5

Indonesia's Slow Geothermal Evolution

> Every nation has a unique and different energy transition strategy in line with their situation. [*Setiap negara miliki strategi transisi energi yang unik dan berbeda karena disusun sesuai kondisi nasional*.]
> *–Indonesian President Joko Widodo, Remarks at the Asia Zero Emission Community Summit in Tokyo, 18 December 2023*

Indonesia is the world's second largest geothermal producer after the United States, and it is estimated to hold more than 40% of the world's geothermal reserves. However, the history of geothermal development in Indonesia illustrates persistent barriers and lack of political will to prioritize the technological development that would harness the full potential of this resource. Indonesia's geothermal energy development provides an ideal example of the impacts of the regime complex in removing barriers to technology diffusion in EMDEs.

As discussed in Chapter 1, different geothermal technologies have varying levels of maturity. Dry steam and binary turbines are more mature technologies in widespread use; more recent technological advancements include enhanced geothermal systems (IEA 2011; IRENA n.d.). Geothermal energy has been successful in developing and developed countries alike. For decades, the two largest producers of geothermal energy were the United States and the Philippines, respectively, while Indonesia came in third despite having more potential in terms of total reserves. In 2018, Indonesia surpassed the Philippines as the second largest producer. This chapter traces the processes entailed in Indonesia overcoming challenges in geothermal development from the 1970s up to the early 2020s, and the ways that the clean energy regime complex supported the government and industry in addressing these challenges.

Persistent financial and regulatory barriers have slowed progress on geothermal development in Indonesia. Despite investment and increasing deployment in the geothermal industry over several decades, installed capacity has remained below 10% of its full potential. As the Government of Indonesia did not carry out detailed

geological surveys of geothermal exploration historically, the risks and substantive financial burden involved with exploration and early-stage development were left to private developers. Furthermore, regulatory and financial barriers such as forestry and mining laws, power purchasing agreements, and compensation structures have made it difficult to develop projects to the commercial phase. These obstacles have necessitated development assistance to fill in the gaps in financing and provide technical assistance to de-risk investments and reduce barriers to development. The World Bank reiterated the geothermal industry's finance needs in its 2018 report for the proposed Indonesia Geothermal Resources Risk Mitigation Project (GREM):

> The GoI has set an ambitious target to add 6.3 GW of geothermal capacity by 2026, which would translate to a total investment need of about US$27 billion over the next seven years. There are three main sources of funds: public funding, private sector funding, and international support. Public funding and involvement of SOEs will remain strategically important, particularly as part of a drive to increase electrification in Eastern Indonesia and will need support from international financial institutions (IFIs) and bilateral donors. However, the bulk of investment will need to come from the private sector. More broadly, achieving the GoI's ambitious target for scaling-up geothermal-powered generation would require: (i) judicious use of public funds while mobilizing private sector capital at a large scale; (ii) implementation of an effective upstream risk mitigation mechanism; and (iii) ensuring a conducive doing-business environment with transparent and competitive licensing and power purchasing agreement (PPA) award procedures and effective cost-competition for drilling services, as well as management of bottlenecks relate to drilling in forested areas. *(World Bank 2018: 5)*

The summary by the World Bank is illustrative of the steps needed on the pathway to unlocking geothermal energy potential in Indonesia. The clean energy regime complex can play a critical role in unlocking the barriers on this pathway. As explained in Chapter 2, the clean energy regime complex consists of the set of multilateral, bilateral, transnational, and non-state actors that share a common objective of fostering the acceleration of renewable energy development. This chapter focuses on how the clean energy regime complex supports geothermal energy development in Indonesia through the direct provision of financial and technical assistance, and on the technical capacity building and policy advising implemented by the international actors working on the ground in Indonesia.

Chapter 4 measures the regime complex's effectiveness in affecting high-level prioritization for climate change and an energy transition, while this chapter considers its impact on a particular renewable energy technology – geothermal energy – where Indonesia has a competitive advantage. The evidence of the regime complex's effectiveness on geothermal development can be demonstrated through growth in installed capacity attributed to the regime complex's efforts at addressing barriers to development. The ways the regime complex can impact barriers to geothermal development include impacts to the financial or regulatory barriers

and changes that reframe energy security concerns or allow for convergence of domestic political interests. Often in the case of energy transitions, the adoption of policy alone is not sufficient for change but requires implementation as well. In Indonesia, the complex regulatory landscape requires additional reforms in order for renewable energy policy targets and regulations to be implemented to allow for growth and increased investment in the renewable energy sector. Only after various barriers are removed can we start to see the effective implementation of policy, allowing for growth in the installed capacity of renewables over time.

This chapter examines the impacts of the clean energy regime complex on the removal of barriers to geothermal energy technology development in Indonesia. Overall, the effectiveness of the regime complex would be demonstrated by the implementation of renewable energy policy to spur renewable energy development, measured by a change in installed generation capacity. The clean energy regime complex fosters the acceleration of renewable energy development through the removal of financial, regulatory, knowledge, and sociocultural barriers. This chapter also investigates a variety of intervening variables that may have impacted renewable energy development, such as domestic political interests, political will, and energy shocks.

In order to analyze the influence of clean energy governance, the three mechanisms of influence outlined in Chapter 1 – utility modifier, social learning, and capacity building – are evaluated based on how they address barriers to geothermal energy development. An important aspect of the analysis in this chapter also focuses on the interaction between the clean energy regime complex and domestic political interests, and on how special interests are incentivized. In the case of Indonesian geothermal energy development, the utility modifier mechanism takes the form of development assistance earmarked for investment in geothermal power plant development or power sector development. The utility modifier mechanism is embodied through the provision of financial assistance by the World Bank and other multilateral and bilateral agencies to invest in geothermal capacity, assist the government in the implementation of geothermal laws, and carry out construction of geothermal projects. These financial resources fill critical gaps in financing.

