Energy Storage Program Overview

State Energy Advisory Board to EERE (STEAB) Mtg

April 8, 2008

Georgianne H. Peek, PE
Sandia National Laboratories
505-844-9855,
ghpeek@sandia.gov
www.sandia.gov/ess

Sandia is a multiprogram laboratory operated by Sandia Corporation, a Lockheed Martin Company, for the United States Department of Energy's National Nuclear Security Administration under contract DE AC04-94AL85000.

Sandia National Laboratories

DOE Energy Storage Program

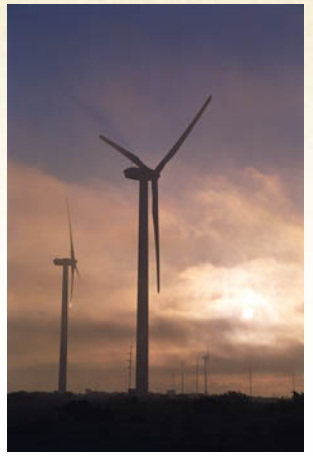
Mission:

Develop advanced electricity storage and PE technologies, in partnership with industry, for modernizing and expanding the electric supply. This will improve the quality, reliability, flexibility and cost effectiveness of the existing system.

Program is led by Sandia National Laboratories

Sandia National Laboratories

What is Energy Storage?



Energy Storage Mediates Between

Variable Sources and Variable Loads

Without storage, energy generation must equal energy consumption

Sandia National Laboratories

Why Electricity Storage ?

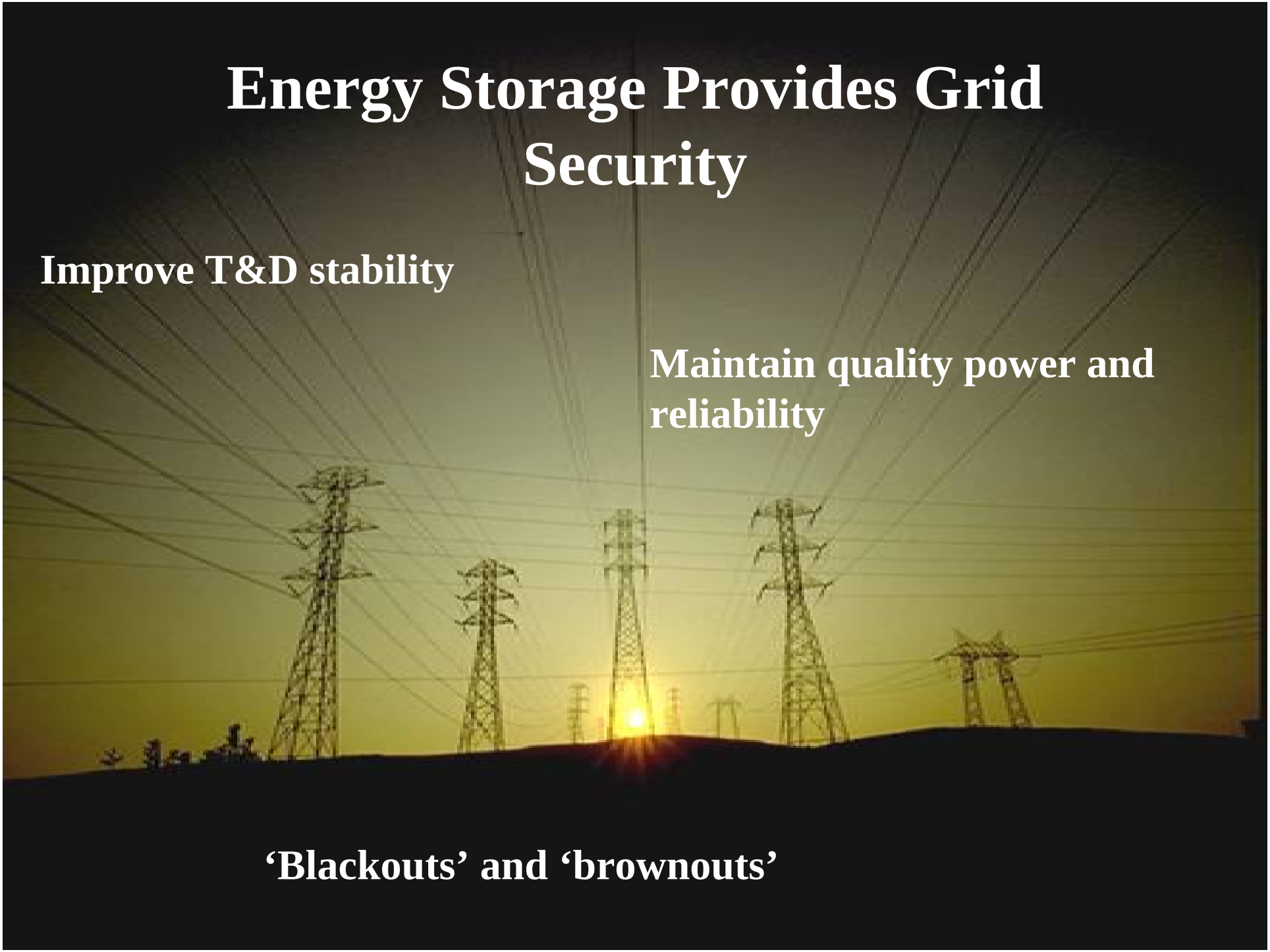
"Power systems have become so **complex** that they exceed man's ability to react to them. They must be designed to give people **adequate time** to manage failure."

