CAES IN ERCOT

AUGUST 24, 2010

Bulk Storage for System Support

Participating Organizations

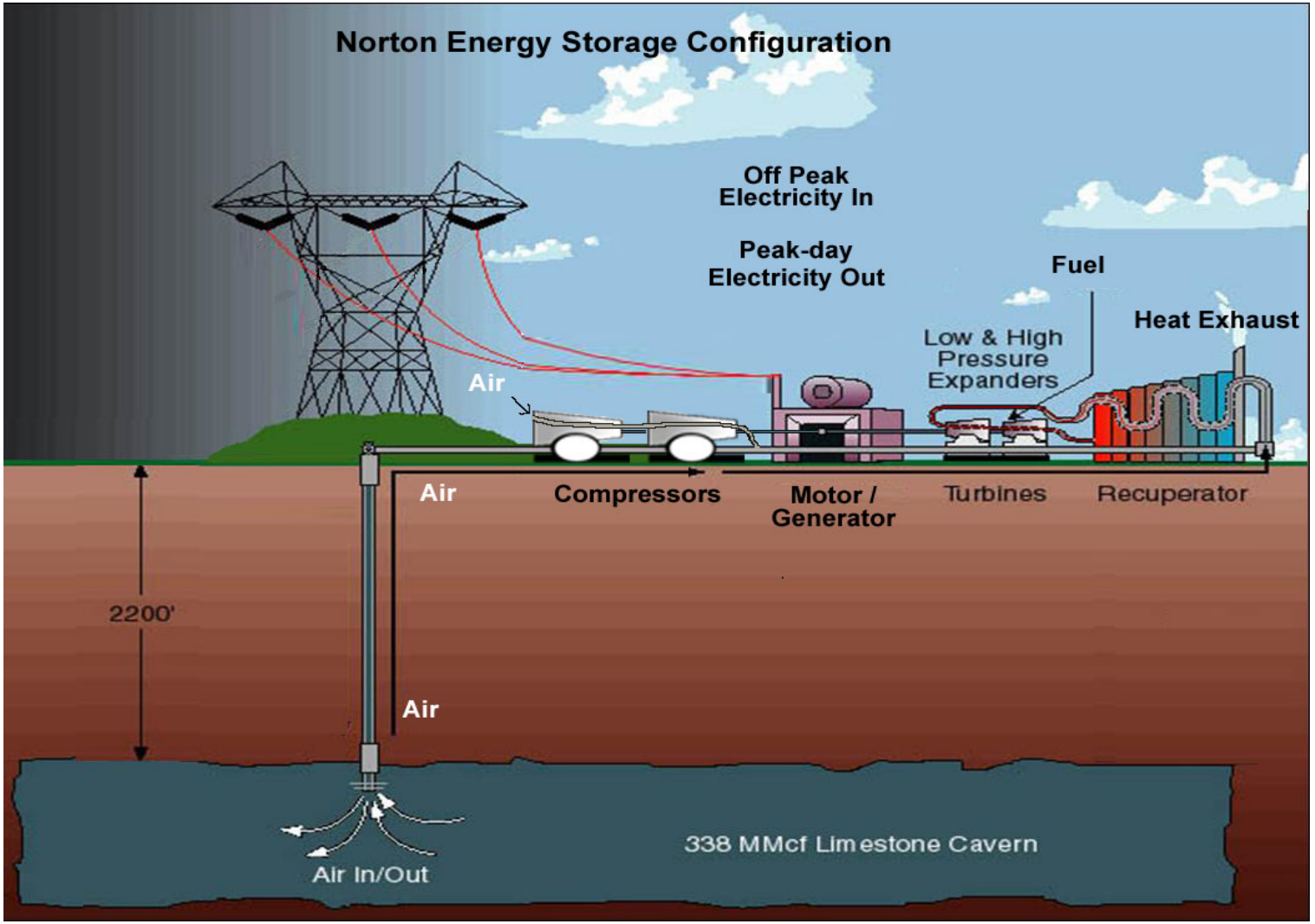
- **Haddington Ventures**
  - Pioneered the development of multiple high deliverability natural gas storage projects (1990 – 2008)
  - An experienced capital provider through its affiliated energy funds, active in early stage energy infrastructure
  - Investment experience in emerging CAES/energy storage
- **Dresser-Rand Corporation**
  - Proven energy storage equipment manufacturer
  - Three major upstate N.Y. manufacturing facilities, 2,400 N.Y. based employees and significant opportunity for new manufacturing and jobs growth in upstate New York
  - Complete surface equipment provider, including long-term service and process guarantees

Haddington Ventures: Equity Provider for Storage

- Private Equity Fund Manager
  - $330 mm under management in Haddington Energy Partners (HEP) I, II, and III
  - Specialize in mid stream energy infrastructure development – pipelines, gathering, processing, storage, and specialized refining and power – across all hydrocarbons.
- Haddington principals have had extensive prior subsurface project development successes
  - Moss Bluff Gas Storage (TPC)
  - Egan Gas Storage (TPC)
  - Lodi Gas Storage (HEP)
  - Bobcat Gas Storage (HEP)
- Power Storage Developments
  - Magnum Energy Storage
  - Norton Energy Storage
  - Texas CAES

