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Distributed Generation, Cogeneration, and Storage - Key Factors in Energy Plans for Data Centers, Campuses and Municipalities

IDEA Campus Energy 2018

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www.siemens.com
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Agenda

- Overview of power generation market changes and associated challenges
- Distributed generation case studies
  - Primary and backup power
  - Cogeneration
  - Energy storage
  - Microgrids & hybrid solutions
- Q&A

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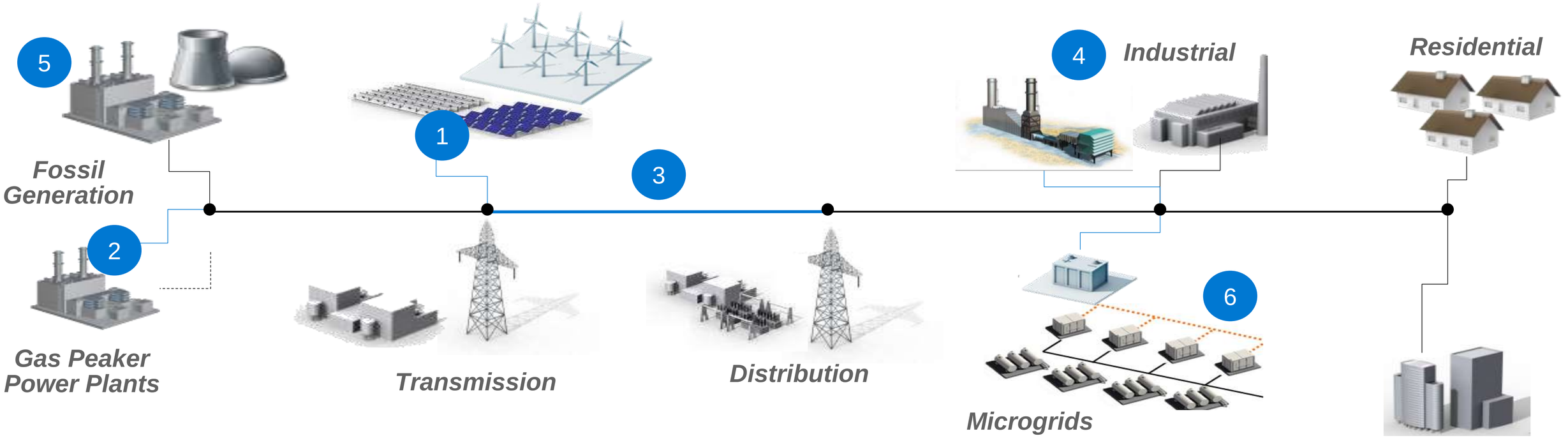
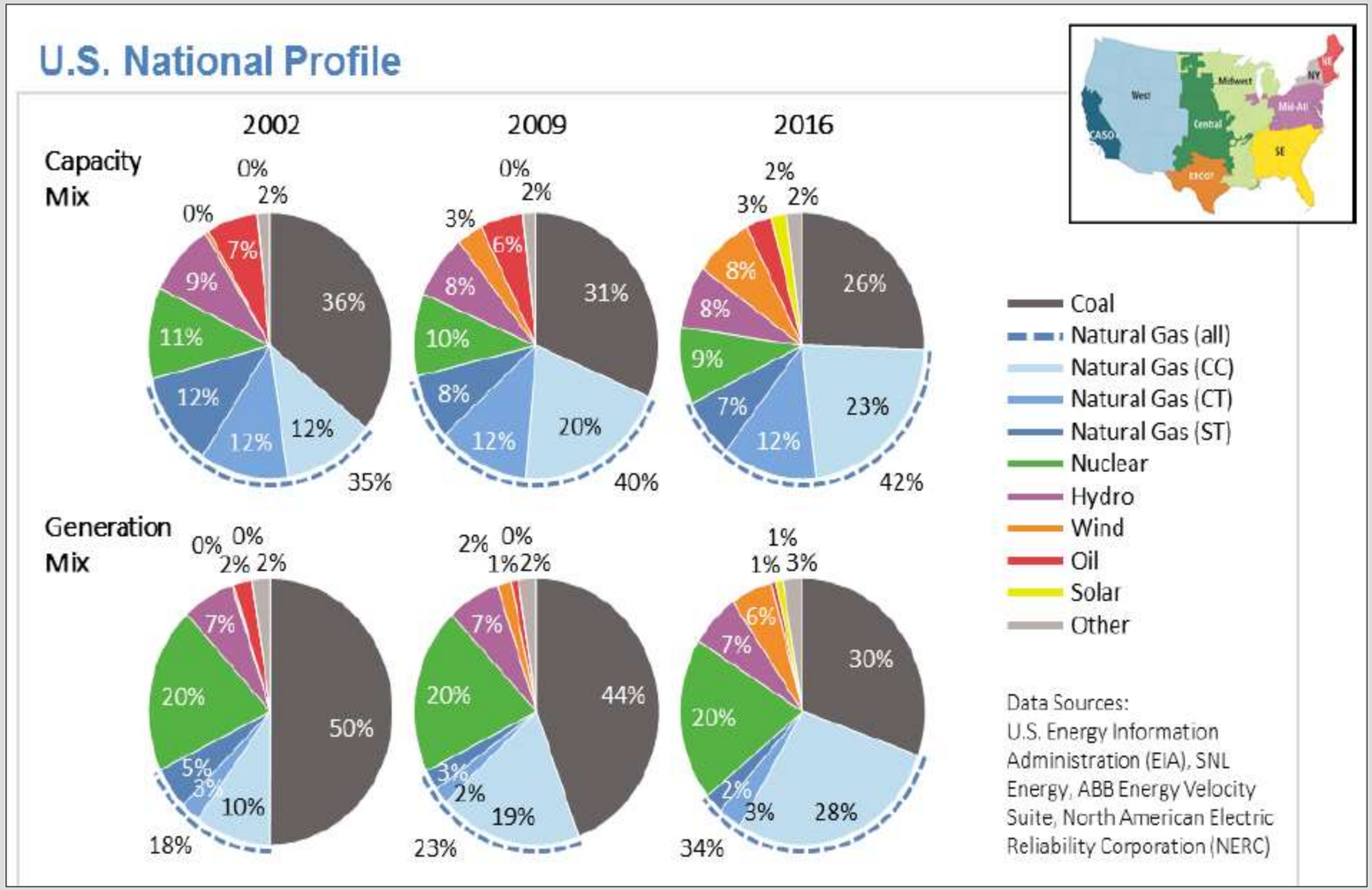
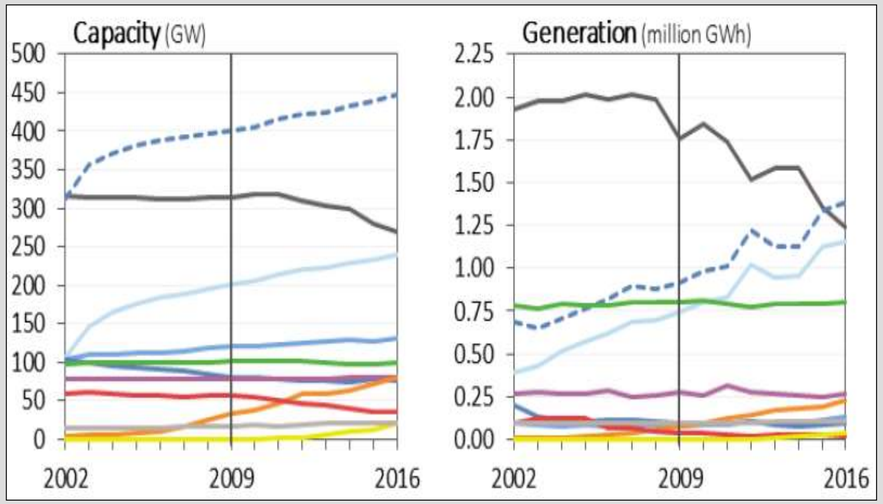
Evolving Grid Creates New Opportunities & Challenges



