

THE IOWA
STORED
ENERGY
PARK



CAPTURING
THE POWER
OF NATURE



Iowa Stored Energy Park (ISEP)

**Platts
Energy Storage Conference**

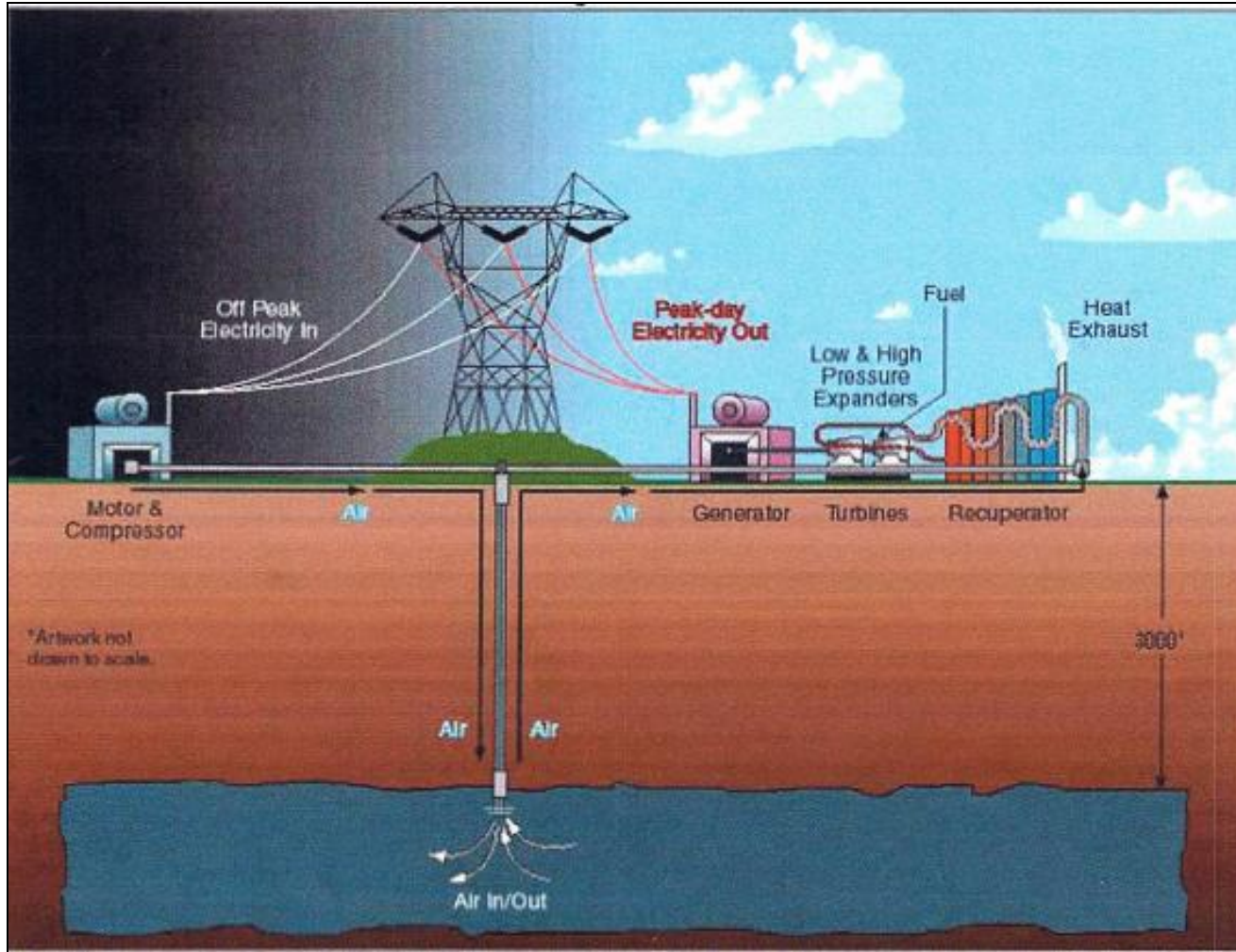
Houston, TX

February 23, 2011

About ISEP

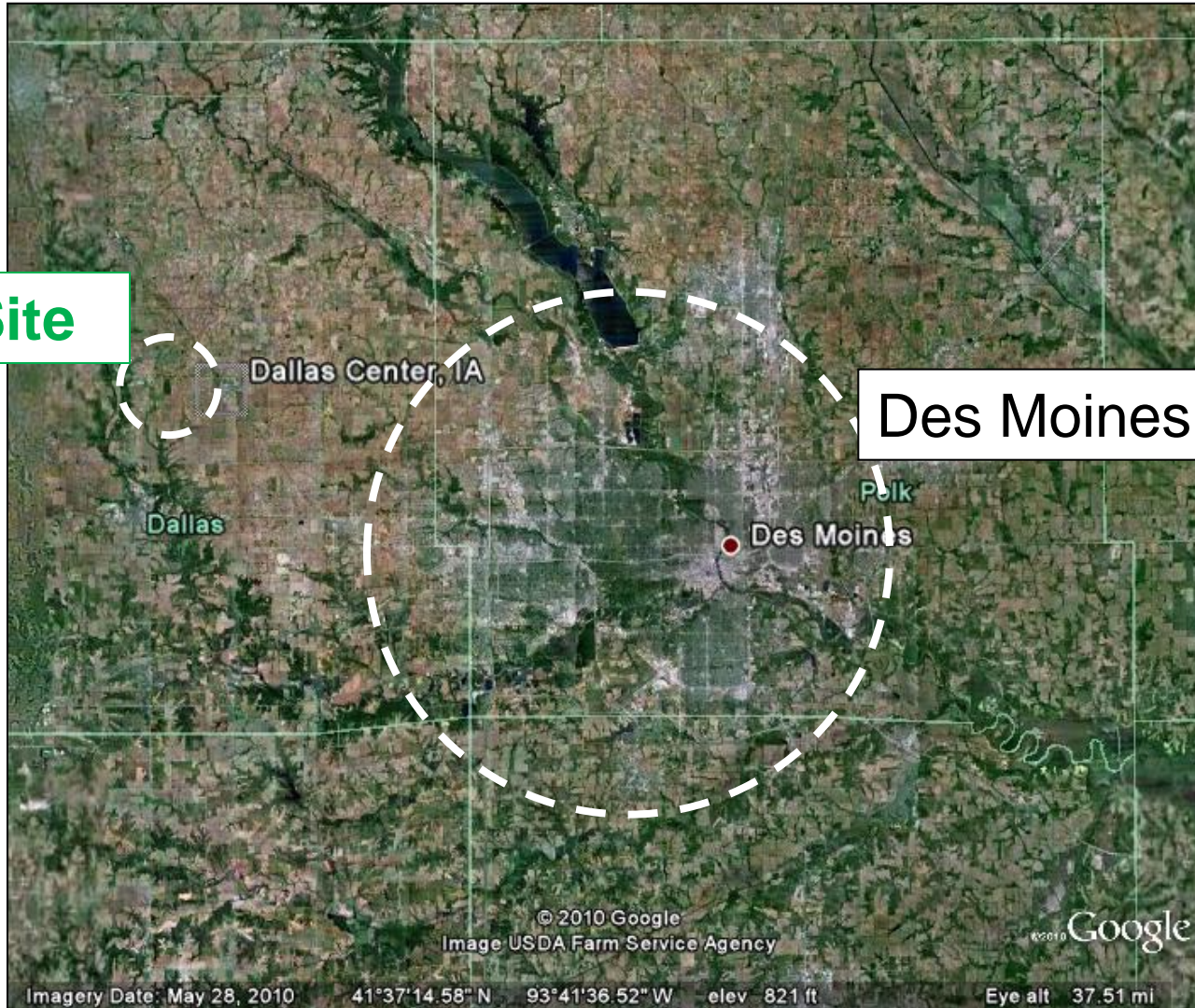
- Proposed 270 Megawatt (MW) compressed air energy storage (CAES) project, 2015 in-service.
- Capital cost: ~\$400 million
- Site: Dallas Center, Iowa
- In daily operation, generation will look like an intermediate-duty, combined-cycle unit.
 - But heat rate only ~4400 Btu/kWh*
- **Unique: Fully-dispatchable electric load**
 - Compress (220 MW): up to 12 to 16 hours, weeknights and weekends.
 - Generate (270 MW): up to 12 to 16 hours per day on weekdays.

