



Geothermal Industry Outlook & SPE Geothermal Technical Section Events

Camilo Mejia
SPE GTTS Chairperson
SEVP Exceed Geo Energy – CEO Enovate
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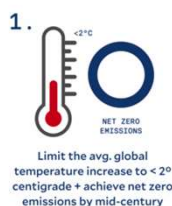


Advancements in emerging
sub-surface technologies have the
potential to scale-up geothermal
development worldwide

Oil and Gas has a lot to do.....



SPE COMMITMENT TO THE PARIS AGREEMENT



The transition to clean energy is critical for achieving the Paris Agreement, which aims to limit the increase in global average temperatures to less than 1.5°C above pre-industrial levels. One of the pillars of the sustainable energy transition is the widespread adoption of renewable energy solutions to lower and eventually eliminate the emission of greenhouse gases from global energy systems. Accelerated deployment of renewable energy solutions such as solar, wind, hydropower, geothermal, bioenergy and ocean energy can put the Paris climate goals within reach. To this end, all renewable energy sources will be needed to create an optimal mix matched to local resource availability and energy market conditions.



SPE GEOTHERMAL TECHNICAL SECTION



- 01 Optimizing costs and resources in business models
- 02 Revolutionizing reservoir modelling
- 03 Sharing digitalization best practices
- 04 Exploration and development drilling and completion
- 05 Supporting related R&D activities
- 06 Addressing flow assurance, project planning, product delivery & operations management
- 07 Workovers, facility designs, and operations



The SPE GTTS is intended to accelerate the translation of technologies and ways of working across the two industries to reduce the risk and costs of geothermal projects.