- Bruce Nussbaum

Business Week, September 8, 2003

Sandia National Laboratories

Energy Storage Provides Grid Security

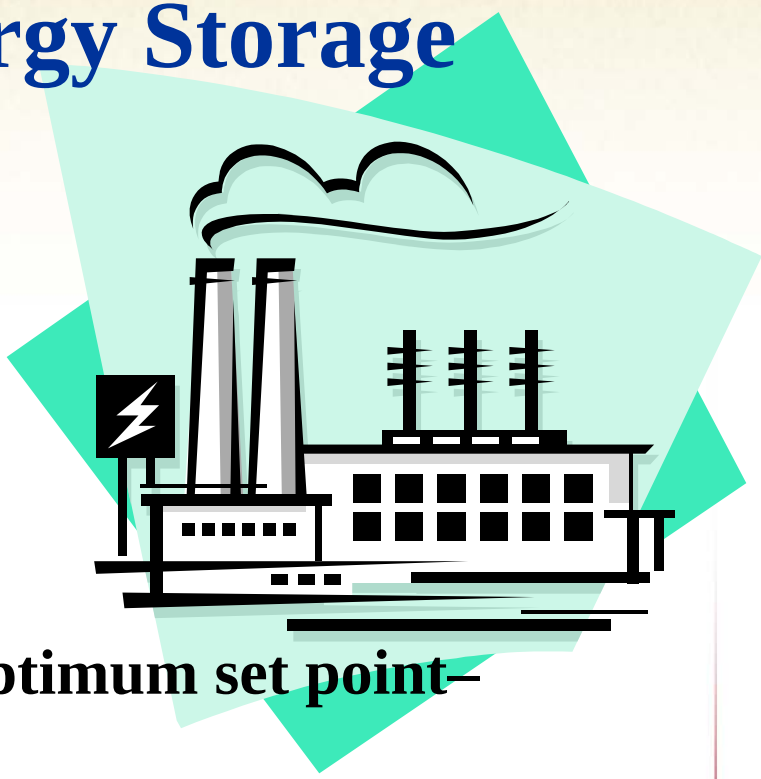


Improve T&D stability

Maintain quality power and reliability

‘Blackouts’ and ‘brownouts’

