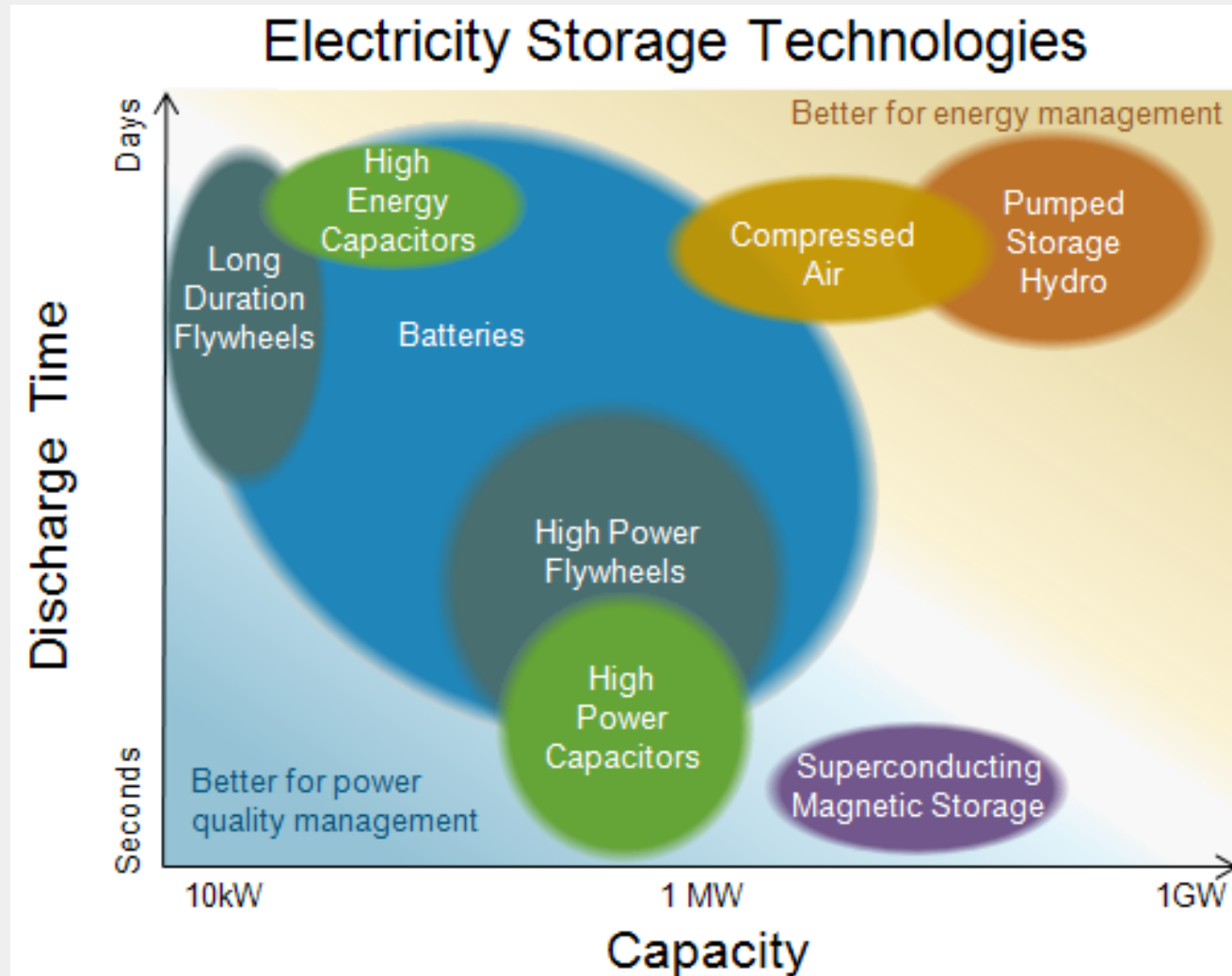# CLS Energy Consultants DMCC

WETEX Solar Show
Grid Connected Energy Storage Applications

Prevailing Energy Storage Technologies

Electricity Storage Technologies

## Focusing on Battery based Energy Storage Applications:

- Batteries are the most versatile ES Technology available today

- Battery based ES has a large Supplier Base (OEM's and Solution Providers)

- New Built Battery based ES storage capacity is outpacing classical ES technologies

Global Power Grids Are Fragile And Facing Serious Challenges!