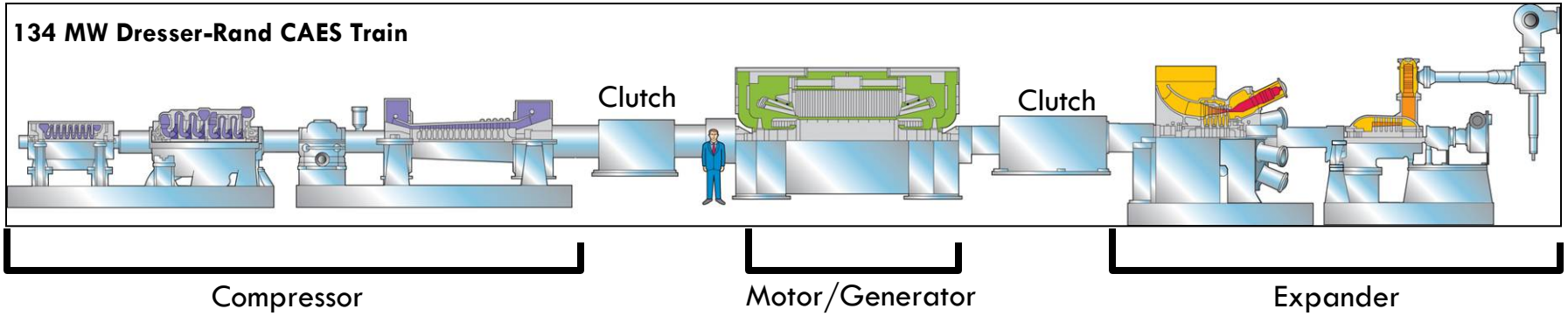
What is CAES?

SmartCAES System



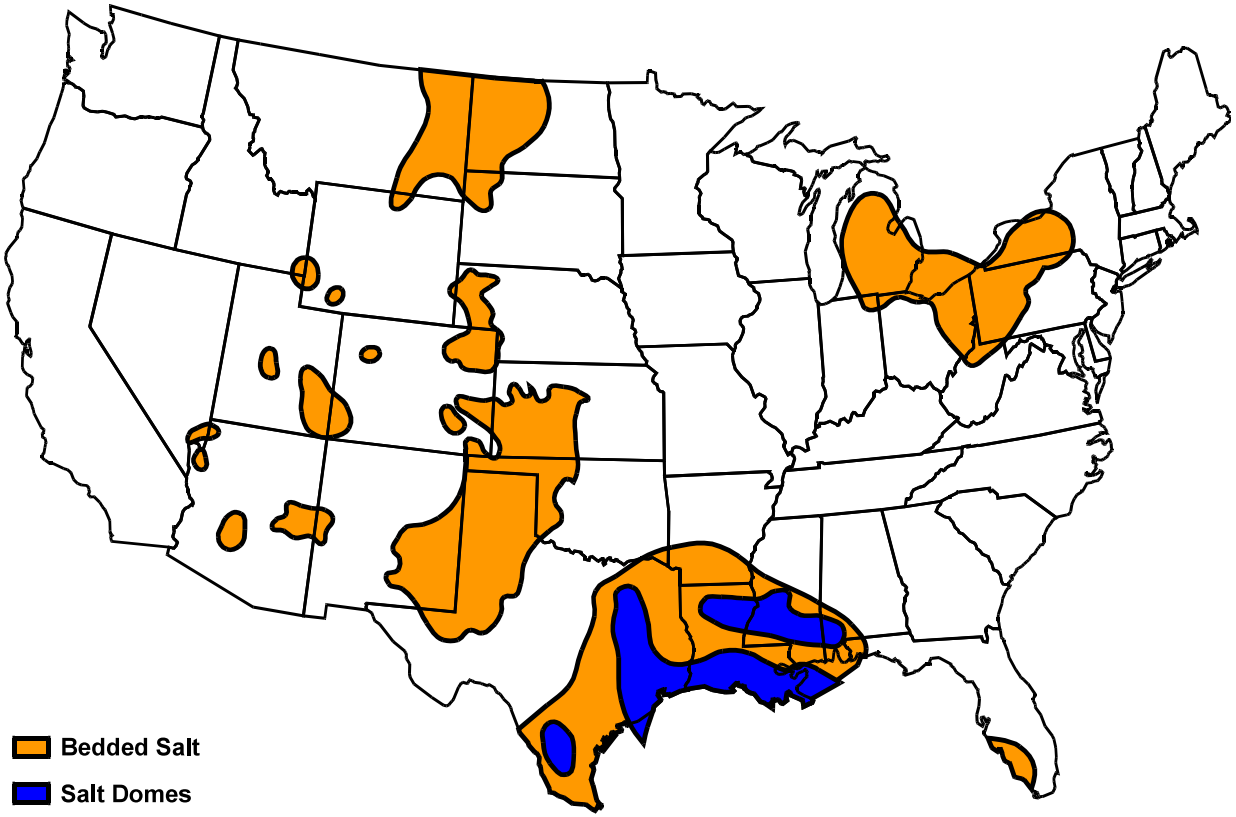
SmartCAES Project Approach

- Provide all major equipment for power island and compressors through a single vendor (Dresser-Rand) with a single point of responsibility
- Same arrangement and equipment as McIntosh CAES plant
- Economy of shared motor-generator
- Positive locking devices (clutches) provide synchronous condensing option



