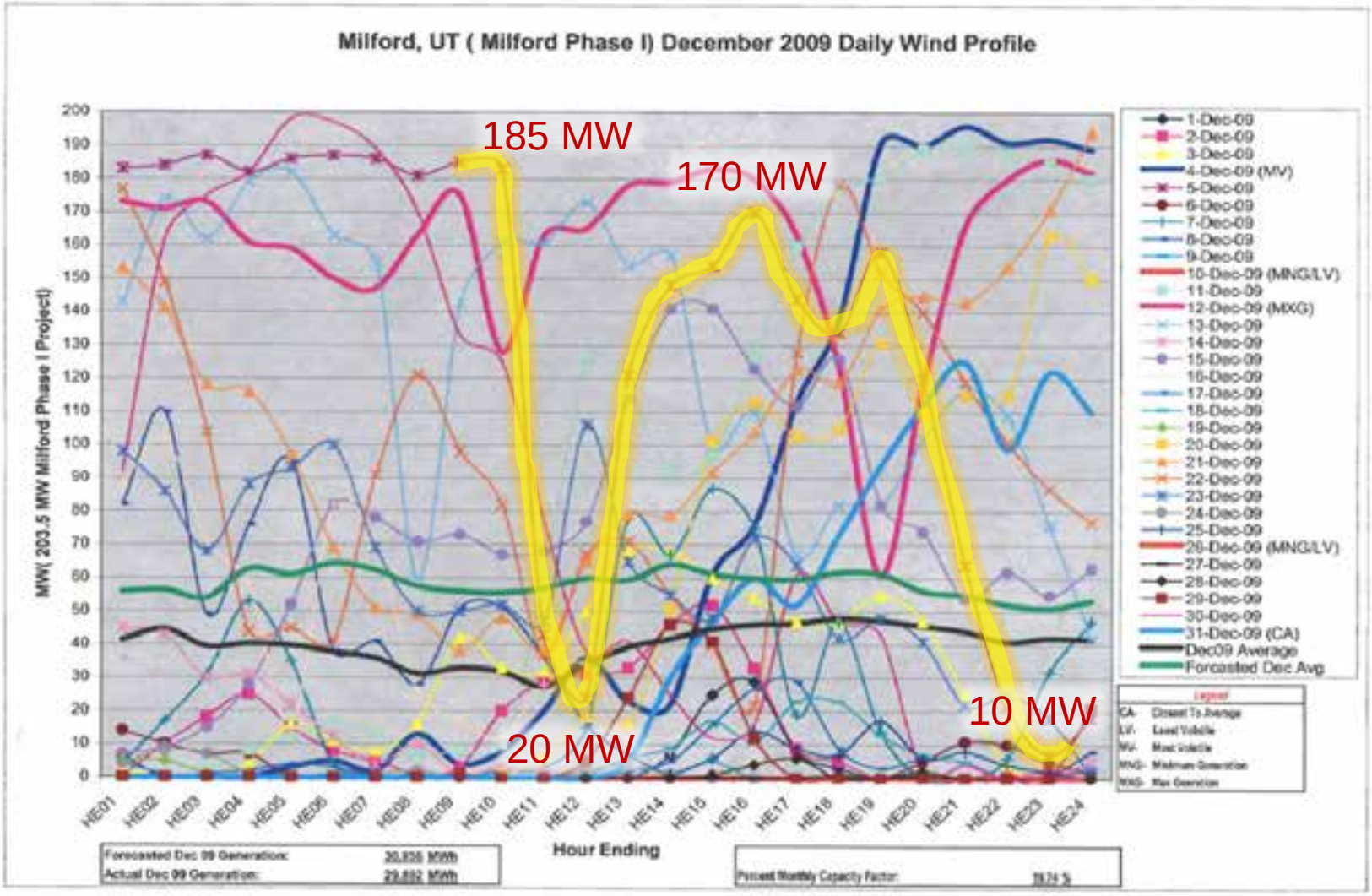




- Burbank now is considering obtaining 50% of electricity from renewable resources by 2025
- Renewables will be a combination of primarily wind, solar, and compressed air storage systems