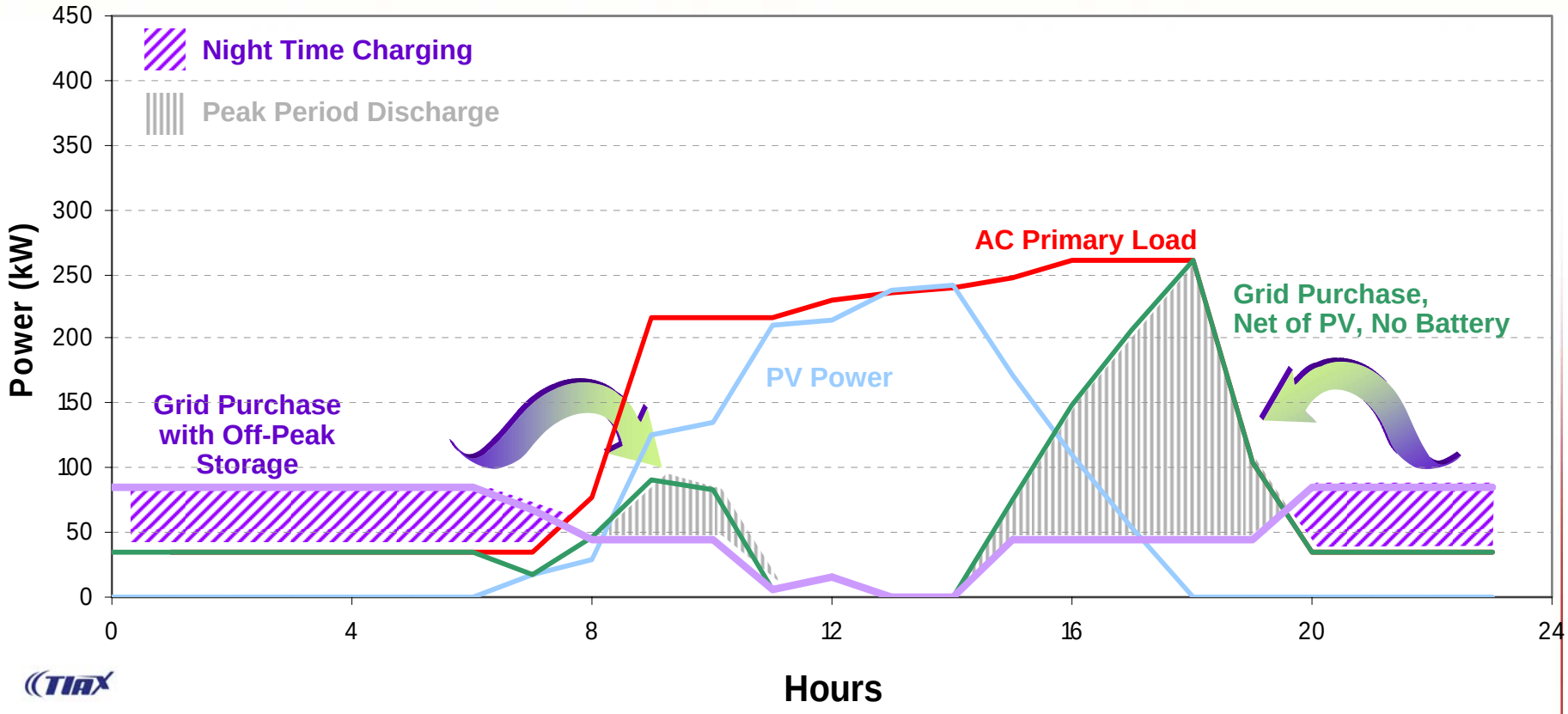
Fossil Fuels and Energy Storage



- **Enhance asset utilization**
- **Defer upgrades**
- **Operate Fossil fuel generators at optimum set point– reduce emmissions**

Sandia National Laboratories

Customer Services



TIAX

Sandia National Laboratories

Energy Storage and Renewable Resources

- **Enhance reliability and power quality**
- **Reduce emissions**
- **Increase the value of Renewables and Distributed Generation**

Enabling Technologies

Energy Storage Systems Program Goals

- Develop and evaluate integrated energy storage systems
- Develop batteries, SMES, flywheels, super capacitors and other advanced energy storage devices
- Improve multi-use power electronics, controls, and communications components
- Analyze and compare technologies and application requirements
- Encourage program participation by industry, academia, research organizations and regulatory agencies

