

GLOBAL GEOTHERMAL ALLIANCE

Co-ordinated by



TAP INTO GEOTHERMAL INSIGHTS AND EXPERIENCE



The Alliance aims to foster an enabling environment to attract investments in geothermal power generation and direct use of geothermal heat

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The Global Geothermal Alliance (GGA) serves as a platform for dialogue, co-operation and co-ordinated action between the geothermal industry, policy makers and stakeholders worldwide.¹

Launched at COP21,² the GGA is a coalition for action to increase the use of geothermal energy, both in power generation and direct use of heat. It calls on governments, businesses and other stakeholders to support the deployment of realisable geothermal potential.

The Alliance has an aspirational goal to achieve a five-fold growth in installed capacity for geothermal power generation,³ and a three-fold growth in geothermal heating and cooling by 2030,⁴ compared to 2014 levels.



2nd High-Level conference of the Global Geothermal Alliance

What the Alliance does

The GGA aims to foster an enabling environment to attract investments in geothermal power generation and direct use of geothermal heat. The Alliance provides customised support to regions and countries with geothermal market potential and facilitates the exchange of insights and experience among key stakeholders in the geothermal energy value chain. It identifies and promotes models for sharing and mitigating risks, attracting private investment and integrating geothermal facilities into energy markets. It also helps to streamline outreach efforts to give geothermal energy greater visibility in the global energy and climate debates.

¹ Objectives and principles of the Alliance are stipulated in the Joint Communiqué on the Global Geothermal Alliance, available at www.GlobalGeothermalAlliance.org.

² The 21st Conference of the Parties to the United Nations Framework Convention on Climate Change (UNFCCC), held in Paris, France, in December 2015.

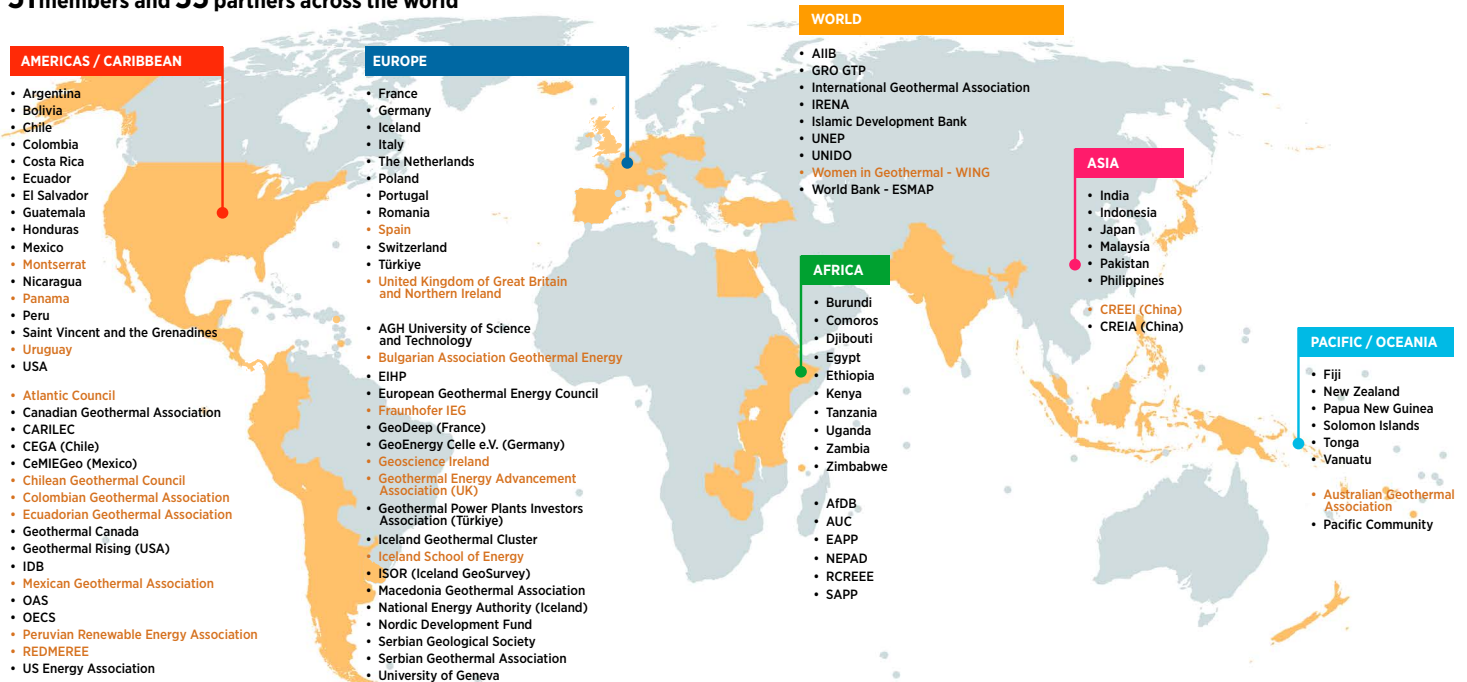
³ Based on REmap analysis – a global roadmap to double the share of renewables in the energy mix.