Generation Value Chain: US Potential for Air Storage in Salt Formations

- CAES systems rely on suitable underground formations
- Salt formations are the favored medium
  - straight-forward to mine or develop
  - seal well and are self healing
  - provide good open flow for fast recovery
- Texas has the benefit of the bmost prolific wind resource in the country and suitable underground resources for air storage



CAES and Historical Integration

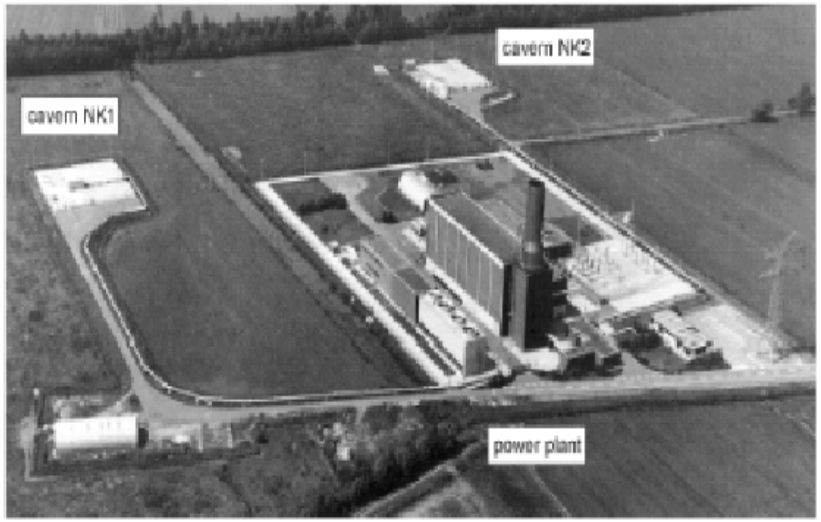
Existing CAES Plants

110 MW McIntosh, Alabama CAES power plant

- Commercial Operation Date: May 31, 1991
- Plant Availability: 95%
- Major Equipment Supplier: Dresser-Rand

290 MW Huntorf, Germany CAES power plant

- Commercial Operation Date: 1978
- Plant Availability: 86%
- Major Equipment Supplier: Alstom