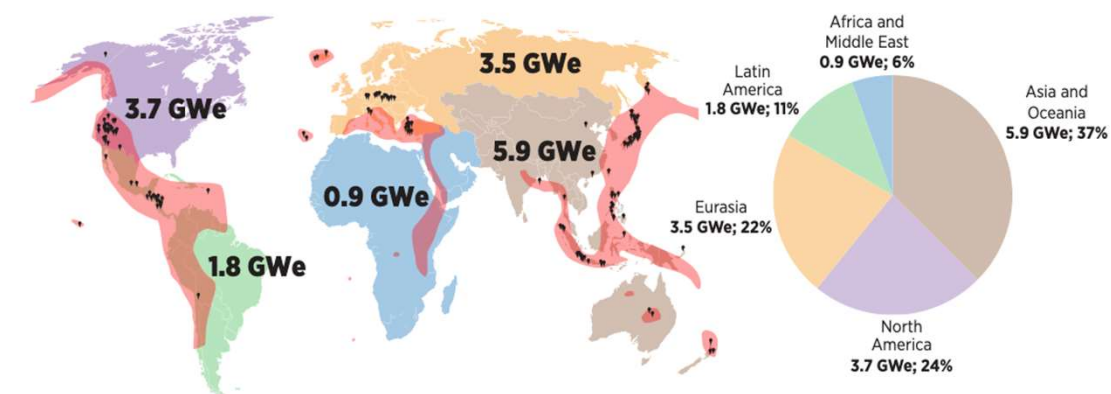


Knowledge Transfer Platform



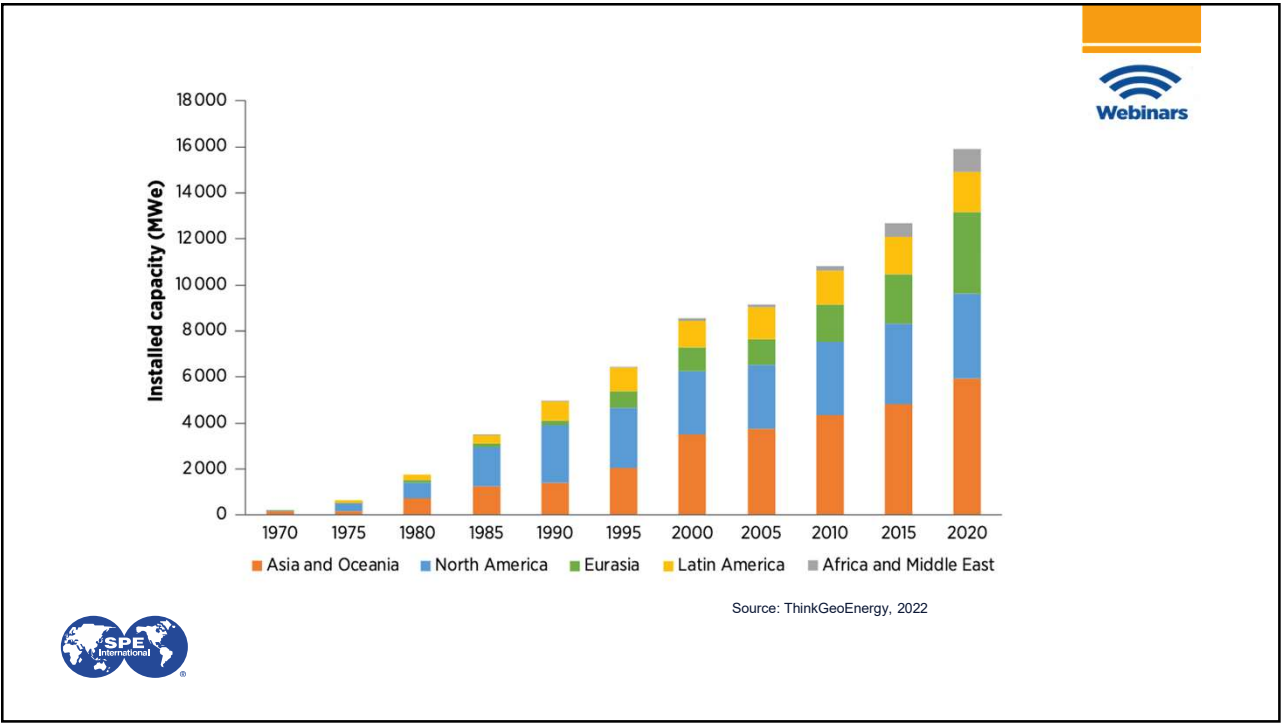


INSTALLED GEOTHERMAL ELECTRICITY



Source: IRENA, 2022a; ThinkGeoEnergy, 2022 (b); Hutterer, 2021







The INTERNATIONAL ENERGY AGENCY expects geothermal power generation to rise to up to 857TWh by 2050—an 800pc increase compared with the 94TWh generated in 2020. And, according to consultancy Rystad Energy, geothermal investment is expected to reach \$85bn between 2020 and 2030.

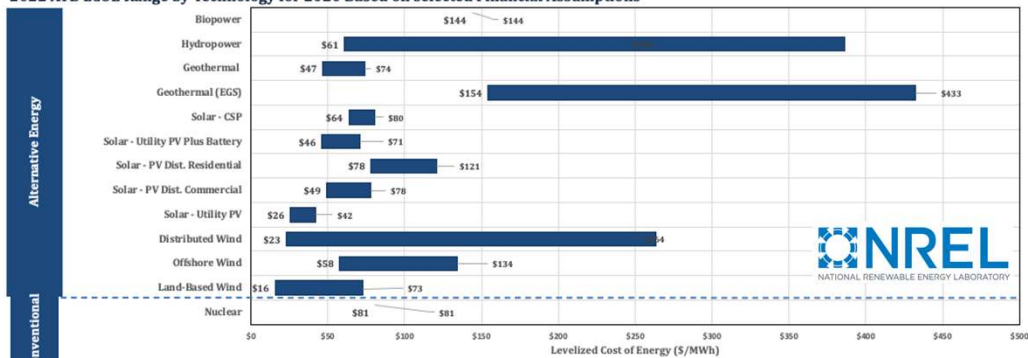


Source: IRENA, 2022a; ThinkGeoEnergy, 2022 (b); Hutterer, 2021

Levelized Cost of Energy (LCOE) has to be competitive, and its reliability means it has a role as part of an integrated low-carbon energy solution alongside wind, solar, wave, hydrogen and battery storage.

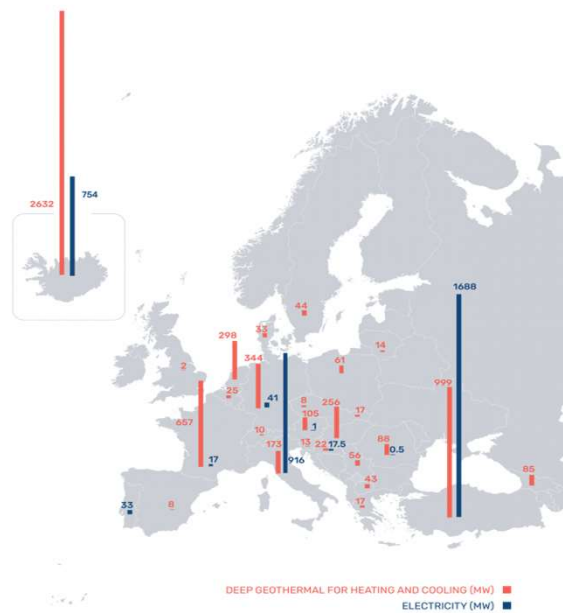


2022 ATB LCOE Range by Technology for 2020 Based on selected Financial Assumptions



*LCOE calculates present value of the total cost of building and operating a power plant over an assumed lifetime.