⁴ The Scaling Up Geothermal Heating and Cooling Compact developed by IRENA and the International Geothermal Association for the benefit of the GGA in the framework of the UN High-Level Dialogue on Energy.

Members

Argentina, Bolivia, Burundi, Chile, Colombia, Comoros, Costa Rica, Djibouti, Ecuador, Egypt, El Salvador, Ethiopia, Fiji, France, Germany, Guatemala, Honduras, Iceland, India, Indonesia, Italy, Japan, Kenya, Kingdom of the Netherlands, Malaysia, Mexico, Montserrat, New Zealand, Nicaragua, Pakistan, Panama, Papua New Guinea, Peru, Philippines, Poland, Portugal, Romania, Saint Vincent & the Grenadines, Solomon Islands, Spain, Switzerland, Tonga, Türkiye, Uganda, United Kingdom of Great Britain and Northern Ireland, United Republic of Tanzania, United States of America, Uruguay, Vanuatu, Zambia, Zimbabwe.

51 members and 55 partners across the world



* In orange: Members/partners joining in 2021-22.

Disclaimer: This map is provided for illustration purposes only. Boundaries and names shown on this map do not imply any endorsement or acceptance by IRENA.

Partners

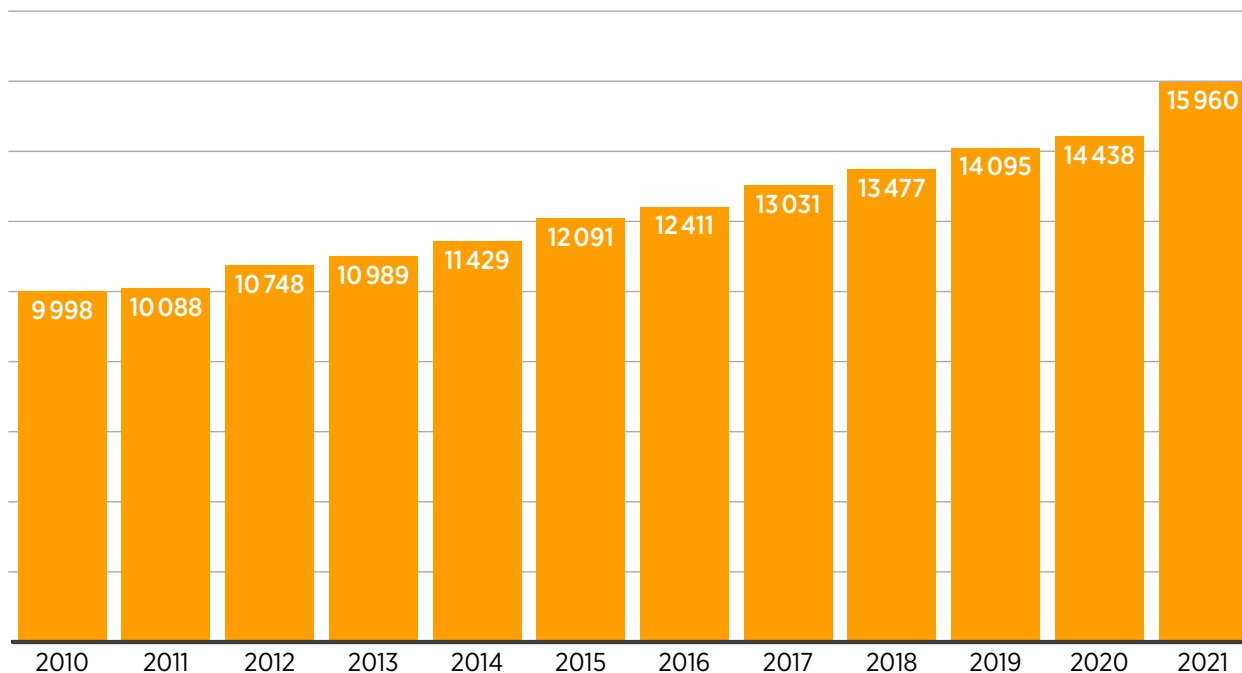
African Development Bank, African Union Commission, AGH University of Science and Technology (Poland), Andean Geothermal Center of Excellence (Chile), Asian Infrastructure Investment Bank (AIIB), Association GeoEnergy Celle e.V. (Germany), Australian Geothermal Association, Atlantic Council, Bulgarian Association Geothermal Energy, Canadian Geothermal Energy Association, Caribbean Electric Utility Services Corporation (CARILEC), Centro Mexicano de Innovación en Energía Geotérmica (CeMIEGeo), Chilean Geothermal Council, China Renewable Energy Engineering Institute (CREEI), Chinese Renewable Energy Industries