CAES Conceptual Layout



Project Site

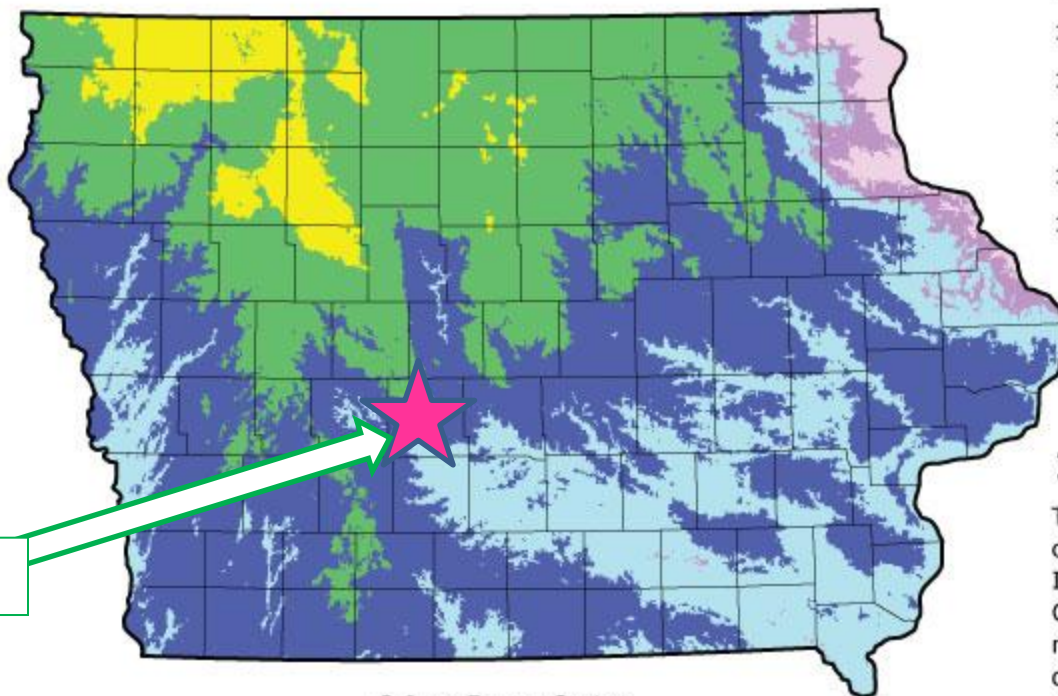
ISEP Site



Wind Energy Country

Estimated Average Annual Wind Speeds

Typical average wind speeds on well exposed sites at 50m above ground



ISEP Site

© Iowa Energy Center

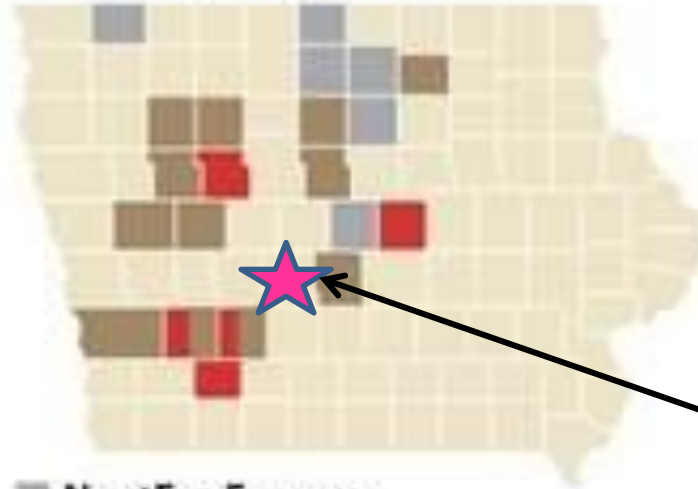
MPH	m/s
> 19.0	> 8.5
17.9 - 19.0	8.0 - 8.5
16.8 - 17.9	7.5 - 8.0
15.7 - 16.8	7.0 - 7.5
14.5 - 15.7	6.5 - 7.0
13.4 - 14.5	6.0 - 6.5
12.3 - 13.4	5.5 - 6.0
< 12.3	< 5.5

Iowa Energy Center

This map was generated from data collected by the Iowa Wind Energy Institute under Iowa Energy Center Grant No. 93-04-02. The map was created using a model developed by Brower & Company, Andover, MA.

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Wind projects in Iowa



