CHAPTER 4

Create a Co-learning Environment for Geothermal Energy Communities Across the European and African Unions

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Policy Highlights To achieve the recommendation stated in the chapter title, we propose the following:

- Enable and encourage Geothermal Energy Communities (GECs) in the European Union and African Union.
- Acknowledge and embrace the potential of geothermal resources for energy communities.

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- Assess GECs' feasibility using interdisciplinary and participatory approaches.
- Investigate and address critical GEC issues, including financial obstacles and land politics.
- Develop an enabling and social learning environment for GECs.
- Ensure GEC projects are embedded in the community by using on-site transdisciplinary co-learning workshops that bring together Engineering, Social Scientists, and Geoscientists as well as community representatives and critical outsiders.

Keywords Subsurface · Social development · Participatory approach · Land politics · Community engagement

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4.1 Introduction

This chapter integrates three elements important to European Union (EU) energy policy: geothermal energy (herein 'geothermal') in the energy transition; communities as a key driving agent; and EU energy relations with Africa. Whereas geothermal's share of the energy supply has long been below its potential, the European Commission (EC) now seeks to raise this share through policy incentives. This is fortunate, considering geothermal's potential to accelerate the energy transition. What is lacking, however—and what we therefore call for—is policy acknowledging geothermal's potential for local communities, similar to energy communities focused on solar and wind electricity. In short, we recommend that the EC encourage and enable geothermal-powered energy communities (GECs)—both in the EU as well as in the African Union (AU), through the EU—AU energy partnership.

Our recommendation speaks to the EC in its two roles: that of policymaker and enabler of the EU's energy transition; and as development partner helping Africa realise its 'green energy future' (AEEP, 2023). The recommendation draws on insights gained from a two-day co-learning workshop, augmented with insights from an interdisciplinary EU–AU research project called Geothermal Village. The Geothermal Village project is part of the LEAP-RE programme, and aims to introduce off-grid, geothermal-powered energy systems to four rural communities in Kenya, Rwanda, Djibouti, and Ethiopia. There is significant geothermal potential in the EU to realise the same concept—hence our call to support GECs in both continents. What is more, we believe GECs from both continents could learn from each other, a point we elaborate in the concluding section.

The co-learning workshop that informs our recommendation took place in November 2023 in Homa Hills, in western Kenya. We brought together Geoscientists, Engineers, and Social Scientists from Europe and Africa, representatives of the Homa Hills community and three Kenyan civil-society advocates with experience in EU–AU energy cooperation. The 18 participants tackled three main topics: (1) the promises and pitfalls of GECs in East Africa; (2) how these relate to potential GECs in the EU; and (3) how both could be supported in a broader framework of EU–AU energy cooperation. Each discipline/group shared its expertise and views followed by discussions. The plenary sessions were alternated with two types of subgroup sessions 'in the field', on which more below.

4.2 Enable and Encourage Geothermal Energy Communities

4.2.1 Geothermal's Potential for Energy Communities

Geothermal—the Earth's natural heat—is a renewable energy source with a high and diversified development potential. This potential is hardly tapped in the EU, with geothermal only providing 3% of its renewable energy (RE) (European Union, 2023). Current EU policy calls for a significant increase in geothermal by 2030, acknowledging geothermal's importance for the energy transition (Dulian, 2023; European Commission, 2023). A point that is underacknowledged is the major role that communities can play in, and multiple ways in which they can benefit from, geothermal development. We suggest geothermal can complement existing energy communities in the EU that mostly draw on solar or wind electricity.