The social learning mechanism is evident in development financing for policy advising and institutional capacity building for policymakers to reform policies that better facilitate development of geothermal and diffuse norms prioritizing renewable energy development. For example, efforts to address governance barriers to manage corruption may be evident in policy reforms targeting corruption or rent-seeking, while efforts to address sociocultural barriers to geothermal development may manifest in attempts to negotiate with protesting communities or to institutionalize environmental guidelines and community outreach. The capacity-building mechanism is the provision of resources directed to building human capacity

through training and education. The distinction between the social learning mechanism and capacity-building mechanism is the difference in outcomes with knowledge and skills: the former deals more with societal or institutional knowledge that leads to different approaches to or perspectives on solving problems, the latter with boosting technical expertise capacity within public sector institutions or private industry. In this chapter, this mechanism takes the form of international development assistance for training a technical workforce or scholarships for skills related to geothermal energy development.

Indonesia's Untapped Energy Supply: Case Description

Indonesia holds abundant geothermal resources. Estimates for potential geothermal energy capacity are approximately 23.6 GW (MEMR 2023).[1] Indonesia also has plentiful hydropower and solar power resources, with higher potential production capacity, as seen in Figure 4.4. However, geothermal energy is a more fitting technology to analyze because, as outlined in Chapter 1, it produces firm, dispatchable clean electricity, compared to other intermittent renewable energy technologies. Therefore, it provides an excellent source of baseload power and a clean, net zero substitute to coal power. Furthermore, geothermal energy development requires less land per MWh produced than other renewables or fossil fuel projects (Gross 2020). Geothermal energy projects face barriers to deployment that hydropower and solar power projects do not, including high risk and costs associated with exploration and lack of appropriate finance mechanisms, regulatory barriers related to the prior legal status of geothermal activities such as mining, and knowledge barriers requiring a highly skilled technical workforce. Furthermore, geothermal exploration and drilling have been linked to earthquakes and mudslides, creating community fears and protests of geothermal projects, representing additional sociocultural barriers. For these reasons, geothermal energy provides key insights into the complex barriers to energy development in Indonesia.

The Government of Indonesia has been working to develop geothermal technology for decades, but progress remains slow. As of 2023, the installed capacity for geothermal was 2.6 GW, only 11% of the total potential for geothermal energy development (MEMR 2023). For many years, despite its superior potential capacity for geothermal production, Indonesia lagged behind the Philippines in terms of its total installed capacity, and it still lags behind in terms of share of potential capacity developed. Nevertheless, there has been an evident rise in geothermal energy development measured through installed capacity (see Figure 5.1). Between 2010

[1] Following the government's exploration drilling, estimates on Indonesia's potential are expected to be revised downward, but final estimates are still pending (MEMR interview, 2024).

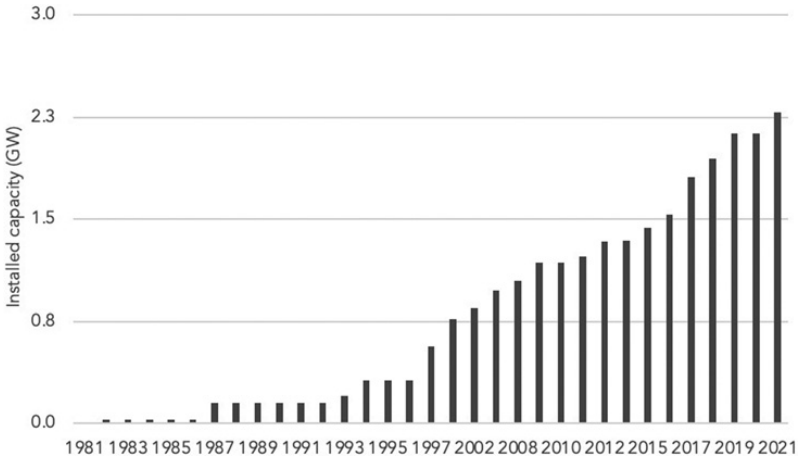

Figure 5.1 Indonesia installed geothermal capacity, 2010–2021.
Source: MEMR 2020, 2021; Yunis 2015

and 2020, the installed geothermal capacity increased by nearly 80% (MEMR 2020). As Figure 5.1 shows, the last decade demonstrates rapid growth in the geothermal industry as projects with long development timelines – sometimes up to 10 years – finally reached commercial operation.

In Indonesia, as of 2020, SOEs owned 76% of geothermal assets split between power plants and steam field operators, while IPPs owned 9%; 15% are hybrid, joint operating assets (MEMR 2022). There is a great deal of variation in public and private investment in the geothermal industry over time. The ebb and flow of geothermal development can be attributed to major historical and political events and persistent barriers to development. The major barriers are discussed in the next section, followed by a historical view of Indonesia's geothermal development in the subsequent section.

Main Barriers to Geothermal Energy Development

The current barriers to clean energy technology development in Indonesia are deeply intertwined with the country's economic and regulatory history. While the government is ambitious in its aims to accelerate these renewable energy projects, the reasons behind the slow implementation of policy objectives to increase renewable energy in the mix provide clues to ongoing barriers. These barriers to investment in renewable energy technology are financial and economic, regulatory, technical, and, finally, sociocultural. Financial and economic barriers include a mismatch between available finance and the needs for sustainable energy projects, insufficient subsidy and tariff schemes for renewables, and economic externalities.