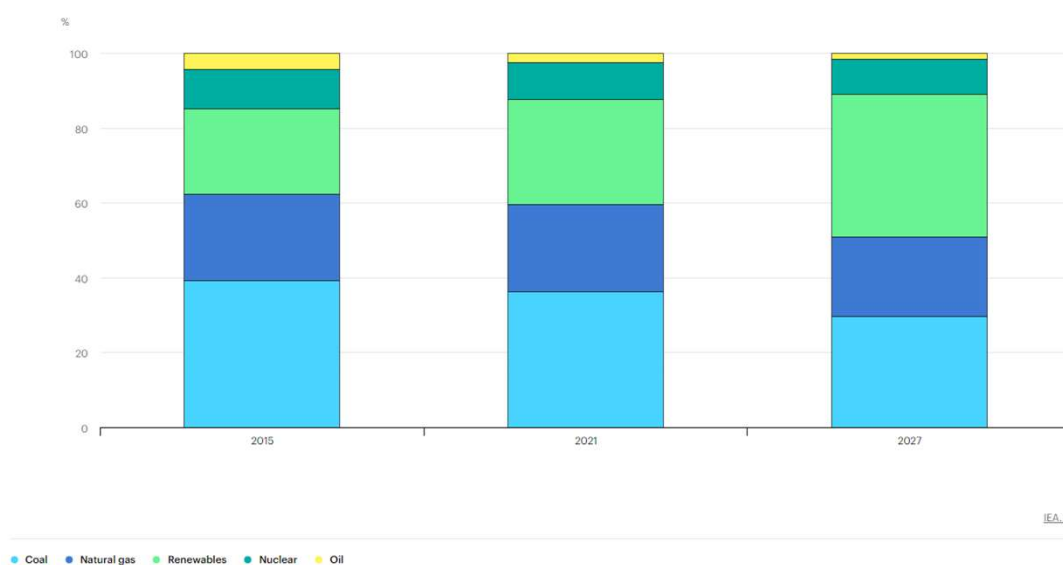
The IEA anticipates that faster deployment of renewables and efficiency improvements in the EU will bring down natural gas and oil demand by 20pc this decade. However, there is an increased urgency to seek out and deploy new energy sources as the world needs affordable, environmentally sustainable and reliable energy.



Source: European Geothermal Energy Council (EGEC)

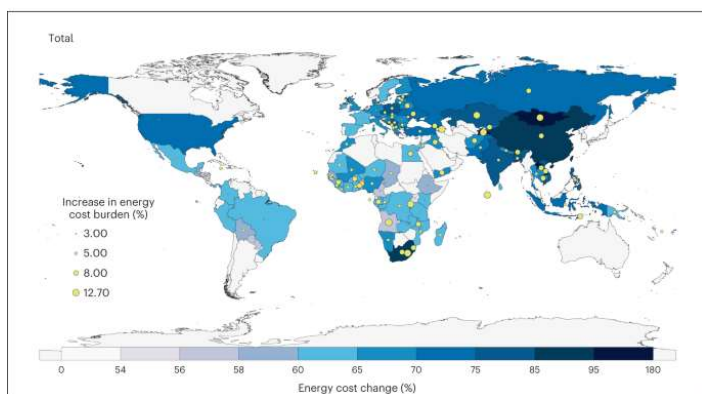
A major driver of growth in renewable power over the next five years will be countries implementing policies more quickly in order to combat the energy crisis. IEA says.

Global electricity generation by technology, 2015, 2021 and 2027



IEA. Licence: CC BY 4.0

ENERGY SECURITY DRIVES RENEWABLES GROWTH



The size of the circle refers to the change in the per capita energy cost burden rate (that is, the additional energy cost as a percentage of total household expenditure)

Source: World Countries





GEO THERMAL IS HOT!

The time is NOW.....





- What have occurred in recent years?
- What trends have affected the geothermal sector?
- Which technologies are expected to drive growth?
- How have global and regional events and changes affected the geothermal industry?



