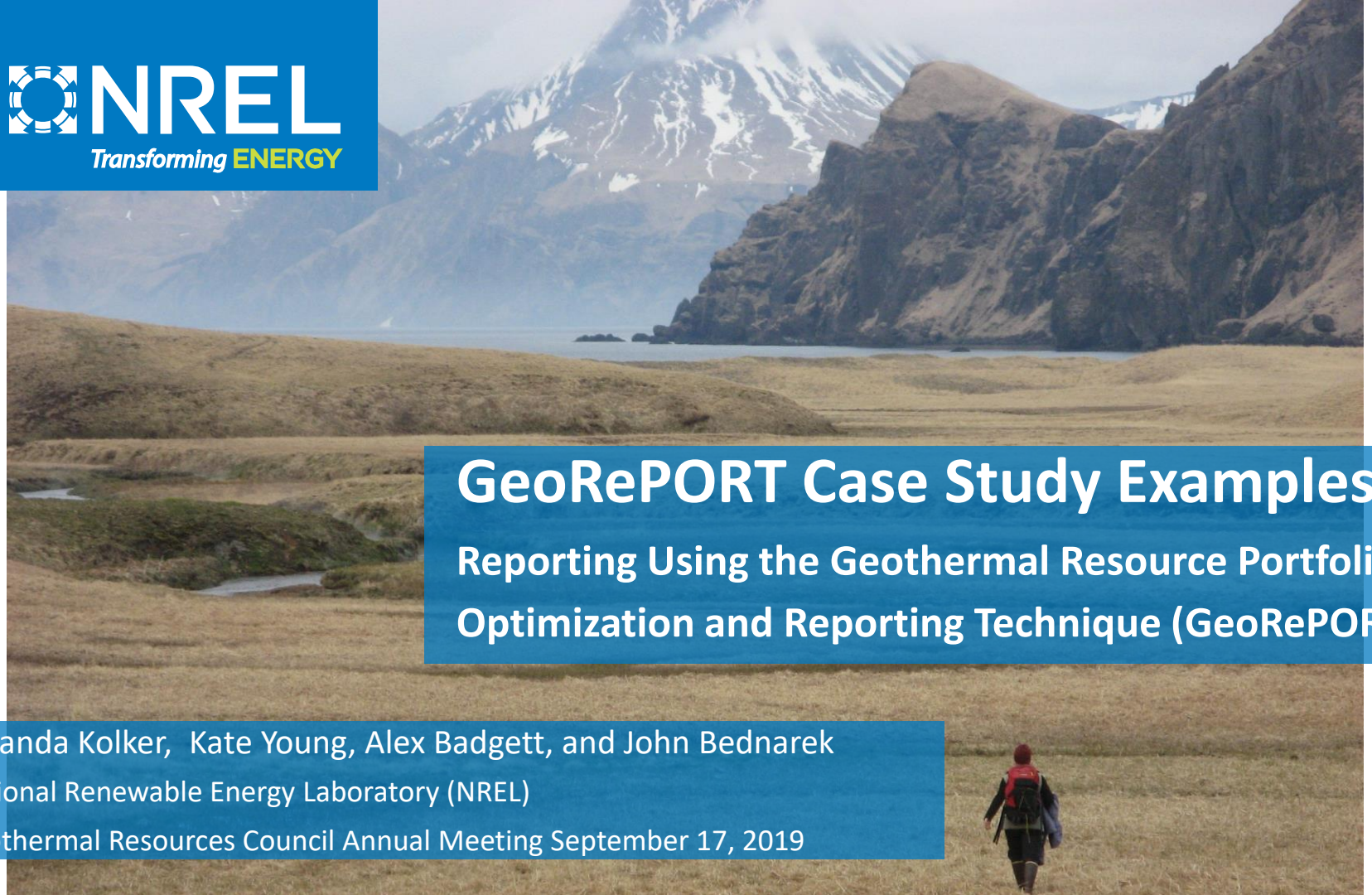


GeoRePORT Case Study Examples:

Reporting Using the Geothermal Resource Portfolio Optimization and Reporting Technique (GeoRePORT)

Amanda Kolker, Kate Young, Alex Badgett, and John Bednarek
National Renewable Energy Laboratory (NREL)

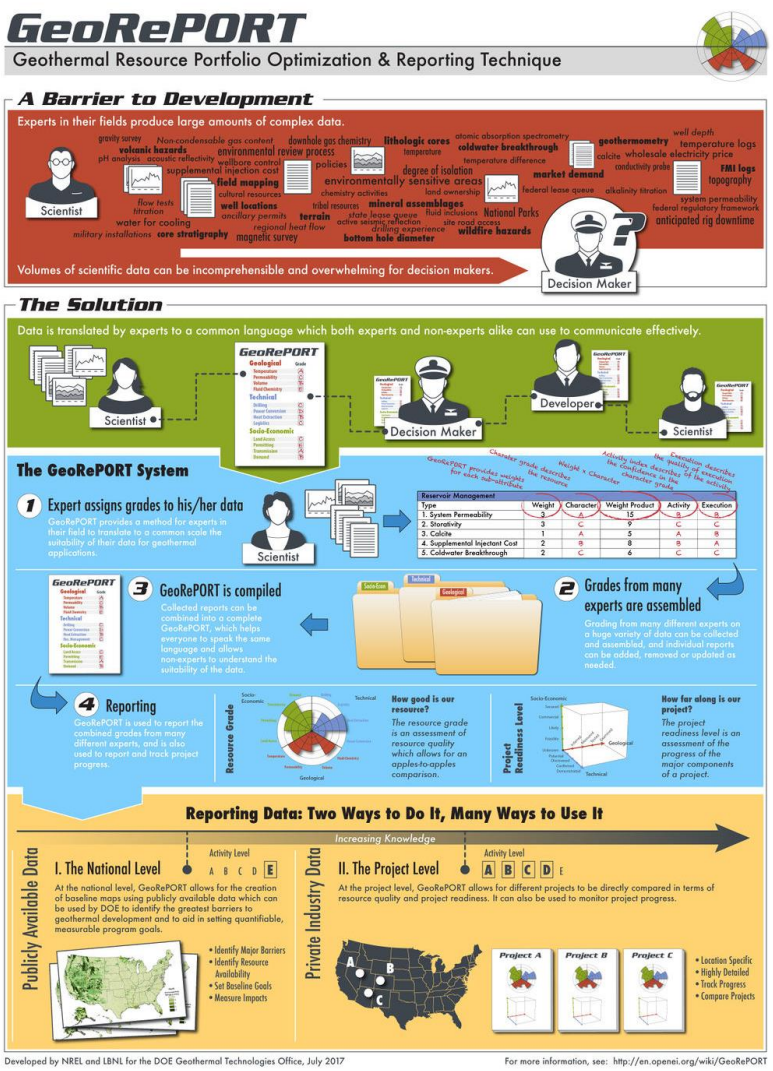
Geothermal Resources Council Annual Meeting September 17, 2019