■ **NextEra Energy**

Cerro Gordo, Franklin, Hancock, Osceola, Story and Winnebago

■ **Existing MidAmerican projects**

Adair, Buena Vista, Carroll, Cass, Crawford, Floyd, Sac, Hamilton, Pocahontas, Polk (at the fairgrounds), Pottawattamie and Wright

■ **New MidAmerican projects**

Adair, Adams, Calhoun, Cass and Marshall

Sources: MidAmerican Energy and NextEra Energy

THE REGISTER

Iowa Stored Energy
Park (ISEP) Site

Map source: The Des Moines Register, 12/19/10. (ISEP site added.)

Geology: Tapping the Mt. Simon Sandstone

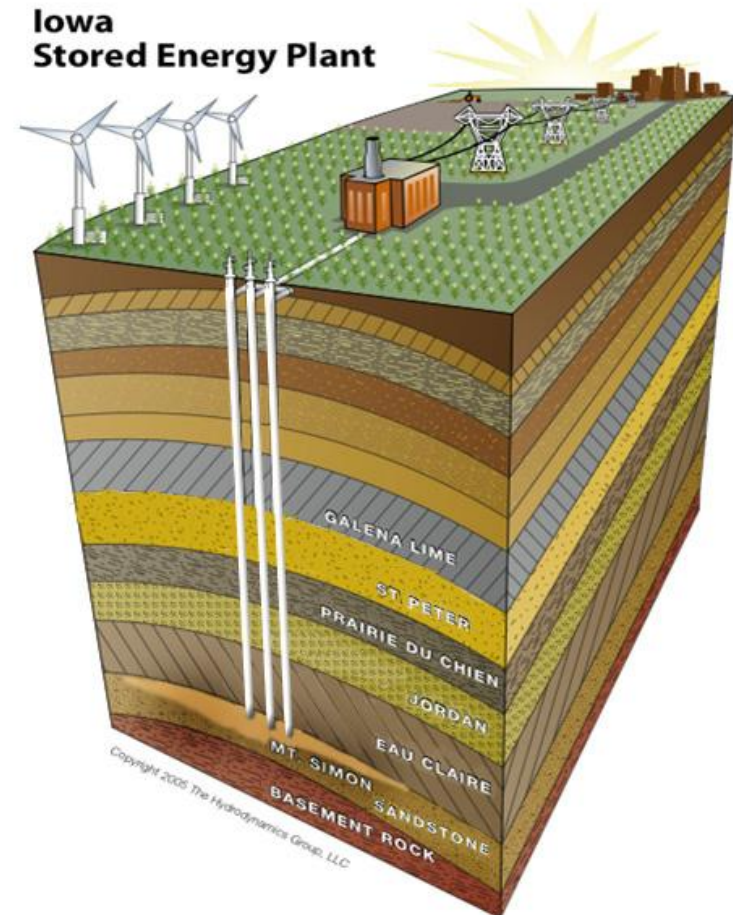
Completed Work Activities

- Dallas Center Site Selected
- Geophysical Surveying
- Drilled & Cored Three Test Wells
- Economic Analysis Phase I