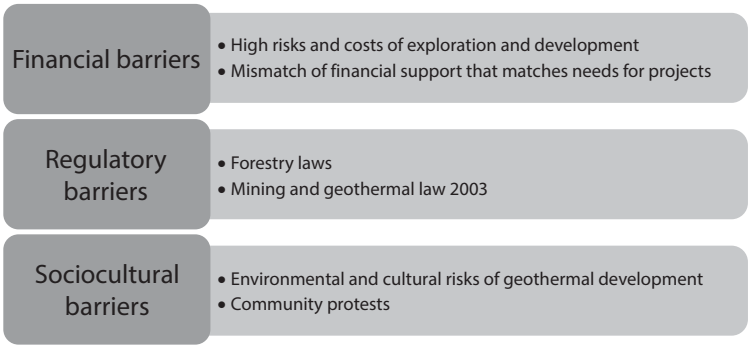

Figure 5.2 Major barriers to geothermal development in Indonesia.

The regulatory barriers relate to contradictory laws and policies, further complicated by ongoing corruption and lack of coordination between central government ministries and the local government (TI 2013; WWF 2012b). Technical barriers include challenges surrounding the implementation of specific renewable energy technology and topical and geographic characteristics of the site and overall geology. Cross-country grid extension is difficult due to the thousands of islands making up the archipelago and the geographic divide between the islands with high energy consumption and dense populations and those with abundant geothermal resources. Technology-specific challenges are often intertwined with the regulatory framework, but can also relate to overall lack of infrastructure. Sociocultural barriers include challenges related to culture, fear and perception of risk, and lack of training in renewable energy technology deployment in local governments and the labor force. This chapter focuses on three major barriers: financial, regulatory, and sociocultural (see Figure 5.2).

These three barriers represent the main historical obstacles that the clean energy regime complex must address to change behavior and facilitate the development of clean energy technologies. The next section looks at how the clean energy regime complex has addressed these barriers in Indonesia's geothermal energy sector through financial aid, policy advising, and technical capacity building over three periods of analysis.

Period 1: History of Indonesia's Geothermal Development Evolution

Although Indonesia began creating an inventory of geothermal resources in 1972 after the United States, Japan, and New Zealand provided technical assistance, the government did not start systematic geothermal exploration until the early 1990s, with support from the Netherlands and New Zealand (Fauzi et al. 2000). Since the 1990s, the Embassy of New Zealand has provided a training program for

geothermal engineers in Indonesia. This training program provides funding for scholarships in a technical field relevant to geothermal energy development, such as engineering or geology. Through this bilateral cooperation, New Zealand provides technical assistance and training for workforce development.[2] The interest in developing alternative energy in EMDEs can be seen as the producers' response to the oil crisis of 1973 (ESMAP 2012: 22).

The inventory of geothermal reserves led to regulatory reforms in Indonesia that stimulated geothermal development. Presidential Decree No. 20/1981 allowed Pertamina to enter joint ventures with local and international partners and endorsed Joint Operation Contracts. Presidential Decree No. 49/1991 provided economic incentives for Presidential Decree No. 45/1991, which allowed Pertamina partnerships to build and operate geothermal power plants (Fauzi et al. 2000). The dots in Figure 5.3 indicate the proven geothermal reserves along the Indonesian archipelago.

Following the Asian financial crisis in 1997, the Government of Indonesia carried out extensive regulatory reforms, including a government decentralization overhaul in response to IMF emergency economic stabilization loans. In the aftermath of the crisis and the fall of the Suharto regime, the president of Indonesia at the time, B. J. Habibie, initiated a massive decentralization of the government, shifting authority away from the central government and to the district

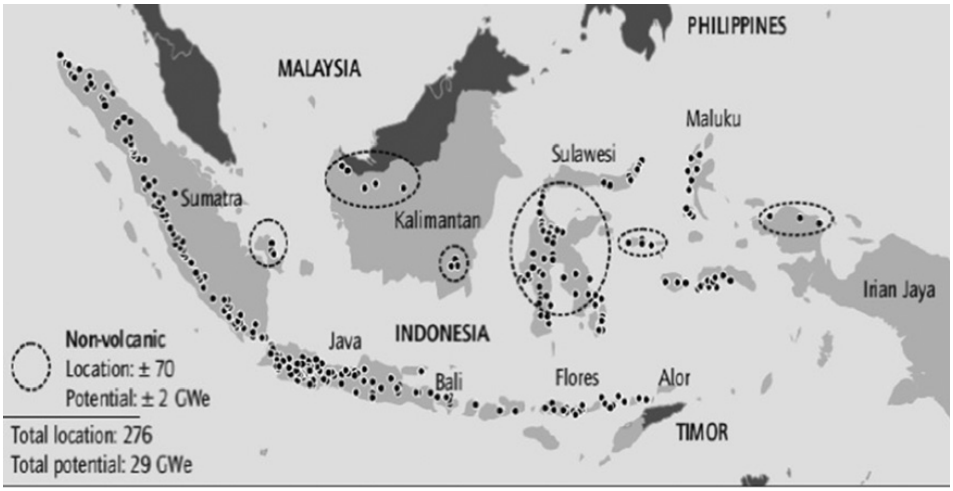

Figure 5.3 Map of Indonesia's geothermal reserves.
Source: MEMR n.d.