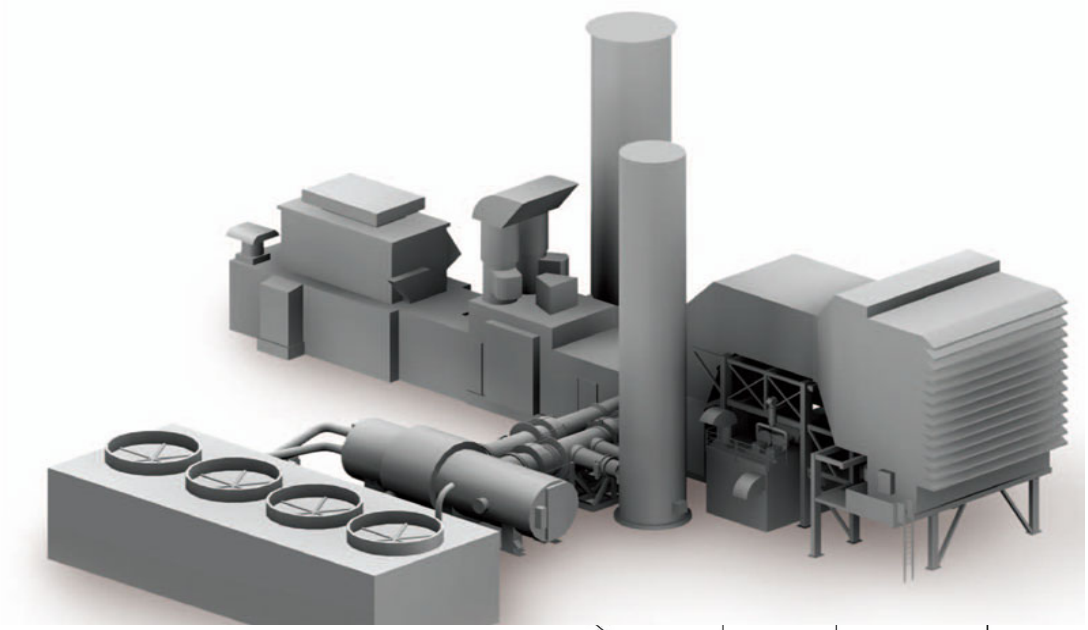


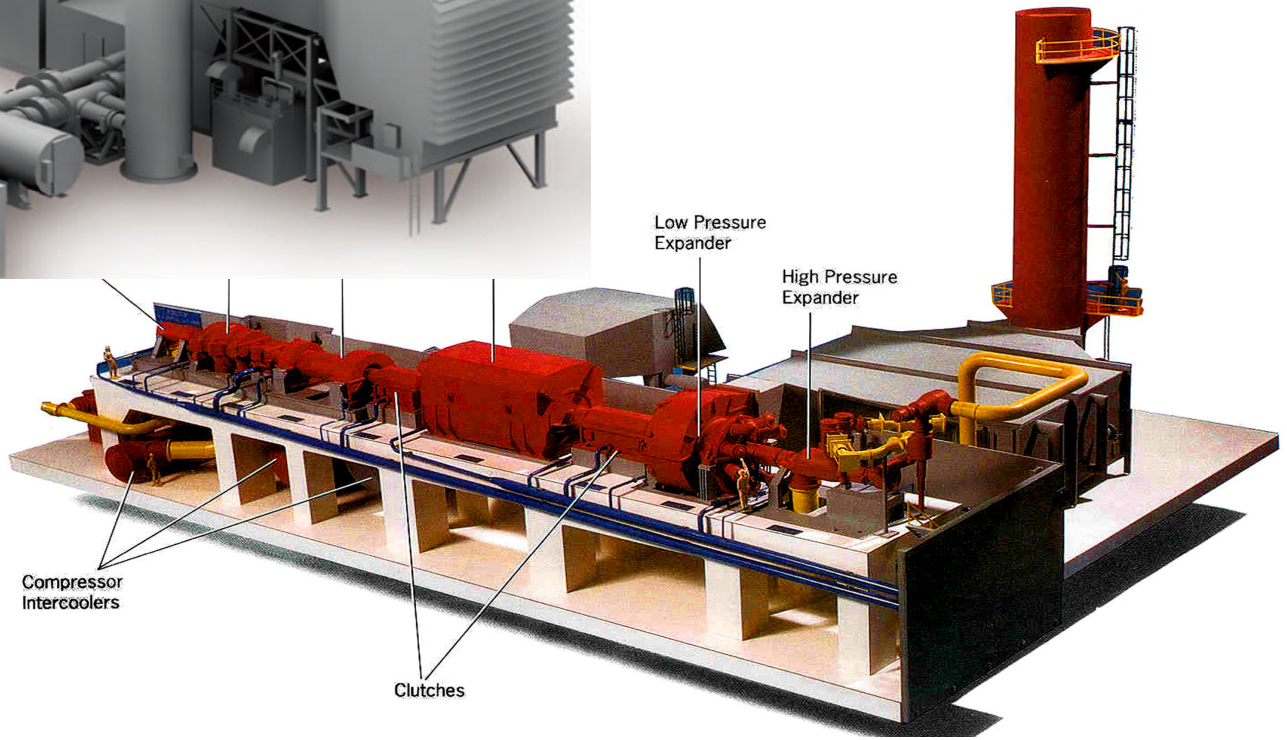
US CAES Asset Owner

- Powersouth is a Generation and Transmission Co-op that developed the McIntosh CAES plant to meet the Co-Op's intermediate load-following needs.
- PowerSouth is registered with SERC Reliability Corporation as a:
  - Balancing Authority (BA)
  - Transmission Owner (TO), Transmission Service Provider (TSP), Transmission Operator (TOP), Transmission Planner (TP)
  - Generator Owner (GO), Generator Operator (GOP), Load-Serving Entity (LSE), Purchasing-Selling Entity (PSE)
  - Resource Planner (RP), Planning Authority (PA) and Interchange Authority (IA).
- The McIntosh plant has been running successfully for 19 years
  - Averaging over 200 generation and 200 compression starts a year
  - Generation reliability at 95% and compression reliability at 99%
  - Average run time is less than 3 hours

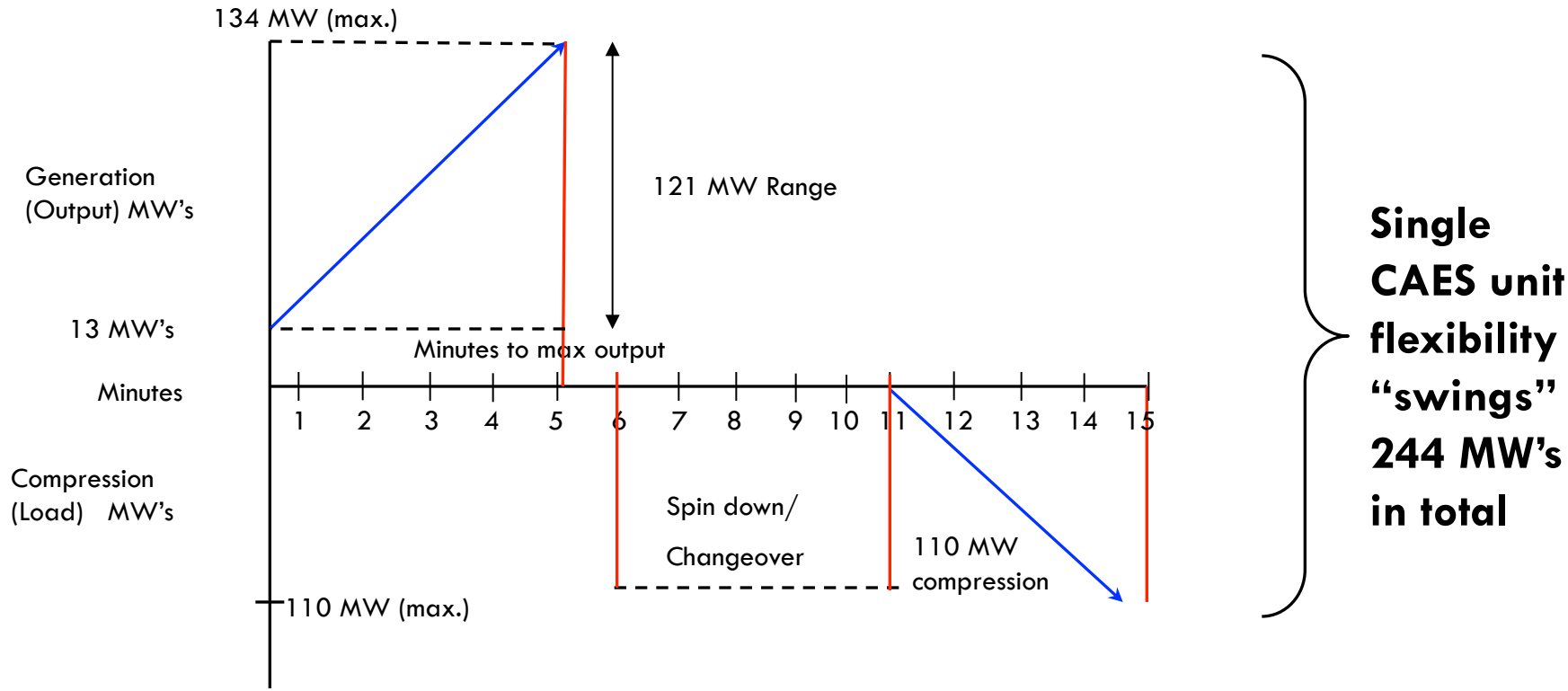
CAES Integrates in ERCOT Like Generation