1. Penetration of Renewables
2. Change of Energy Mix
3. Saturation of Infrastructure
4. Increase of Grid complexity
5. Fuel Price Fluctuations
6. Deployment of Microgrids

US National Energy Profile





Source: U.S. Department of Energy,
Staff Report on Electricity Markets and Reliability, August 2017

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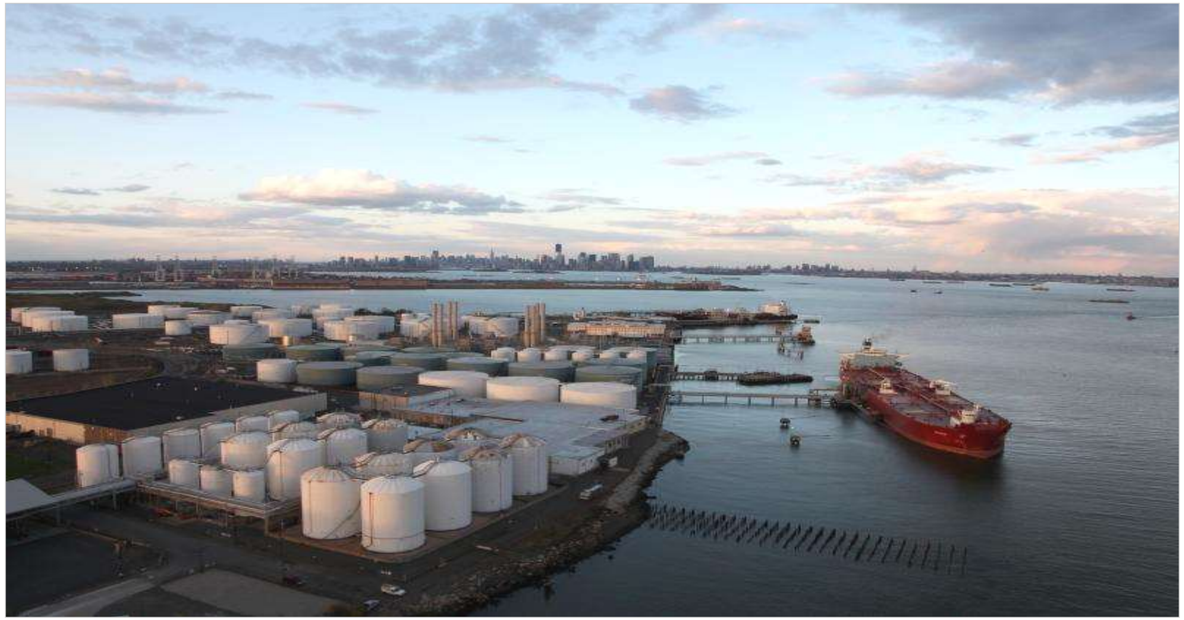
Bayonne Energy Center – Electric Power Plant