[2] New Zealand Embassy interview, 2015. Also see www.mfat.govt.nz/en/aid-and-development/our-work-in-asia/indonesia.

level – completely bypassing the provincial level – in an effort to suppress secessionist ambitions in the provinces (Pisani 2014a, 2014b). Major multilateral development banks, particularly the ADB and the World Bank, strongly supported this move. The decentralization process redirected significant governing authority to the more than 500 districts across Indonesia, instead of placing it with provincial or central governments where there was more institutional capacity. The ADB approved more than USD 1 billion for six core decentralization projects and nearly USD 15 million for technical assistance after 1998 (ADB 2010). The World Bank contributed more than USD 4.7 billion to Indonesia for decentralization between 1989 and 2014 (World Bank 2016a).[3] The decentralization process helped reform governance, reduce corruption, prevent secessionist threats, and improve accountability. However, it has had unforeseen negative effects on the efficiency of bureaucracy and lasting impacts on the development of renewable energy projects, among other development projects (ADB 2010).

The post-1997 financial crisis IMF stabilization loans also increased pressure on the Government of Indonesia to improve the transparency of government spending. In response, Suharto issued Presidential Decree No. 39/1997 on the Postponement/Review of Governmental Projects, State-Owned Companies and Private Projects Related to the Government/State-Owned Companies and Presidential Decree No. 5/1998 (Kantor et al. 2011). This law halted projects involving SOEs and the private sector to review expenditures, effectively stalling investments in Indonesia and further exacerbating risks for private investors and risks of economic downturn in the country (PR Newswire 1998). Five years later, the government reopened the sector to private investment with Geothermal Law No. 27/2003, which increased transparency in the industry and overthrew Pertamina's monopoly of the geothermal industry by opening up a tender process to all bidders for exploration contracts (Suryantoro et al. 2005). While the 2003 Geothermal Energy Law (27/2003) opened the industry to private sector involvement, it was not actually implemented until 2007.[4]

The four-year gap is partially attributable to the fact that the law was issued by the parliament and not by the government, which was unusual. At the time, Irwan Prayitno was the head of the House's Commission VIII for Energy, Mineral Resources, Environment, Science and Technology. He was a charismatic politician who strongly believed in sustainable energy, particularly in the potential for geothermal energy. Chairman Prayitno pushed the 2003 Geothermal Law through the parliament so as to counterbalance the Oil and Gas Law (Law No. 22/2001) (*Jakarta Post* 2001).[5] Furthermore, many of the working areas with the best-quality

[3] Calculated using data from World Bank 2016a. The category of "decentralization" was selected for Indonesia, and 42 projects were counted.
[4] Supreme Energy interview, 2014. [5] Supreme Energy interview, 2014.

steam reserves are located in forested areas, where geothermal exploration was prohibited under Law No. 27/2003. However, Indonesia was still heavily dependent on cheap oil and gas, which remained the priority at the time. It was not until after the dramatic increase in oil prices in 2007, leading to the 2008 energy crisis, that the parliament prompted the government to invoke the 2003 Geothermal Law as a potential solution to this crisis. At that point the government issued a "*Peraturan kumerita*," a mandate to enact the original 2003 Geothermal Law.[6] The background of the 2003 Geothermal Law demonstrates the importance of political will when domestic leaders embedded in bureaucracies can push forward a sustainability agenda. Nevertheless, the slow implementation of the law shows that vested interests in oil and gas and the low priority of geothermal energy at the time limited its impact until energy crisis prompted a different approach to diversification and spurred action on renewable energy.

Period 2: International Support for Indonesia's Geothermal Development

By the mid 2000s, during Period 2, international support through bilateral development agencies and multilateral development banks became more active in support for geothermal development in Indonesia. Major international actors supporting the development of the geothermal industry in Indonesia included the JICA, the World Bank, KfW (the German government-owned development bank [*Kreditanstalt für Wiederaufbau*]), the ADB, the Governments of the Netherlands and New Zealand, Agence Française de Développement (AFD), the USAID, the US Trade and Development Agency (USTDA), and the International Bank for Reconstruction and Development (IBRD), among others. Support ranged from feasibility studies to concessional financing for the institutional strengthening of environmental impact assessments. For example, during Period 2, JICA provided substantial financial and technical support for geothermal development in Indonesia, which helped the government's geothermal development planning. This support included a loan of approximately 5.8 million Japanese yen (equivalent to USD 36 million in 2024 terms) to develop the Lahendong geothermal plant (20 MW) as a climate change mitigation project (JICA 2004).

In 2008, the World Bank initiated a program aimed at removing barriers to geothermal energy development in Indonesia with the support of a USD 4 million grant from the GEF (Polycarp et al. 2013: 3). This program involved key components to assist the Government of Indonesia in implementing the 2003 Geothermal Law, develop a regulatory and policy framework to create incentives for investment, and strengthen the capacity of the MEMR for engaging investors in

[6] Supreme Energy interview, 2014.

geothermal transactions and closing ongoing projects (Polycarp et al 2013; World Bank 2008). The reform of the 2003 Geothermal Law did not happen until 2014 (Period 3) with the adoption of Geothermal Law No. 30/2014. Once adopted, the reformed geothermal law removed major regulatory barriers to geothermal development and acted as a signal to reluctant investors that there are new opportunities in this sector.[7] However, the implementation of this law and the creation of an investment-friendly environment was slower than expected (World Bank 2010). This may have been due to differences in domestic political interests and a lack of political will on part of the government to address barriers to development. The next section details the inroads made on regulatory reform and the amelioration of barriers to technology development, examining the impact of both the regime complex and intervening variables such as domestic political interests and external shocks.