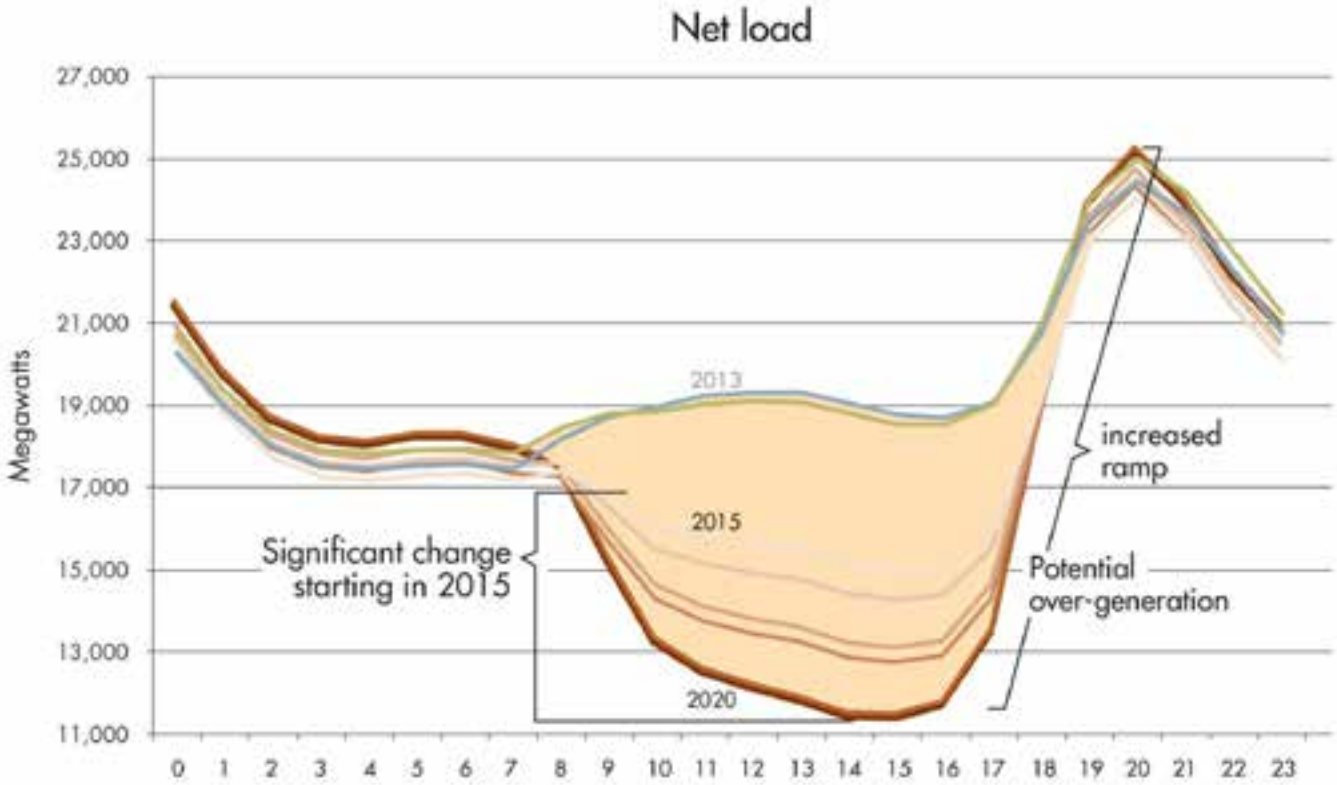


Renewable Resource Variability



Impacts of Renewable Generation on Electricity Demand

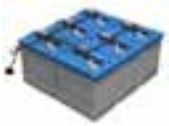
Growing need for flexibility starting 2015



Definitions

- Distributed Generation (DG)
  - Dispersed generation, typically less than 10 MW, in the distribution network
  - Controllable DG: Combined Heat and Power, Generators, ~Hydro
  - Non-controllable DG: Wind and Solar

- Energy Storage Systems (ES)
  - Battery Banks, Compressed Air Systems, Thermal Storage Systems



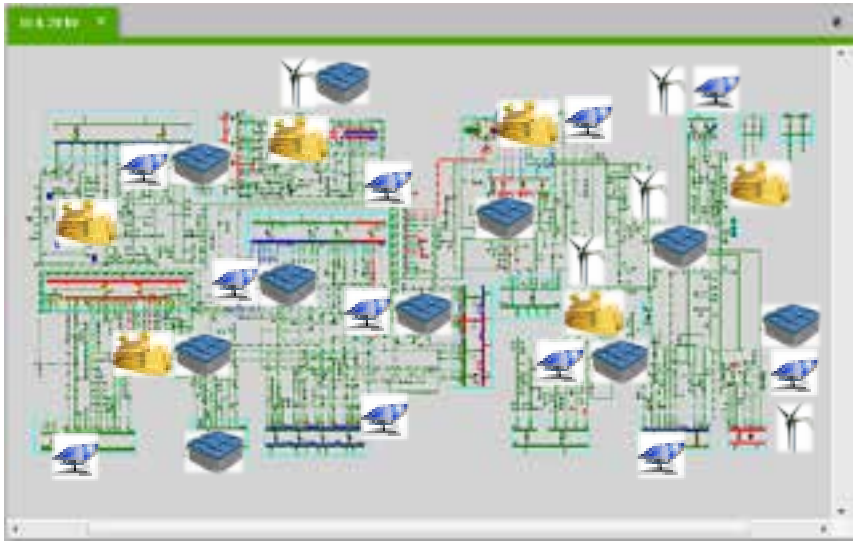
- Distributed Energy Resources (DERs)
  - Combination of DG and ES, located throughout the distribution network
- Microgrid
  - DERs + loads, can optionally be islanded