Peak power for New York City



Siemens Scope of Supply

(8) SGT-A65 (Industrial Trent) WLE ISI gas turbine units installed – more units currently getting added

512 MW dual fuel fired electric power plant

Challenge

Complex 10,800 square foot facility with SGT-A65 (Industrial Trent) gas turbine units in simultaneous operation, running up to 12 hours daily, to export over 500MW via under-water cable to the grid for the City of New York.

Solution

Full power can be delivered in less than ten minutes from start, enabling on/off cycle flexibility, reducing fuel costs and emissions.

Delivers sufficient power to supply electricity to over 500,000 homes at peak times.

10min

Start from 0 to 512MW output and similar cycling capability

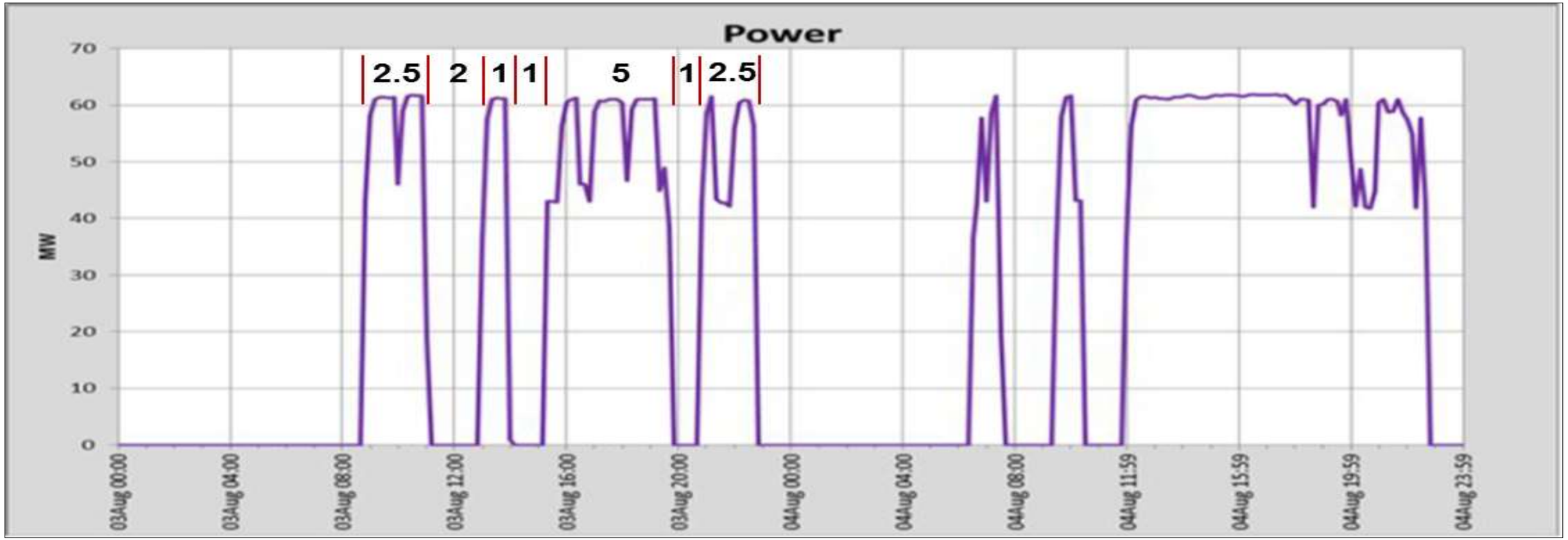
500K

Homes supplied with reliable electricity at peak times

Maximum flexibility to adjust to dynamic market needs

Aeroderivative Gas Turbines in Simple Cycle Applications

Operation flexibility to match evolving energy market



Operation over 2 day period

Importance of Flexible Generation
Critical facilities – reliability & resilience

- Fast cold start (less than 60 seconds)
- Fast ramp up and down capability
- High cycling capability – no start/stop penalty
- No hot lockouts
- Fuel flexibility
- High power density
- Modularity – 5 MW blocks
- Compact & light weight packaging
- Integrated controls