SmartCAES vs SCGT (Seimens V94.2)



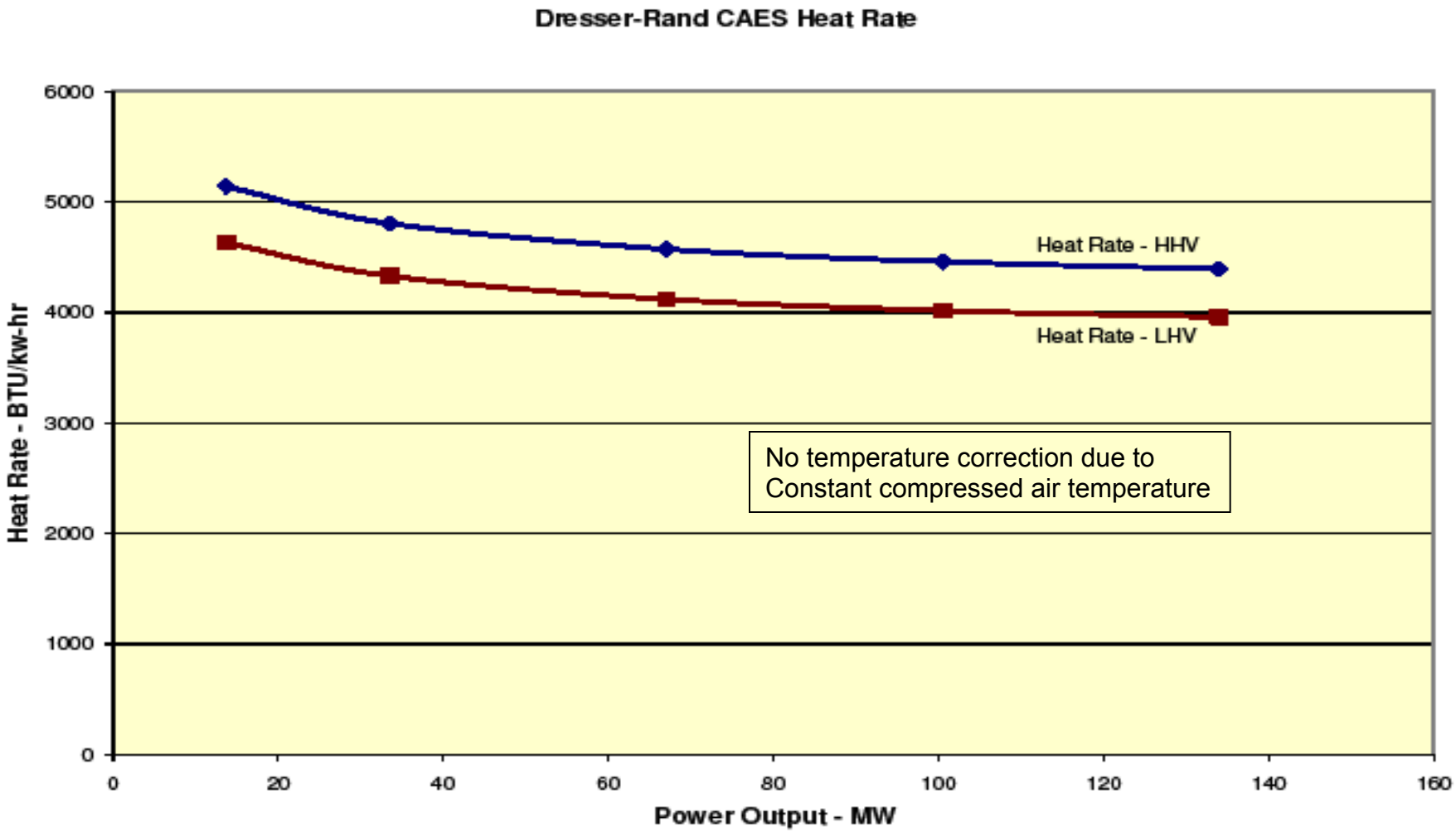


SmartCAES Ancillary Services Flexibility



- **Generation**
  - 13 MW min run
  - 13 to 134 mw's, < 5 min
  - Zero to 134 mw's, <10 min
- **Compression**
  - Zero to 110 mw's <5 min