Period 3: Overcoming Barriers to Geothermal Development in Indonesia

Despite ambitious targets to accelerate the development of renewable energy, with a priority on geothermal energy, several barriers to geothermal technology development, including the financial, regulatory, and sociocultural barriers outlined in Figure 5.3, have prevented progress. This section examines the mechanisms through which the clean energy regime complex addresses barriers in Indonesia's geothermal development using evidence from specific projects and stories derived from interviews with stakeholders and donors working on geothermal energy.

Addressing Financial Barriers through Investments and Technical Assistance

The financial barriers to geothermal development in Indonesia include high risks and costs of exploration and early-stage development, a mismatch of financial support, reluctance of the PLN to sign geothermal contracts, and other market failures. The high costs and risks are associated with the four stages of project development, with exploration drilling representing the highest relative costs and risks. The estimated geothermal project cost breakdown is shown in Table 5.1.

A 2009 JICA study on catalyzing private investment in Indonesia's geothermal industry describes the major financial risks for geothermal development in Indonesia as follows:

> The barriers which hinder smooth development of geothermal energy are the development risks of underground resources and the burden of enormous up-front investment. Therefore,

[7] USTDA interview, 2015.

Table 5.1 *Estimated geothermal costs in Indonesia (2019 prices)*

Stage	Stage 1: Preliminary survey	Stage 2: Exploration drilling	Stage 3: Delineation drilling	Stage 4: Construction
Description	Resource identification, geoscientific exploration and baseline environmental studies	Feasibility study, exploration drilling, add well testing	Delineation drilling and technical feasibility study	Construction and production drilling
Risk level	High resource identification risk	High resource and financing risk	Lower resource risk, high financing risk	Limited construction risk and financing risk
Cost (US$)	$1 million	$25–50 million	$20–120 million	$20–200 million
Timeline	Year 1	Year 2	Years 3–4	Years 5–6

Source: ADB and World Bank 2015; Chelminski 2022; World Bank 2019, 2020b

the purchase price of geothermal energy should include a reward for challenging these barriers. Consequently, although it is lower than the price of diesel or heavy-oil power plant energy, the price of geothermal energy becomes higher than that of coal-fired plant energy. However, PT PLN, a buyer of geothermal energy, has a mission to supply inexpensive power to consumers and this mission makes it reluctant to increase the purchase price it pays for geothermal energy. The unattractive purchase price of PT PLN causes private IPP companies' hesitation in investing geothermal projects in Indonesia. *(JICA 2009: ES-1)*

Bilateral and multilateral organizations have tried to address the financial barriers through a variety of types of financing, technical assistance, capacity building, and policy advising. Project financing has taken many forms, but the evolution of financing for the highest-risk and highest-cost phase of development – exploratory drilling – has taken decades to address. The next section covers the CDM and CTF project funding, the failed Geothermal Fund, the Geothermal Energy Upstream Development Project (GEUDP), setting up a government-led drilling program, and finally the recently created the GREM, a revolving fund created by the World Bank.

The CDM and CTF are two major multilateral funding sources that have helped address financial barriers for geothermal energy development in Indonesia. Between 2006 and 2012, 16 geothermal projects in Indonesia were registered with the CDM (UNFCCC 2016). The CDM funding supported geothermal energy development with financial and technical resources primarily to accelerate generating capacity, demonstrating the utility modifier mechanism, but the social learning aspects of the CDM projects were also relevant. Following meetings with

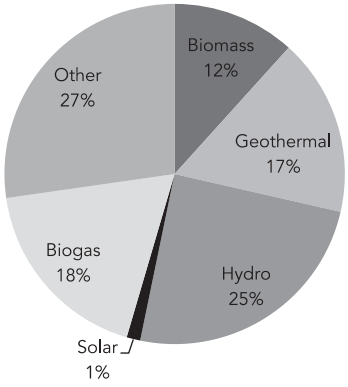

Figure 5.4 Breakdown of Indonesia's CDM projects in the energy sector. Source: Calculated using UNFCCC 2016

international organizations such as UNEP, the Indonesian government and the private sector increasingly became familiar with how the CDM worked and began to register projects that would qualify for emissions reduction credits (ERCs). Large-scale projects for emission reductions in the energy sector were identified as the best options for CDM projects in Indonesia – particularly electricity generation from renewable energy sources including geothermal, biomass, and hydropower (UNEP 2010). Out of 77 energy-related CDM projects, the largest shares of projects were in hydro, biogas, and geothermal (see Figure 5.4). The other category includes projects ranging from co-generation to methane capture and recovery.