Power Resource	Type*	Controllable?
Generators	Supply	Yes
Wind	Supply	No
Solar	Supply	No
Interties	Supply/Demand	Yes
Battery Banks	Supply/Demand	Yes
Electric Vehicles	Supply/Demand	Yes
Compressed Air Systems	Supply/Demand	Yes
Thermal Storage Systems	Demand	Yes
Demand Response	Demand	Yes

* Supply-side provides power, demand-side consumes power or affects consumption

The DER Challenge

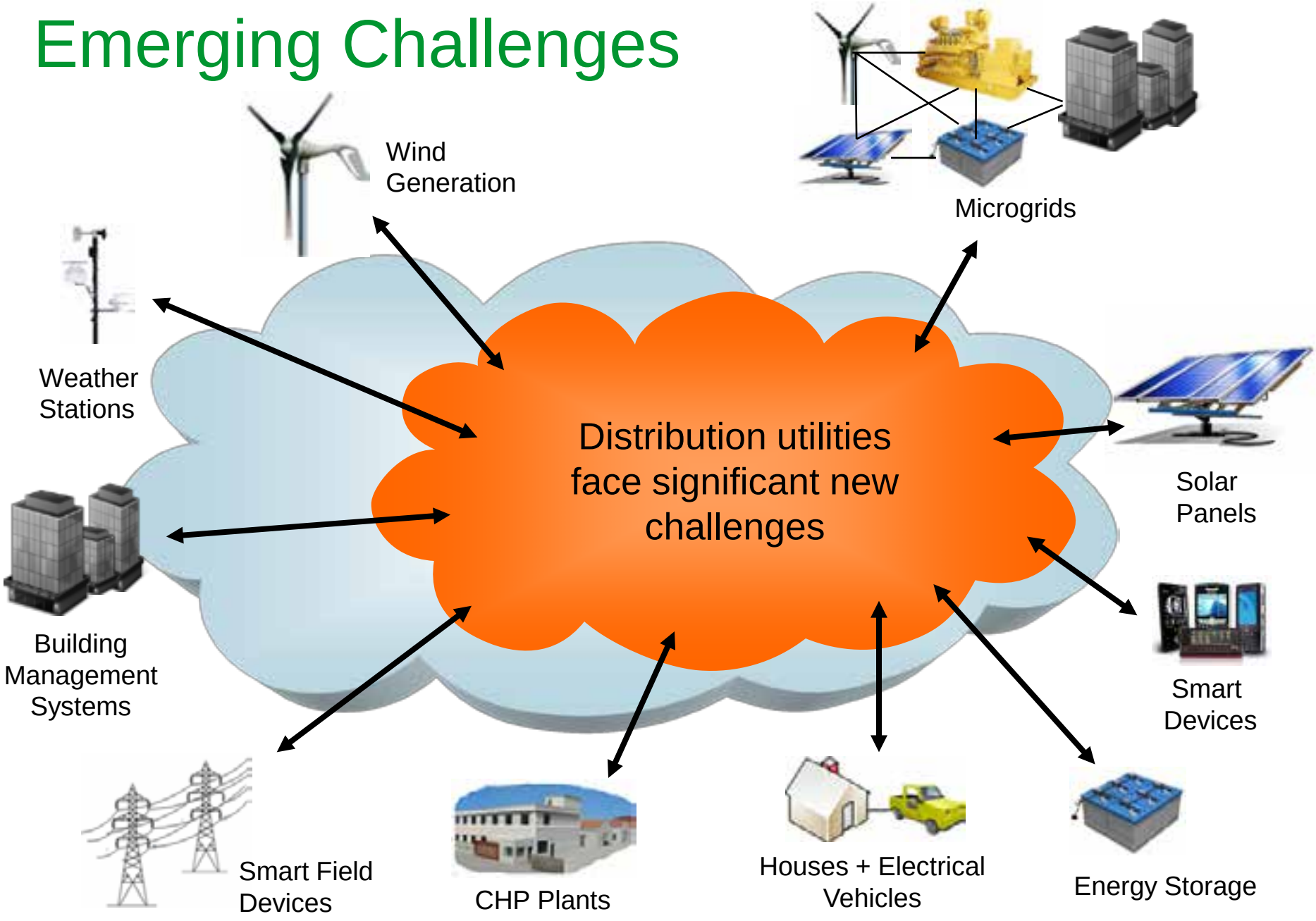
- Integration of renewables, storage, and microgrids is a challenge for networks designed to operate in the “classical” way
  (one way: transmission –> distribution -> consumer)
- DER’s in the distribution system completely change the philosophy of network operation:
  - reverse power flow
  - impact on voltage profile
  - protection schemes
- Distribution network starts to look more like the transmission network