Introduction to GeoRePORT

GeoRePORT Background and Overview

- Developed to help DOE's GTO track and measure project progress, the impact of geothermal R&D funding, and to communicate with stakeholders.
  - Tool development led by NREL and LBNL
  - Users: geothermal experts
  - Audience: non-technical stakeholders

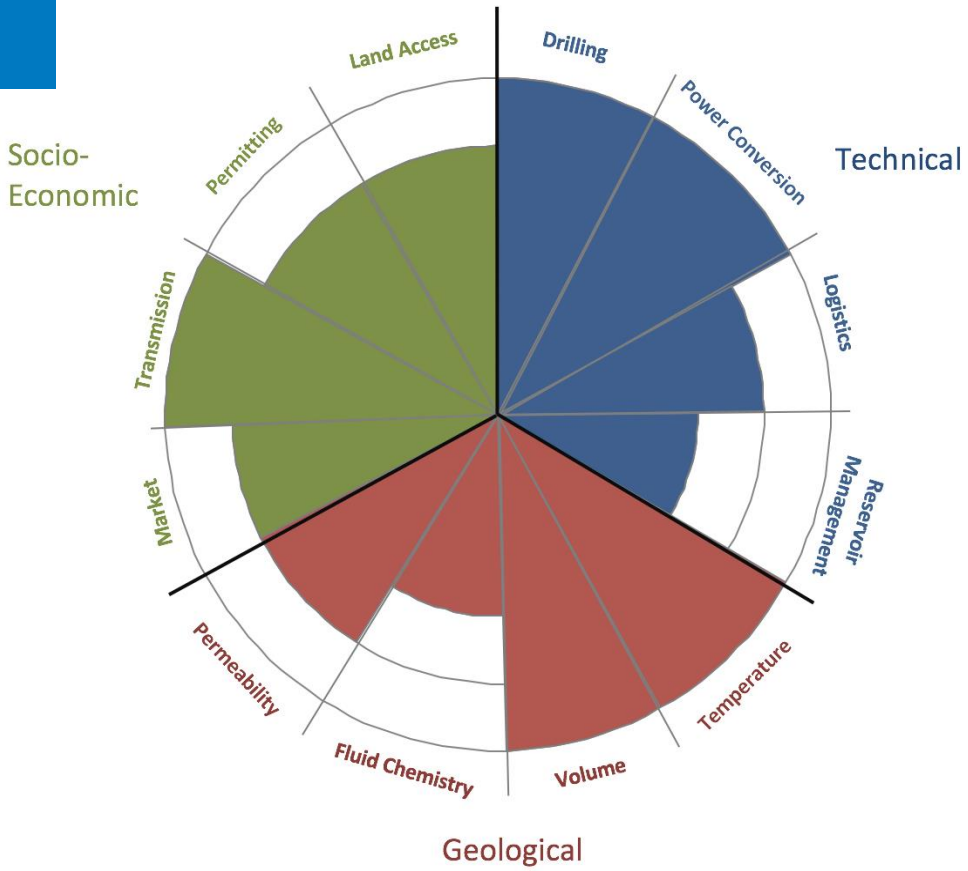
- Provides uniform assessment criteria for resource **grades** and developmental **phases** of geothermal projects.
  - Provides consistency in *reporting*
  - Not a prescription for exploration/development
  - Not a replacement for conceptual or reservoir models and geothermal expertise



GeoRePORT Methodology

Methodology: Resource Grade

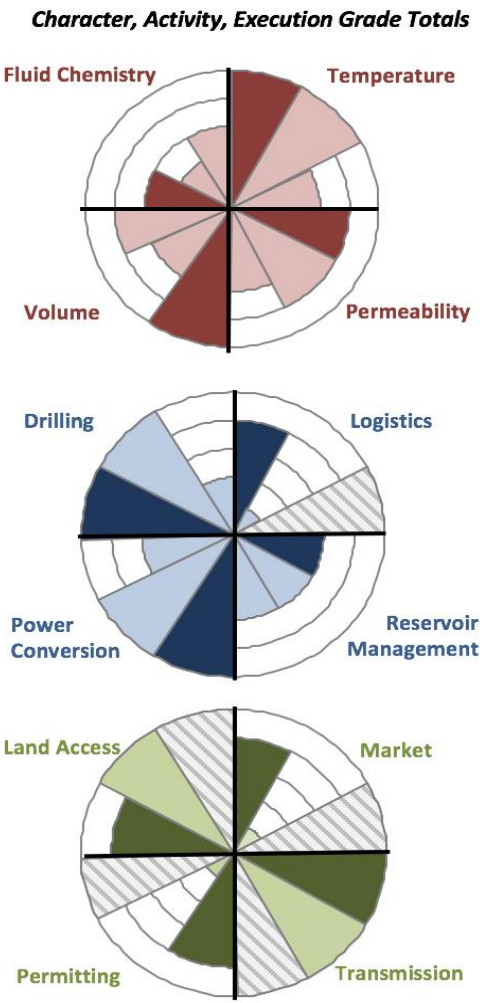
- The resource-grade system provides information on the **character** of a geothermal resource
- Resource character is a function of its ***geological***, ***technical***, and ***socio-economic*** attributes
- 3 attributes encompass 12 sub-attributes
  - Developed with heavy industry input
  - Designed for continuous update throughout a project lifetime
- 3 protocols available for download on GeoRePORT website: https://openei.org/wiki/GeoRePORT/Protocol#top
  - Geologic Assessment Tool (GAT)
  - Technical Assessment Tool (TAT)
  - Socio-economic Assessment Tool (SEAT)



Methodology: Resource Grade

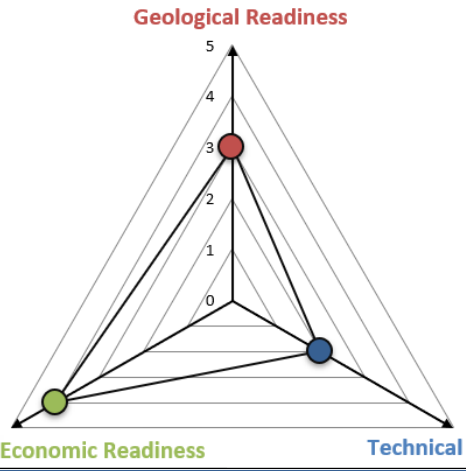
- In addition to **character**, GeoRePORT grading system also reports on what is known about the **quality of the data** collected.
- For the geological attributes, uncertainty in the reported data addressed by:
  - The ***activities*** conducted to measure each attribute
  - The ***execution*** of such activities (how well the activity was executed)
- Execution indices do not apply to all technical and socio-economic attributes.

	Activity index example: Temperature
A	Measured temperatures: Downhole temperature probe readings (well[s] drilled into reservoir)
B	Estimated temperatures: Geothermometry (geothermal brines and gases)
C	Estimated temperatures: Geothermometry (immature or mixed fluids, inconsistent results between geothermometers)
D	Extrapolated temperature: Thermal gradient holes (TGHs) /well(s), alteration mineral assemblages, stable isotopes, fluid inclusion data
E	Regional heat flow data



Methodology: Project Readiness Level

- Users can report on incremental **project readiness level**.
- As projects progress, they pass through activity thresholds, which are minimum activities required to qualify for the next category.
- Like the resource grade, project readiness reporting designed to be updated throughout the project lifetime.



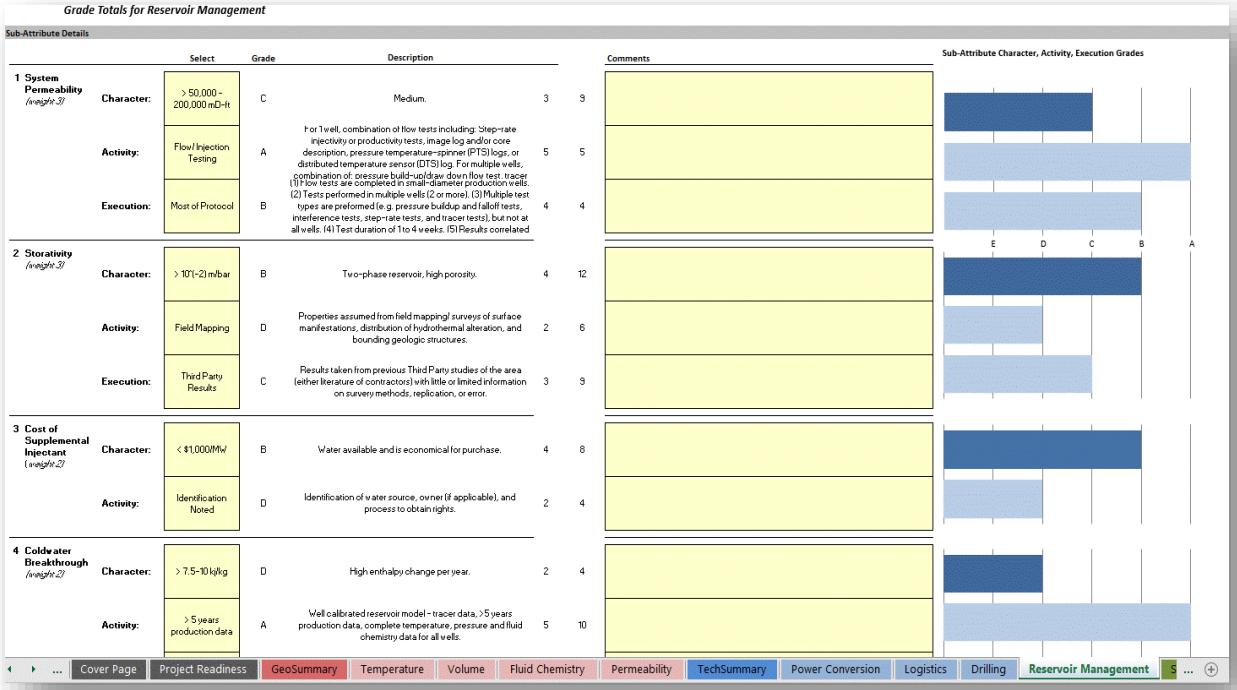
Technical Readiness

	Qualifying Criteria
Place an "x" in all applicable boxes	
x	Site analysis completed including a geotechnical site analysis
	Site evaluated and determined not to have economic potential
x	Promising geophysical analyses and conceptual model completed
x	Well drilled into reservoir proves reservoir temperature and fluid flow
	Two or more successfully drilled and tested wells
	Production wells produced geofluids at necessary temperatures and flow rates for a minimum of 30 days
	Well field and supporting infrastructure must be operational for a minimum of 30 days
	Plant must produce power at or above initial power production estimates

Socio-Economic Readiness

	Qualifying Criteria
Place an "x" in all applicable boxes	
	No site Environmental or Trasmission Interconnection Analysis
	Site evaluated and determined not to have economic potential (No-Go)
x	Environmental and Transmission Interconnection Analysis complete
x	Site evaluated and determined to have economic potential
x	Approval of Notice of Intent to Conduct Geothermal Exploration and Geothermal Drilling Permits
	Approval of a Utilization Plan for construction and operation and a Commercial Use Permit (if on a federally manage
x	Approval of any state or level local permits/approvals for construction, operation, and sale of the resource
	Power Purchase Agreement Secured with off-taker

Methodology: Case Studies



- Spreadsheet tool facilitates reporting using the GAT, TAT and SEAT protocol (https://openei.org/wiki/GeoRePORT/Protocol#top)
- Case study data collected using best practices outlined in the protocol documents
  - Maximum input from site experts
  - Publicly available information (OpenEI, NGDR, Geothermal Prospector, lit. reviews)