Association (CREIA), Colombian Geothermal Association, Eastern African Power Pool, Ecuadorian Geothermal Association, Energy Institute Hrvoje Požar (Croatia), European Geothermal Energy Council, Fraunhofer IEG, Geothermal Canada, GEODEEP - Geothermal Cluster for Heat and Power (France), Geoscience Ireland, Geothermal Energy Advancement Association, Geothermal Power Plants Investors Association (Türkiye), Geothermal Rising (USA), Geothermal Training Programme in Iceland (GRO GTP), Iceland GeoSurvey, Iceland Geothermal Cluster Initiative, Iceland School of Energy, Inter-American Development Bank, International Geothermal Association, International Renewable Energy Agency, Islamic Development Bank, Macedonian Geothermal Association, Mexican Geothermal Association, National Energy Authority (Iceland), New Partnership for Africa's Development, Nordic Development Fund, Organization of American States, Organisation of Eastern Caribbean States, Pacific Community, Peruvian Renewable Energy Association, Regional Center for Renewable Energy and Energy Efficiency, Renewable Energy and Energy Efficiency Women's Network (REDMEREE), Serbian Geological Society, Serbian Geothermal Association, Southern Africa Power Pool, United Nations Environment Programme (UN Environment), United Nations Industrial Development Organization (UNIDO), United States Energy Association (USA), University of Geneva, Women in Geothermal, World Bank.

*GGA members and partners of as of December 2022.

GLOBAL TRENDS FOR GEOTHERMAL ELECTRICITY AND DIRECT USE

The installed capacity for geothermal electricity has continued to grow over the years, albeit at a modest rate. A multi-stakeholder approach can support the accelerated deployment of geothermal energy.

