H-2-Salt

Storing Fossil Energy as Hydrogen in Salt Caverns

Kansas Geological Survey
University of Kansas Center for Research, Inc.

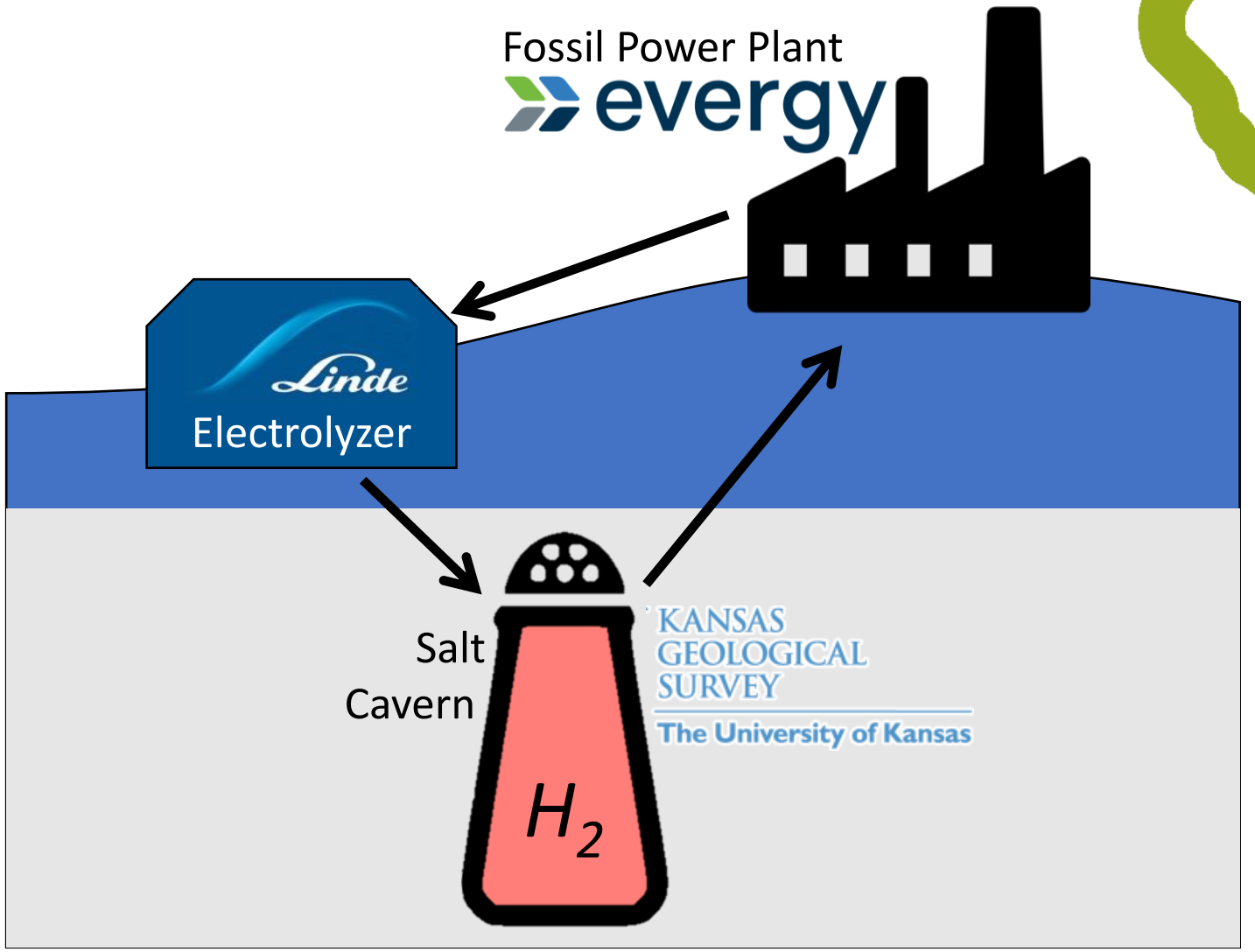
PI: Franek Hasiuk, PhD

Sub-Recipients:
Linde Inc., Evergy, Inc.