Data Centers

Hospitals & Medical Centers

Airports

Tate and Lyle – Tennessee Cogeneration Plant

CHP solutions in industrial applications – CO2 emissions reduction

TATE & LYLE

Source: https://www.tateandlyle.com

Challenge	Solution
Implement energy efficient on-site power solution to ensure safe and reliable operations	Replaced aging coal-fired boilers with CHP system
Ensure continuity of plant operations regardless of the challenges with external energy supply	On-site power system (CHP) boosts energy reliability and security while making use of the heat

50MW

Reliable power supply offering same electrical and thermal outputs with lower costs and emissions

City of Holland – Cogeneration Plant

Municipalities implementing CHP solutions

Challenge	Solution
Coal-fired plant no longer met city energy needs	Two SGT-800 and One SST-400 provide cost-efficient power
Underground snowmelt system could not meet energy demands	Waste heat from circulating water system provides heat for increased snowmelt system demands
Complex development process	Provide “bundle buy” solutions to facilitate supply process

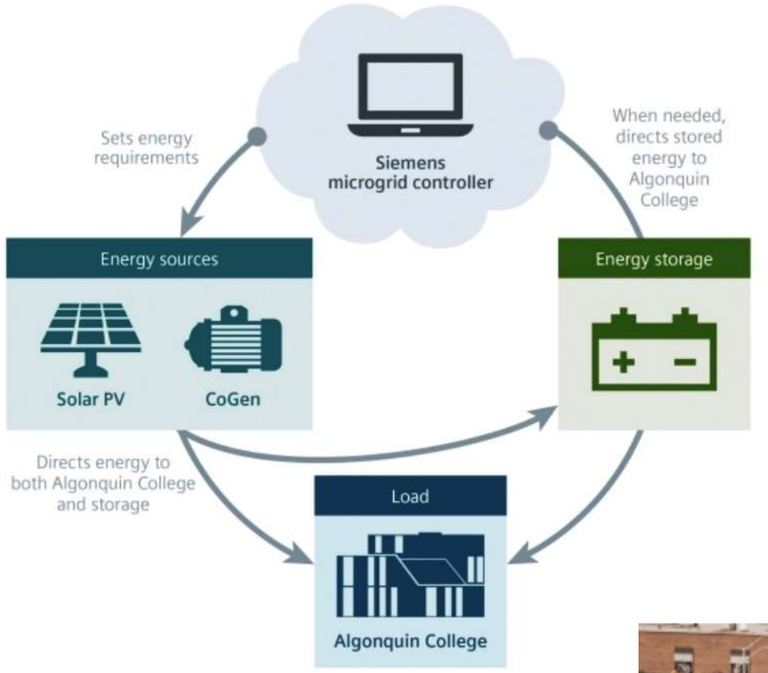
145MW
New power generated via CHP plant

~50%
The CO2 emissions reduction rate from existing supplier

Leveraging portfolio breadth to facilitate project development goals

Hybrid Energy Solutions in Campuses

Integrating cogeneration, renewables, & storage



- **Micro-grid management**
- **Cogeneration plant**
- **Solar PV**
- **Energy storage**
- **EV charging**

ALGONQUIN COLLEGE

Hybrid energy solutions in industrial facilities
SIESTART™ - integrating gas turbines & energy storage

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Customer
Vulkan Energiewirtschaft Oderbrücke GmbH
Location
Eisenhüttenstadt, Germany
Date
2013

Secure power supply (on- and off-grid)

Independence from public power grid

Grid services (frequency, voltage)

Challenges

- Black start capability for an industrial gas turbine
- Grid stability (frequency, voltage)
- Islanding and off-grid services
- Smart peak load management