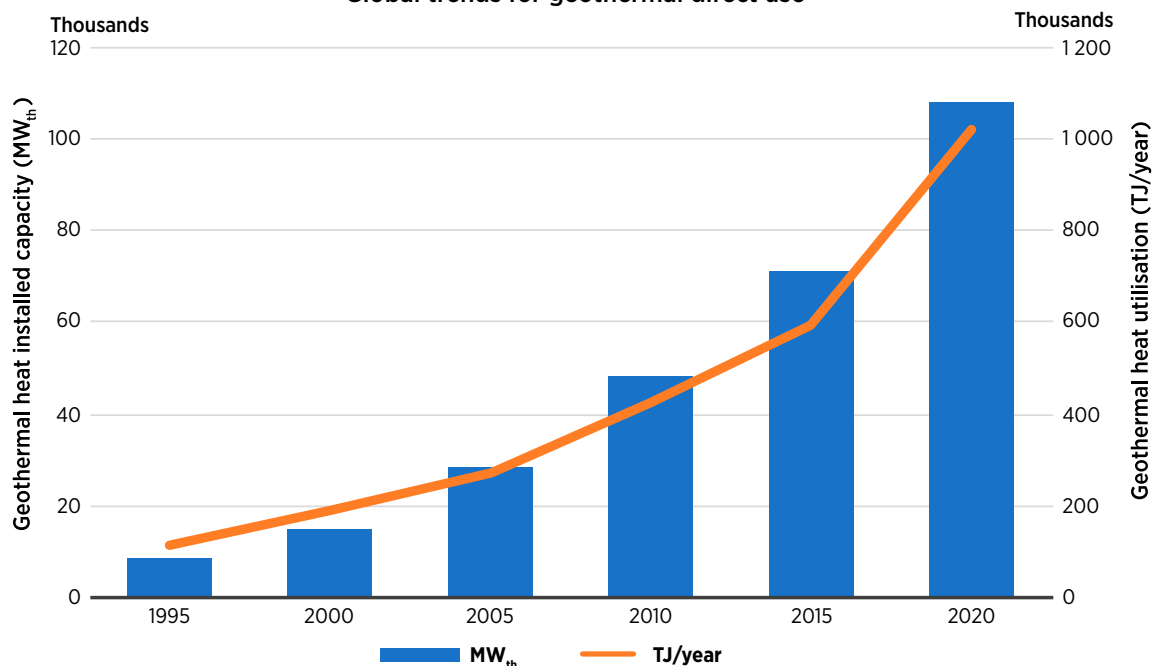
Global trends for geothermal electricity capacity (MWe)



Source: IRENA Statistics, 2022.
Note: MWe = Megawatts electric.

Direct use is an important component of geothermal utilisation with applications in heating and cooling of buildings, bathing and swimming, greenhouse heating, aquaculture heating and industry.

Global trends for geothermal direct use



Note: MW_{th} = Megawatts thermal; TJ/year = terajoule/year.
Source: Adopted from Lund and Toth (2020).

GGA ACTION PLAN

Based on the principles stipulated in the GGA Joint Communiqué at the launch in Paris, the GGA Action Plan was endorsed by Members and Partners in May 2016.

The Action Plan identifies focus areas for GGA action and the modalities for implementation and funding. The Alliance aims to co-ordinate closely with existing structures, programmes and facilities that share the common objective of promoting geothermal energy deployment at the international, regional and national levels. It operates based on activities linked to the Action Plan, supported in implementation and funding by committed Members and Partners.

Priority Action Areas

- **Action 1 – Resource and Market Assessment:** Identification and mapping of geothermal resources for development, including existing and potential geothermal market status and near-term projects in the pipeline.
- **Action 2 – Needs and Obstacles Assessment:** Scoping the need for assistance of countries with transformative potential; can involve removing obstacles, such as policy, regulatory, funding capacity building.
- **Action 3 – Enabling Frameworks:** Supporting the development of effective enabling policy, regulatory and institutional frameworks as well as relevant legal, fiscal and capacity building activities, to achieve national objectives for geothermal energy deployment; facilitating access and proposing improvements to financing and risk mitigation instruments.
- **Action 4 – Global Geothermal Network:** Establishing and improving a robust global network of geothermal energy experts that builds upon existing networks; promoting geothermal energy's role in supporting decarbonisation strategies and the implementation of national climate plans.

Who can join?

The GGA is an inclusive and neutral multi-stakeholder platform that brings together public, private, intergovernmental and non-governmental actors that share a common vision of accelerating the deployment of geothermal energy for power generation and other applications.