With geothermal energy technologies, international companies participating in geothermal energy development in Indonesia, like Chevron, were some of the first to register geothermal projects in 2006. Major domestic energy actors like the PLN, Star Energy, and PT Pertamina Geothermal followed in 2009 and 2012. The first geothermal project involving domestic actors registered with the CDM was the Lahendong II-20 MW Geothermal Project, which involved PLN, the Netherlands, and the IBRD (UNFCCC 2013). As outlined in the CDM project document for the Lahendong Project, the CDM project was considered an opportunity to build confidence within the government and SOEs (PLN in particular) about the viability of geothermal energy as a solution to energy demands. This CDM project documentation provides an example of the clean energy regime complex's utility modifier mechanism:

> The fact that 4% of Indonesia's power is derived from geothermal resources despite having 40% of global potential, demonstrates a major disconnect between resource potential and geothermal development thus far, best explained by barriers to development. . . . PLN recognizes the non-financial benefit of investing in CDM projects due to a desire to mitigate

the impacts of climate change, as Indonesia has ratified the Kyoto Protocol. The successful registration of the project may stimulate confidence within PLN and the geothermal sector to make other similar investments. *(UNFCCC 2013: 13)*

PT Pertamina Geothermal learned of the opportunity to register geothermal projects with the CDM to receive ERCs from meetings with UN actors, the PLN, consultancy firms, and private sector actors.[8] Pertamina registered 5 of the 12 geothermal projects in the CDM registry in time for the 2012 deadline. Pertamina became interested in participating in the CDM process for the economic and reputational benefits. The CDM funding "raised Pertamina's profile," made geothermal projects more economical, and helped cover the cost of exploration.[9] The reputational benefit and financial incentive motivated the government and the private sector to register CDM projects. Registration involved multiple stakeholders in the public and private sectors and allowed for social learning to take place, which established the connection between renewable energy, emissions reduction, and climate change mitigation. This provides support that social learning was impactful due to the transfer of information and ideas through multiple layers of domestic political actors.

Some of the allocation of CDM funding for other projects is questionable – such as the CDM projects that are funding geothermal power projects developed by Pertamina Geothermal and Chevron. As demonstrated by previous experience, these two companies have the resources to successfully develop geothermal energy projects without CDM financing. Smaller Indonesian geothermal power developers, such as Supreme Energy, have higher financial needs for project support, as they have limited capital available compared to large multinational companies.

One prime example of the way that the clean energy regime complex targets barriers to geothermal energy development is illustrated by PT Supreme Energy, an Indonesian geothermal company that has received both CTF and CDM funding for various projects. PT Supreme Energy is one of the few private Indonesian companies that managed to break through the tangled legal regulations, permitting, exploration, and finance issues to develop geothermal energy projects (*Shanghai Daily* 2014). The history of Supreme Energy's development of geothermal power projects is illustrative of the many barriers and challenges that smaller project developers face. In 2008, once the geothermal law was enacted, the founders of PT Supreme Energy saw an opportunity in the market and created the company.

Rantau Dedap, Supreme Energy's second geothermal working area in South Sumatra, was allocated finance from both the CDM and the CTF. The project's installed capacity is 98 MW (MEMR 2021), with later phases (units) of project development estimated to install up to 240 MW in geothermal capacity (ADB

[8] Pertamina Geothermal interview, 2015b, 2015c. [9] Pertamina Geothermal interview, 2015b, 2015c.

2014a). As written into the UNFCCC Project Document, the project would not be commercially viable without climate finance. "Without incentives from [CDM] CER revenues, project IRR [internal rate of return] is 10.07% which is lower than benchmark that has value of 17.10%. It can be concluded that the project activity is not financially attractive" (UNFCCC 2012: 14). Clean Technology Fund financing totaling USD 50 million was then allocated to Supreme Energy to fill gaps in finance for exploration of Rantau Dedap (ADB 2014b).[10] Supreme Energy, along with GDF Suez and Marubeni Corporation (other shareholders in the project), benefited from a USD 50 million nonrecourse loan allocated through the ADB.[11] The funding of the exploration stage of development marked a change in practice for international organizations in the clean energy regime complex in response to needs on the ground, and it also demonstrated the successful targeting of financing barriers to geothermal development. The Rantau Dedap project is of particular significance as it received development aid to support exploration costs, which is the riskiest and most costly portion of geothermal energy development (UNFCCC 2012). The project's first unit reached commercial operation in 2021.[12]

In 2011, KfW, the ADB, and JICA worked with the Government of Indonesia to design a revolving fund to finance geothermal projects: the Geothermal Fund Facility (Chelminski 2022). The ADB had expressed interest in matching the government's contribution to the Geothermal Fund on the condition that the government would take on the risk of exploration. However, the government was unwilling to agree to these terms, so no international funding was contributed to the Geothermal Fund (Polycarp et al. 2013). By law, the Government of Indonesia cannot take a loss in profit due to corruption implications; therefore, it was averse to supporting high-risk geothermal exploration with government funding. While the ADB and JICA worked with the government to reframe the risk of exploration from a potential "loss" to a gain in terms of geological data, there were several unresolved barriers to implementation of government financing for exploration activities.[13] The government contributed IDR 1.2 trillion (USD 102.4 million) to the Geothermal Fund, which is managed by the Pusat Investasi Pemerintah (PIP), Indonesia's sovereign wealth fund governed by the Ministry of Finance (Damuri and Atje 2012). The Ministry of Finance Regulation No. 3/2012 stipulated that the Geothermal Fund would provide financial support to geothermal developers for data collection for the exploration activities. The PIP was also supposed to offer loans to geothermal developers for exploration activities whereby developers could borrow up to USD 30 million, with the loan repaid only if the site proved to be productive, which would reduce financial risks during early stages of geothermal

[10] ADB interview, 2015. [11] ADB interview, 2015.
[12] See www.supreme-energy.com/pt-supreme-energy-rantau-dedap.
[13] ADB interview, 2015; World Bank interview, 2023, 2024.

development. However, the PIP was unable to function optimally in various investment financing scenarios (Cahyafitri 2015).[14]