Location: Lawrence, Kansas

Budget

DOE	$200,000
Non-DOE	$50,000
Total	**$250,000**



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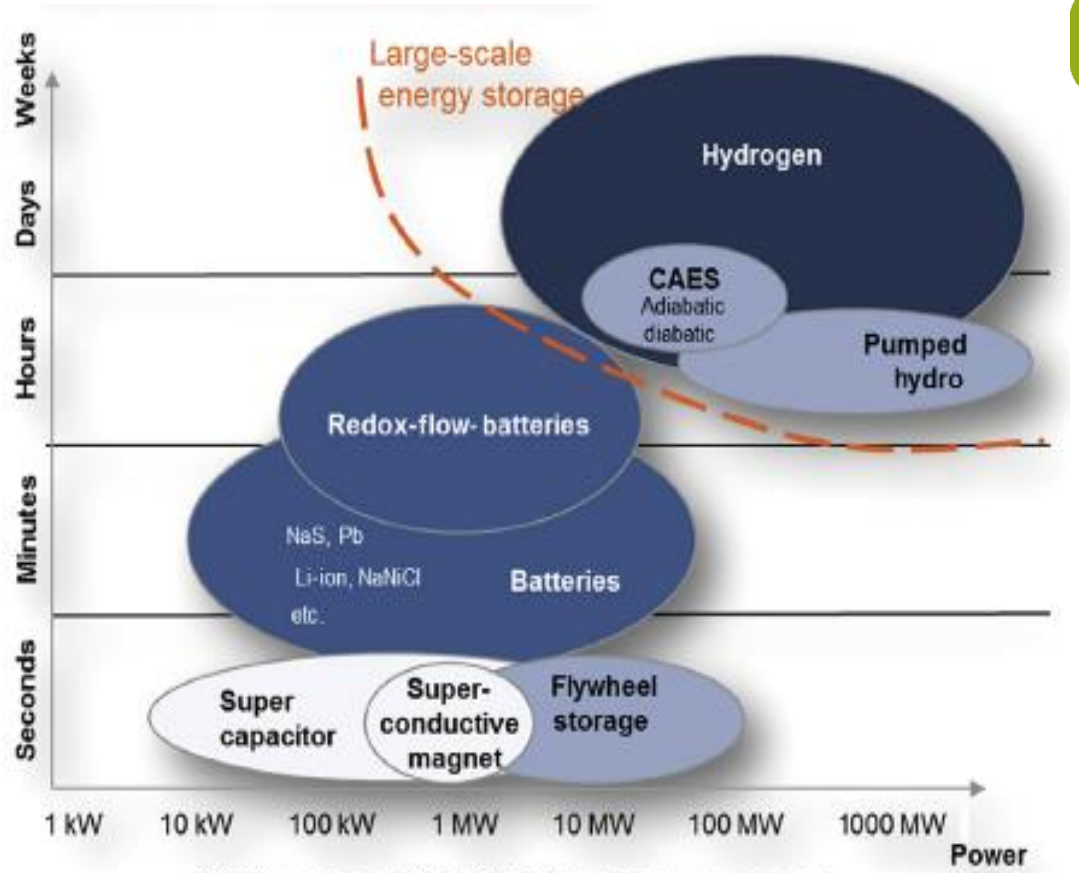
- Energy storage is important
  - To prolong life of fossil fuel energy generators
  - To help with manage variable power from wind/solar
- Cavern storage of hydrogen is the largest “battery” we can build
- Hydrogen storage also works on longer times scales (hours-weeks)



Time-scale vs power storage plot showing H_2 storage as having the potential for significant energy storage (Tarkowski, 2019)

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Use Case

- Generate hydrogen from uneconomic fossil power
- Store hydrogen in salt cavern under plant site
- Recover energy by co-firing hydrogen with natural gas
- And/or…supply to industrial users, pipeline, transport