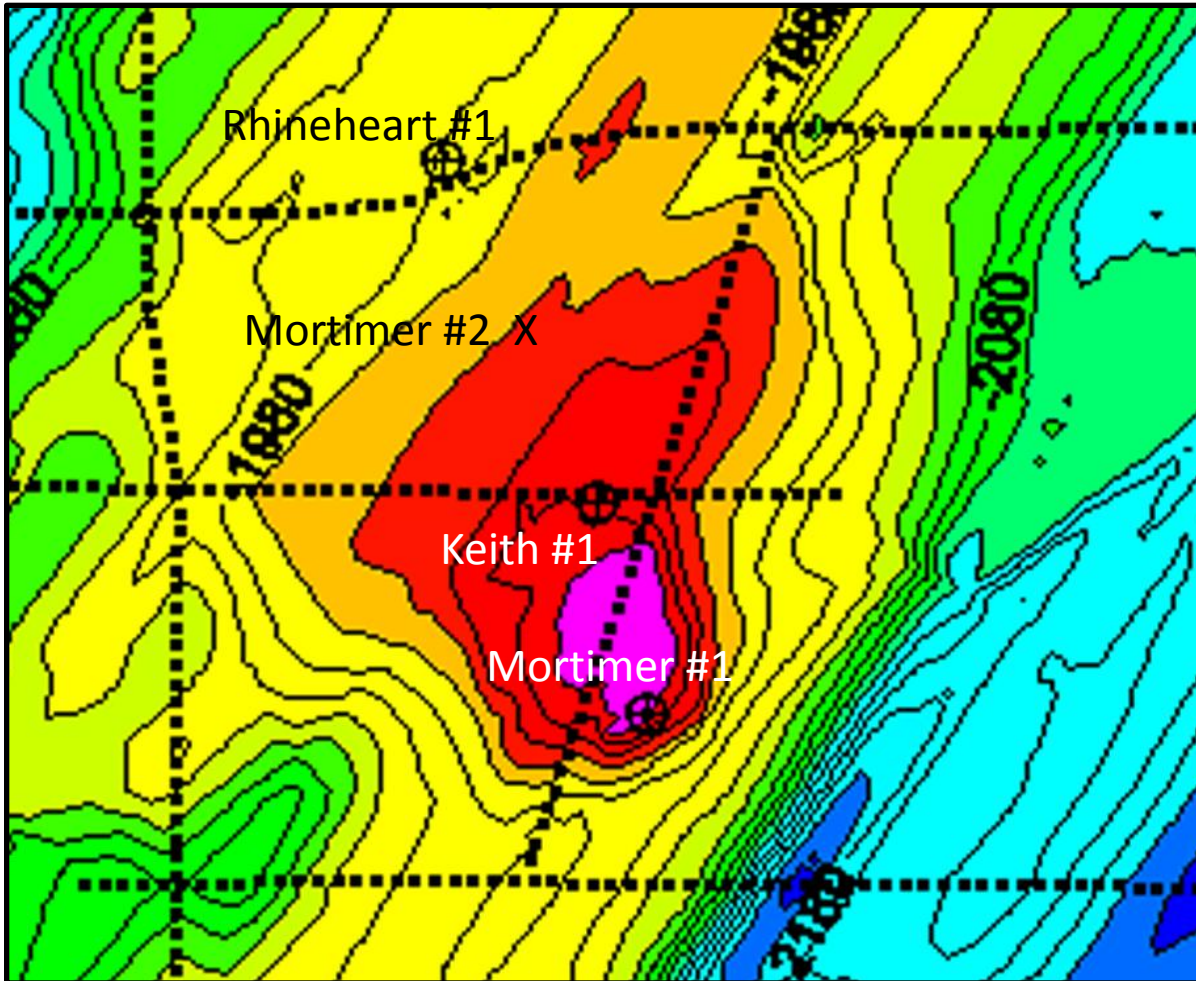
Current Work Activities

- Economic Analysis Phase II
- Complete Laboratory Core Analysis
- Perform CAES Reservoir Simulation Analysis
- Perform Geology Peer Review