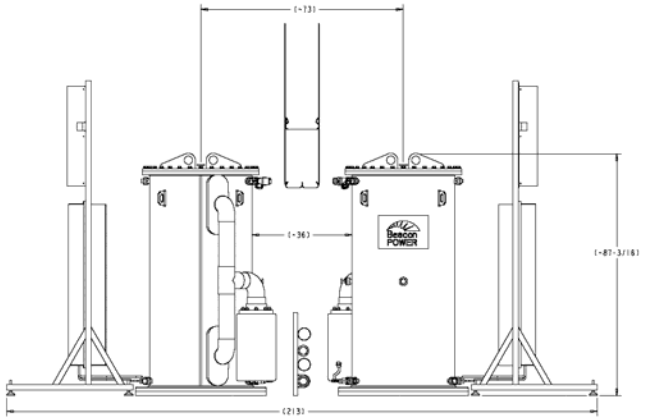
In short, develop a broad portfolio of demonstrated storage technologies for a wide spectrum of applications.

Sandia National Laboratories

ESS Program Projects

Sandia National Laboratories

20 MW FESS Plant



CEC/DOE Energy Storage PROJECTS

450 kW Ultra-Capacitors to provide Wind Smoothing and Backup Power for the Palmdale, CA Water Treatment Plant 1.25 MW Microgrid (Maxwell)

100 kW / 25 kWh Flywheel for Grid Frequency Regulation (Beacon Power)

Sandia National Laboratories

NYSERDA/DOE PROJECT

1MW NaS Battery by NGK to Store Off Peak Power for Running 1,800HP Natural Gas Compressors in a Long Island NG Refueling Station for 220 Busses

- **Relieves LIPA Peak Load,**
- **Eliminates Night Shift at Plant**

Costshare from NYISO, TVA, EPRI, Southern, First Energy, Con Ed, PSE&G, APPA, LIPA, CEATI (Canada), San Diego

Sandia National Laboratories

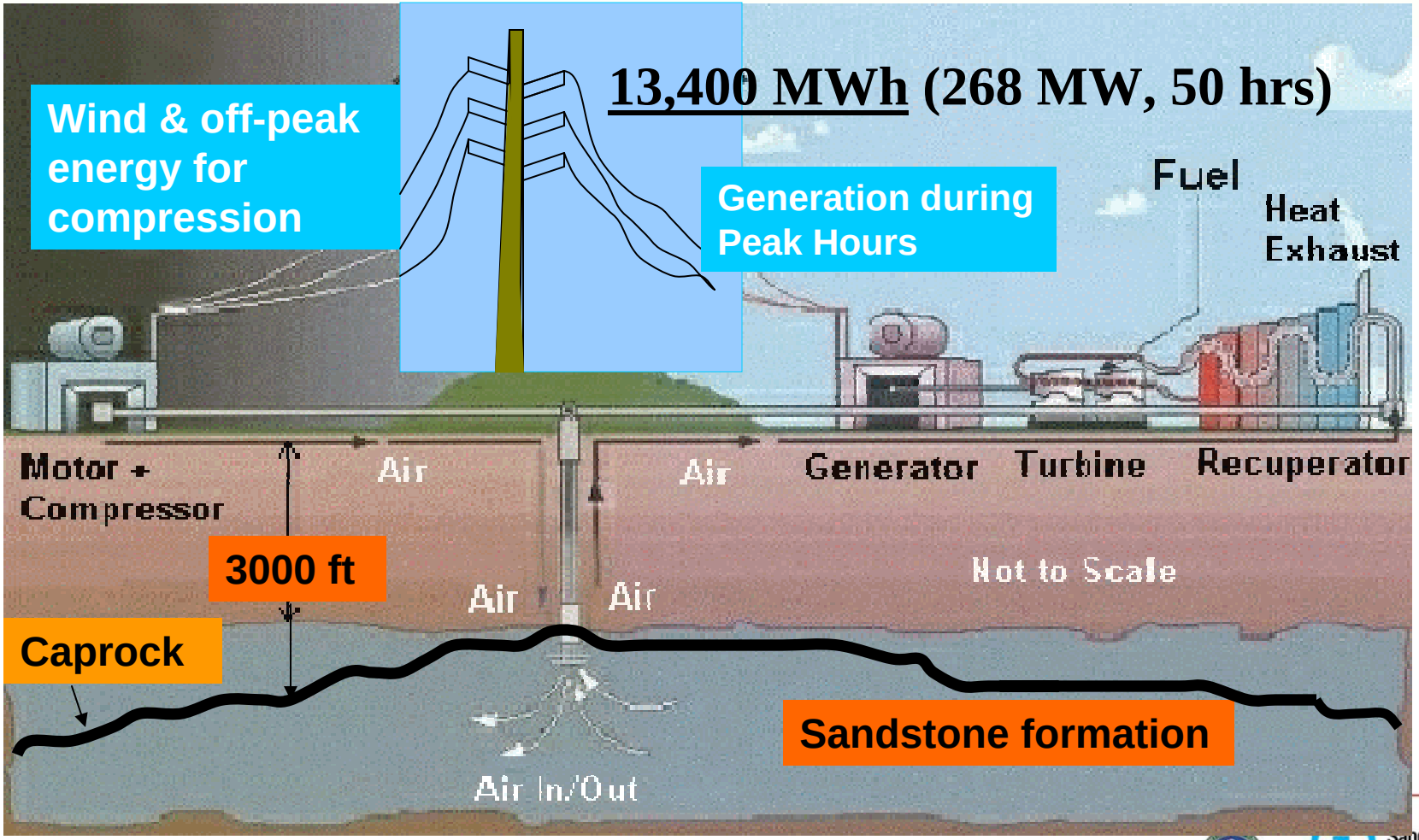
Rail Application - *High-Speed Flywheel Demonstration*