Problems Created By DER in the Network

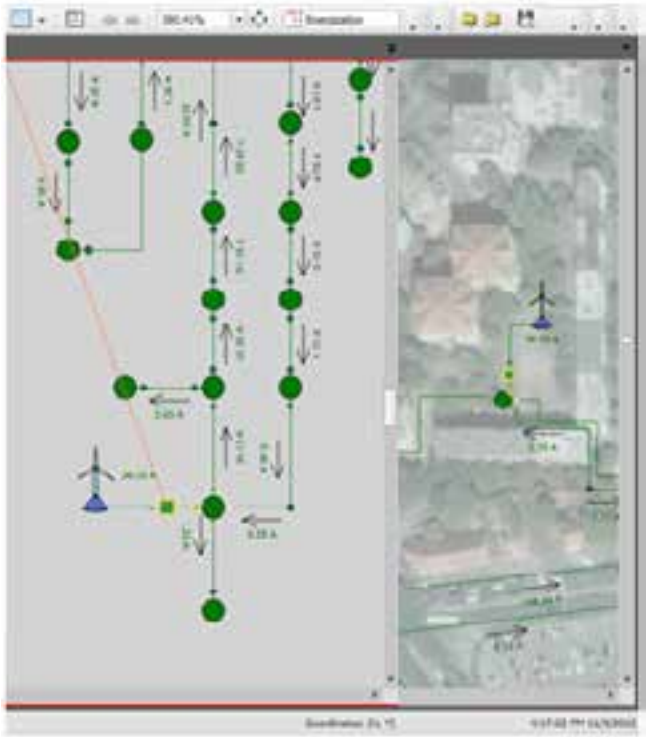
- Without ADMS, DG/DER's in the network introduce several dilemmas for engineering and operations:
  - No visibility of network state with DG/DER's
  - Not clear if operating problems like high/low voltages are caused by DG/DER's or normal loading conditions
  - Not clear how to select the optimal location for connecting large DG/DER resources to the network
  - No clear direction on how to maximize the operation and value of "green" energy provided by renewables
- Result is operating problems such as high/low feeder voltage and reverse power flows may go unseen until customers are affected

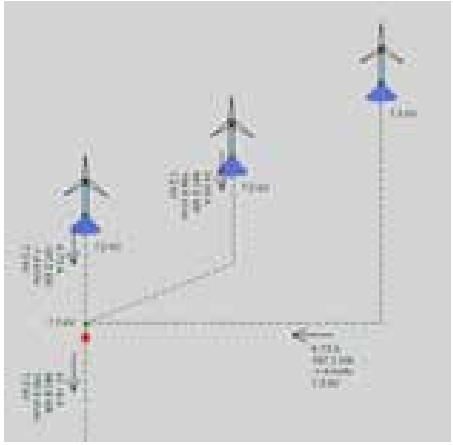
Emerging Challenges

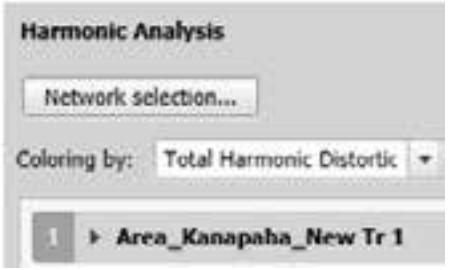


DER Visualization, Monitoring, Analysis, and Forecasting with ADMS

- Visualization - Geographic, schematic, substation views
- Monitoring - DG/DER activity and active/reactive over/under generation
- Harmonic analysis and remediation
- Historical trending and reporting - violations
- Near-term and short-term forecasting - load and solar/wind generation







WeatherSentry

- Weather imposes the largest external impact on your Smart Grid
- Demand, renewable energy supply, and outages are heavily influenced by weather
- Intelligent weather integration is the key factor in efficient Smart Grid management

Load Forecasting

90% of demand variation due to weather

Transmission

Temperature, humidity and wind impact line capacity

Distribution

Weather is largest cause of outages (lightning, high winds, ice, transformer failures due to high load, etc.)