Operating Parameters – Heat Rate



Regulation Resource Comparison – CAES/GAS/COAL

CAES provides the most Ancillaries per nameplate at a reasonable cost and no stand-by cost

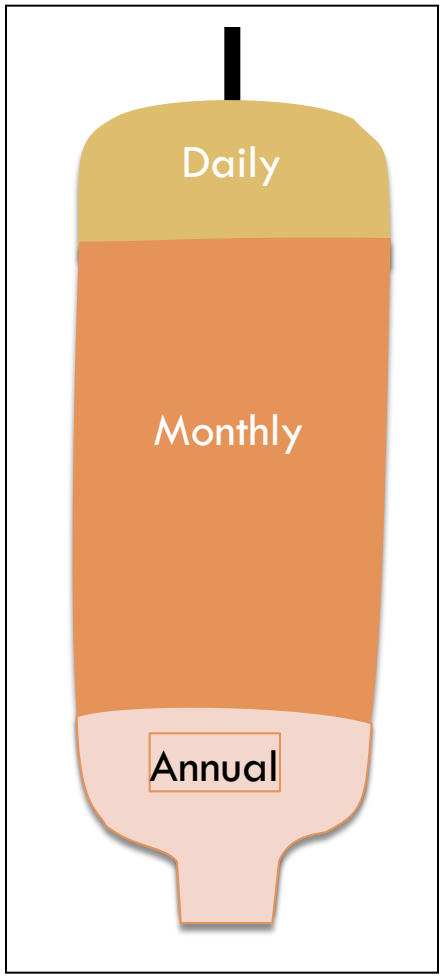
Attribute	CAES	Gas-fired peaker (OCGT)	Combined-cycle gas turbine (CCGT)	Coal-fired (PC)
5-minute ramp rate	100% turbine production + 100% compressor load	100% turbine production	<100% gas turbine production + <10% of steam turbine production	<15% production
Variable cost*	$45/MWh	$79/MWh	$58/MWh	$41/MWh
Cost to stand ready	Zero	High	Medium	Low cost to run/ Medium lost opportunity margin

* Based on $7/MMBtu natural gas, $15/MWh offpeak power, $60/ton eastern coal; O&M at $2/ MWh for CAES/OCGT, $6 for CCGT, and $8 for coal

Source: Dresser-Rand/ Haddington

Seasonal and Diurnal Characteristics

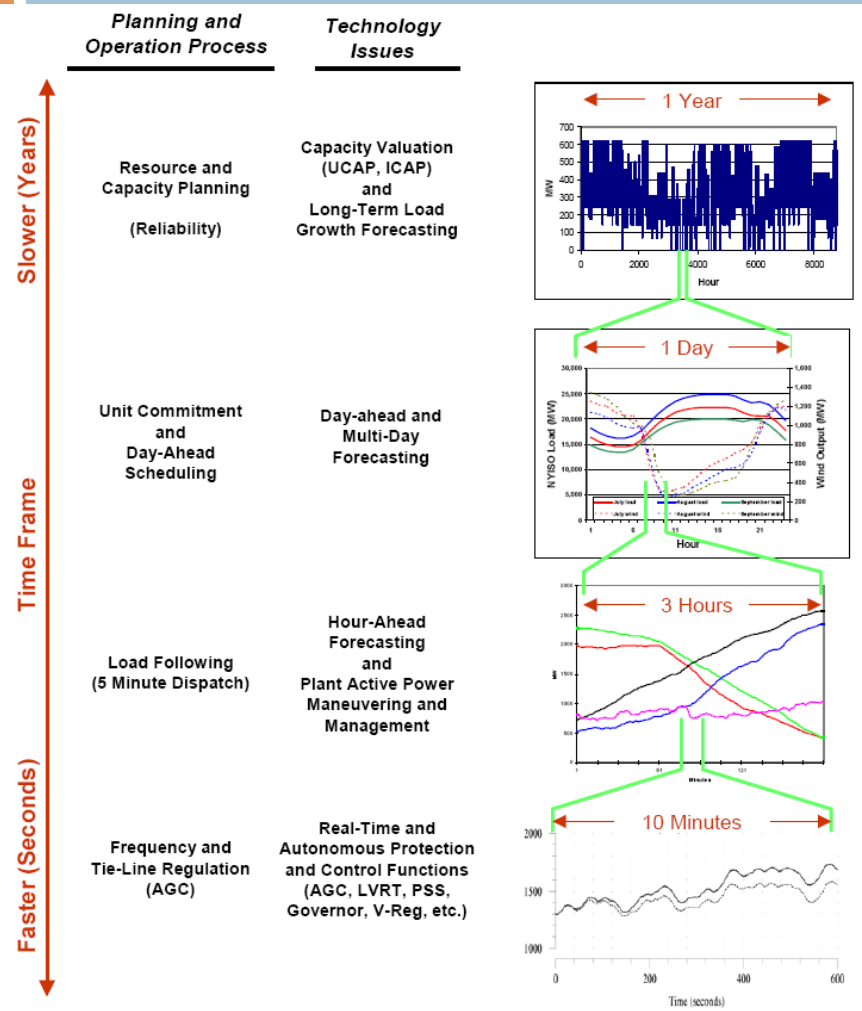
- Seasonal services from salt cavern gas storage
  - 10 BCF facility with "6 turns"
    - 30 days to inject and withdraw
    - Facility is empty in 30 days at full load
  - Customers pay for seasonal, monthly and daily
    - Storage is the RIGHT but NOT THE OBLIGATION to withdraw a commodity
    - **Customers never ask "HOW LONG UNTIL THE FACILITY IS COMPLETELY OUT OF GAS?"**
  - Customer Mix: High, Medium, Low turn
- Application in Air Storage
  - A typical size salt cavern matched with 270 MW of CAES can store 10,000 MWh seasonally at full load or 13,000 Mwh on partial load.
  - More likely: weekly cycle averaging half full
  - Once operators get comfortable with the dispatch of CAES assets in markets with financial products, we expect similar "extrinsic" monetization as gas storage