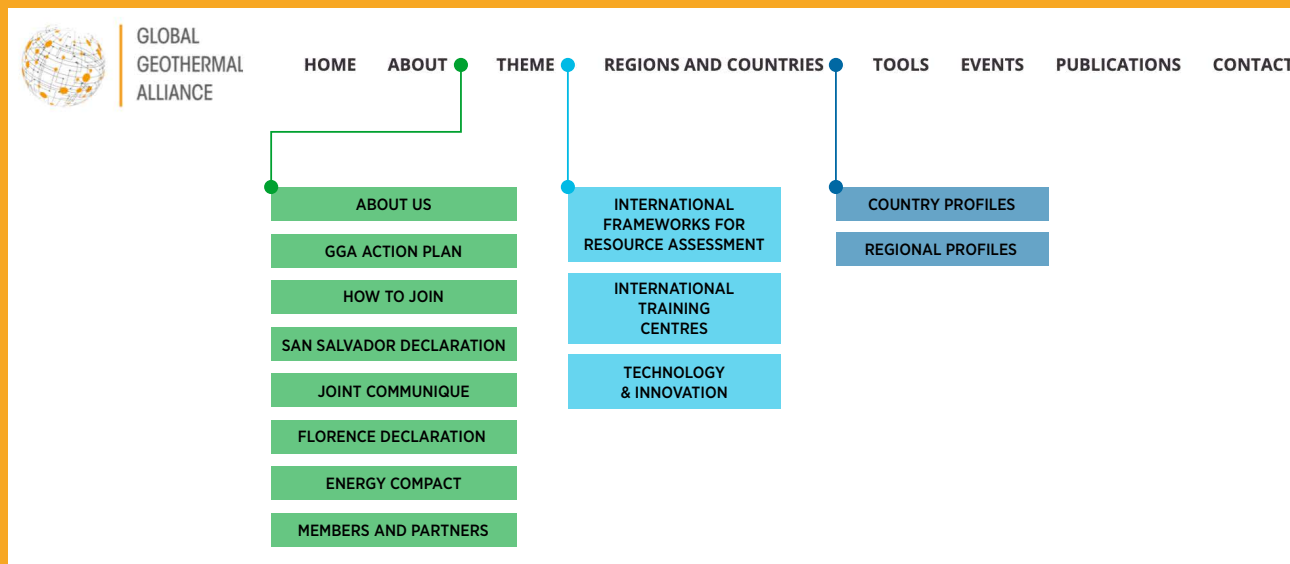
Member countries include those with resource potential that are established or emerging as geothermal markets, along with other countries that wish to support the activities of the Alliance.

Partner institutions include:

- Development partners, international and bilateral development organisations, international financial institutions, institutional investors, international organisations, and other geothermal energy development partners.
- Geothermal industry represented by geothermal business associations at the global, regional and national levels.
- Research and development (R&D) and academic organisations operating in the field of geothermal energy at the regional, national or subnational level.

Knowledge Sharing Platform

To enhance access to information, the GGA has developed a knowledge-sharing platform. The platform is an upgrade to the GGA website and aims to collate information from members and partners about their geothermal activities. The knowledge-sharing platform serves to streamline access to geothermal information to any interested party or individual.



The knowledge-sharing platform highlights activities being undertaken by different actors to address the barriers hindering geothermal development as well as those that have been implemented and resulted in a conducive environment for geothermal investment. Information about installed capacity for geothermal electricity and heat, international frameworks for resources assessment, international training centers, and country and regional geothermal profiles is available. Furthermore, technologies and innovations in geothermal development and utilisation are highlighted.

Becoming a Member or Partner

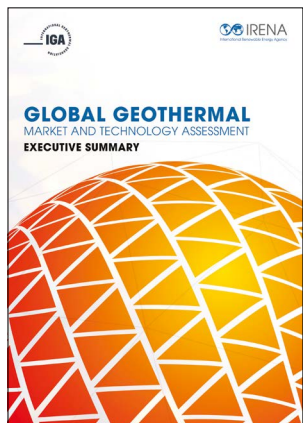
In line with the inclusive and neutral nature of the GGA, applying for membership or partnership is straightforward. Requests by interested countries and institutions should be sent to the International Renewable Energy Agency (IRENA), as the co-ordinator and facilitator of the GGA, by way of an official written request addressed to IRENA's Director-General (for countries) or the Director for Country Engagement and Partnerships (for partners).