ENTHALPY ENVIRONMENTS

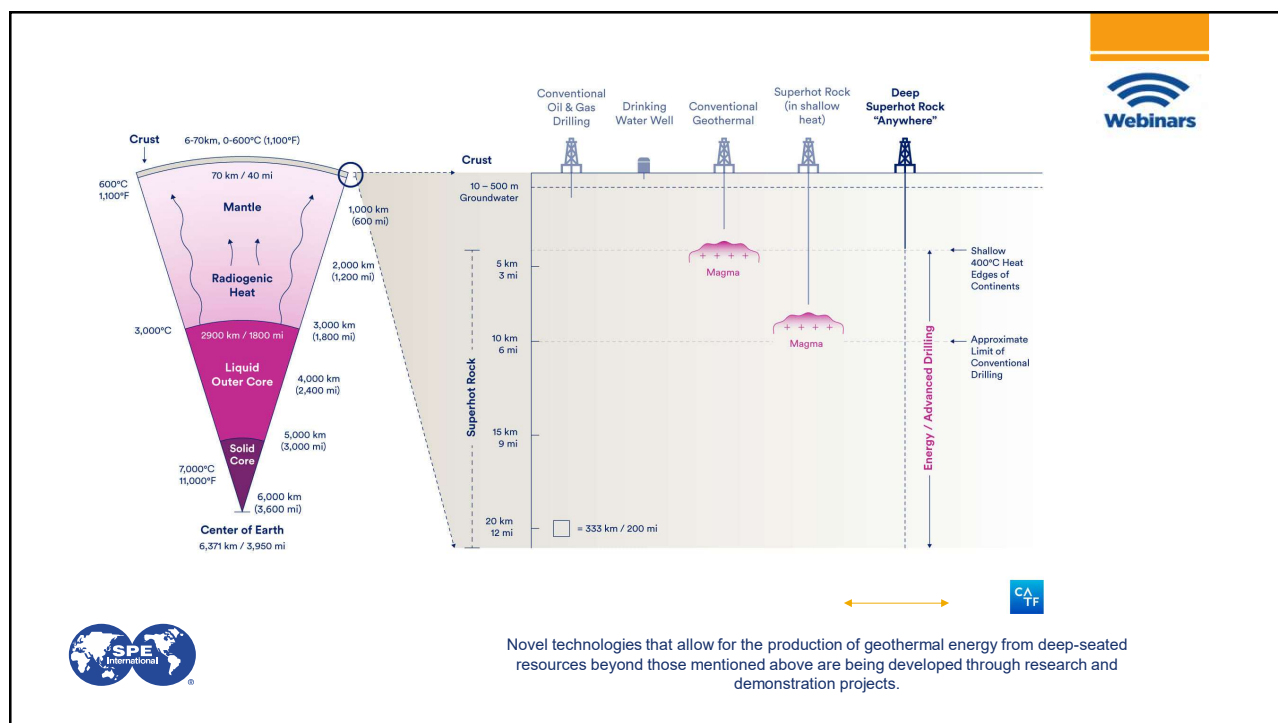


Most high-temperature geothermal resources are found around volcanoes in areas that are tectonically and volcanically active, such as the Pacific Ring of Fire, the mid-Atlantic ridge, parts of Europe and the East African Rift. Depending on the local sub-surface temperature gradient, these resources can be found at depths of a few hundred meters (m) and several kilometers (km).

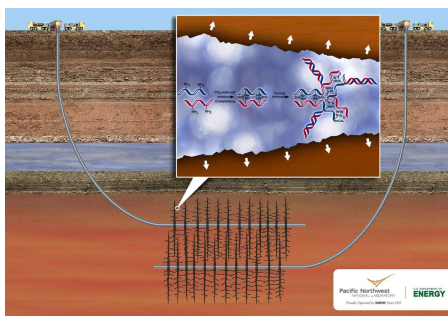
Low - and medium-temperature resources are more widely distributed geographically, with significant resources along faults and fractures in tectonically active areas as well as deep in sedimentary basins. As sedimentary basins usually have lower temperature gradients than volcanic areas, deeper drilling (to several kilometers) is usually necessary to reach sufficient reservoir temperatures.

The stable, low-temperature (near-ambient temperature) conditions in the shallow sub-surface are also widely used through GHPs to provide efficient space heating and cooling.