Typical Gas Storage Inventory Mix

CAES ERCOT Market Participation

CAES Market Participation



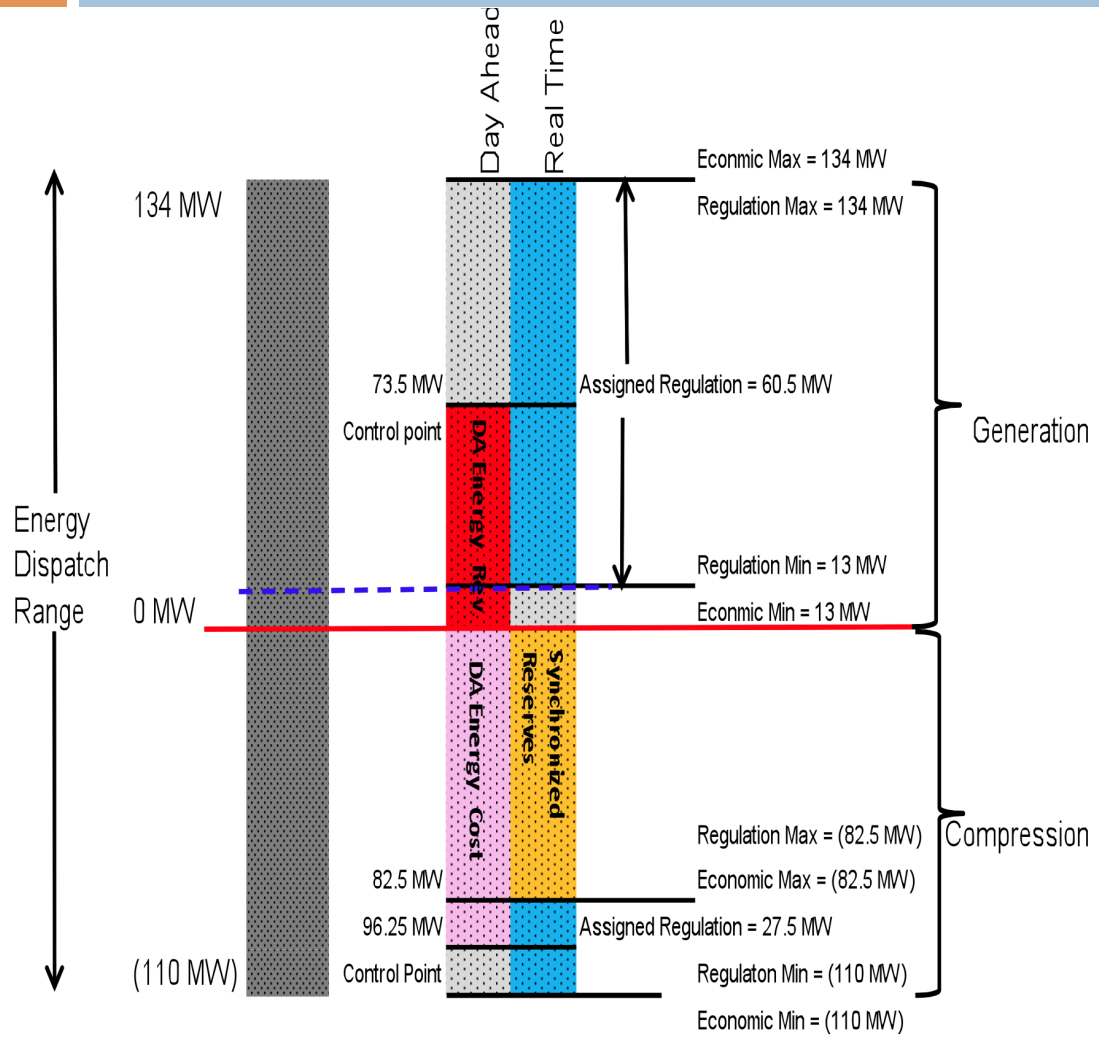
CAES can participate across all products

- Provides a 95%+ available resource for generation
- Available for scheduling day-ahead and real-time
- System flexibility allows dispatch of nearly the entire unit in 5 minutes
- Both AGC on generation/ compression and syncronous condensing allow the use of the asset for system control functions