- For country applications, IRENA confirms membership with the country and informs GGA Members and Partners accordingly.
- For institutional applications, IRENA seeks the consent of GGA Members, as per the GGA Joint Communiqué. Upon approval, IRENA confirms the partnership with the institution and informs GGA Members and Partners accordingly.

Member countries and partner institutions are not required to contribute any membership fee. The costs associated with GGA activities, including co-ordination meetings, shall be borne by participants.

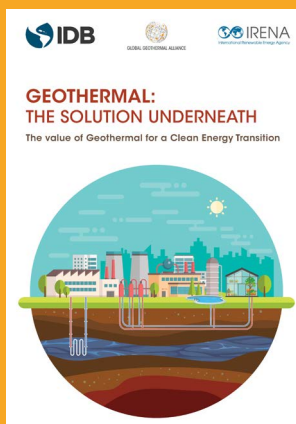
ADVANCING ENERGY TRANSITION WITH GEOTHERMAL ENERGY

Global Geothermal Market and Technology Assessment



The report provides an overview of the developments in the geothermal sector and the key elements that are likely to drive the geothermal market in the near future. It discusses the progress of geothermal energy today and the trajectory of its recent developments. It also reviews the status of geothermal technologies, with particular reference to new technological approaches and developments which have the potential to scale up geothermal utilisation. Furthermore, the different geothermal markets were analysed to establish the current and expected future place of geothermal energy in the global energy mix. The purpose of this report is to provide actionable recommendations to guide policy makers, governments, organisations, institutions, potential investors, development partners, and public and private sector stakeholders on how to promote market growth, demonstrate the potential of geothermal energy and further expand its integration within the global energy systems.

Geothermal: The Solution Underneath



Geothermal is a clean and abundant renewable source of energy. It is also a sustainable and resilient resource that offers base-load capability and grid flexibility, making it complementary with the integration of high shares of variable renewables. A publication by IRENA and the Inter-American Development Bank (IDB), *Geothermal: The Solution Underneath - The Value of Geothermal for a Clean Energy Transition*, provides insights into the benefits and competitive advantages of geothermal in the energy transition as shown below.

Geothermal energy resource are widespread around the world and can be utilised for both electricity generation and heating-cooling applications to support the global decarbonisation agenda.



Geothermal energy has the key to supply about 8.3% of the total electricity needs of the world and serve about 17% of the global population.



Total installed capacity of 15.4 GW and global technical potential of 200GW of electricity from hydrothermal systems.



Global technical potential of 5 000 GWt for geothermal heat applications.



The annual utilisation of geothermal heat was 1 020 887 terajoules (TJ) in 2020, an increase of about 72% compared with 2015; installed capacity for heating reached 107 GWt (from 70 GWt) during the same period (Lund and Toth, 2020).

Geothermal energy production generates negligible emissions and requires low water use and low land occupancy, while mitigating the effects of climate change.



Exploration



Drilling



Operation



Equipment manufacture

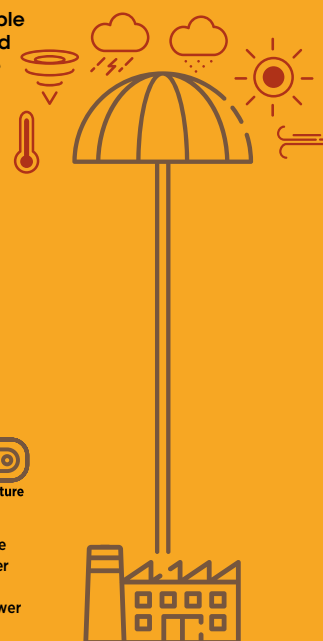
Low greenhouse gas
Life cycle emissions



The land occupancy of a geothermal power plant averages 7.5 km²/TWh.



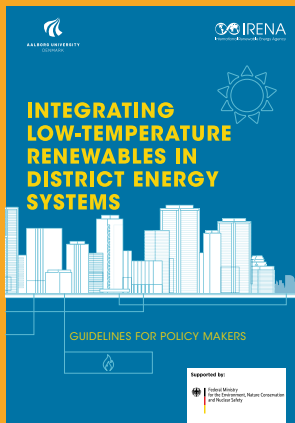
The full life cycle water usage of a binary power plant is 0.66 L/kWh.