They were built to meet the needs of the last century.

- Today's grids require more flexibility to address:
  - Instability caused by increased renewable generation
    - Variable energy resources less easily controlled than traditional thermal generation
  - Changing load patterns
    - PV generation now distributed to load centers
    - Peak demand demographics are shifting
    - EV charging needs will fundamentally shift consumption
  - Aging transmission and distribution network
    - Infrastructure is aging and needs reinforcement
- Energy storage is a powerful tool for flexibility
  - Last century grids were required to move energy through distance in real-time
  - Current and future grids must move energy through time as well
  - Energy storage adds this additional dimension

High Power Applications:
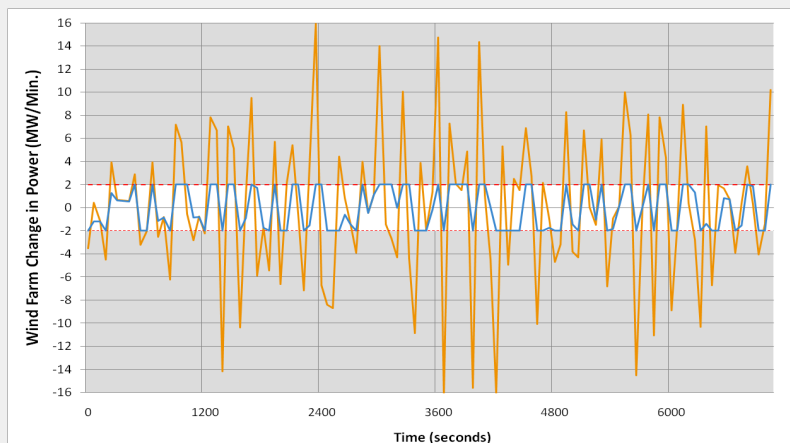
Frequency Regulation

Primary Reserve
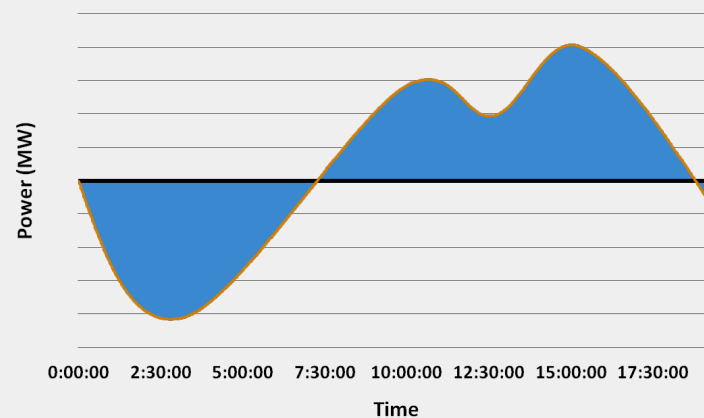
Renewable Integration

    Ramp Management

Requirements:

    High charge/discharge rates

    Short duration (<1hr)
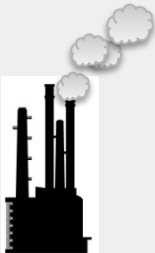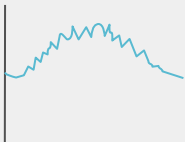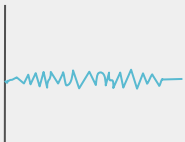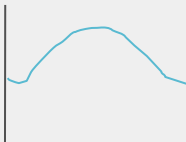
    Many cycles (100's per day)
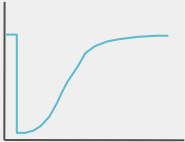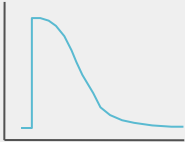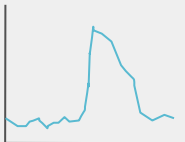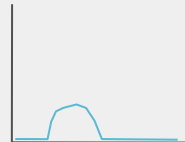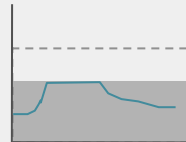
    Continuous use

