GreenFire Energy

CO_2G™ (CO_2-based Geothermal Energy):

Hot, Pressurized CO_2 for a Range of Clean Energy & Industrial Applications

GreenFire Energy - Overview

- Mission: To combine CO_2 with geothermal heat to produce hot, pressurized CO_2 in large volumes at low prices. In this state, CO_2 has great utility in a wide range of industrial and clean energy applications. Our suite of technologies is called ***"CO_2G™."***
- Market: Global markets for CO_2 transport via pipelines, supercritical fluid extraction, energy storage, power generation, sequestration and others.
- Experienced Management Team
- Research Partners
  - Lawrence Berkeley National Laboratory
  - Los Alamos National Laboratory
  - Pacific Northwest National Laboratory
  - The Energy & Geoscience Institute at the University of Utah
  - The Department of Energy ($2 million grant already received)

Why Combine CO_2 and Geothermal Heat?

Utility: Pressurized CO_2 is an immensely useful chemical. Circulating it through a geothermal resource is an inexpensive way to pressurize it in large volumes

The heat resource is huge and widespread: Just 2% of the geothermal resource between 3.75 km and 7.5 km underlying the Continental U.S. could supply ***2,600 times*** the country's total current annual energy use. *(MIT 2006 report)*

Unconstrained by water availability: CO_2 can be used as the geothermal fluid where water is scarce or expensive.

Physical properties of CO_2: CO_2 is a better geothermal fluid than water due to lower viscosity and density differences with temperature and pressure variation. It is also non-toxic and becomes supercritical at relatively low pressures and temperatures

Price competitive: Under certain conditions, CO_2G™ can provide energy that is cost competitive with or even much less expensive than power from fossil fuels.

Economies of scale: Few conventional geothermal energy projects have economies of scale, but they can be achieved with CO_2G™.

Carbon negative: This is the only scalable energy source that sequesters CO_2 .

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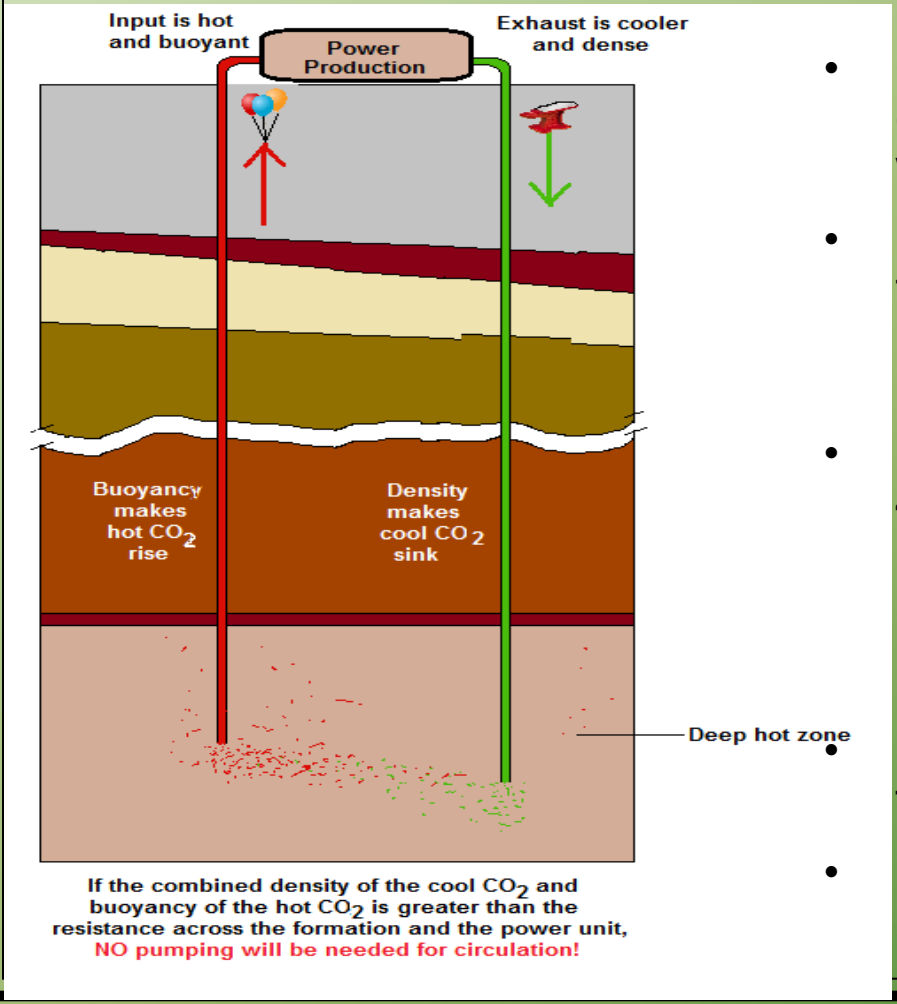
The Key to CO_2G™: The "Thermosiphon"



- **CO_2 provides major advantages as compared to water when combined with geothermal heat.**
- Density of water changes little with temperature
  - No potential for density-driven circulation
  - Expensive pumping must be utilized
- Density of CO_2 can change as much as 4X with temperature
  - Cool CO_2 is dense; warm CO_2 is less dense
  - Density-driven circulation can occur; this is the "Thermosiphon"
  - Expensive pumps and pumping not required
- Similar density siphon used in refining for 50+ years
- ***The thermosiphon opens the door to numerous opportunities.***

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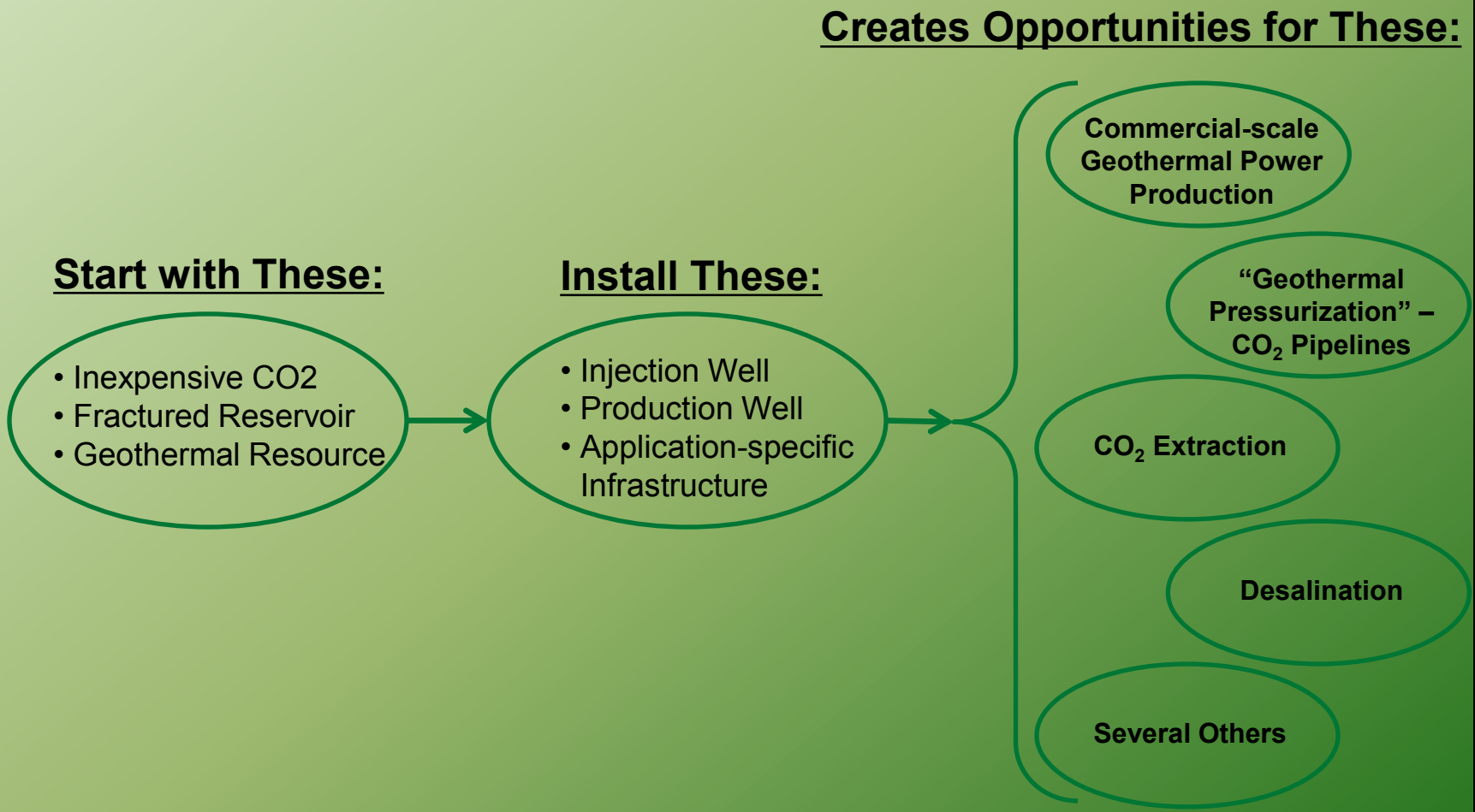
Wide Variety of Applications for CO_2G™



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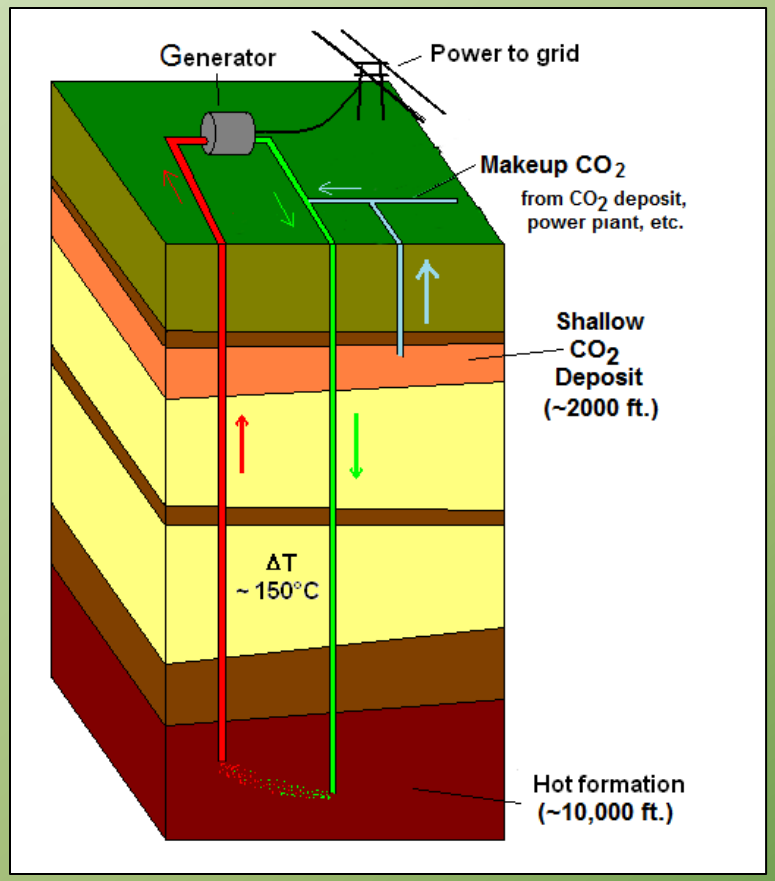
CO_2G^{TM} for Power Generation



Large-scale, baseload power generation

- Generate power using conventional power plants
- 50% greater heat extraction rate than water
- New technology can increase advantage to 100% (MOHCs from PNNL)

Grid scale, responsive energy storage

- Response time on the order of seconds
- Can “firm up” wind or solar power
- No separate, expensive storage technology required

Ideal for grid management

- Baseload, firming or peaking power

Uses CO_2 as the geothermal fluid

- Natural and/or anthropogenic sources
- Carbon-negative power with anthropogenic CO_2

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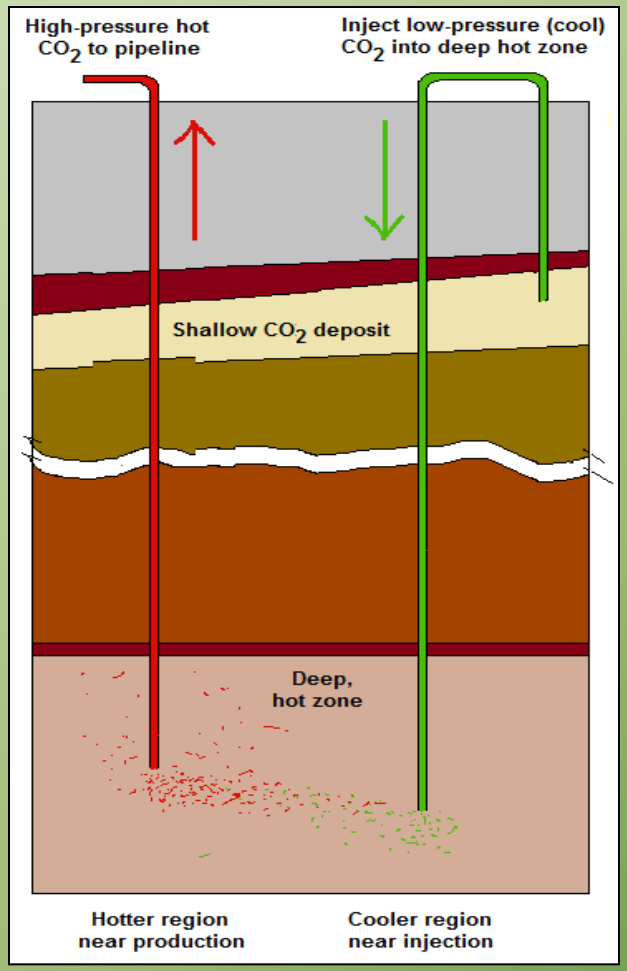
CO_2G™ for "Geothermal Pressurization"



- With the right set of conditions, "Geothermal Pressurization" can replace conventional CO_2 compression for pipeline transportation.
- The CO_2 must be pressurized to 2,200 psi prior to being injected into the pipeline.
- Conventional technology utilizes compressors and electricity.
- GreenFire's technology uses geothermal heat to pressurize the CO_2 at a small fraction of the cost.
- High throughput is achieved because CO_2 only goes through the system once.
- It may be possible to compress 10 million tons per year or more with only 2 wells.

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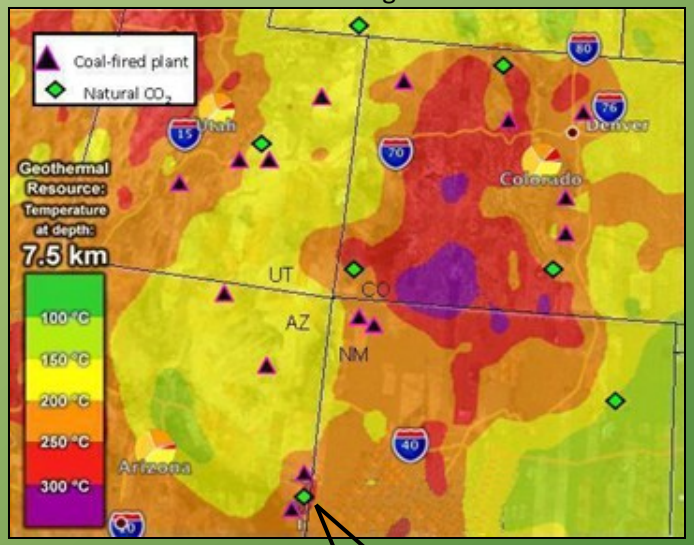
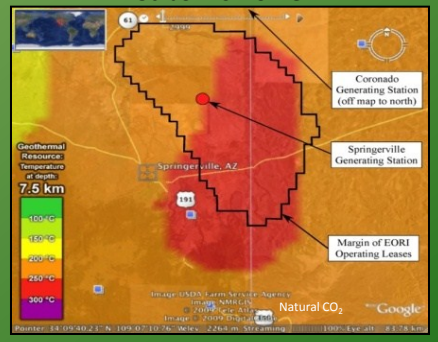
Project Site:
St. Johns Dome, AZ and NM

- No other comparable site identified in North America
  - Geothermal heat
  - Large natural deposit of CO_2; 450 million tons are considered recoverable
  - Proximity to electrical transmission lines
  - Immediate proximity to two coal-fired power plants and regional proximity to four additional plants for possible future CO_2 supply
- Agreement with Kinder Morgan, holder of 90% of CO_2 leases at the dome
  - KM needs to pressurize and ship 10MM tons of CO_2 per year
- Technology license from Los Alamos National Laboratory:
  - Exclusive right to use CO_2E™ in the U.S.

Four Corners Region



St. Johns Dome



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St. Johns Dome Project: Key to Worldwide Development

- Inexpensive
  - All necessary factors are present
  - Very inexpensive CO_2 available
  - Will save years and tens of millions of dollars in development costs
- Permitting and seismic studies underway
  - At least a 2-year head start on potential competitors
- Low seismic risk
  - Important for any technology using fracking
  - Will allow development of technologies to mitigate risk in places with seismic risk potential
- Demonstration project can be highly profitable commercial project
  - 2-well demonstration project can also serve as geothermal pressurization project
  - Geothermal pressurization project shortens power generation technology timeline
  - Will save years and tens of millions of dollars as compared to developing power generation technology to commercial scale

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Economics of Geothermal Pressurization: The Kinder Morgan Project

	Conventional Compression	Geothermal Pressurization
Equipment	Mechanical compressors	Two wells (injection and production)
Electricity Requirements	Yes – 70 MW	No
Estimated CapEx	$50 million	$35 million
Estimated annual OpEx	$65 million per year	Approx. $150,000
NPV (10X multiplier)	$700 million	$35 million

- Kinder Morgan intends to transport 10 million tons of CO_2/year via pipeline from the St. Johns Dome to West Texas for enhanced oil recovery.
- It may be possible to use the technology at three other sites. If so, we would be replacing conventional technology projects with an NPV of $5.6 billion.

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Geothermal Pressurization vs Solar Energy

Four potential geothermal pressurization projects vs the BrightSource Energy Ivanpah Project		
Technology	Solar Energy	Geothermal Pressurization
Capital Cost	2.2 billion	280 million
Size (MW)	400	560 MW replaced
Capital cost per MW ($)	5.5 million	500,000

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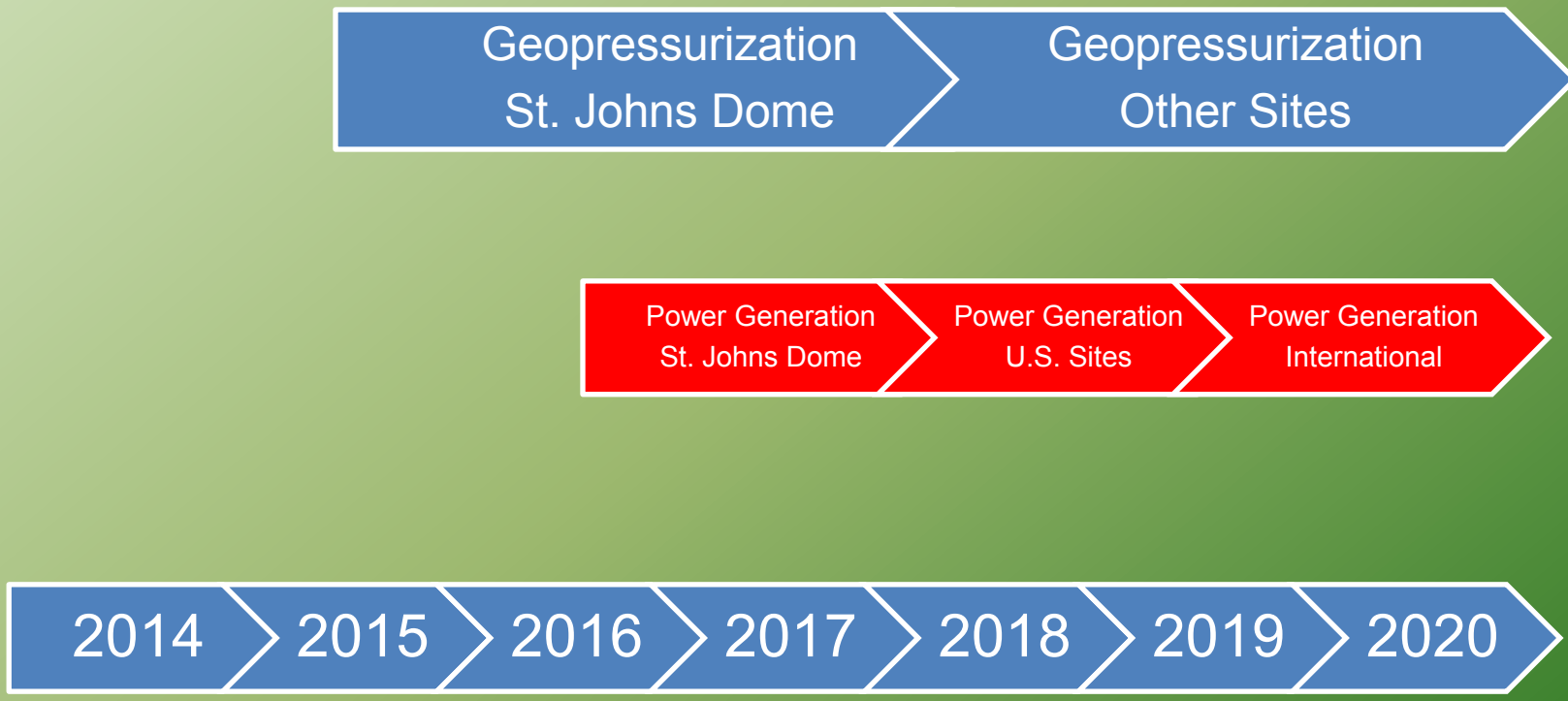
Expected Development Path



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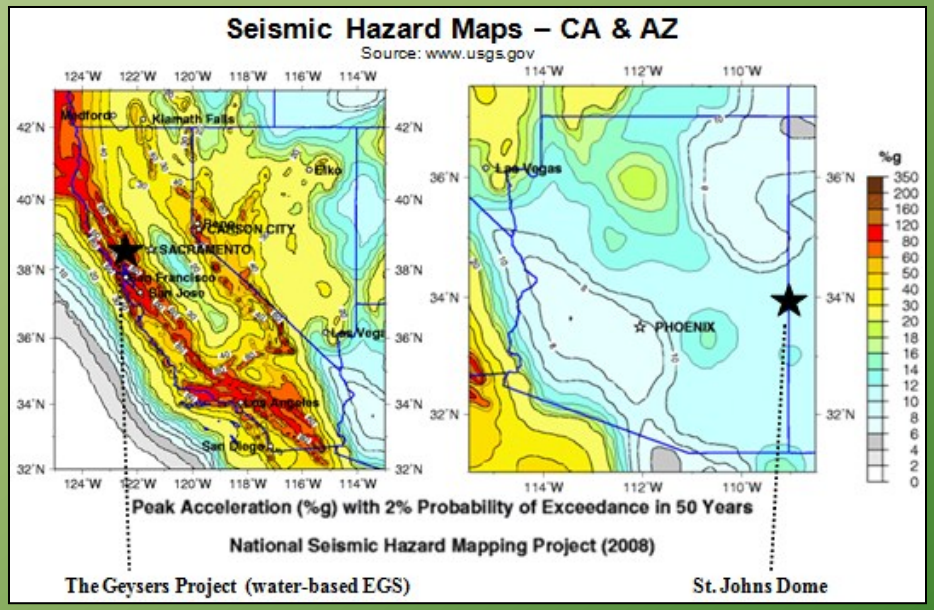
Seismic Risk

- Geothermal projects employing hydrofracturing may be associated with seismic activity
  - Two projects in Europe
  - The Geysers project in California
- Seismic activity has been minor, despite bad publicity
  - Seismic activity is unavoidable with high pressure fluid injection
  - Injection hasn't yet occurred at the EGS project at The Geysers (just bad press so far)
- These projects are in areas of moderate to high seismic risk
- GreenFire's location at the St. Johns Dome is in an area of <u>low</u> seismic risk



Comparison of Seismic Risk

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Sourcing of CO_2

- Natural Deposits
  - The St. Johns Dome is just one example
  - Other deposits around the world
- Natural Gas Processing Plants:
  - Plant in SW Wyoming used to emit 6 million tons per year
  - Natuna Block D in Indonesia (5 billion tons)
  - About 20% of natural gas fields have significant percentages of CO_2
- Cement Plants
  - Smaller amounts emitted
  - 50% of CO_2 emissions are a pure stream
- Recycled CO2 can be very low cost
- Annual Losses for Recycled CO_2
  - Unknown, estimated to be 100% or more
  - Lost CO_2 is effectively sequestered

GreenFire's Intellectual Property Position

- License holder of core technology from Los Alamos National Laboratory ("Brown patent")
  - Exclusive in the U.S.
  - Expires in 2019
- Developing portfolio of relevant patents. Applications already filed for:
  - Generating technology
  - Energy storage
  - Geothermal pressurization of CO_2 for transport via pipelines
  - Supercritical fluid extraction
  - A range of others
- We anticipate filing yet more patents from working with our research partners
  - National energy laboratories
  - Major research university
  - Department of Energy

Thank you for your attention!

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