ENHANCED OR ENGINEERED GEOTHERMAL SYSTEMS (EGS)

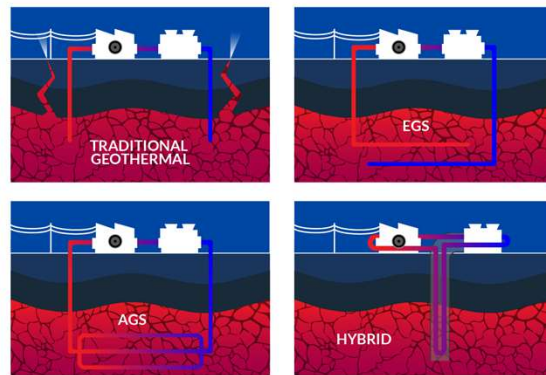


improve the permeability of geothermal systems through hydraulic, chemical and thermal stimulation. This stimulation can be done in some geological settings that have high sub-surface temperatures but where fluid volumes and/or rock permeability are not sufficient to permit economic extraction using current techniques. In such cases, permeability can be enhanced by stimulating the reservoir through pumping of water (or other fluids, such as carbon dioxide [CO₂]) to fracture the rock, thereby creating an artificial reservoir

ADVANCED GEOTHERMAL SYSTEMS (AGS)



are deep, large, artificial closed-loop circuits in which a working fluid is circulated and heated by sub-surface rocks through conductive heat transfer. As AGSs do not require a water-bearing reservoir with good permeability, they have the potential to be applicable in almost any location worldwide. However, substantially longer well bores are required to increase the surface area for heat transfer, which may result in higher drilling costs



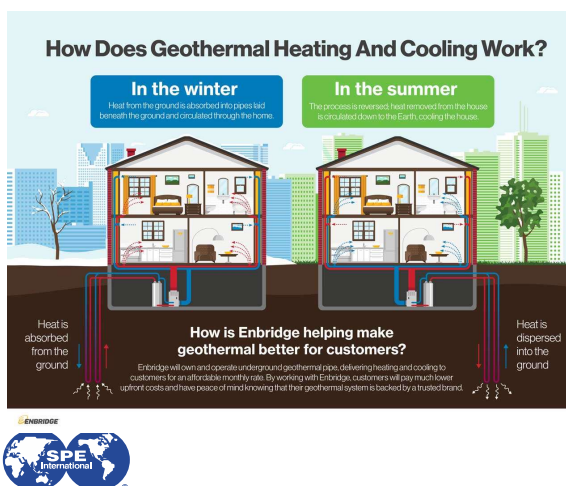
SUPERCRITICAL GEOTHERMAL SYSTEMS



are characterized by very high temperatures and a natural reservoir containing fluid in the supercritical state. For pure water, this means a temperature of at least 374°C and a pressure of at least 221 bar (Reinsch et al., 2017). Such supercritical fluids can be found deep in volcanic hydrothermal systems in Iceland, Japan, Kenya, Mexico and New Zealand, among other locations. The productivity of such supercritical systems could be much greater than conventional high-temperature geothermal systems, because of the higher energy content of the fluid.

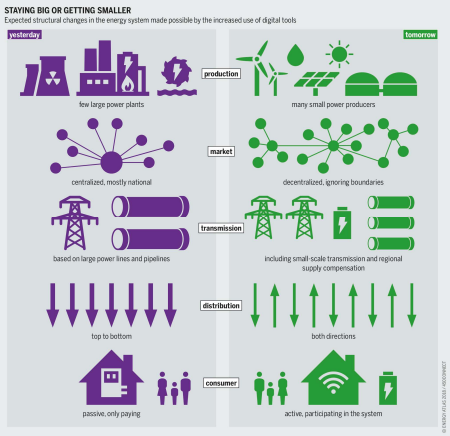


GEOHERMAL HEATING AND COOLING



Geothermal energy for heating and cooling can be obtained at varying depths. Geothermal fluids can be extracted from shallow wells that are a few hundred metres deep using GHPs or from deep wells of several kilometres in depth. With heat exchange, heat (or cold) can also be artificially stored in the shallow sub-surface using heat pumps to create underground thermal energy storage (UTES) systems and then used later for heating or cooling applications. The major categories of geothermal heating and cooling applications are space heating and cooling; agriculture and food processing; industrial process heat; and health, recreation and tourism

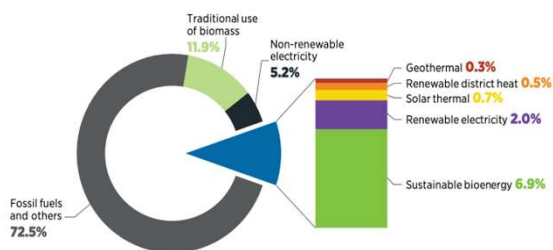
SMART AND CLEAN CITIES



DIVERSIFICATION OF THE ELECTRICITY MIX



To achieve the energy transition, every country needs an optimal combination of renewable sources. As countries increasingly deploy wind and solar energy, geothermal can play an important role by compensating for their variable operation