High Energy Applications:

- Peak Load Shifting
- Renewable Integration
  - Firming, Shifting & Curtailment Recovery
- Arbitrage
- T&D Support
- **Requirements:**
  - Low charge/discharge rates
  - Long duration (1+ hrs)
  - 1-2 cycles per day

Four Main Applications:

		Today's Grid	Energy Storage	Net Result	
Regulation			+	=	Increase efficiency Reduce CO_2 emission
Reserves			+	=	Faster and more reliable reserve power
Renewable Integration			+	=	Firm renewable power Enable greater penetration
T&D Support			+	=	Reinforce the grid Frees capacity for future growth

Application: Frequency Regulation

**Load > Generation
(Regulate Up – Discharge)**

**Load < Generation
(Regulate Down - Charge)**
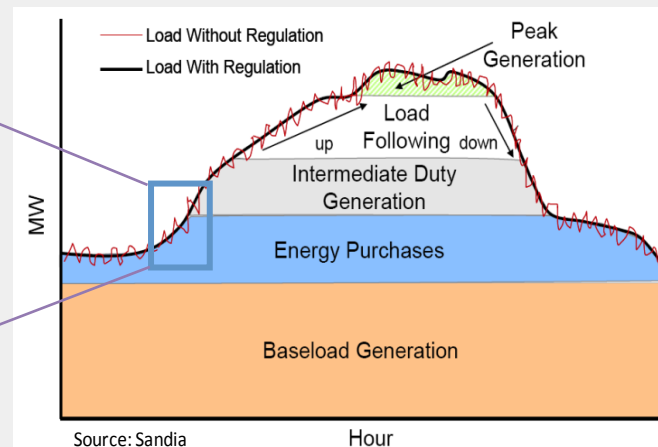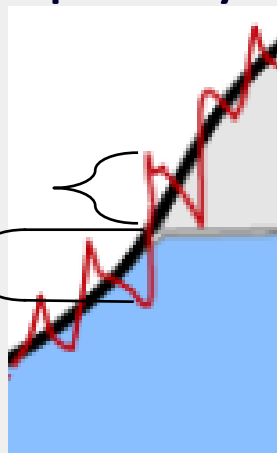
Regulation is used to reconcile momentary differences between supply and demand.

Primarily required to manage power flows between and frequency within a balancing area (Control section of grid).

Worldwide reliability requirement for electric grids (45GW in 2012 per Pike Research)

Open commercial market in U.S. and developing elsewhere (e.g. Ray Power in China)

Open market in deregulated power markets. Cost reduction opportunity in regulated markets.

FERC has issued a rulemaking proposal, Docket No. RM10-11-000, that would make it an open market in regulated power markets as well.

EU organization ENTSO-E is in the process of crafting rules for ancillary markets continent-wide

Application: Primary Reserve

Electric supply reserve capacity that can be called upon when some portion of the normal supply becomes unavailable unexpectedly.