Wind Power

Highly variable, difficult to predict. Causes increases in spinning reserve generation and risk of grid instability

WindPower Forecasts

Trading

Improved prediction of load and renewable energy contribution improves trading decisions

Distributed Generation

Home solar contributions can cause system instability due to rapid cloud cover changes

Solar Power Forecasts

Distributed Generation and Renewable Power Forecasting

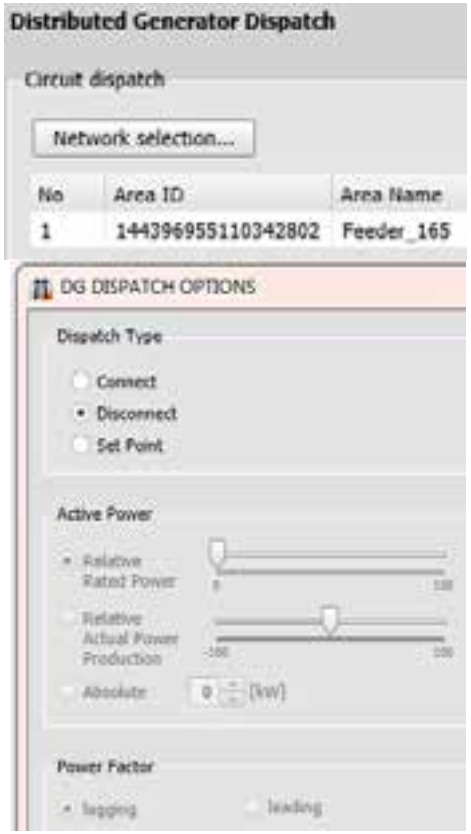
Forecasts:

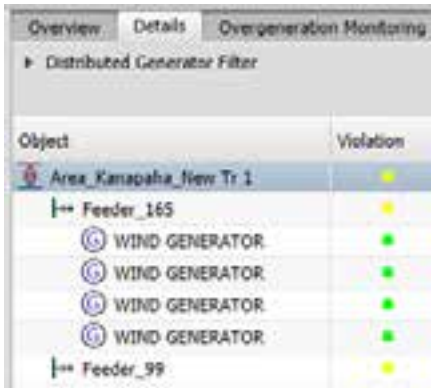
- Generation Planning
- Grid Stability

- Schneider Electric provides
  - solar irradiance and wind forecasts
  - temperature and humidity for load forecasting
- Highest accuracy forecasting in North America