Solution

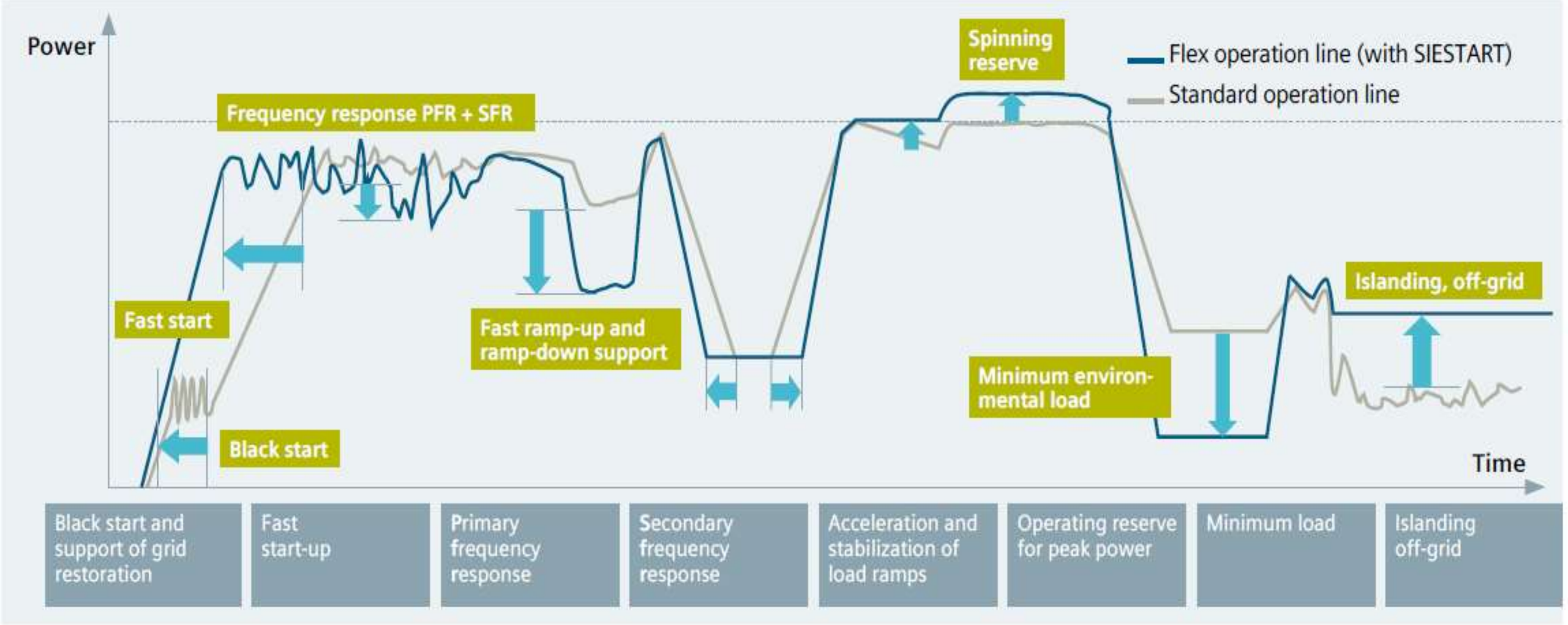
- Existing GE gas turbine and generator
- SIESTORAGE Li-Ion battery storage system (2,8 MVA / 1,2 MW, 1,080 kWh)
- Integration of components to existing unit control system

Customer benefits

- Siemens turnkey solution with 57 MW_{el} and steam generation of 180 t/h, 120 bar, 540° Celsius
- Secure power supply through black start capability for sustainable steel and rolling mill operation

Integrating Energy Storage in Existing & New Power Plants

Optimized operation- new opportunities for flexible generation



Optimized Operation and Flexible Generation

Hybrid Power Plant Integrating Several Technologies
Isabela Island microgrid

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Highlights
- Full turnkey supply of complete hybrid power plant (including ESS, PV plant, Gen sets, plant automation and grid control)
- Guaranteed minimum renewable share, and capability to work with 100% renewable penetration during sunshine hours (diesel off)

  Economic optimized operation of hybrid power plant (e.g. diesel vs. ESS)

Project Size
- ESS: 305KW / 620 kWh
- Biodiesel Generators: 5 x 325kW
- PV Plant: 922 kW
- Controls: T-3000 Siemens Controller

Location
- Isabela Island, Ecuador

Hybrid Power Plant Integrating Several Technologies

Blue Lake Rancheria deploys low-carbon microgrid

Challenge	Solution
Diverse renewable energy sources - .5MW solar PV, 950 kWh battery storage syst., a biomass fuel cell and diesel generators need to be optimally managed and controlled to achieve energy efficiency, cost savings and emission reduction goals	Siemens SP MGMS software for managing numerous energy sources and balancing with energy loads
Operations need to be automated to allow limited staff to manage the system in event of a grid outage to ensure energy security for the on-site emergency shelter	Microgrid defined sequence of operations programmed to coordinate with the local utility

7 days

Duration of available on-site power independent from the utility

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Questions?