Online, synchronized to grid, and can be called upon instantaneously.
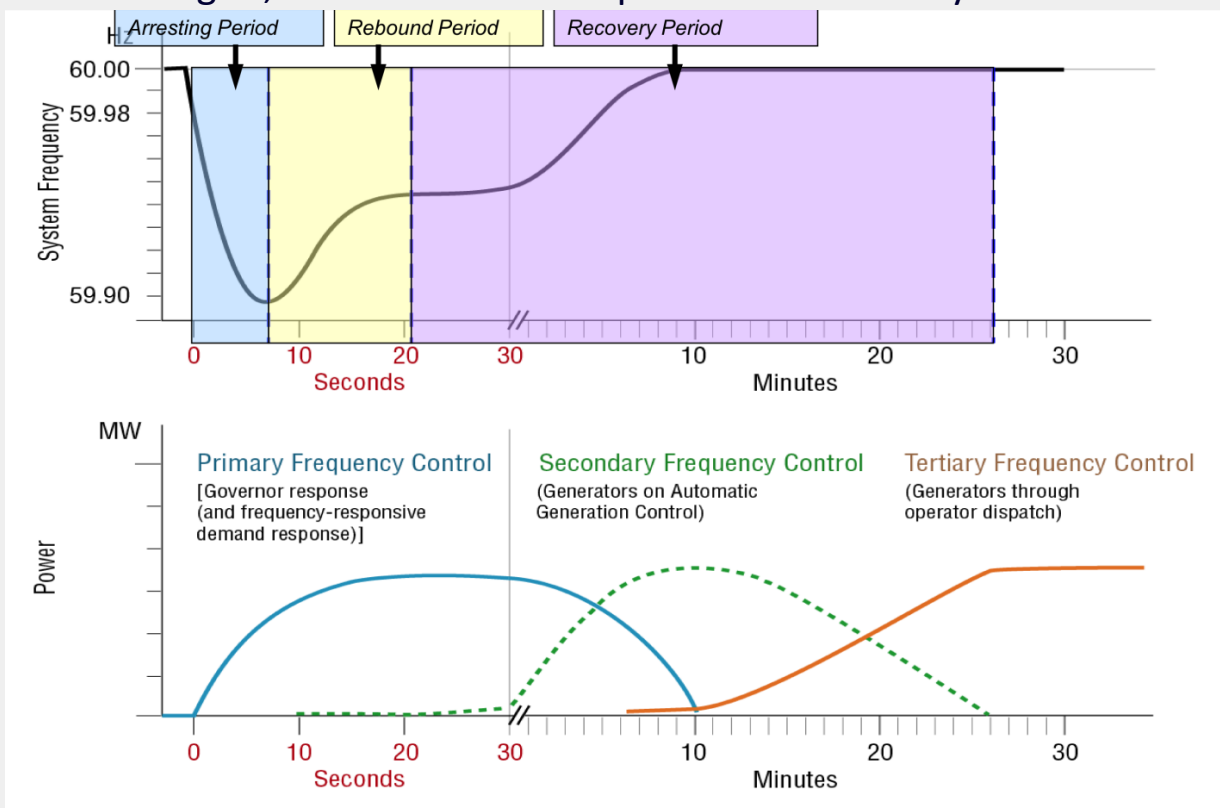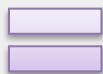

Figure 1: Following a disturbance at time 0, three types of reserves are used to restore the grid. Source: Robert W. Cummings, "Frequency Response Trends," NERC Frequency Response Technical Conference, May 22, 2012.

Application: Renewable Integration

Demand is variable but predictable
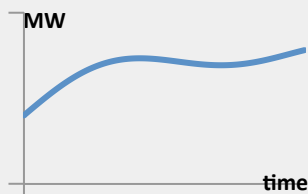
Traditional Generation is controllable and predictable
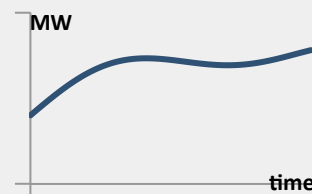
But Renewable Generation is uncontrollable and unpredictable

With Storage, Renewable Generation can be controlled and made predictable
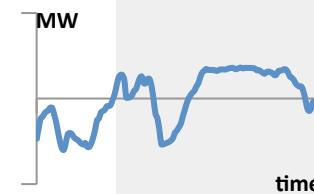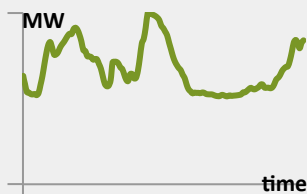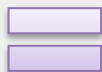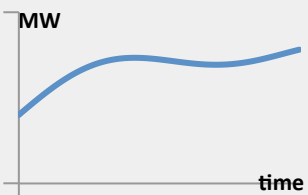
Application Overview: T&D Support

Delaying or avoiding large "lump" utility investment in transmission and/or distribution system upgrades
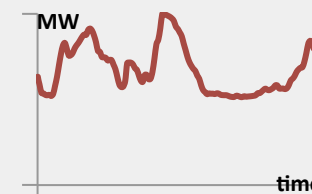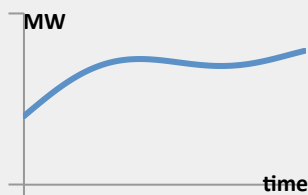
- Can range from a transformer upgrade or replacement, to a new substation to a new transmission line.