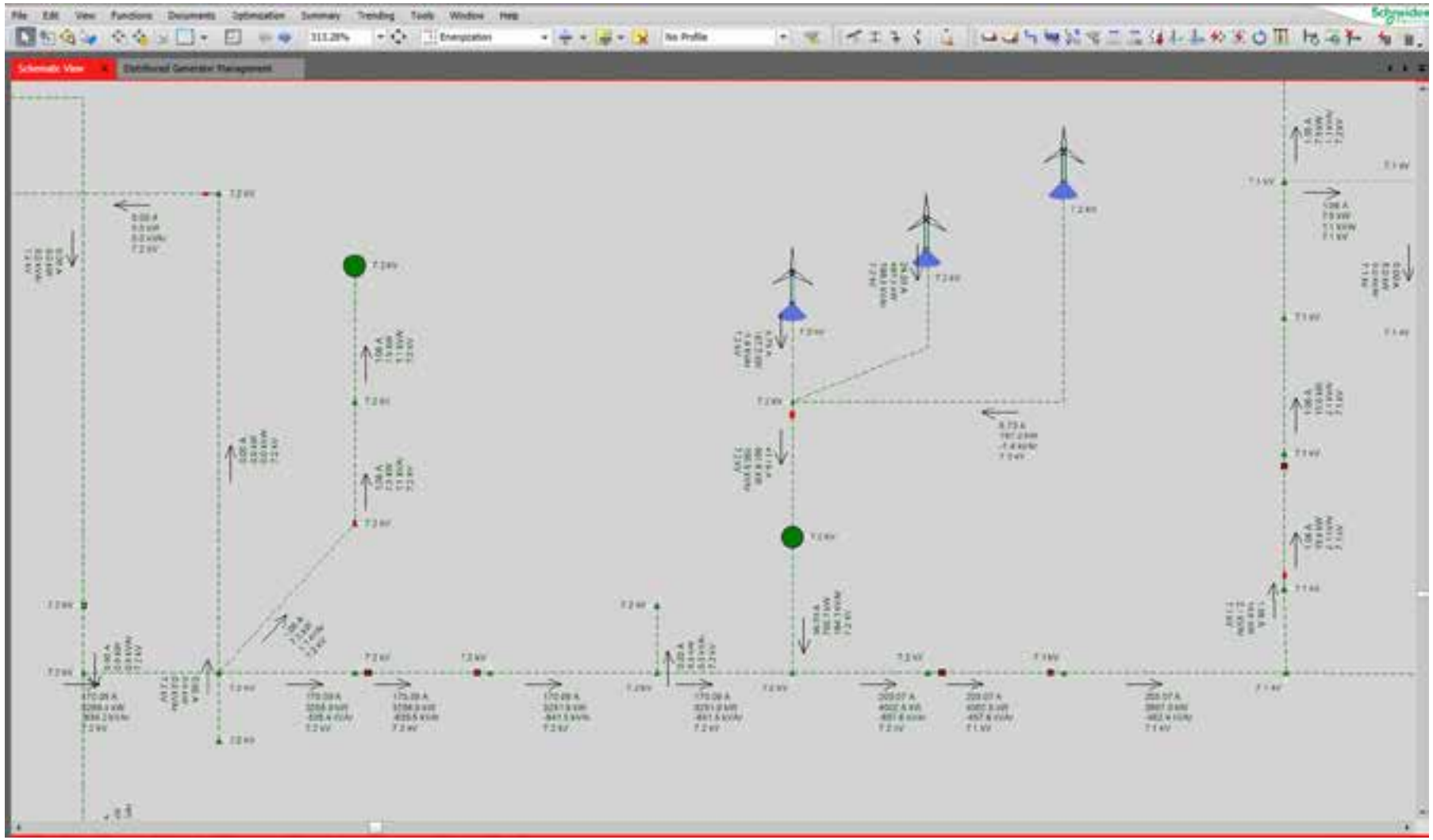
ADMS Operation & Optimization of DER

- Dispatch (reliability, economic)
  - Dispatch entire network or localized areas
  - Increase or decrease generation (automatically/manually)
- Operation Validation
  - What-if analysis in simulation mode
  - Prevent operation on adjacent feeders
- Volt/VAR Optimization
  - Manage VVO in the presence of DERs
  - Utilize DERs as VVO resource
- Relay Protection Coordination
  - Adaptive relay protection and transfer trip settings
- Microgrid Islanding
  - Maintaining reliable service with islanded networks