DECARBONISING END USE SECTOR WITH GEOTHERMAL HEAT

Geothermal applications in district heating and cooling

District energy networks are an efficient way of supplying the heating and cooling needs of building. The networks are also an enabler for the deployment of locally available renewable energy solutions, including geothermal, to decarbonise the building sector.



In the framework of the “Energy Solutions for Cities of the Future” project, and under the umbrella of the Global Geothermal Alliance, IRENA in collaboration with Aalborg University, and with the support of an advisory group of experts on district heating and cooling developed a guidebook for policy makers on *Integrating low-temperature renewables in district energy systems*. The guidebook provides policy makers with examples of available tools and options to facilitate the use of low-temperature renewable heat sources such as low-temperature geothermal in new and existing district energy systems.

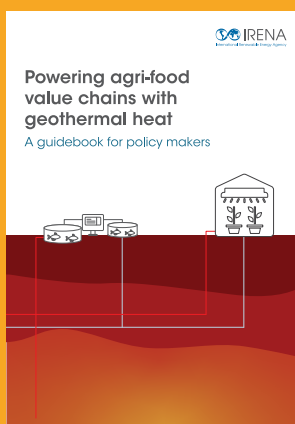
The guidebook is available in Chinese, English, Russian and Spanish; and includes a translated summary for policy makers.

The guidebook has been used for capacity building activities in countries and regions that have shown transformative potential to switch from the use of fossil fuels to clean heating options.

In the framework of the GGA, IRENA has collaborated with stakeholders in the **Western Balkans** (December 2019), **Belarus** (February 2021) **China** (March 2021), and **Mongolia** (May and June 2022) to carry out capacity building activities geared toward the deployment of renewable energy sources for district heating and cooling.

Geothermal applications in the agri-food sector

Renewable energy solutions can support the development of sustainable food systems to enhance food security for the growing world population. Due to their multiple streams, including electricity and heat, geothermal resources are uniquely positioned to enhance food production, processing and storage.



IRENA's publication, *Powering agri-food value chains with geothermal heat: A guidebook for policy makers*, provides recommendations for accelerating the deployment of geothermal energy in the agri-food sector by addressing challenges related to inadequate data on geothermal resources and existing heating demand for agri-food applications, absent or misaligned enabling framework conditions, inadequate financing, and a lack of awareness, among others. Key priority areas whose implementation would result in an accelerated development of geothermal agri-food applications are highlighted. The guidebook benefits from an analysis of key success factors, drawn from various global case studies, which have resulted in the successful deployment of geothermal heat in the agri-food sector. Several case studies of geothermal utilisation in the agri-food sector from Africa, Asia, Europe, the Americas, and Oceania are presented in the publication.

IRENA is co-operating with partners in the framework of the GGA to promote the application of geothermal heat in the agri-food sector globally. A **global dissemination webinar** was held in June 2022; while regional capacity building activities were held for **Africa** (July 2022) and **Latin America** (September 2022). Building on the findings of the guidebook, a short course on geothermal heat as an enabler for food security in Africa was conducted in Djibouti during the ARGeo C9 Conference (November 2022).

FOSTERING DIALOGUE AND SUPPORT AT COUNTRY AND REGIONAL LEVEL

1. GGA High Level Conference

IRENA and the Government of El Salvador, with the support of the International Geothermal Association organised the **Second High-Level Conference of the Global Geothermal Alliance** in September 2022 in San Salvador.



The event was attended by over 120 high-level representatives from the public, intergovernmental, non-governmental, and the private sector to discuss the role of geothermal as a key driver for energy transition towards sustainable development and climate action. Through the adoption of the outcome of the Conference, the **San Salvador Declaration**, which emphasised the need for international co-operation to create effective enabling frameworks for increased investments in geothermal energy, the countries reaffirmed their political commitment to accelerating geothermal development.

2. Engaging the Small Island Developing States (SIDS)

Geothermal energy could play a key role in meeting the energy requirement of the SIDS. Geographically, several SIDS are located along the earth's plate boundaries where tectonic and volcanic activities are high, resulting in excellent geothermal resources.