2.5 MW/30sec FESS

NYPA/LIRR

Sandia National Laboratories

THE IOWA STORED ENERGY PARK



Sandia National Laboratories

Power Electronics

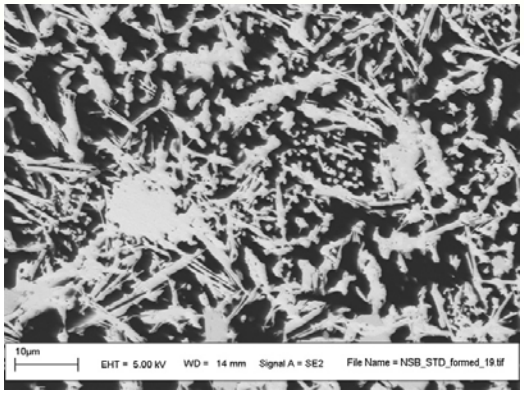
- **Power Electronic System is 25-60% of system cost**
- **Power Electronic Systems do not have the desired reliability**
- **Power Conversion from storage to/from desired output contributes significantly to system size, complexity and design tradeoffs**

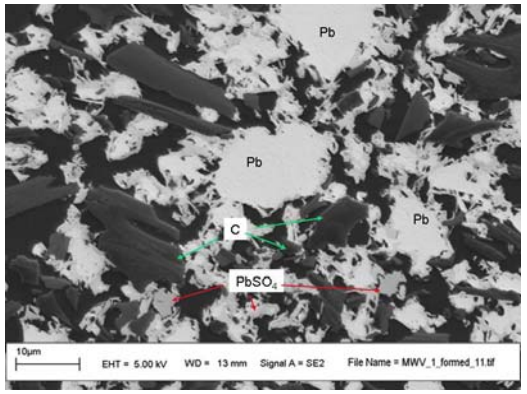
Emitter Turn-Off Thyristor

Sandia National Laboratories

Development of Lead/Carbon Devices

- MeadWestvaco is developing several new classes of carbon material for energy storage
- Collaboration with Wisconsin Public Service Co. to evaluate utility markets
- Collaboration with Northstar Batteries to build lead carbon batteries
- Evaluation of batteries for hybrid vehicles, motive power, and frequency regulation by Sandia, MeadWestvaco and ETA Using Both Testing and Specialized Analytical Methods