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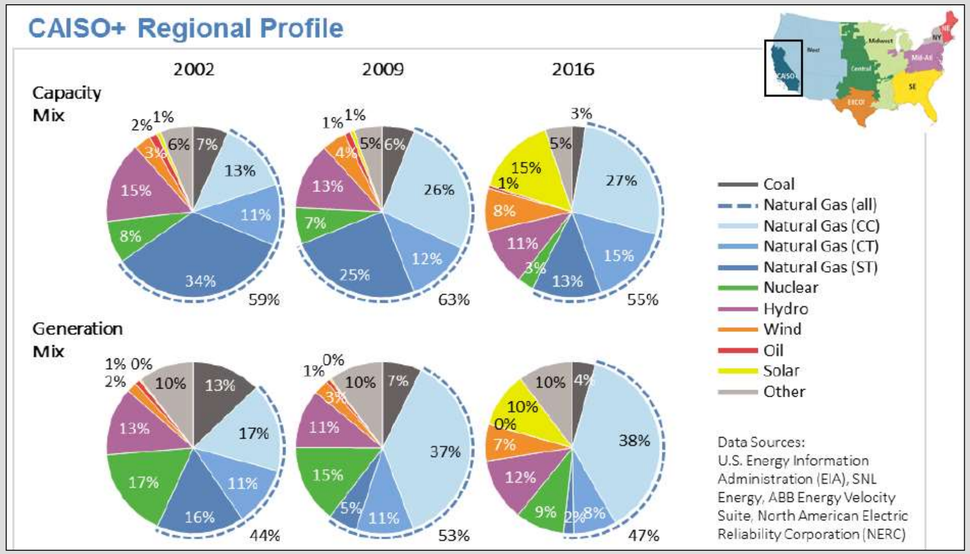
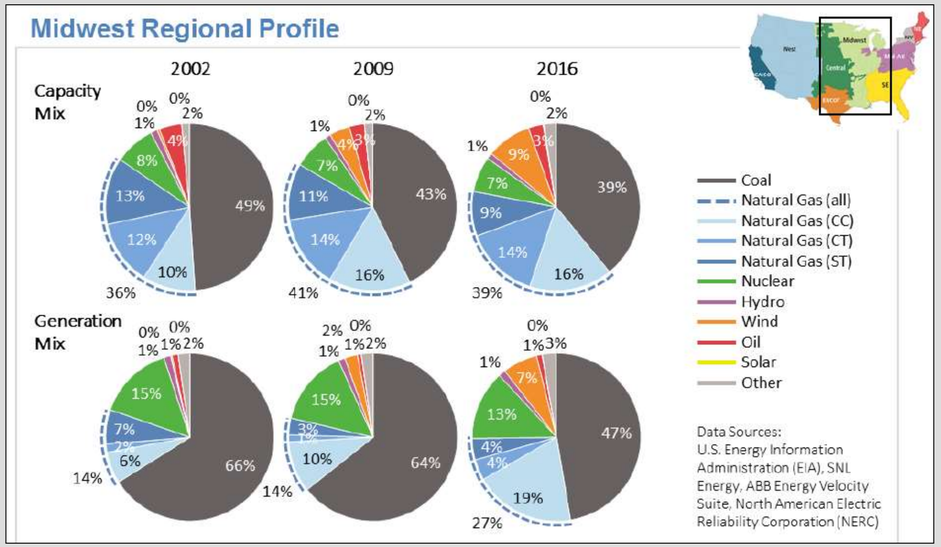
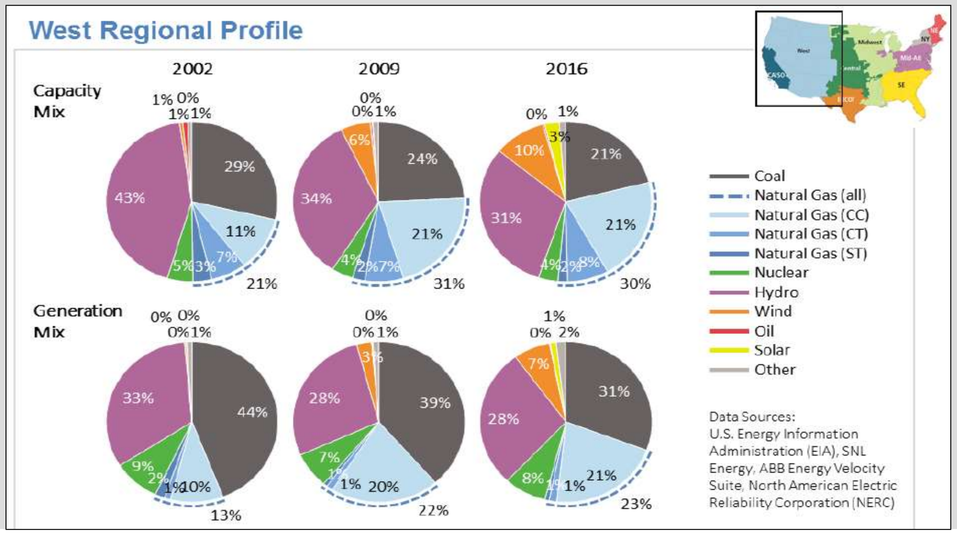
Back-up Slides