Geothermal provides a powerful new source for energy communities, understood as "decentralised socio-technical systems where energy is jointly generated and distributed among a community of households locally" (Fouladvand et al., 2022, p. 1). As Table 4.1 shows, geothermal has some advantages over, and can therefore complement, solar and wind as RE sources. Geothermal offers continuous baseload energy at low cost, is immune to the vagaries of climate and weather, can store energy as heat or cold, and has a relatively modest footprint (Lovering et al., 2022). It offers a range of uses, depending on the geothermal source's temperature. High-heat resources (200+ °C, found at deep depths) allow for generating electricity on a large scale. On the low end, resources below 30 °C (at shallow depth) can be used to heat or cool individual buildings, typically using heat pumps. It is the medium-heat geothermal resources (50–120 °C) that offer the most potential for powering energy communities, that is, for meeting a range of community-scale energy needs at economical drilling depths. These community-scale energy needs include heating and cooling neighbourhoods, and small-scale productive uses (e.g. greenhouse farming, pasteurising and freezing dairy products). Energy wells can store surplus heat or cold and, if the temperature exceeds 90 °C, produce electricity (Onyango, 2022; Varet et al., 2014).

GECs, however, need to be promoted and require tailored incentives because most communities are unfamiliar with geothermal as a potential power source. As such, they can be wary of disturbing the subsurface

Table 4.1 Comparison of renewable energy sources, highlighting the strengths of each, and aspects unique to geothermal

RE characteristics	*Geothermal*		*Wind*	*Hydro-electric*	*Biomass*	*Solar*	
	<90 °C	*>90 °C*				*Thermal*	*PV+ batt*
Produce electricity	No	Yes	Yes	Yes	Yes	No	Yes
Produce heat	Yes	Yes	No	No	Yes	Yes	No
Long-term thermal storage	Yes	Yes	No	No	No	No	No
Up-front financial risk	In cases	Yes	No	No	No	No	No
% of year at full output	98%	98%	*50%	*98%	*98%	*50%	*98%

Asterisk '*' indicates output depends on weather/climate. 'PV+ batt' indicates solar photovoltaic electricity with battery storage

(Steward & Lewis, 2017) and expect the resources to be difficult and expensive to exploit. Fortunately, new technologies have made it easier and less costly to access these resources (Ciucci, 2023). While this has raised the prospects for GECs in the EU, these enhanced conditions have mostly led to larger private and/or public companies taking advantage of geothermal.

In large parts of the AU, especially along the East African Rift System (EARS), medium-heat geothermal resources abound and are accessible even at shallow depth, making them easier to exploit than in the EU. The problem here is that African governments and their development partners prioritise large-scale electricity production from deep, high-heat geothermal resources and are unaware of, or neglect, the potential for community energy development. Here lies a major opportunity for the EU, as the world's largest development cooperation donor, to support development of GECs in the AU.

Overall, we welcome the EC's efforts to promote geothermal, and emphasise its potential for community development in both the EU and AU. Yet, having potential is one thing, developing GECs is quite another.

4.2.2 *Assessing GEC's Feasibility: An Interdisciplinary and Participatory Approach*

Developing a GEC requires assessing its feasibility from different disciplinary perspectives, and in close cooperation with community members and groups. One dimension to consider is the subsurface geology and temperature, and the landscape topography in relation to community power requirements. Geoscience and Engineering studies give the community an estimate of the subsurface energy potential, the cost of drilling to access the hot water or steam, and the degree of risk to drinking water and the environment. These studies are site-specific, typically time-consuming, and present a large up-front cost. Confirmation of the resource is only obtained by drilling wells, which are themselves expensive.

A second, crucial dimension is the GECs' social aspects and dynamics. Understanding is gained by assessing a community's socio-economic needs and how a GEC can meet (some of) those. To this end, different segments of the local population should be included and represented in a GEC's decision-making process to share their visions and needs. This is a complex process, given the heterogeneity—and in some cases in the EU and AU, indigeneity—of communities. In Eastern Africa, the surface geothermal manifestations have been used by local populations since time immemorial. Their indigenous knowledge regarding the resources must, along with scientific knowledge, inform the third dimension: the engineering design and implementation of a GEC (Onyango & Varet, 2016), so that it responds to socio-economic needs and fits the community's unique context. The intersection of energy potential and social needs informs the technical design and thus informs the basis of a GEC. This requires continuous interchange with social groups locally and should be flexible to follow the evolution of the community's energy use.