Irrespective of the administrative and political obstacles, practical concerns remained. The Geothermal Fund was not well matched to the needs of small project developers who need finance the most, as it required proof of collateral, which most small project developers do not have.[15] Whereas large project developers have collateral, loans offered by the Geothermal Fund were not of interest to these companies since they would not use borrowed money for such a high-risk activity and would use equity instead. The political, financial, and administrative issues put the Geothermal Fund at an impasse and it remains undisbursed.[16]

To fill financial gaps and reduce risks, a range of bilateral development agencies, such as KfW, JICA, and USTDA, among others, provided targeted support to the development of the geothermal energy industry in Indonesia. Financial support has included soft loans and mobilizing finance for the exploration of commercial sites for pilot projects, providing training to local government officials responsible for tendering contracts for geothermal development, and working with the government to reform the tariff regime for geothermal (Polycarp et al. 2013: 4).[17] The cooperation among bilateral and multilateral funding agencies provides insights into the interaction among the clean energy regime complex's elemental institutions on the field level. Focusing first on bilateral development assistance, KfW has provided a range of different loans for investment in geothermal, funding for capacity building in government ministries to improve data collection, and support for a joint project with the World Bank and ADB to implement policy reform.[18] The KfW launched its Geothermal Program in 2010 with EUR 7.7 million (USD 10.3 million) in soft loans to PLN and Pertamina for funding to rehabilitate Kamojang and to support exploration and financing for geothermal power plants in Flores and Aceh (Downing 2011).[19] The KfW provided soft loans to attract private finance through a public–private partnership structure, which was established in 2014, with supplemental support from New Zealand for technical assistance (Downing 2011).[20] The KfW's grant for Aceh was in part to assist with the tendering process since there were political issues with the Seulawah Agam geothermal project in Aceh in determining the benefit sharing between Pertamina, private developers, and the local/provincial-owned company, which slowed the tendering process.[21]

Following more than a decade of policy dialogues between the World Bank and government ministries at various levels, coupled with World Bank-led financing mechanisms to reduce exploration risk, the Government of Indonesia shifted its

[14] Tusk Advisory interview, 2015. [15] ADB interview, 2014.
[16] ADB interview, 2015; KfW interview, 2015; World Bank interview, 2024. [17] KfW interview, 2014a.
[18] KfW interview, 2015. [19] KfW interview, 2015. [20] KfW interview, 2014a, 2015.
[21] WWF Indonesia interview, 2015.

approach to geothermal exploration to create a government-led exploration drilling program in 2021 (Dobson et al 2025; MEMR 2021).[22] Through the GEUDP and GREM financial mechanisms, the World Bank significantly advanced the risk-sharing approach with the Government of Indonesia to address the major financial barrier of exploration drilling risk. The World Bank's GEUDP approved USD 55.25 million in CTF and GEF grants to support exploration and drilling and leveraged matching funding from the Government of Indonesia, which is a landmark development in terms of progress on government funding (World Bank 2017b). The CTF funding (USD 49 million) finances infrastructure development and exploration drilling and is matched by the Indonesian Ministry of Finance and the state-owned financing company PT Sarana Multi Infrastruktur, in addition to GEF funding (USD 6.25 million) allocated to capacity building and technical assistance, particularly for due diligence (World Bank 2017b).

Policy dialogues between the World Bank staff and the Government of Indonesia were critical in reframing the "loss" of an unsuccessful project as added value by contributing data on projects to guide the feasibility of projects and pricing for project loans (World Bank 2019).[23] The World Bank launched the GREM in 2019 to create a risk-sharing facility leveraging USD 4 billion in investments in steam production drilling and power plant construction to reduce the risks through an innovative financing mechanism, technical assistance, and capacity building (Chelminski 2022; World Bank 2019). The hope is the financing mechanism will enable 1 GW of geothermal energy development by 2029 (World Bank 2019). The financing mechanism uses both equity and debt in a special purpose vehicle (SPV), so that if the drilling produces high-quality resources, equity investors share the profits of the project. However, if the wells are not productive, the SPV value is reduced to USD 0 and the losses are pooled (World Bank 2020a).[24] As the success rate is typically 25% of projects, the successful projects would cover the losses of the 75% of unsuccessful projects, making the risk-sharing facility a long-term, self-funding solution for exploration financing. The technical assistance and capacity-building funding would be allocated to the MEMR and the PLN so as to improve licensing and power offtake agreements.

In 2021, the MEMR started an exploration drilling program, including the survey, construction of roads, and contracting out slim hole drilling (MEMR 2024).[25] This program aims to de-risk early-stage exploration drilling and provides the data to investors and developers through tenders for project development.[26] While further development of this program is expected, the

[22] MEMR interview, 2024; World Bank interview, 2020. [23] World Bank interview, 2020.
[24] World Bank interview, 2020. [25] MEMR interview, 2024. [26] MEMR interview, 2024.

onset of this program represents a significant change in the Government of Indonesia's problem-solving approaches and norms around risks surrounding geothermal exploration drilling. The clean energy regime complex through the World Bank GREM and GEUDP funding mechanisms substantially addresses financial barriers to geothermal energy development through the utility modifier and social learning mechanisms. The regime complex's impact is demonstrated through the creation of a government-led geothermal exploration drilling program aimed at de-risking exploration and early-stage development; this change in approach provides strong evidence of the impact of the clean energy regime complex through the social learning mechanism.