Target Scale

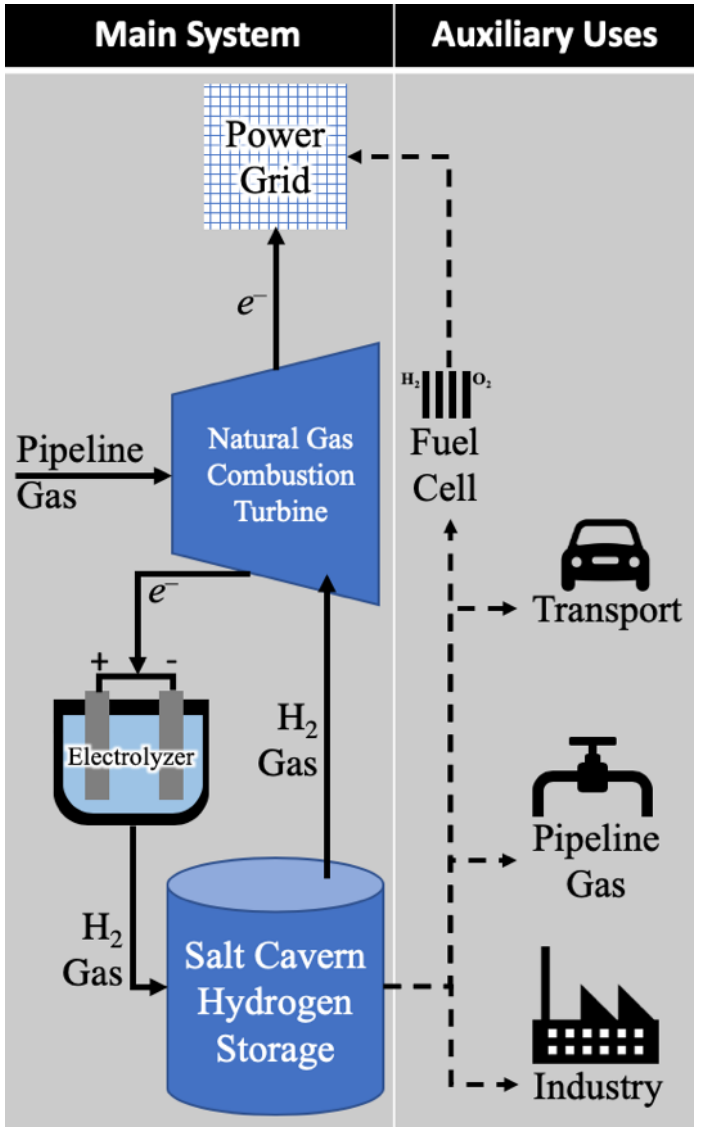
- 1 cavern… ~60 million cubic feet

Target Duration

- 24h to seasonal

Key Commercialization Considerations

- Matching market to production capacity (near term economics)
- Cavern construction cost
- Public acceptance