Source: IRENA, 2021



CURRENT TRENDS IMPACTING ELECTRICITY MIX AND GEOTHERMAL DEV

1. Climate change politics and policies
2. Sustainable energy for heating and cooling
3. Global events affecting energy markets
4. Financial and economic incentives
5. Financing and risk mitigation
6. International collaboration
7. Local policies and regulations



2023 GTTS STRATEGY :
#COLLABORATION

1. GREEN HYDROGEN PRODUCTION USING GEOTHERMAL ELECTRICITY

Generation of hydrogen is an energy-intensive process. Renewable sources, including geothermal, are increasingly being promoted to reduce the carbon footprint of hydrogen generation. For example, geothermal electricity can be used to power the electrolyser in the hydrogen generation process.

2. MINERAL RECOVERY FROM GEOTHERMAL BRINES AND OTHER SYNERGIES WITH THE MINING INDUSTRY

Minerals such as lithium, silica, zinc, manganese, several rare earth elements and potentially many other elements can be recovered from geothermal brines and sold commercially. Extraction of lithium from geothermal brine, for example, could be of value to produce batteries in a more environmentally sustainable manner compared to traditional lithium production from dry salt lakes or hard-rock mining.

3. CARBON CAPTURE AND STORAGE

Carbon capture and storage technologies exploit the geological conditions of areas that harbor geothermal resources, using them to store CO₂ that otherwise would be released into the atmosphere. CO₂ can be injected back into the geothermal reservoir for permanent storage through natural mineralization, as it is in the Carbfix initiative in Iceland.

4. REUSE OF OIL AND GAS WELLS

Repurposing depleted or late-stage oil and gas wells is really a large financial opportunities. In the US only, this is a multi—million-dollar market

5. REPURPOSE OF MINES

Several projects in Canada and Europe use abandoned and flooded coal mine shafts to extract geothermal energy and store thermal energy. In Europe, examples of such systems are found in the Netherlands, Spain, the extraction of geothermal fluids contemporaneously with mining operations provides electricity for operations at the gold mine while also providing electricity for nearby communities.



GEOHERMAL INDUSTRY CHALLENGES TOP 3 – SPE GTTS



Paul Choate
GTTS Vice- Chair

1. Energy Investments
2. Engineering Cost
3. Technology Evolution/Innovation

There has been more innovation in the past 3-5 years than the 20 years before..... the oil and gas industry is driving most of it.....