Getting thorough insight into each of these dimensions and their interplay requires an approach that is both interdisciplinary and participatory. Such an approach informed the co-learning workshop we held. It not only brought into dialogue the researchers from the Geosciences, Social Sciences, and Engineering, who had each collected data on the Homa Hills prospective GEC, but also brought these scientists into dialogue with community representatives and civil-society advocates. Each discipline/group presented its unique view(s) on the promises and prospects of a GEC. This '360 degree' overview allowed a further discussion on how the different views relate. During these plenary sessions, there were two alternated subgroup sessions in the field to enrich the transdisciplinary dialogues. One subgroup session was a visit to hot springs associated with the deeper geothermal resource that would be drilled to power a Homa Hills GEC. The other comprised short transect walks in which we observed and discussed different social and economic activities in the community that could potentially be powered by geothermal energy.

Being in and jointly walking the site enabled the groups to better imagine and picture how a concrete geothermal energy system could take shape, taking into account the different aspects. For instance, we discussed a system's socio-spatial properties—that is, where wells and buildings of the geothermal energy system could best be constructed considering the soils, subsurface geothermal resource, proximity to households and businesses, land ownership, and where technical solutions (e.g. pipes, wires) would be placed. People living adjacent to the resources told us on the spot how they value the resources (hot spring waters) and use those daily. The board of a Community-Based Organisation established for the GEC shared their views on how best to approach the different development stages. The workshop thus enriched the insights and understandings of individual actors, and brought together different scientific and non-scientific perspectives that will jointly inform the next development stages of the GEC in Homa Hills. While most of this workshop was dedicated to this specific GEC, we believe the idea behind it is generally applicable to all GECs. Whether in workshop or other form, it is valuable, if not necessary, to juxtapose and integrate the different (non-)scientific perspectives.

4.2.3 Critical Issues and Barriers to GECs

The workshop, as well as our research experience on the Geothermal Village project and secondary data, also raised critical issues that need to be addressed in different development stages of GECs.

An important, practical issue relates to the up-front financial and other resources required for assessing a GEC's feasibility. For most community-sized uses, this will include expert surface exploration followed by drilling a well to confirm geothermal potential—a scenario perhaps more likely in much of the EU than in the EARS where medium-heat resources are often apparent at the surface. Drilling a well is relatively expensive and, as it may reveal insufficient geothermal potential for a GEC. There is thus a risk—although a low one compared to drilling for high-heat, deep resources—of losing the investment. GECs should be able to hedge such risk through risk-mitigation funds, which are currently only available for high-heat, deep drilling. A related challenge is the time taken for the feasibility assessment. In our Geothermal Village research, we observed that this tests the patience of community members, especially those who are less intensively involved in the preparations of a GEC.

The workshop also raised the issue of how people perceive the underground. Some community members in our research sites attribute special powers to geothermal resources, be they spiritual, religious, or medicinal (Onyango, 2022). Some also believe interfering with subsurface geothermal resources may bring harm, rather than good. Likewise, in Europe, events such as fracking, carbon sequestration, and building damage, due to subsidence or earthquakes caused by gas extraction, have made people wary of subsurface operations. Such perceptions and lived experiences need to be taken very seriously when developing a GEC—those involved should be transparent about the risks and uncertainties as well as the advantages of geothermal energy, let the decisions come from the community, and involve the community in monitoring.

Closely related are land issues. These were discussed at length in the workshop, because current land and subsurface policies and legislation in most Eastern African countries hinder effective participation of communities in geothermal development processes. Most communities lack the resources (legal, financial, technical) to compete for geothermal exploitation licences against private investors. Most governments, under the influence of liberalisation and privatisation, privilege private sector development of energy (including geothermal) resources, with severe implications for energy justice. In the Homa Hills GEC case, a private developer received the licence for geothermal exploration. The developer is favourable to the community creating a GEC, whereby the latter can use shallow geothermal resources up to a set depth, as long as the developer's licence rights are not restricted. While this enables the community to develop its GEC for now, the community still finds itself dependent on, and in an uneven power relationship with, a private developer. This is contrary to the rationale of GECs, whereby communities have autonomy over energy decision-making. Communities must, therefore, be supported to gain geothermal development licences themselves or at least be entitled to the shallow resources. Commercial licences would still be attractive to investors if the uppermost 800m (approximately) of the subsurface was reserved for GECs.