- Typical upgrades add 25%-50% of capacity at a time and are underutilized

Using relatively small amounts of storage to deliver high value

- Can be added in small targeted increments across the transmission and distribution grids

Grid Connected Energy Storage Applications
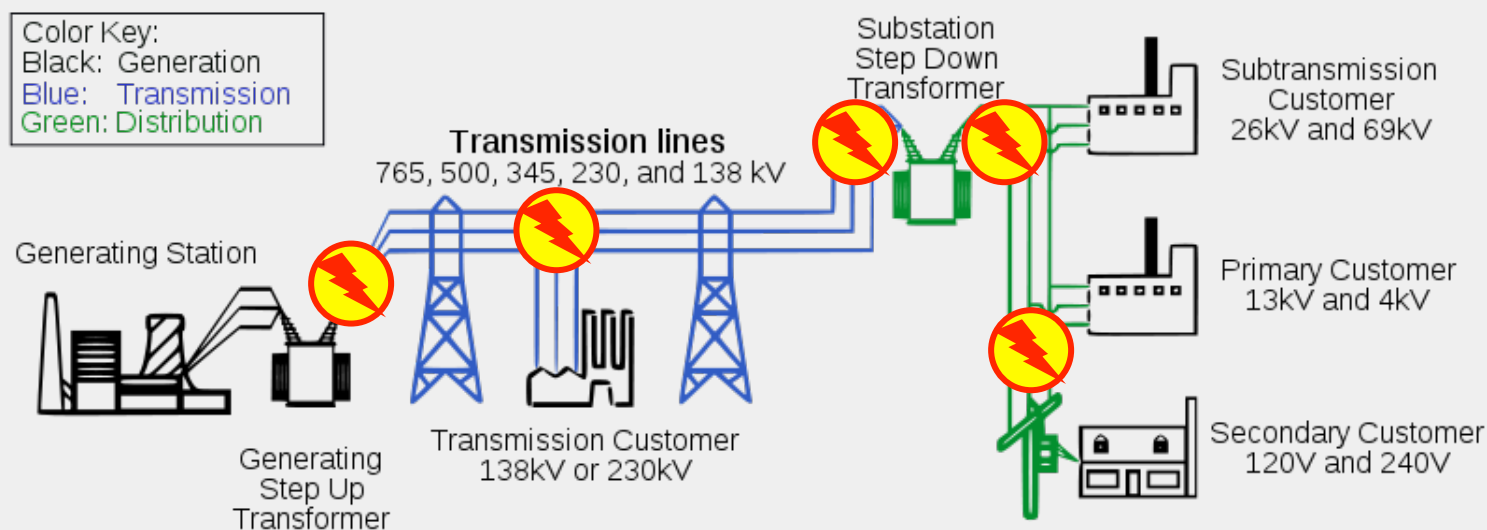
Summary Grid Applications:

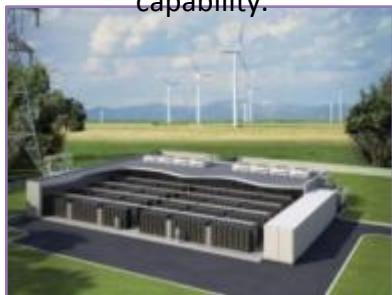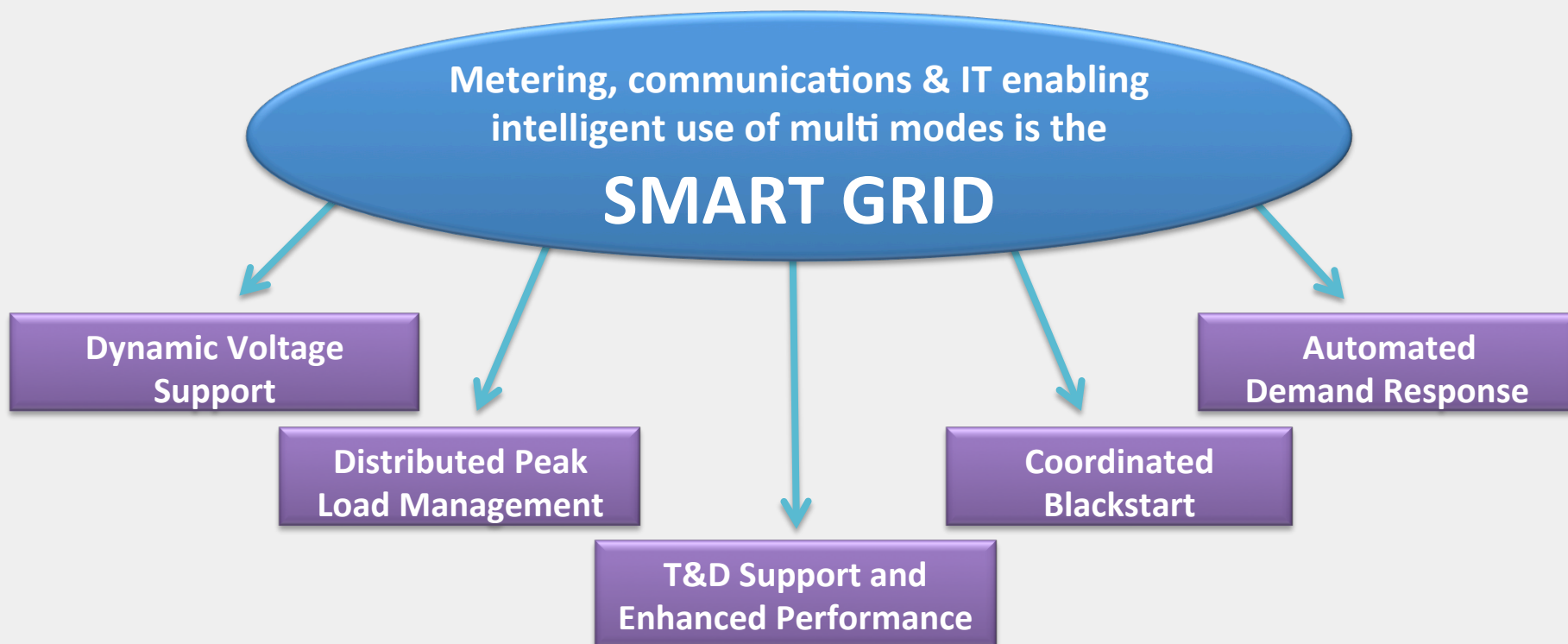| Generation	Transmission	Distribution
➢ **Frequency Regulation** ➢ **Frequency Response** ➢ **Renewable Integration** ➢ **Power Plant Hybridization**	➢ **Voltage Support** ➢ **Dynamic Line Rating Support** ➢ **Renewable Integration** ➢ **Upgrade Deferral**	➢ **Upgrade Deferral** ➢ **Community Energy Storage** ➢ **Microgrids**
Improve plant efficiency and output, lower O&M costs, and decrease plant emissions, with no water consumption, no emissions of its own, and rapid deployment capability.	Increase grid reliability, increase asset efficiency and utilization, enable wind and solar, defer upgrades to transmission assets.	Improve power quality, increase asset efficiency and utilization, smart grid ready; aggregation and automation, defer upgrades and support distribution assets.

Providing benefits throughout the electricity supply chain

Future Applications: Smart Grid Will Enable

Today, the GSS™ is used primarily in Frequency Regulation , Reserve and Renewables Integration service

Next, leverage Smart Grid and GSS™ functionality (speed & control) to deliver additional operating modes of value