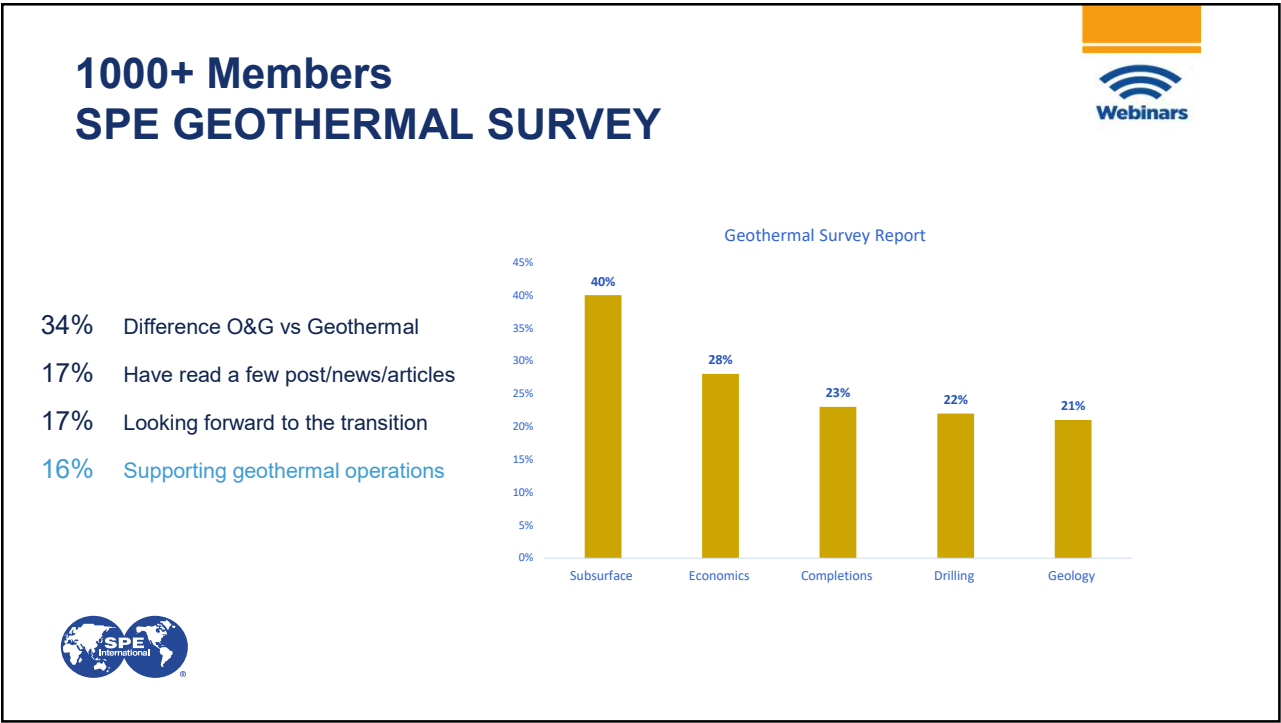
2023 GTTS STRATEGY #collaboration



With:

- Geothermal Industry
- Oil and gas Industry
- Academy
- Research
- International Associations
- Governments
- Financial community
- SPE Members





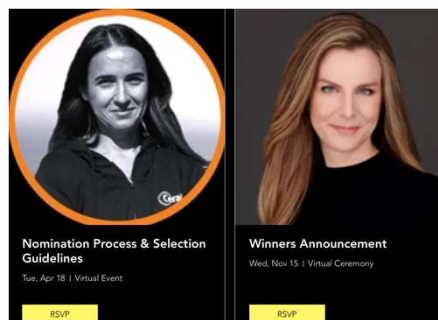
1. SPE GTTS – Geothermal Industry Awards (GIA)

#COLLABORATION W/ FINANCE



The GIA Event will recognize petroleum engineer professionals, companies and institutes that are making the difference to achieve geothermal energy at scale for both: Power Generation and Direct Heat. The categories for nomination are:

1. Commercial Models
2. Asset Repurposing
3. Emerging Innovation
4. Reservoir Engineering
5. Digital Innovation
6. Well Construction
7. Decarbonization
8. Cross- Industry collaboration
9. Iconic SMEs.



Higinia Torregrosa
GTTS Director of Training

Rebecca Schulz
GTTS Founder

2. GEOTHERMAL TRANSITION SUMMIT

COLLABORATION W/ ASSOCIATIONS



GTS 2023 NA HOUSTON
GEOTHERMAL TRANSITION SUMMIT, NORTH AMERICA
MAY 23 - 24

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GEOTHERMAL TRANSITION SUMMIT NORTH AMERICA

Utilize cross-sector collaboration to enhance geothermal production and commercial optimization by introducing innovative tech, reservoir management and well ops from the O&G community

Date: 23-24 May 2023
Location: Houston, Texas

[REGISTER HERE](#)
[VIEW AGENDA](#)



3. SPE WORKSHOP

COLLABORATION W/ SPE RESERVOIR ADVISORY





Jerjes Porlles
GTTS Director Reservoir Engineering



Vicent Artus
GTTS Program Chair



SPE Workshop: Reservoir Aspects of Geothermal Systems

15-16 AUGUST 2023 | GALVESTON, TEXAS, USA




Discuss the state-of-the-art of reservoir engineering for geothermal operations, identify new best practices, and discuss the future challenges of reservoir engineering to accelerate the success of new innovative technology.

REGISTER TODAY 

4. SPE ATCE SPECIAL SESSIONS

COLLABORATION W/ MULTIPLE SPE SECTIONS



Tony Pink
GTTS Director of External
Engagement

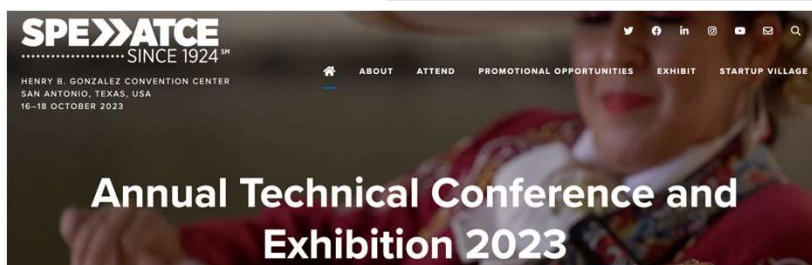
1. Drilling Automation
2. Reuse Of Oil And Gas Wells
3. Heat Flow In Hot Dry Rock

What area of the geothermal industry are you interested to learn in 2023 the most?