**GO/NO-GO DECISION
FOR AIR INJECTION TESTING
Spring/Summer 2011**



A Unique Underground Structure



- Not a cavern.
- Porous sandstone structure
 - ~ 1 square mile x 100 feet thick.
- 3000 feet underground.
- Originally discovered by Northern Natural Gas in the 1960s as a potential natural gas storage site.
- Northern stores natural gas in a similar structure 10 miles away.

Cost & Economics Studies Phase I

- Primary contractor: RW Beck
- Funded by DOE Energy Storage Program
- Study timeframe: July to December 2010
- Elements:
 - Capital and O&M cost estimates for CAES and alternatives.
 - “Merchant” view of benefits and costs
 - MISO market price forecasts for various scenarios
 - Intrinsic and extrinsic (option) values.
 - 20-year planning period (2015 to 2034).
 - Compression energy from available MISO market resources. (Not wind alone)
 - Off-peak to on-peak price arbitrage.
 - Ancillary services revenues for spin and non-spin.

Phase I Results

- **Conclusions:**

- In normal operation, ISEP will look like an intermediate generating unit (generating on weekdays); not a peaking unit.
- ISEP's 220 MW compression cycle did not challenge the assumed storage capacity of the reservoir (100 million pounds).
- ISEP can pay for itself in the MISO marketplace (i.e., benefits exceed costs).
- ISEP costs are competitive with a conventional, combined-cycle alternative.
- Extrinsic value was a significant portion of the benefits.
- For investor-owned utilities, investment tax credit (ITC) proposed in Congress for bulk storage represents material benefit.

*Storage 2010 Act, sponsored by Senators Bingaman, Wyden and Shaheen.

Phase I:

What it Did Not Include

- Potential benefits of better coordination of storage with wind resources.
 - Benefits to the wind owner of using storage
 - Time-shifting wind output from off-peak to on-peak
 - Giving bulk storage credit toward state or federal Renewable Energy Standard (RES) requirements.
- Ancillary services revenue for providing regulation.
 - Using fast-ramping storage to directly offset cycling wear and tear on conventional plants.
- Potential transmission benefits.
- Benefits of storage operating as an integrated part of a specific utility's resource mix.

Economics Study Phase II: Issues

- The dispatch-ability of bulk storage and the intermittency of wind are a natural match.
 - ISEP will have very fast start-up and ramping cycling capabilities.
 - In both compression and generation modes.
 - But, there are currently few/no pricing (tariff) mechanisms to marry storage capabilities and intermittent wind.
 - To-date, intermittent wind resources have not been penalized for the variability they represent.
 - So the storage solution has no revenue stream for the benefit it offers.
- Benefit of off-peak storage charging load (valley filling) accrues to the generation system as a whole.
 - It does not accrue to the storage facility itself.
 - Or to the specific wind facility interested in using the storage.

Economics Phase II: The “Greening” of ISEP

- All about linking storage and wind:
 - What is the probability that the lowest MISO prices off-peak (for ISEP compression/storage cycle) occur when the wind is blowing?
 - How much additional wind generation is possible because of ISEP?
 - How much less curtailment of wind energy will occur because of ISEP?
 - What system savings result?
 - What transmission savings accrue?
 - What improvements in baseload utilization and reduction in conventional units’ cycling result?
 - How will high penetration of renewables in MISO impact ancillary services, and how can ISEP be used to offset that?

Schedule

- Phase II Economics Study **March – May 2011**
- Geology
 - Test well results and recommendations: **March 2011**
 - Peer review 2nd opinion: **April 2011**
 - Air injection testing: **Fall 2011 – Fall 2012**
- Engineering & Permitting **2012 – 2013**
- Notice to Proceed **2013**
- Commercial Operations **2015**

Questions?

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