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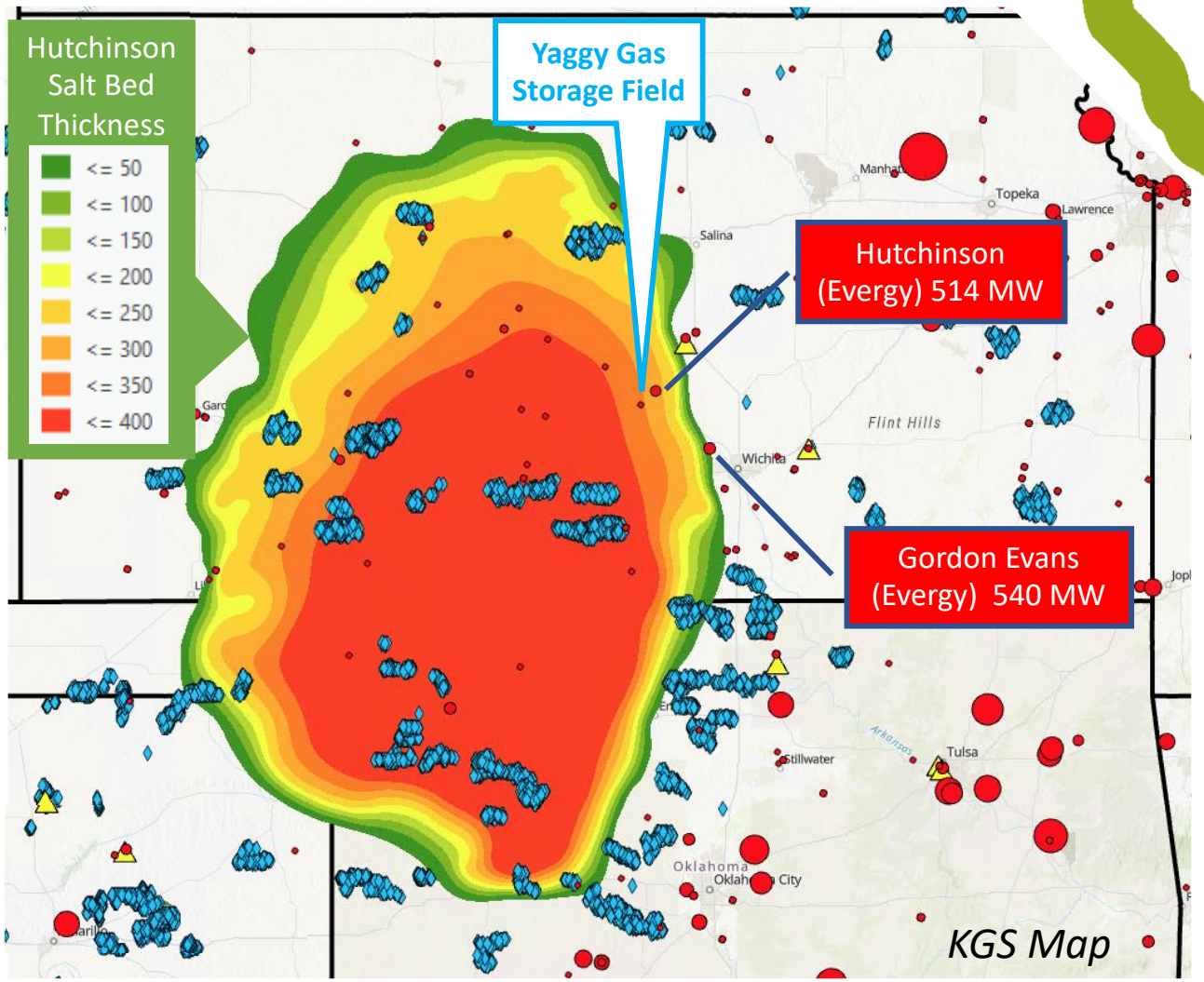
Geology of Storage

- Two possible sites (Hutch & Gordon Evans)
- Hutchinson salt bed
- Refineries (yellow triangles)
- Cavern storage field
- Fossil EGU's (red circles)
- Wind turbines (blue diamonds)

AEC 8-inch Salt Cores (Lyons, KS)