You can see how people vote. [Learn more](#)

Heat flow in hot dry rock	29%
Temperature limits of Drilling	15%
Reuse of Oil and Gas wells	46%
Surface Technology	10%

202 votes • 1d left • [Undo](#)



5. SPE WORKSHOP

COLLABORATION W/ GEOTHERMAL RISING



Matthew Holdeman
GTTS Director of Well Engineering



Tony Pink
GTTS Director of External Engagement



SPE/GR Workshop: Geothermal and Oil & Gas - Mutual Challenges and Solutions
14 - 15 Nov 2023 | Denver Hilton Inverness | Englewood, Colorado, USA

Home About Sponsor

The Society of Petroleum Engineers (SPE) and Geothermal Rising (GR) have developed a workshop to address mutual problems and solutions in the field of Geothermal and Oil & Gas drilling, completions and long-term production. Both industries have been borrowing tools and technologies from each other for decades, and this workshop has been designed as an opportunity to continue to examine possible solutions and delve into issues that have increased well costs and limited productivity.

SPE Workshop

6. SPE WORKSHOP

COLLABORATION W/ SPE DATA SCIENCE AND ANALYTICS



Pushpesh Sharma
GTTS Membership Chair

SPE GEOTHERMAL DIGITAL AND AUTOMATION WORKSHOP January 2024



7. MONTHLY SPOT HIGHLIGHT

Geothermal Start Ups Webinar

#Collaboration w/ SPE Technical Directors



Jesus Capo
GTTS Administration Chair



Jesse Nyokabi
GTTS Digital Webmaster



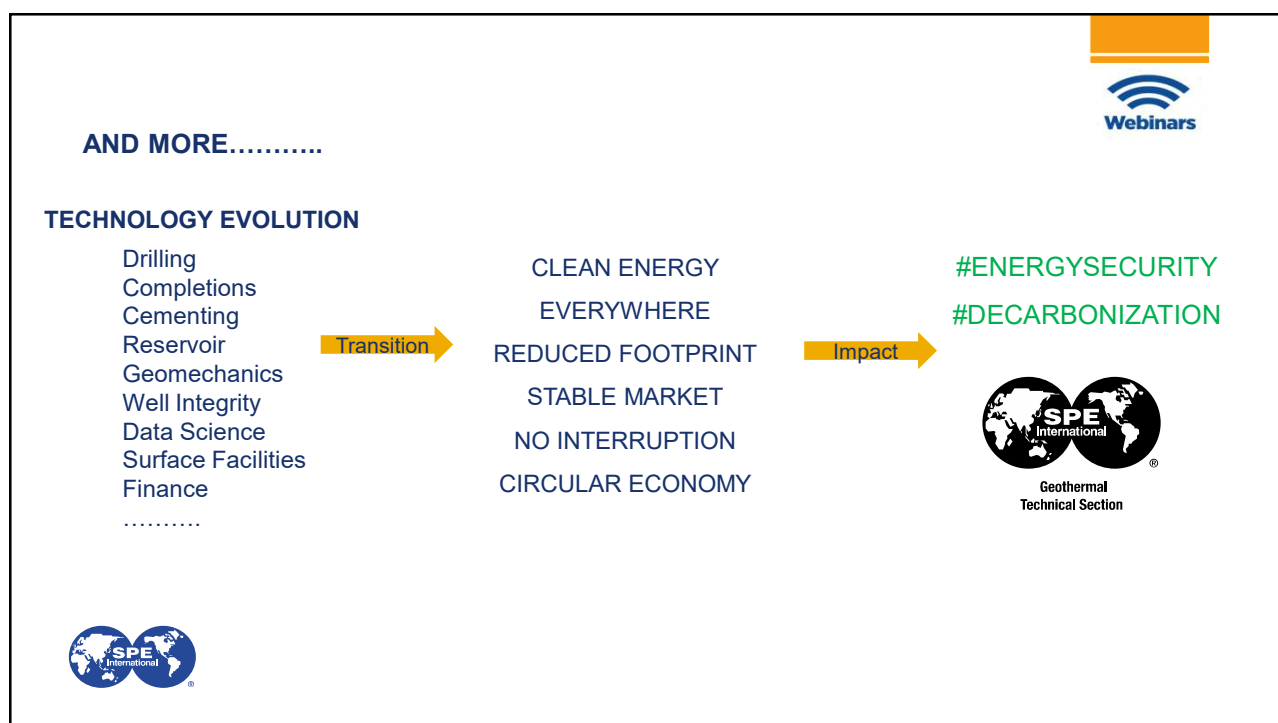
SPE LIVE & WEBINARS



SPE Live:
**Application of the UNFC to Geothermal
Energy Resources**







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