Addressing Regulatory Barriers through Policy Advising and Social Learning

Forestry, mining, and geothermal laws have been one of the most critical obstacles to geothermal energy development in Indonesia; the decentralized authority of the government adds further complications. Geothermal energy development was legally considered part of the mining sector according to Article 38(4) of Forestry Law No. 41/1999, and open-pit mining is prohibited in protected and conserved forests, aside from a few negotiated exemptions under Article 28 (Damuri and Atje 2012: 21).[27] This was a barrier to geothermal energy development because 57% of geothermal resources are thought to be located in conserved forests (WWF 2013: 38). Often, higher-quality resources – high heat and steam, low acidity – are located in forested areas. These higher-quality resources are cheaper and easier to develop and do not require newer, more expensive technology. Industry stakeholders such as the Indonesian Geothermal Association and private companies, as well as international actors such as the ADB, the World Bank, USAID and the WWF have lobbied for reform of the geothermal laws, but it took more than 10 years for any of these changes to be approved by the government.[28]

Finally, in 2014, a new geothermal law replaced the 2003 Geothermal Law, and the legal definition of geothermal energy development changed, declassifying geothermal as "mining" in order to allow development in forested areas (Cahyafitri 2014). Geothermal energy development was previously considered mining because the legislation was modeled on regulations for mining and oil and gas. This regulatory change is a positive move forward in terms of removing regulatory barriers for developing high-quality geothermal energy resources in areas that previously had restricted access.

[27] Pertamina Geothermal interview, 2015b, 2015c.
[28] Pertamina interview, 2015a; Supreme Energy interview, 2014; WWF Indonesia – Ring of Fire Program interview, 2014.

Nevertheless, while government officials provide assurances of minimal intrusion to forests since geothermal plants only require a small area for a well relative to other forms of energy development (*Jakarta Post* 2011; WWF 2013), conservationists have raised concerns about opening forested areas to unrestricted access of geothermal energy developers (Greenpeace 2015). Potential negative impacts include increased construction traffic changing the wildlife habitat or uncontrolled steam release contaminating surface water (WWF 2013: 39–40). Furthermore, there is an increased risk of earthquakes from the reinjection of geothermal fluid and gases. The environmental risks of geothermal energy development are significantly less than other energy sources, particularly when compared with fossil fuels. World Wildlife Fund Indonesia developed the Sustainability Guidelines for Geothermal Development and worked with developing country governments to institutionalize these guidelines in order to prevent damage to forested areas and ensure the precautionary principle with the sustainable development of geothermal resources (WWF 2012a, 2013).[29] The environmental impact assessments (EIAs) alone are insufficient to prevent environmental harm from geothermal energy development in forested areas.

Corruption in Tendering

The second complication in the regulatory landscape stems from decentralized government and corruption issues. Until recently, local governments held significant authority in the implementation of energy policy by developing regulations and issuing permits for exploration and development of renewable energy projects, as well as running the tendering process for concessions. Interviews with project developers suggested the "lowest bid wins" as a problem in geothermal energy development, since inexperienced project developers were allowed to participate in the bidding process and won tenders at less than competitive prices.[30] While the "lowest bid wins" is standard procedure for tenders, the lack of prequalification standards for project developers' participation in the tender process is the underlying problem, as there are limited barriers to entry. The local governments failed to initiate prequalification standards or barriers to participation. Rent-seeking or cronyism is evident when new geothermal companies with close ties to local government benefit from the tender process in winning tender contracts, but then drop the projects early on since the developers never had the interest or capacity to complete geothermal development in the area awarded to them (Winters and Cawvey 2015).[31]

[29] WWF Indonesia Ring of Fire Program interview, 2014. [30] Supreme Energy interview, 2014.
[31] Supreme Energy interview, 2014.

In the revised Geothermal Law of 2014, tendering authority for geothermal projects was shifted from local governments to the central government, and standardized electricity pricing rules were created (Cahyafitri 2014). As partial compensation for the local governments' loss of authority over the tender process, the 2014 law included a production bonus for local governments as participating interests in a geothermal power purchasing agreement.[32]

The implementation regulation for the 2014 Geothermal Law is MEMR Regulation No. 14/2015 on the Types of Non-Tax State Revenues Applicable at the Ministry of Energy and Mineral Resources. This regulation establishes fixed fees on geothermal exploration and production based on the size of geothermal working areas, to be paid to the state treasury (MEMR 2015b; SSEK 2016). The regulation also stipulates late payment penalty fees at 2% a month. This law provides for the collection of taxes and revenues for geothermal energy development by the local government in a transparent manner that ensures that local communities and governments also benefit from energy development.

However, the geothermal production bonus is less transparent since it does not define specific shares of production that would need to be paid by developers. The production bonus gives local communities and governments priority access to a share of the profits (SSEK 2016). Critics of the production bonus see the compensation for shifting authority away from local to central government and argue that it exemplifies the culture of rent-seeking.

The transfer of authority solved one of the major regulatory barriers to geothermal energy development by bypassing the district level governments that did not effectively manage the tender process for geothermal contracts and removed the corruption barriers causing the slowdown in the tendering process. The successful reform of the 2003 Geothermal Law, particularly related to the tender process, was due to domestic efforts by the Indonesian Geothermal Association, private sector lobbying, and international pressure to reform geothermal policies.

The policy reforms carried out in the geothermal industry represent some level of social learning, providing evidence of the regime complex's impact. Since the Geothermal Law of 2014 fixed many of the problems created by the 2003 law, there is evidence that the social learning process was successful in facilitating changing perspectives on regulatory reform for policymakers to learn which parts of the law needed reform and then put these elements into law in a politically feasible manner.[33] The entire process took more than seven years – indicating political obstacles, vested interests, and inertia – despite active lobbying efforts from industry associations, geothermal energy producers, and the clean energy

[32] