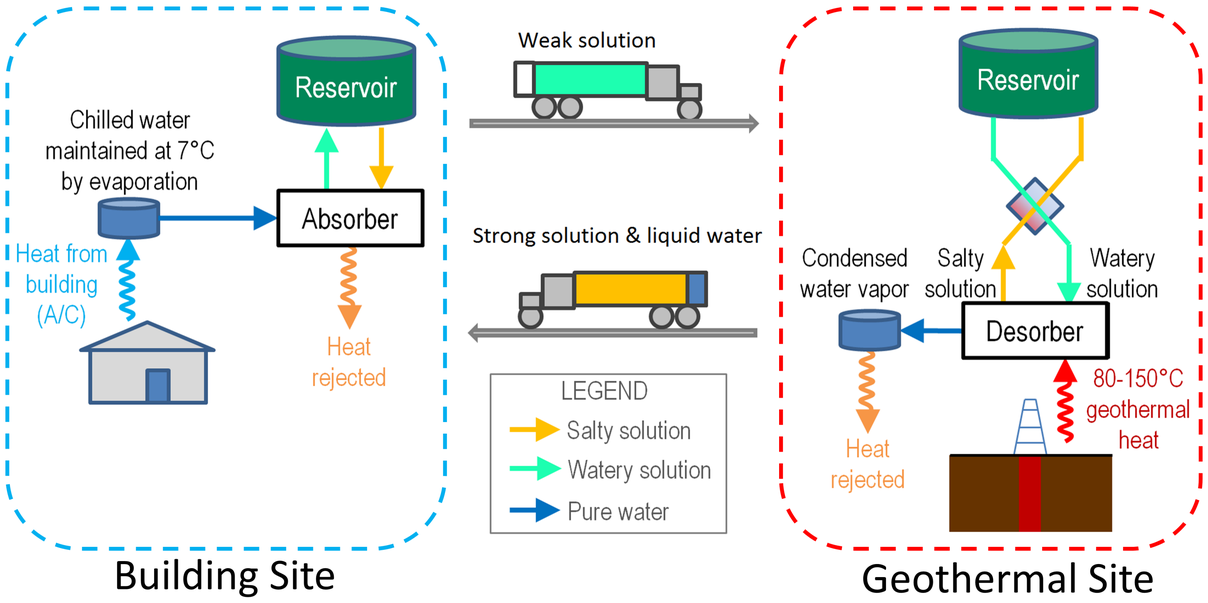
Transporting Geothermal Heat to Condition Buildings

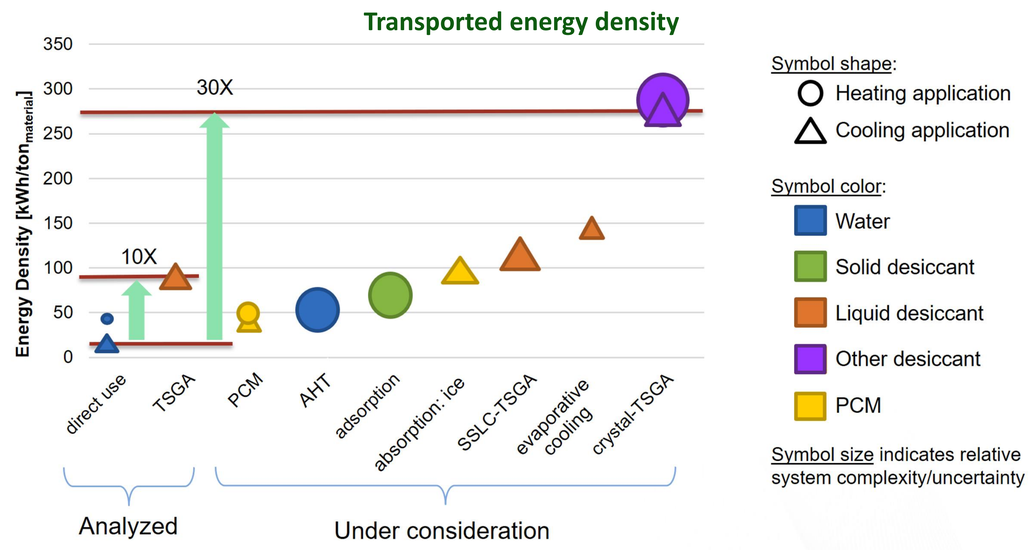
Zhiyao Yang, Xiaobing Liu Ph.D., Kyle R. Gluesenkamp Ph.D., Ayyoub M. Momen, Ph.D.
Oak Ridge National Laboratory

Introduction

- To overcome the barrier of distance between resources and demand, this project designs and evaluates innovative technologies to transport geothermal energy.
- A screening tool is being developed to quickly evaluate the economic performance of new technologies under user-defined geothermal resource and demands.
- 24% of U.S. primary energy is used for heating below 120°C (248°F), mostly met by electricity and natural gas.
- US low-temperature geothermal resources (<90°C/194°F) have potential to provide 42,600 MW_{th} heat; less than 2% of this has been installed.
- In addition to hydrothermal resources, 25 billion barrels/year of geothermal fluid (mostly water) at 80–150°C are co-produced at oil and gas wells in the US (DOE 2015).



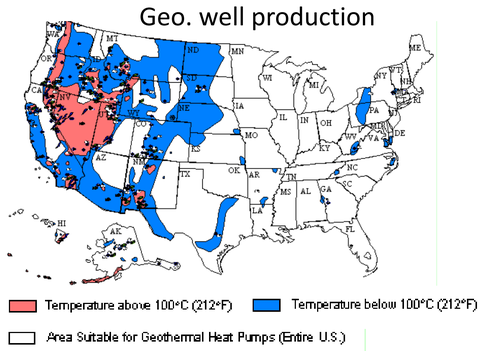
Highlights



Method

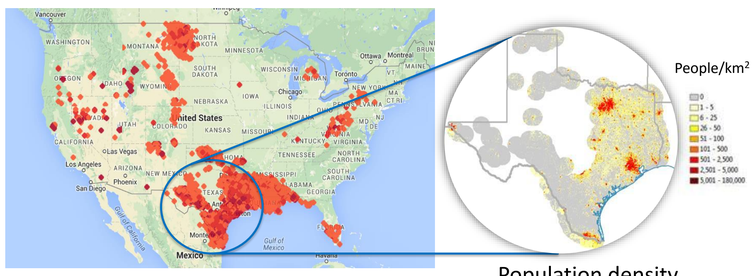
- **Review available low-temperature geothermal resources**

Geo. well production



Location of geothermal resource areas
(http://geoheat.oit.edu/dusys.htm)

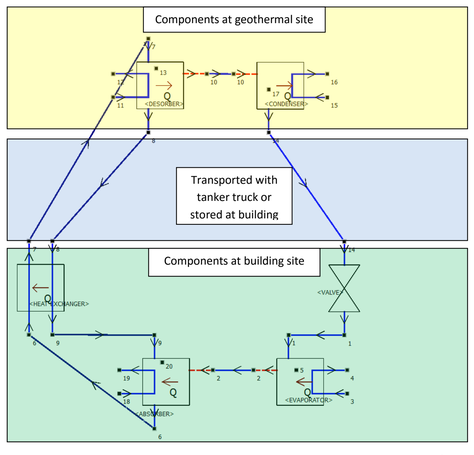
Co-production

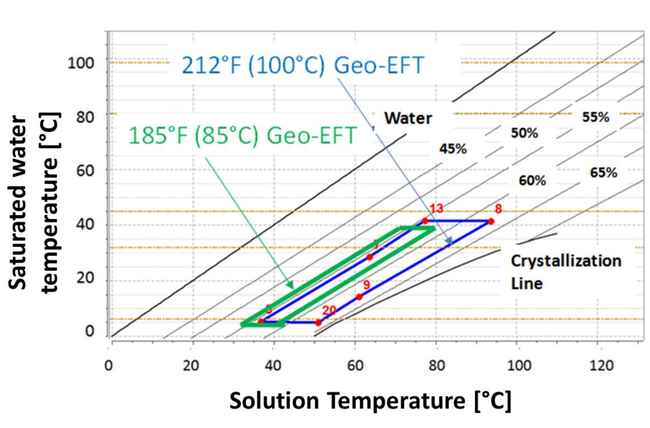


Locations of oil/gas wells with bottom borehole temperature >215°F (102°C)
(map generated with NREL Geothermal Prospector)

Population density within a 50 km radius of oil/gas wells in Texas
(Xiaobing Liu et al., 2015)