Thanks to our partners

Chena Hot Springs Resort
Where hospitality and sustainability go hand in hand

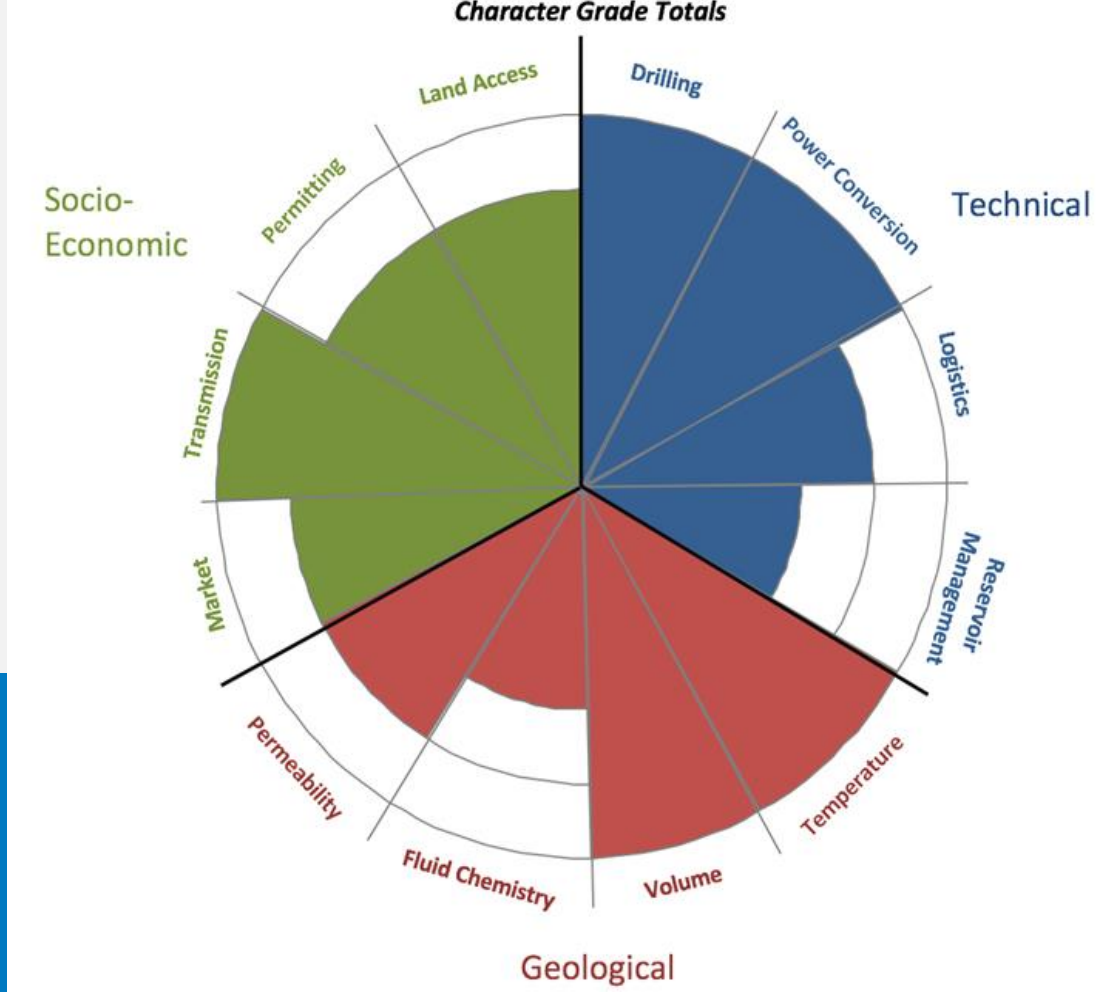
DOE GTO team, plus:
Adam Brandt
Greg Nash
David Meade
Andy Sabin
Joe Iovenitti
Bernie Carl
Dick Benoit
…and many others

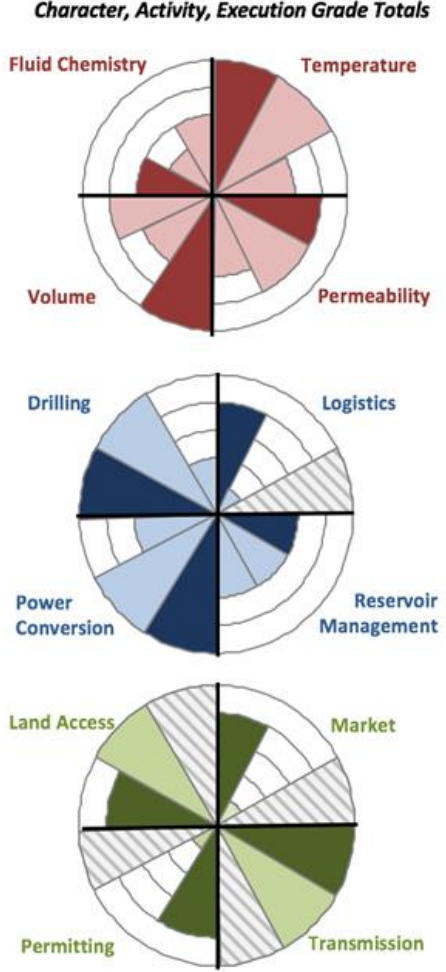
EGI Energy & Geoscience Institute AT THE UNIVERSITY OF UTAH Since 1972