Recent research on this topic in the EU shows similar and additional factors to consider. Fouladvand et al. (2022) argue that behavioural and institutional aspects are particularly important in realising (geo)thermal energy communities. This notably includes the role of community boards in leading such energy communities. This is in line with our own research experience, where a Community-Based Organisation proved to be a key actor in the broader social arrangement of a GEC. Fouladvand et al. (2022) also call attention to the 'four A's' of availability, affordability, accessibility, and acceptability, that shape GECs' potential of becoming energy-secure and inclusive systems. While there are always trade-offs between these dimensions when developing GECs, they conclude GECs should be feasible in many places. Finally, regulations for the social and technical design of a GEC are not as clear as they are for electrical energy communities, thus requiring further development.

4.3 Achieving Our Recommendation

So far, this chapter has raised and discussed important preconditions and critical issues that need to be met or addressed for GECs to be realised. In this concluding section, we propose what EU agencies could do to enable GECs, and as such achieve the recommendation outlined in our title—*create a co-learning environment for Geothermal Energy Communities across the European and African Unions*.

Geothermal energy offers much potential for community development in the EU and AU, but this potential has been underacknowledged and untapped. We thus call on the EC—and specifically its Directorate-Generals for Energy and for International Partnerships—to address this policy gap and to *encourage and enable the development of GECs in the EU and, in its role of donor, in the AU*. GECs are a novel kind of energy community, whose feasibility and development hinge on some important preconditions and issues discussed above.

There is the need to acknowledge *and embrace the potential of geothermal resources for energy communities*. Communities should be encouraged, and enabled, to become more empowered players in geothermal development than is currently the case. This requires community-friendly policies and regulatory frameworks. These are policies and frameworks that allow for, and stimulate communities to, guide the geothermal development process, recognise their representative bodies as key stakeholders rather than peripheral players, and adjust support/aid mechanisms and the funding bureaucracy accordingly. By recognising energy communities as a crucial agent in the energy transition in the EU (European Commission, Directorate-General for Energy, 2019), and by providing support through the Energy Community Repository, the EC already took an important step. Yet, the unique character and subsurface investment of GECs require specific support and risk alleviation.

Support is especially required in the stage of *assessing a GEC's feasibility using interdisciplinary and participatory approaches*. The community's insights, knowledge, and collective needs should be central but may require EC support mechanisms for close engagement with advisory bodies to guide the social, natural, and technical scientific investigations, as well as the financial planning and implementation.

This feasibility stage should *involve the investigation of critical issues specific to GECs*. One such issue relates to finance. Whether in the EU or AU, the amount required for setting up GECs likely exceeds the financial resources available to communities. Communities who wish to develop a GEC should therefore have easier access to financial resources, with favourable conditions, such as a low interest and long payback time, and a risk mitigation fund. The European Investment Bank (EIB) could be an important facilitating agency. As one of the largest multilateral financial institutions in the world, the EIB is well-equipped to offer a financial support programme in the EU and AU—perhaps in partnership with regional investment banks and pension funds pulling out of fossil fuels. Another crucial issue for GECs is gaining land rights and licences to develop geothermal resources in the liberalised energy landscape. Current policy regimes tend to favour big, often private, players drilling for deep energy, and discourage, rather than enable, symbiotic community-scale shallower geothermal energy. An enabling environment for GECs recognises and allows alternative property-rights arrangements better suited to energy forms organised around the commons (Bridge & Gailing, 2020). The EC would do well to allow and support property regimes that are based on communal ownership and management of energy systems—whether in its own territory or (via aid) in the AU. In its role of donor, the EU could more actively encourage African governments to enable geothermal development at community level.