- **Design proposed system for target commercial buildings**

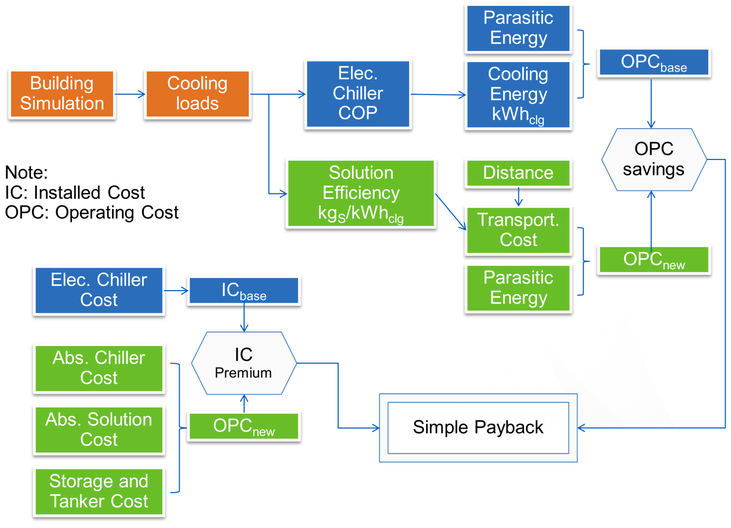




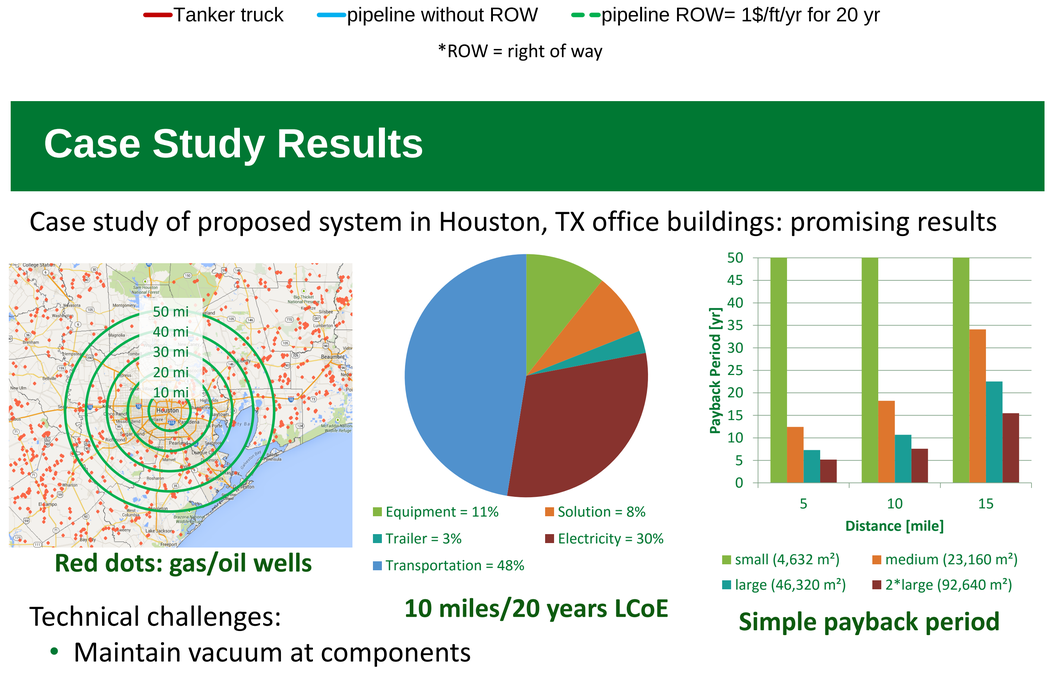
Design parameters determined with ORNL's SorpSim program

- **Economic analysis**

Key performance metrics:
- Simple payback period
- Cooling provided per unit primary energy consumed:
  - Transportation fuel
  - Electrical loads
- National/regional technical potential energy savings vs. baseline system



Case Study Results



Case study of proposed system in Houston, TX office buildings: promising results

Red dots: gas/oil wells

10 miles/20 years LCoE

Simple payback period

Technical challenges:
- Maintain vacuum at components
- Reduce required volume of absorption working fluid
- Design of two new semi-open, "half-absorption systems" (hardware, controls)
- Adapt to varying production and sparse distribution of geothermal resources

Conclusions

- The proposed two-step geothermal absorption (TSGA) technology has potential to utilize low-temperature geothermal energy to provide space cooling to buildings at some distance from the geothermal resources.
- It can reduce fossil fuel consumption, peak electric demand, and avoid using refrigerants with high potentials for global warming and ozone depletion.
- Improving the transported energy density can reduce the transportation cost and stretch the viable distance.

OAK RIDGE National Laboratory

U.S. DEPARTMENT OF ENERGY