COSO Operating Company since 1987

RUBY MOUNTAIN

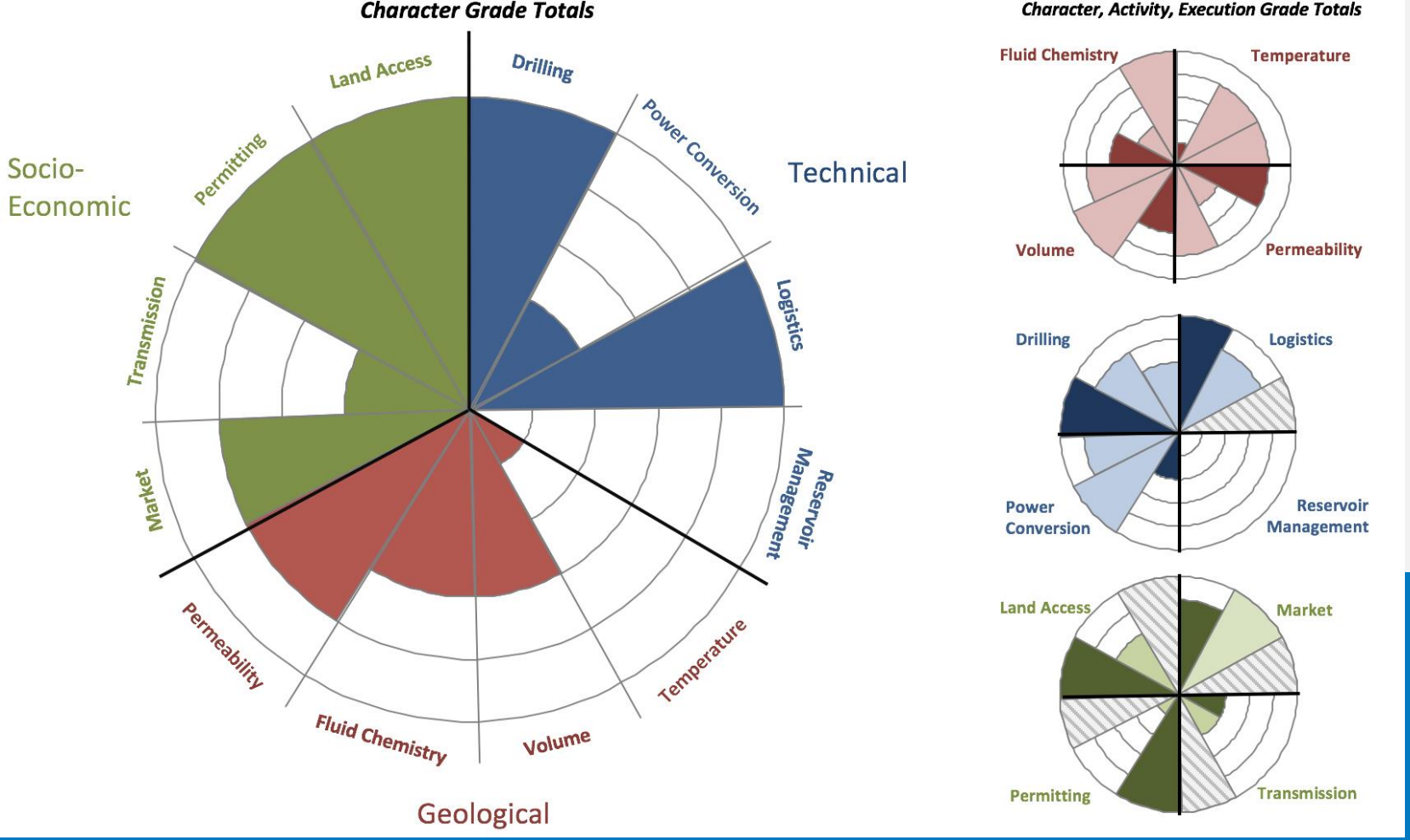
GeoRePORT Case Study Results





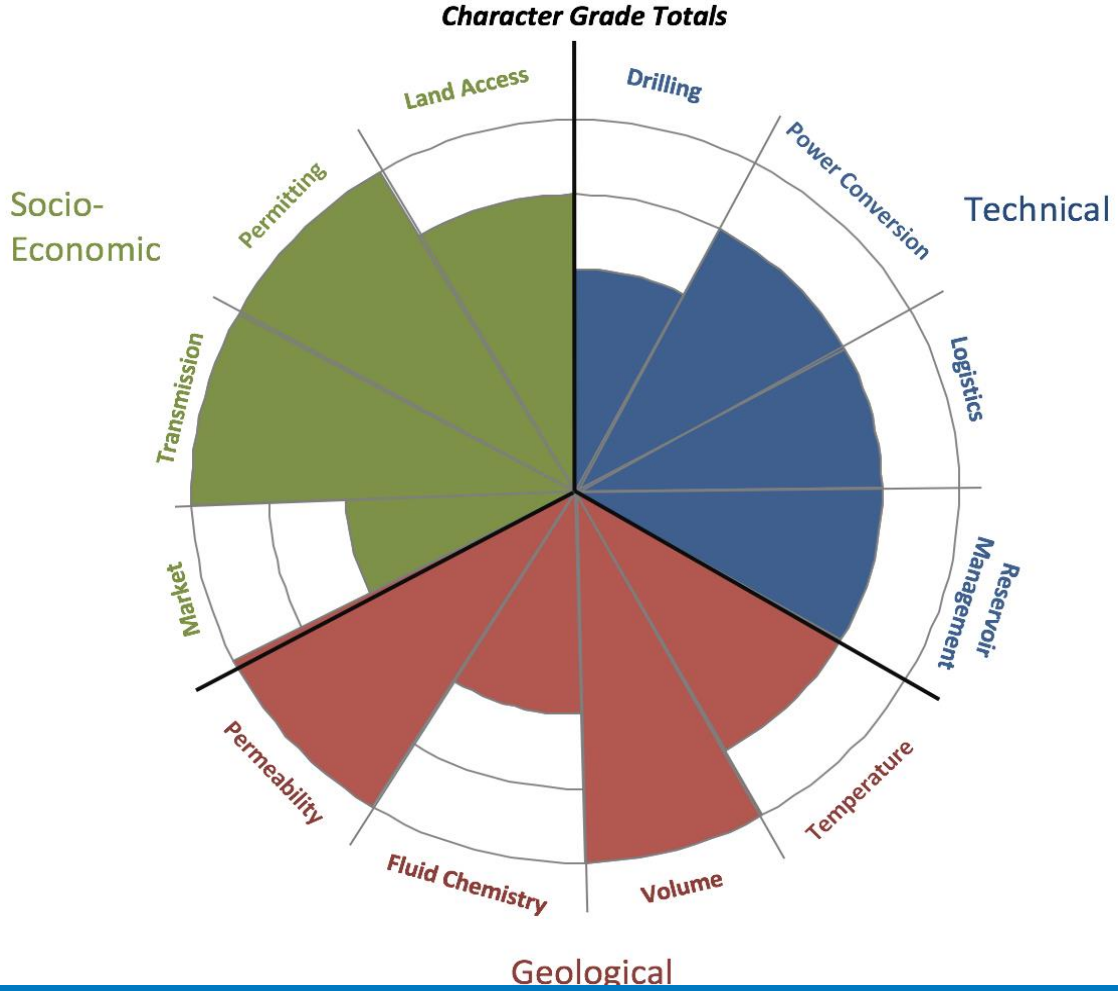
Coso

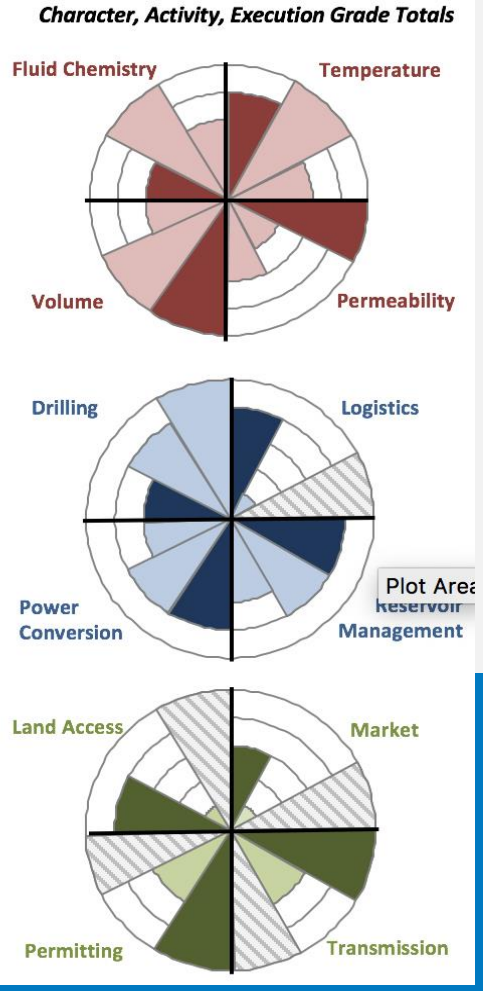