Finally, GECs are new and innovative undertakings, but also adventurous and uncertain. Considering this, it will help existing and prospective GECs if they were to connect and partner up in peer-learning programmes, where they could exchange insights and lessons learned. Such a programme could take different shapes. Given physical and social proximity, GECs partnering up within either the EU or the AU is most easily arranged. Yet, setting up connections between GECs from both continents can be equally rewarding and appropriate. After all, as this chapter has shown, communities in the EU and AU have similar energy community issues that merit exchange. Two platforms may take this further—one is the Africa—EU Energy Partnership (AEEP, 2023), the other is the EU-Africa Green Energy Initiative that aims to enhance what GECs offer: clean energy access via off-grid decentralised solutions (European Commission, 2022).

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References

AEEP. (2023). *The gateway for joint action on a Green Energy future*. The Africa-EU Energy Partnership.

Bridge, G., & Gailing, L. (2020). New energy spaces: Towards a geographical political economy of energy transition. *Economy and Space, 52*(6), 1037–1050. https://doi.org/10.1177/0308518X20939570

Ciucci, M. (2023). *Innovative technologies in the development of geothermal energy in Europe*. Briefing to the European Parliament by the Directorate-General for Internal Policies.

Dulian, M. (2023). *Geothermal energy in the EU*. Briefing to the European Parliament by the European Parliamentary Research Service.

European Commission. (2022). *EU-Africa: Global Gateway Investment Package—Green Energy initiative*. European Commission. https://international-partnerships.ec.europa.eu/policies/global-gateway/initiatives-region/initiatives-sub-saharan-africa/eu-africa-global-gateway-investment-package_en

European Commission. (2023). *State of the Energy Union 2023*. COM/2023/650 final. European Commission.

European Commission, Directorate-General for Energy. (2019). *Clean energy for all Europeans*. Publications Office of the European Union.

European Union. (2023). *Directive (EU) 2023/2413 of the European Parliament and of the Council of 18 October 2023 amending Directive (EU) 2018/2001, Regulation (EU) 2018/1999 and Directive 98/70/EC as regards the promotion of energy from renewable sources, and repealing Council Directive (EU) 2015/652*. Official Journal of the European Union.

Fouladvand, J., Ghorbani, A., Mouter, N., & Herder, P. (2022). Analysing community-based initiatives for heating and cooling: A systematic and critical review. *Energy Research & Social Science, 88*, 1–18. https://doi.org/10.1016/j.erss.2022.102507

Lovering, J., Swain, M., Blomqvist, L., & Hernandez, R. R. (2022). Land-use intensity of electricity production and tomorrow's energy landscape. *PLoS ONE, 17*(7), 1–17. https://doi.org/10.1371/journal.pone.0270155

Onyango, S. (2022). Cultural uses and values placed on geothermal resources by Kenya's Luo of Homa Hills: Views from a socio-anthropological perspective. In *Proceedings, 9th African Rift Geothermal Conference, Djibouti, Djibouti city, 3–5 November 2022.*

Onyango, S., & Varet, J. (2016). Future geothermal energy development in the East African Rift Valley through local community involvement: Learning from the Maori's experience. In *Proceedings, 6th African Rift Geothermal Conference, Addis Ababa, Ethiopia, 2–4 November 2016.*

Steward, I. S., & Lewis, D. (2017). Communicating contested geoscience to the public: Moving from 'matters of fact' to 'matters of concern.' *Earth-Science Reviews, 174*, 122–133. https://doi.org/10.1016/j.earscirev.2017.09.003

Varet, J., Jecton, A., Omenda, P., & Onyango, S. (2014). The "Geothermal Village" concept: A new approach to geothermal development in rural Africa. In *Proceedings, 5th African Rift Geothermal Conference, Arusha, Tanzania, 29th–31st October 2014.*