U.S. regional energy profiles







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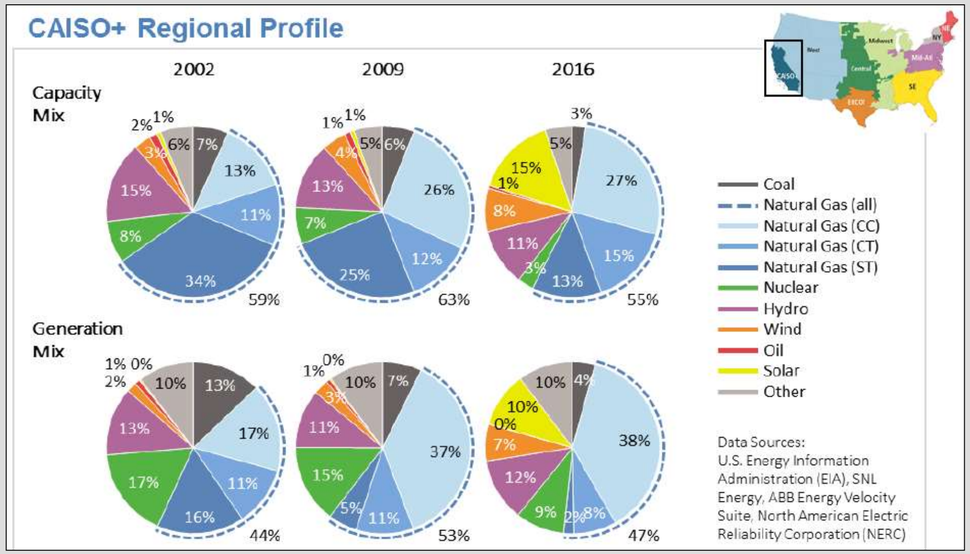
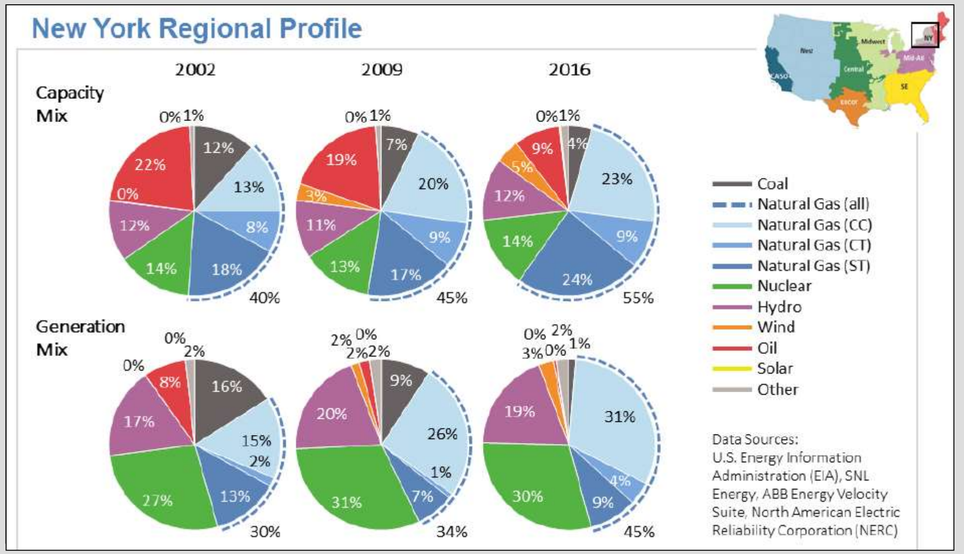
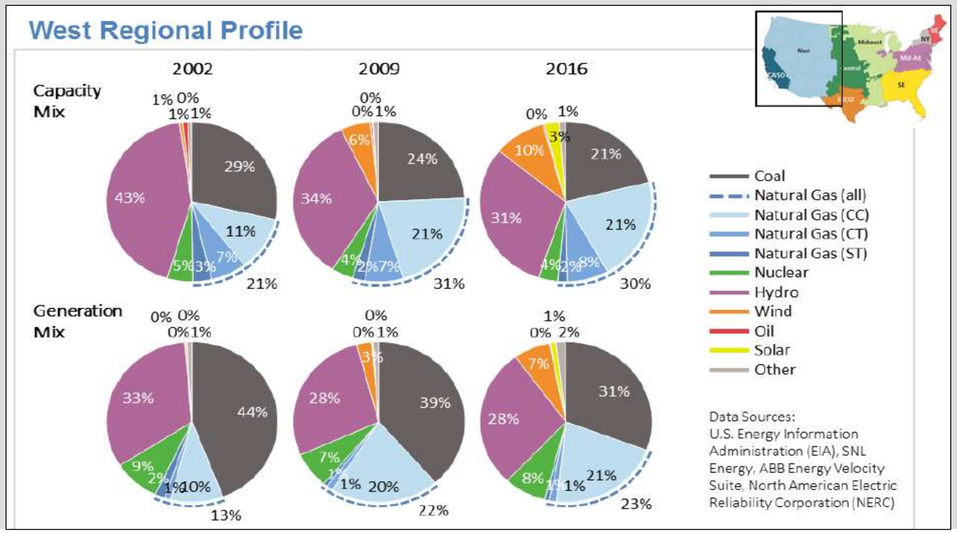
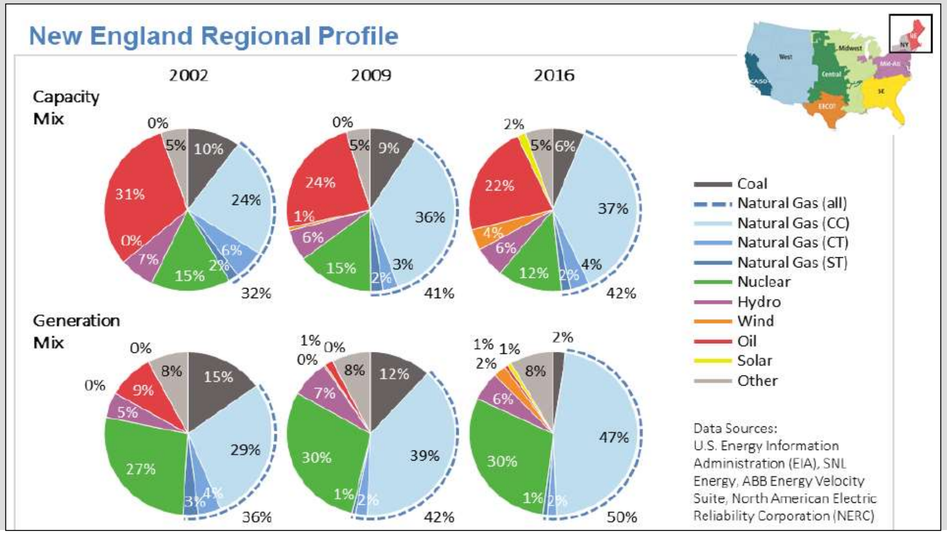
U.S. regional energy profiles