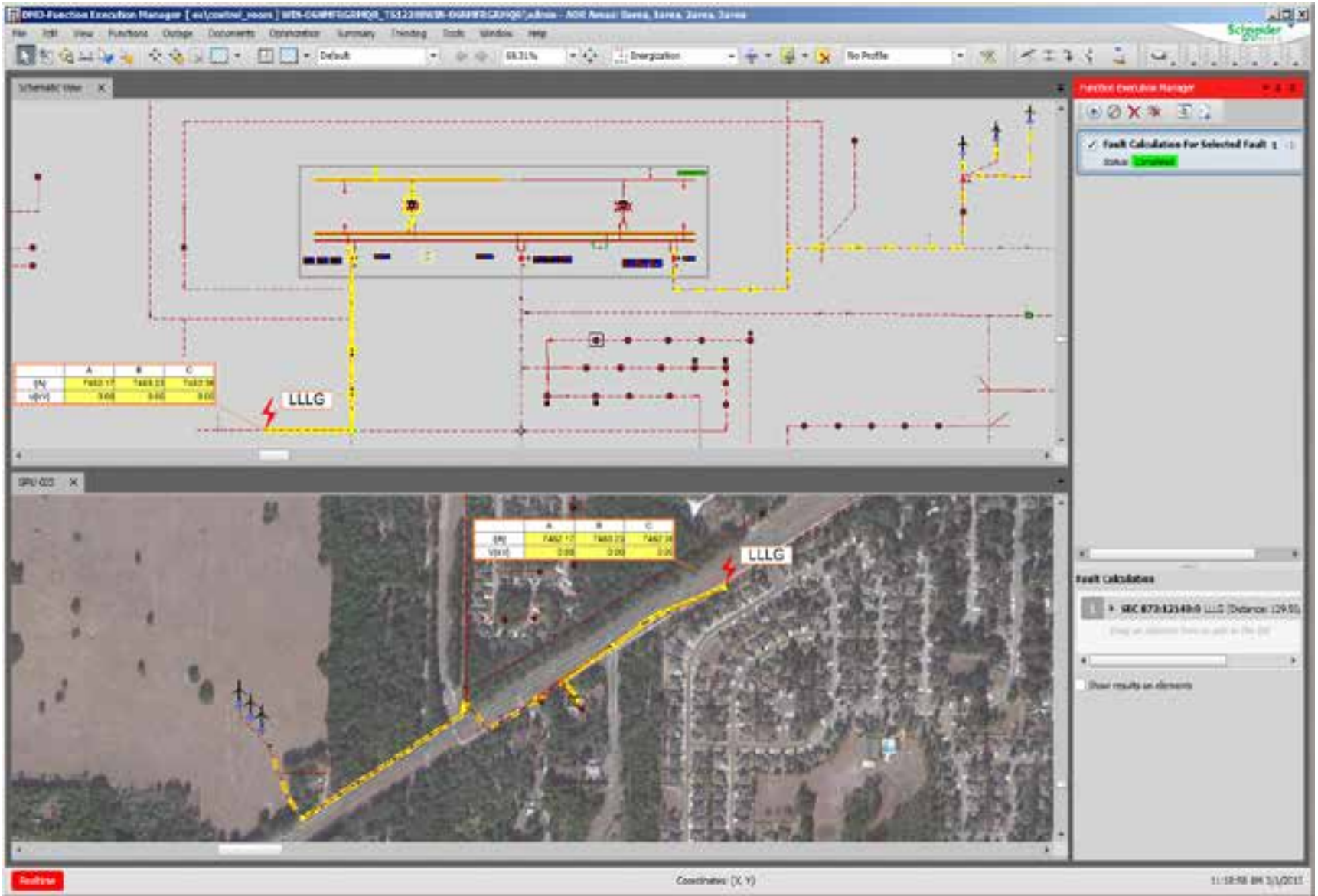




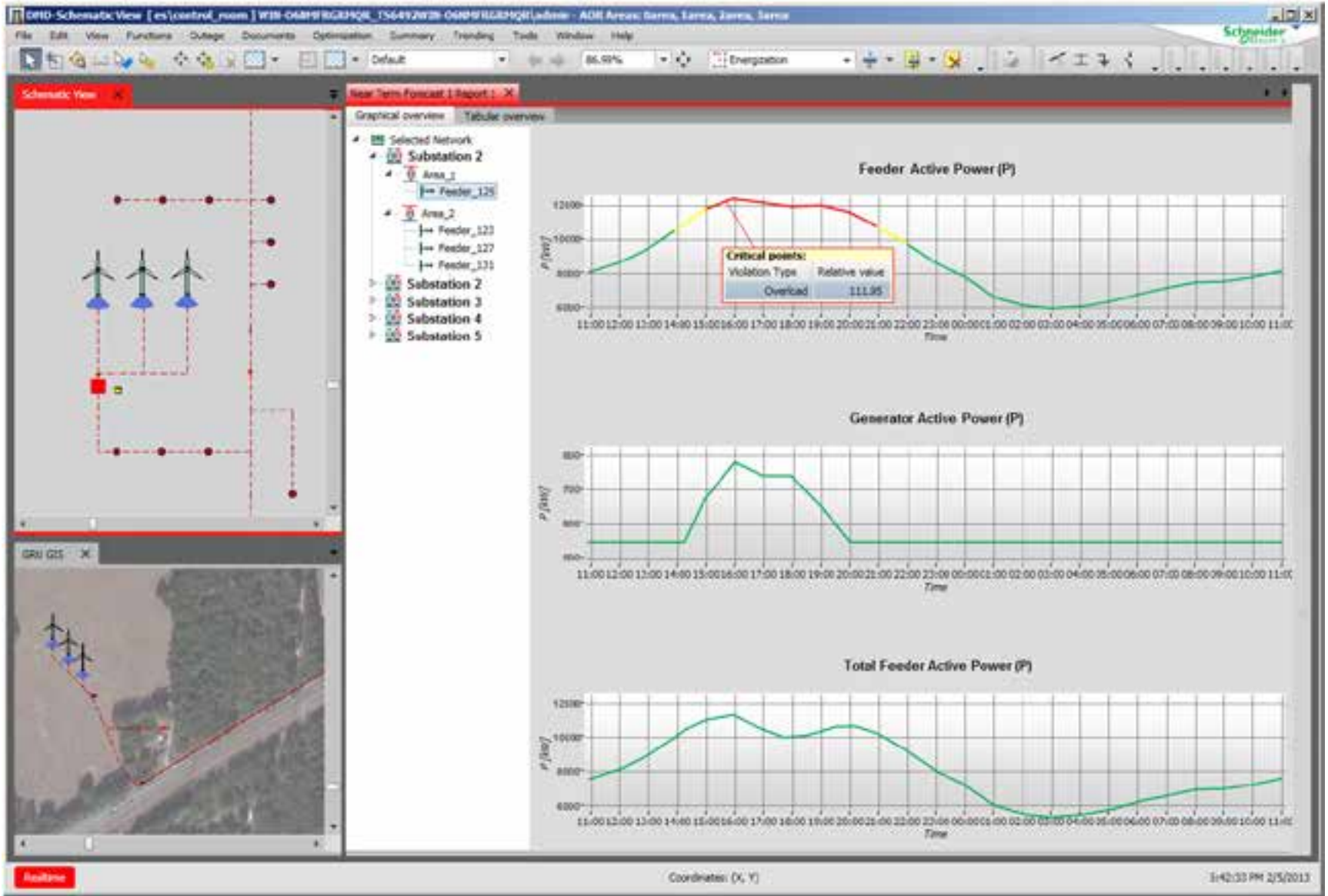
Full Network State Visibility



Short Circuit Current

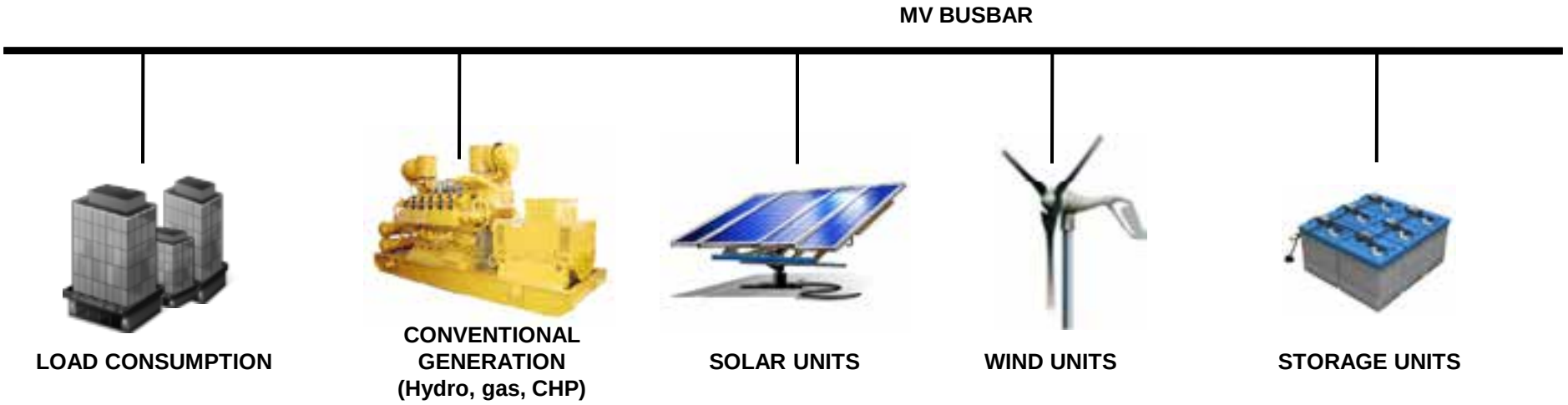


Near Term Operation Planning supported by Weather Forecast Inputs



Microgrid Optimization with ADMS

- Provide monitoring of microgrid level resources
- Identify capabilities of generators; especially renewables
- Determine historical behavior of renewables (vs. weather input)
- Provide monitoring of interchange through supply transformer or tie line
- Provide forecast of load and renewable production (weather monitoring plus weather forecast)
- Calculate costs/benefits of microgrid operation, including forecasting
- Optimize operation of utility resources (“regional islanding”)



Microgrid Island Operation

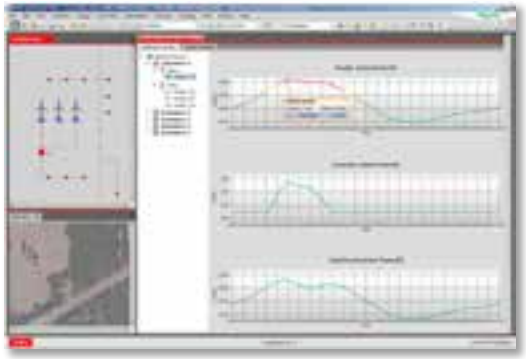
- Real islanding (no connection with main grid) is typically forbidden due to inadequate control and management systems
- Islanding requires much more investment and tuning
  - Load shedding to balance island production and consumption at the moment of islanding
  - Is stable frequency required? If yes, effective and efficient under frequency protection is required to align imbalance at any moment
  - Regulating unit capable of keeping stable frequency
    - e.g. CHP of 10 MW has ramp up about 50 kW/sec; economic threshold for e.g. CHP is above 4000h/year