Resource grade summary



Chena Hot Springs

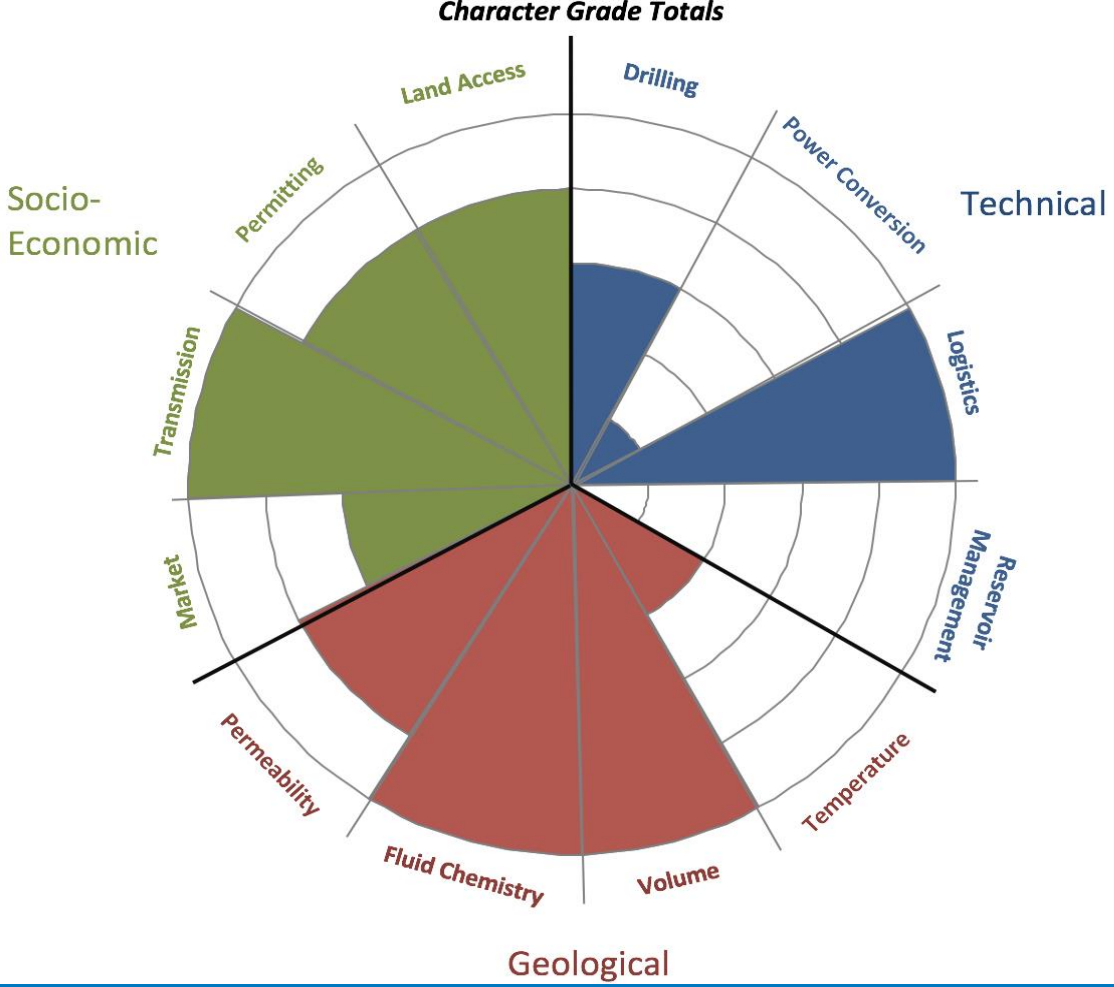
Resource grade summary

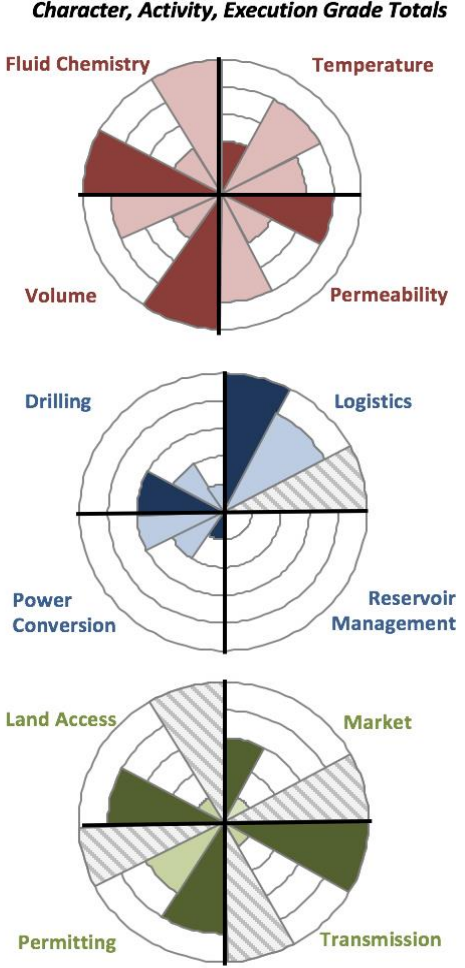




Dixie Valley

Resource grade summary



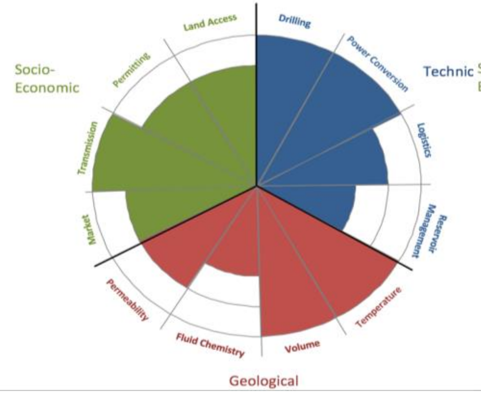