Metering, communications & IT enabling intelligent use of multi modes is the

SMART GRID

Dynamic Voltage Support

Distributed Peak Load Management

T&D Support and Enhanced Performance

Coordinated Blackstart

Automated Demand Response

Major functional Energy Storage System Components
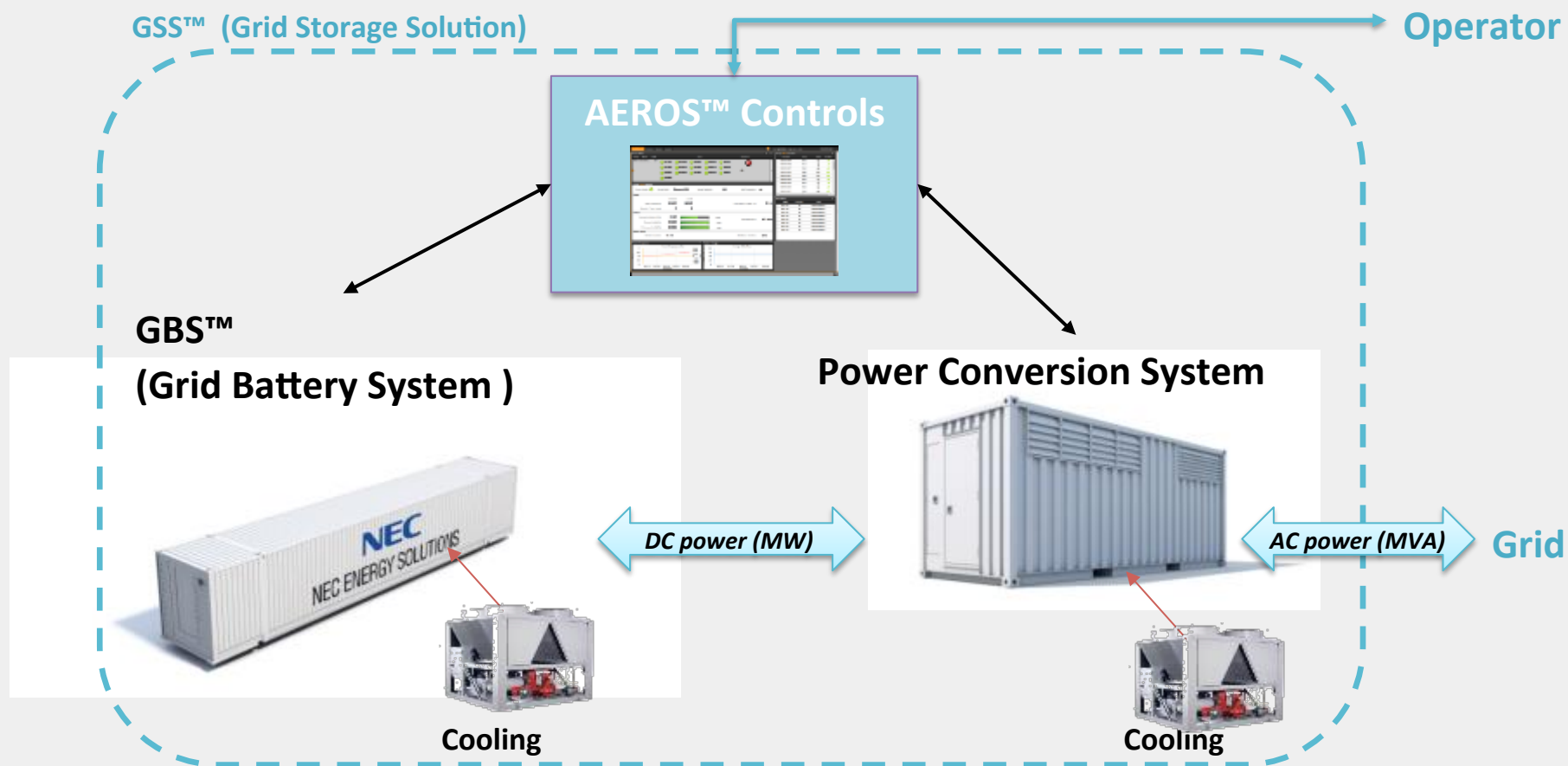
Reference Project: Los Andes (Chile)
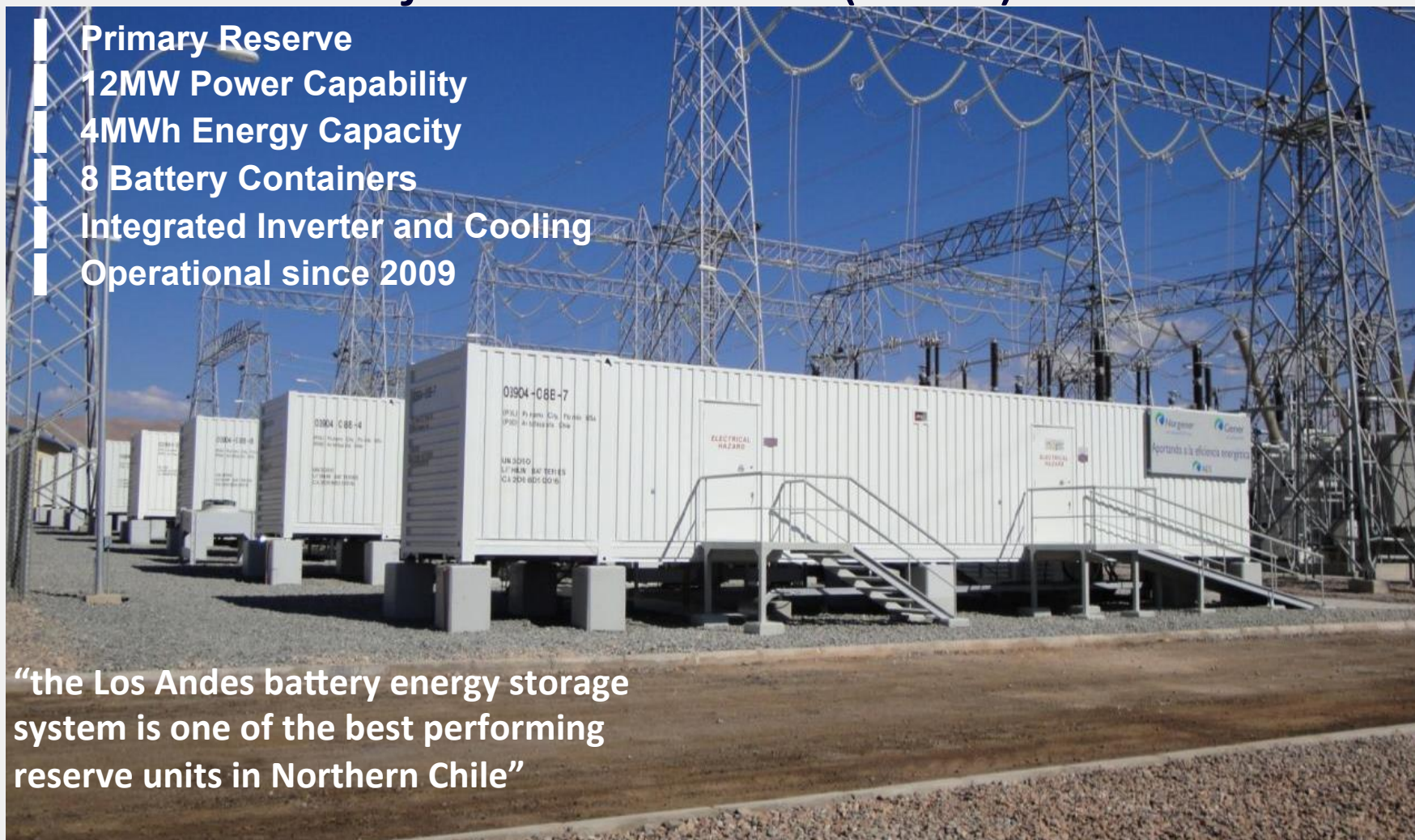
- **Primary Reserve**
- **12MW Power Capability**
- **4MWh Energy Capacity**
- **8 Battery Containers**
- **Integrated Inverter and Cooling**
- **Operational since 2009**

"the Los Andes battery energy storage system is one of the best performing reserve units in Northern Chile"

Reference Project: Calabria (Italy)

T&D Support Pilot
  Peak Shaving, Power Balancing, Voltage Regulation, Frequency Regulation, Black Start
2 MW Power Capability
2 MWh Energy Capacity

Reference Project: Darlington (UK)

- **T&D Support Pilot**
- **Two LD Racks**
- **One 100kW/kVA inverter with integral isolation transformer**
- **One AEROS™ Control Rack**
- **Installed inside a custom container with integral cooling at the High Northgate substation**
- **Commissioned Dec 2013**

Claudio Palmieri

Chief Executive Officer (CEO)

ENERGY CONSULTANTS DMCC

P.O. Box. 340505
Dubai - UAE

info@cls-energy.com
www.cls-energy.com