SmartCaes

Single Unit PJM Dispatch Scenario

Day Ahead & Balancing Markets



Issues to be resolved

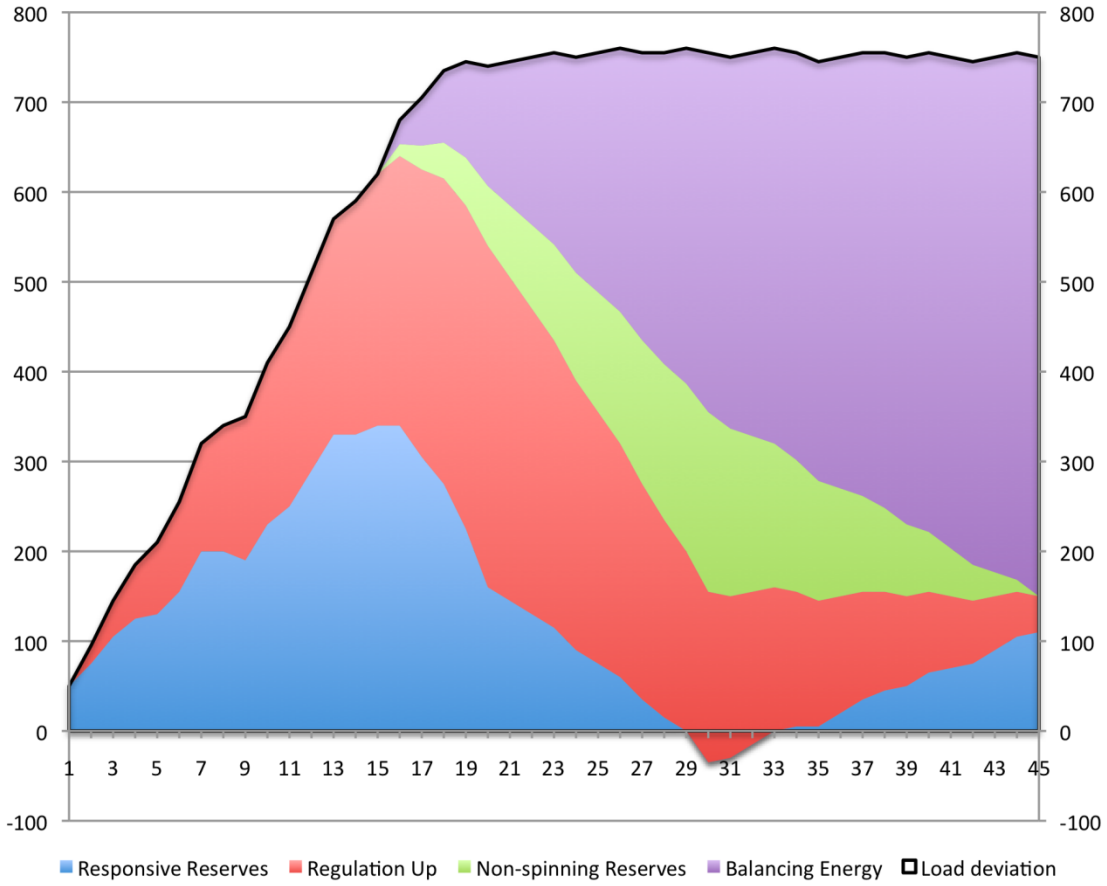
- Economic models assume compressing at the node (PJM and MISO operate this way on PSH)
- The ramp curve on compression is not smooth and there is a one minute "dead-zone" when swinging from full compression to full generation
- Bidding rules need to take into account that some services may have "zero" marginal cost but the economic model for CAES requires payment for those services commensurate with the resource being displaced

Ancillary Services in ERCOT and CAES

- Regulation up/ down 3.17.1
  - Definition on how the Resource must be lowered: increments, speed
  - "Acting as CLR" is troublesome –
  - Dead spot issues
- Responsive reserve 3.17.2
  - Again, as a CLR when a load
- Combinations of Non-spinning,
- Startup offer and Min-energy offer caps 4.4.9.2.3
  - Storage category by device would be helpful
- Energy Offer Curve Caps for Make Whole 4.4.9.3.3
- Mitigated Offer Cap and floor
  - Troubling because of low costs

The Importance of Balancing Energy

- Ancillary Service needs in ERCOT are expected to increase as wind penetration increases
- Below is an example of ERCOT grid stability response showing a 45 minute load deviation



Product	Characteristics
Responsive Reserves	- Respond within 10 minutes - Online - Grid electronically controls unit - Load allowed to supply
Regulation Up/Down	- Respond within 10 minutes - Online - Grid electronically controls unit - Load not allowed to supply
Non-spinning Reserves	- Offline - Respond within 30 minutes - Load allowed to supply
Balancing Energy	- Four 15-minute schedules every hour - Called over 15 minutes prior to start of schedule - Load not allowed to supply
Reliability Must-Run	- Special contracts with generator - Voltage or congestion issue - Non-market solution

Project Funding Complications

- Project development
  - Permitting process for an energy storage project is long and capital intensive
  - Identification and acquisition of suitable project sites is expensive and time consuming
  - Some storage equipment suppliers have been reluctant to provide guarantees
- Development of energy markets
  - Liquid merchant markets have only recently developed for hourly energy and ancillary services
  - Storage has yet to be classified as either a transmission or generation asset.
  - Customer understanding of temporal shifting value of storage is just starting
- Project financing
  - Funding requires lenders competent in both power projects and newer technologies
  - Energy technology and new project funding have always been muddled
  - Current lending market has restricted capital for all types of energy projects

CAES in The Future

Haddington views Texas as an attractive market to develop SmartCAES assets.

We would be interested in working on a toll or development partnership in ERCOT.

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