In the framework of the 2nd High-Level Conference of the Global Geothermal Alliance, GGA and IRENA's SIDS Lighthouses Initiative co-organised a side event to explore the place of **Geothermal as an Integral Energy Solution in the SIDS**.⁵ The side event was a platform for the SIDS stakeholders to share insights on what it would take to develop a thriving geothermal industry to serve their energy markets.

⁵ The SIDS Lighthouses initiative (LHI) is a framework for action to support Small Island Developing States (SIDS) in their energy transition efforts from fossil fuel dependence to renewables.

3. Powering agri-food value chains with geothermal heat - stimulating dialogue at the regional level

The use of geothermal heat in the agri-food sector is rising worldwide, with several examples in Africa, Asia, Europe, the Americas, and Oceania. However, more significant progress can be achieved with increased support in areas such as resource mapping, policy and regulations, financing, and capacity building, as well as with the development of tools that can enable policy makers to carry out assessments of geothermal heat utilisation, such as socio-economic impacts and heat pricing.

In the framework of the Global Geothermal Alliance, IRENA organised workshops in different regions to exchange experiences and share global best practices for accelerating the use of geothermal heat in the agri-food sector. The workshops were based on IRENA's guidebook for policy makers on **Powering Agri-food Value Chains with Geothermal Heat** and its flagship publication on **Renewable Energy for Agri-food Systems**.



Workshop in El Salvador



Workshop in Djibouti

- » **Global Webinar:** Organised in collaboration with the International Geothermal Association (IGA) and the United Nations Food and Agricultural Organisation (FAO) – May 2022
- » **Africa webinar:** Organised in collaboration with the United Nations Environment Programme (UNEP) – July 2022
- » **Latin American Workshop:** Organised in the framework of the 2nd High-Level Conference of the Global Geothermal Alliance, in collaboration with the Rio Lempa Hydroelectric Executive Commission (CEL) in San Salvador, El Salvador – September 2022
- » **Djibouti Training** – Organised in the framework of the African Rift Geothermal Conference (ARGeo C9), in collaboration with UNEP – November 2022



Greenhouse heating

4. Renewable energy solutions for heating and cooling

Cities are a major source of greenhouse gas emissions and air pollution due to the high concentration of energy consumption within city limits, which often relies on fossil fuels. Therefore, decarbonisation of urban energy systems is key to an effective energy transition for stronger climate action. Beyond the power sector, decarbonising the end use sectors, including the building sector, offers significant potential to reduce such emissions to achieve the climate objectives.

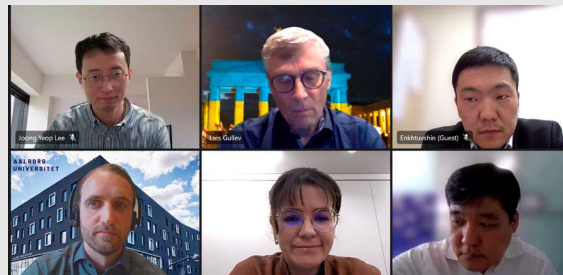
Strategic heating and cooling planning - Mongolia

In the framework of the Global Geothermal Alliance, IRENA is supporting the Government of Mongolia in the decarbonisation of its building sector through the implementation of renewable energy solutions in district heating systems. The support includes two components:

i. Capacity building for policy makers at the national, provincial, and local levels; urban planners; district heating utilities, etc. Two capacity building activities were held as follows:

» **Strategic Heating and Cooling Planning** - May 2022

» **Enabling framework conditions and addressing technical barriers** - June 2022



ii. Development of a Strategic Heating and Cooling Plan (SHCP), that entails mapping of the heating demand and renewable energy potential; and developing scenarios that the country can adopt in transitioning from fossil fuels to renewables in district heating systems.



Geothermal heated buildings and clear skyline in Reykjavik

**The Global Geothermal Alliance
is a coalition to increase the use of
geothermal energy, both in power
generation and direct use of heat**

For more information:

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www.GlobalGeothermalAlliance.org