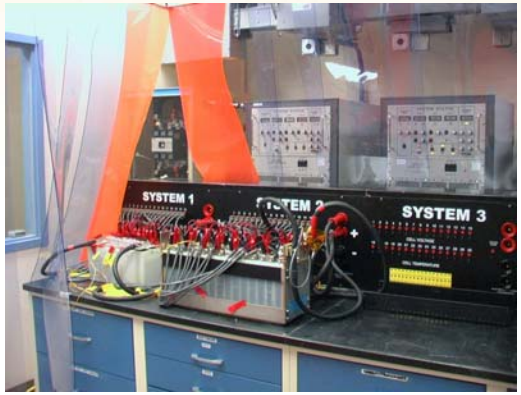




Sandia National Laboratories

Sandia Test Activities

- EC Supercap testing
  - Asymmetric Ni/Carbon Aqueous Electrolyte
  - Symmetric Carbon/Carbon Acetonitrile Electrolyte
  - Symmetric Carbon/Carbon PC Electrolyte
- Battery Testing
  - VRLA (NorthStar, Enersys)
  - NiMH (EEI - Bipolar)
  - Li-Ion (Saft)
- Abuse Testing
  - Symmetric Carbon/Carbon Acetonitrile Electrolyte



Sandia National Laboratories

Distributed Energy Technology Laboratory (DETL)

- **fully instrumented, configurable, controlled, utility-interconnected test bed**
- **interactions of multiple, distributed sources of various technologies**

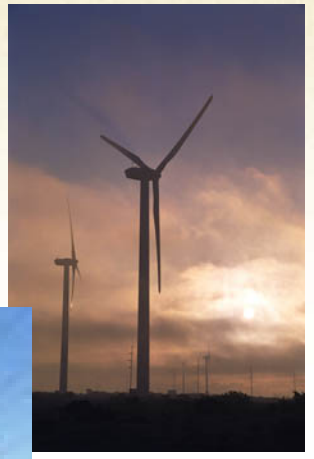
Sandia National Laboratories

Support to EERE - Renewable Systems Interconnection (RSI)

- **Understanding the synergies between PV and Electrical Energy Storage**
- **Benefits that storage can provide PV financial, operational, emissions, security**
- **Define electrical energy storage applicatio for residential and small commercial distributed PV ≤100 kW**
- **Performance specifications**

Sandia National Laboratories

Why Electricity Storage?



Electrical Energy Storage Enables

- **Better system-wide asset utilization**
- **Enhanced reliability / power quality**
- **Reduced emissions**
- **Increases value of Renewables and DER**

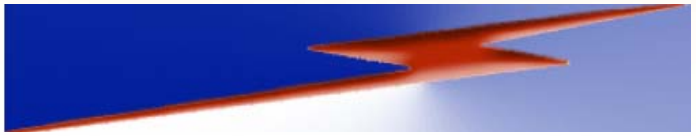
"The ability to store electricity on a large scale would have a profound strategic liberating effect on the utility industry."

- Robert Schainker, EPRI, 2002

Sandia National Laboratories

Electrical Energy Storage Resources

DOE/Sandia Energy Storage Program



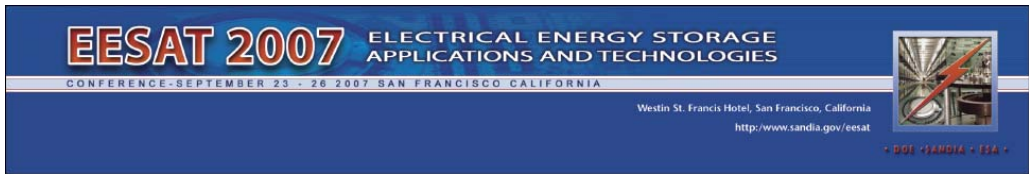
- http://www.sandia.gov/ess/

Electricity Storage Association

ESA
ELECTRICITY STORAGE ASSOCIATION

- http://www.electricitystorage.org/

EESAT Conferences



- http://www.sandia.gov/eesat

Sandia National Laboratories

Electrical Energy Storage

Questions?

Thank You...

Sandia National Laboratories