White Sands Missile Range

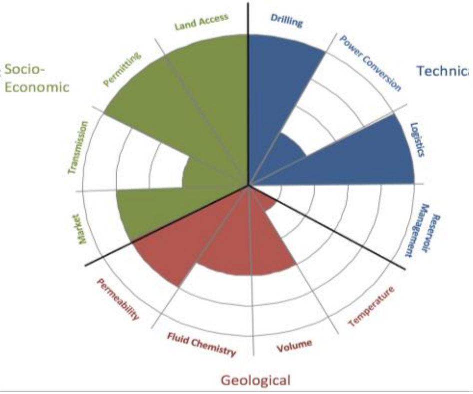
Resource grade summary

GeoRePORT Case Study Analysis: Discussion

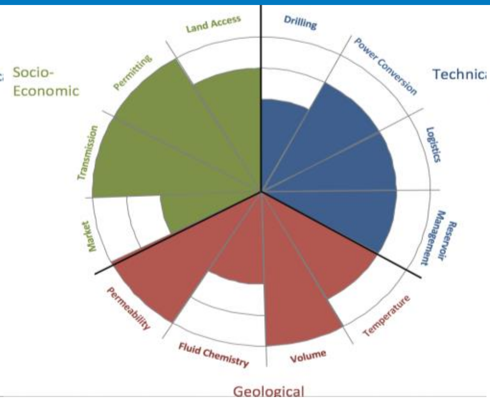
Discussion:
Character Grade & Project Readiness