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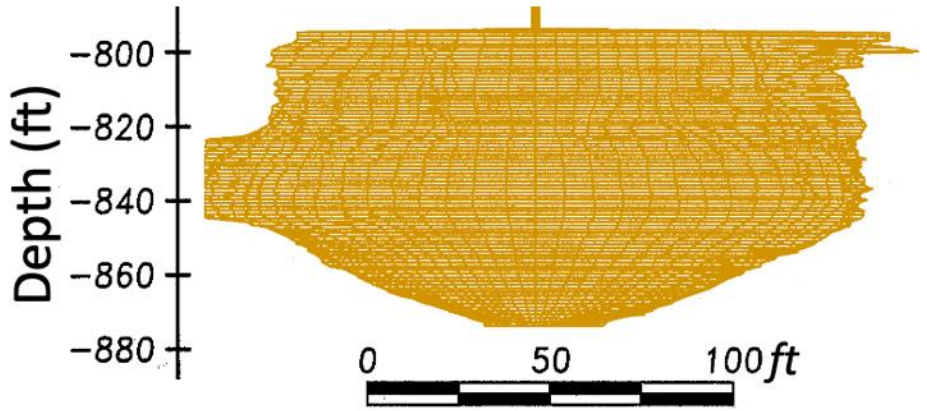
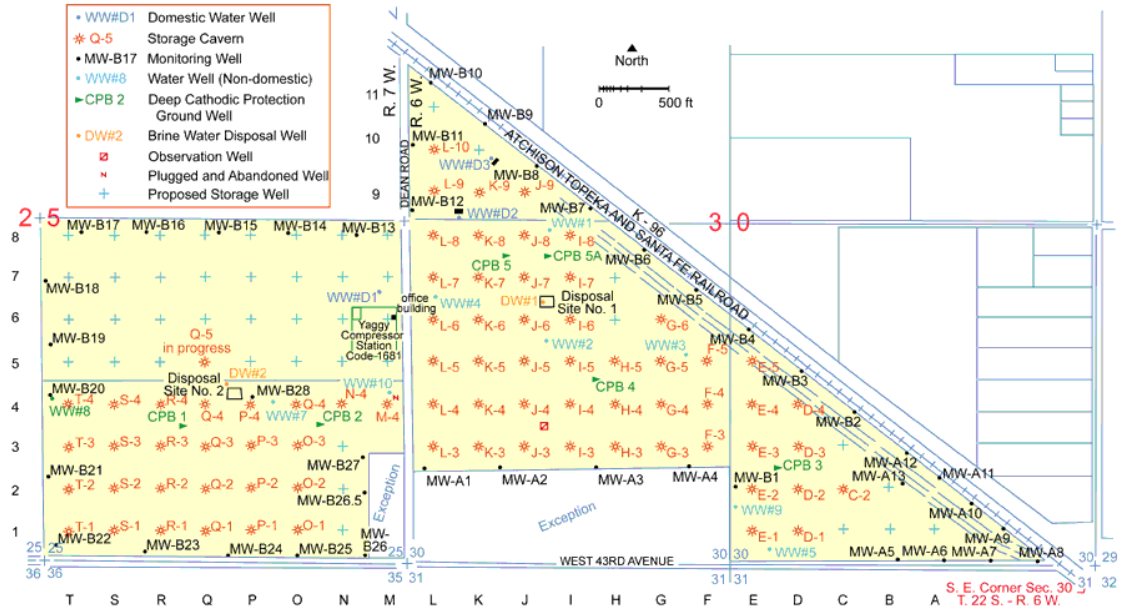
- Hutch Salt has proven cavern storage
- Yaggy Site activated in 1993
- ~10 miles west of Hutch Site
- Caverns
  - 74 caverns, 3.2 BCF of nameplate storage
  - Each store ~60 million cubic feet of gas
  - 80 ft tall, 150 ft wide
  - 400 ft spacing
  - Over 500 ft underground
  - 550-685 psi
- Casing leak in one well in 2001 led to incident 10 miles away in Hutchinson
- H-2-SALT sites could support 40+ caverns





Images from "Geology of Yaggy Field", KGS Website

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What is needed to be able to pilot **a demo plant by 2025?**

- Any plan needs:
  - Salt characterization well + new cavern + electrolyzer
  - To be at a reasonably large scale
- Base Plan: modify existing natural gas turbine
- Stretch Plan: purchase new turbine

Gordon Evans

How can NETL help **transition coal assets** as they retire over the next 10-15 years?

- Salt caverns filled with hydrogen are essentially the largest "batteries" we can build with current technology
- This storage scale can help to balance retirement of large coal assets
- Provide energy during events like the February Freeze

Hutchinson

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Topics, issues, or areas of need that NETL should be aware of…

Public & regulatory acceptance is key

- Underground injection is a complex issue
- Induced seismicity in the US Midcontinent
- Public and regulatory acceptance is key → KGS worked to evaluate regional geology

Hydrogen storage will only happen when finances work

- Salt caverns can be expensive to construct
- Likely from putting a value on CO_2
- Tax credit like for wind would help economics significantly

Geological properties need characterization

- It will be vital to quantify salt/shale interbedding…Will likely require coring program
- This will allow us to estimate maximum pressure that can be maintained in the cavern so we can have maximum hydrogen storage and keep groundwater out

Hydrogen storage in salt caverns is broadly applicable in USA: US Gulf Coast, New York, Michigan, Utah