    - hydro unit can have even greater ramp up, but ramp down can be a problem

Application Support for Microgrids

- Applications:
  - Automatic Generation Control – AGC
  - Economic Dispatching – ED
  - Unit Commitment – UC
  - Load Forecasts – LF
  - Renewable Production Forecast – RPF
  - Load Shedding – LS
  - Interchange Transaction Scheduler – ITS
- Additionally, ADMS applications can be added for monitoring/control when the full network model is used
- Product Focus
  - ADMS for Distribution
  - EMS for Transmission
  - PCS for Generation
  - *Convergence of Systems*

Summary and Questions

- Schneider Electric has a long history of applying technology to solve complex problems for utilities
- Advanced systems like those provided by Schneider Electric can balance and optimize supply and demand and provide reliable, safe, and efficient power in the presence of highly variable renewable resources
- Integrations including weather forecasts for load and renewable forecasting are a critical component of renewable, DER, and microgrid optimization
- For more information on ADMS: http://www.schneider-electric-dms.com/ or contact me at john.dirkman@schneider-electric.com
- Questions?



Thank You!

Scott Mellon

Principal Electrical Engineer/ Project Manager

Burbank Water and Power

John Dirkman, P.E.

Smart Grid Product Manager

Schneider Electric

Esri User Conference

17 July 2014