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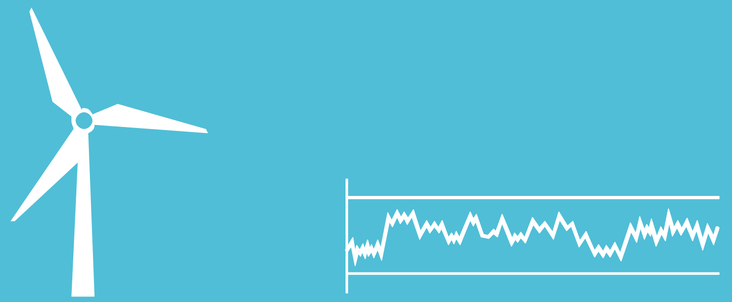
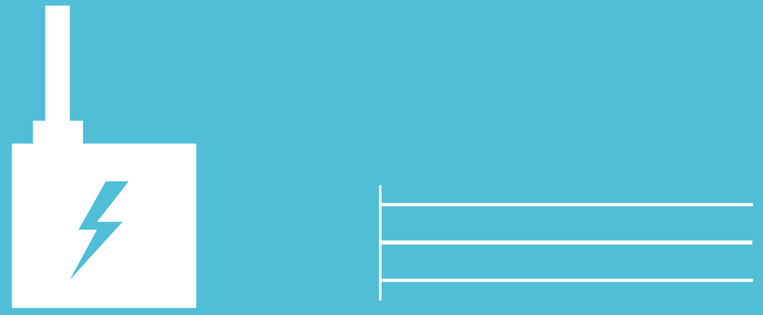
Main challenges in the grid



Higher utilization of renewables and less rotational inertia from conventional power generation units



Stability of the grid and secure supply of power

Higher flexibility and shorter reaction times requirements to the producers

Grid challenges driving critical needs for power plants

Ensure grid stability

Conventional power plants (heavy duty as well as industrial scale) need:

- Accelerated load ramping for fast compensation of unbalances in the grid
- Spinning reserve as additional power reserve to stabilize the grid
- Islanding and off-grid services (especially for industrial power plants)
- Black start capability in the case of a grid failure

Modular power supply:
The Battery Energy Storage System SIESTORAGE

Modular energy storage system based on technology leading power electronics and Li-ion batteries:

- Instantly available, reliable and flexible power
- Fast and accurate response time to consume and discharge energy
- Assured power quality
- Flexible and scalable design - various sizes and configurations

Designed for improved asset performance

SIESTART™ – The performance of conventional power plants combined with instant & reliable Battery Energy Storage Systems

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Siemens Power Generation

- Over 600 GW of installed capacity since 1960
- More than 25,000 Siemens gas and steam turbines in commercial operation
- I&C solutions for all types of plants

SIESTART

Siemens BESS (SIESTORAGE)

- Cutting-edge power electronics, automation, and state-of-the-art Li-ion battery technology
- Modular battery storage concept with flexible and scalable design
- 20 battery storage projects – eight regions, seven use cases

Siemens Control Systems: More than 2,700 power plant projects with Siemens I&C