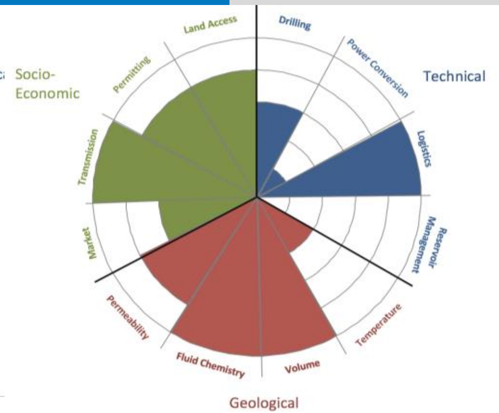
Coso



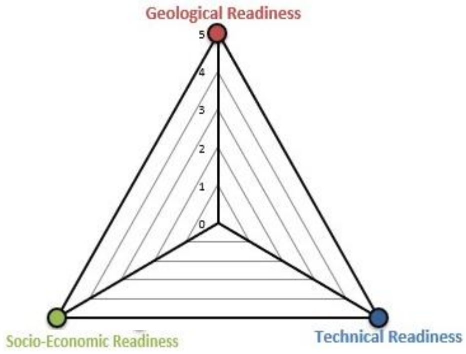
Chena HS

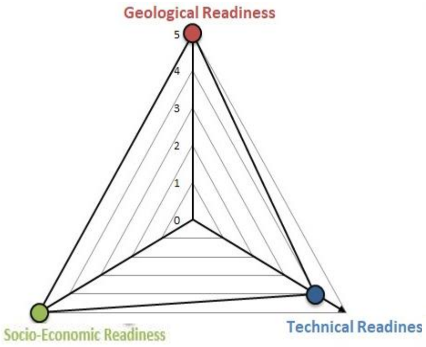


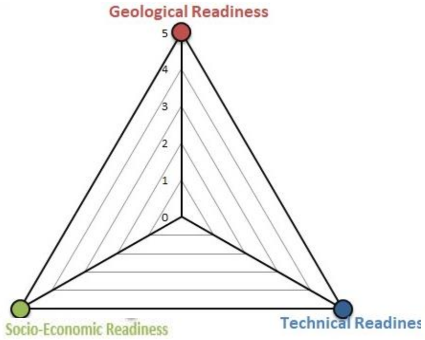
Dixie Valley

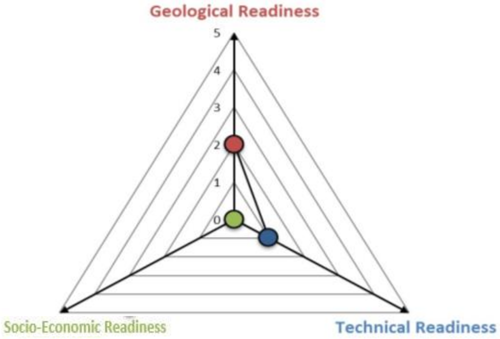


WSMR



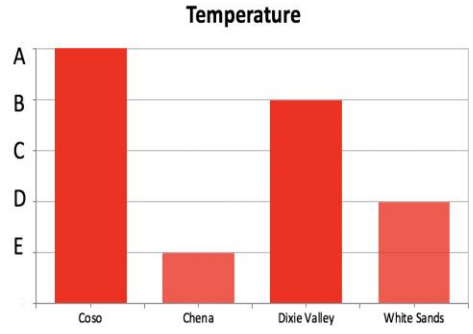


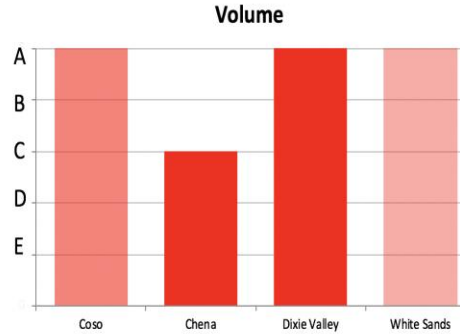


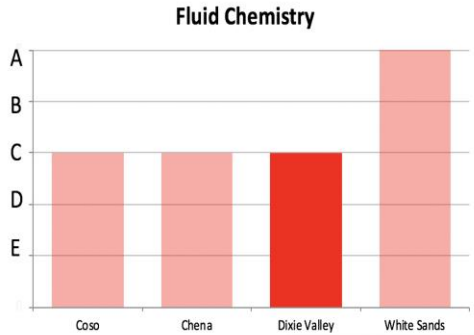


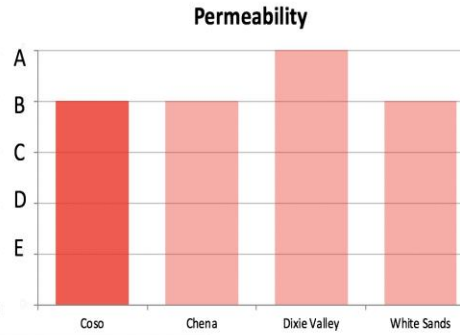
Discussion: Grade & Activity Levels

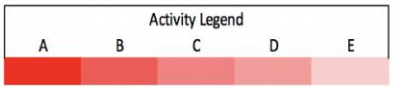
Geological Attributes



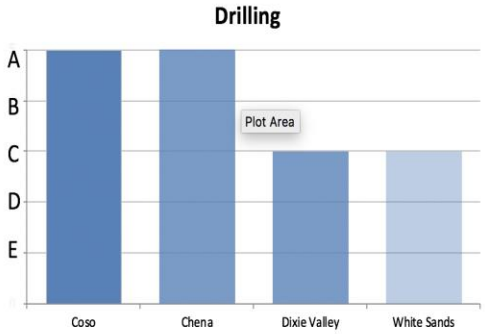


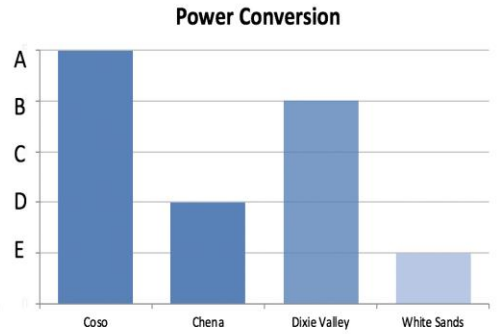


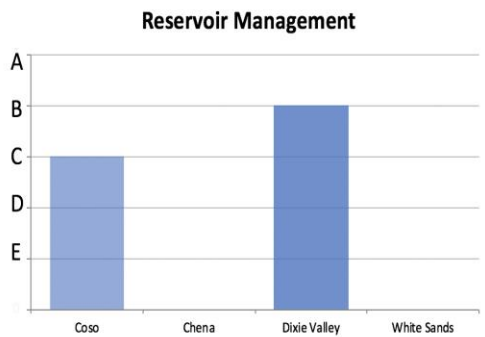


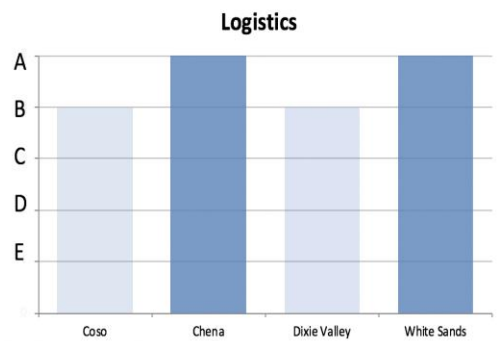


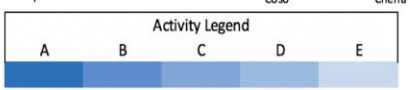
Technical Attributes











GeoRePORT Case Study Analysis: Conclusions

Conclusions & Future Work

- Four case studies illustrate:
  - The ability of GeoRePORT to succinctly provide a project snapshot and tell a story
  - The success of GeoRePORT in making explicit the degree of uncertainty in the data, and missing data (via activity/execution indices)

- GeoRePORT's outputs for four case studies reveal:
  - Trends in which data are collected and reported across several projects
  - Industry-wide areas for improvement and/or streamlining

- Tool development ongoing
  - New insights from case study evaluations and industry feedback
  - Future work: add Resource Size Tool, international expansion of socio-economic attributes, adapt reporting parameters to EGS and direct use projects, etc.
  - More case studies!

Thank you

www.nrel.gov

amanda.kolker@nrel.gov

https://openei.org/wiki/GeoRePORT

This work was authored by the National Renewable Energy Laboratory, operated by Alliance for Sustainable Energy, LLC, for the U.S. Department of Energy (DOE) under Contract No. DE-AC36-08GO28308. Funding provided by the U.S. Department of Energy Office of Energy Efficiency and Renewable Energy Geothermal Technologies Office. The views expressed in the article do not necessarily represent the views of the DOE or the U.S. Government. The U.S. Government retains and the publisher, by accepting the article for publication, acknowledges that the U.S. Government retains a nonexclusive, paid-up, irrevocable, worldwide license to publish or reproduce the published form of this work, or allow others to do so, for U.S. Government purposes.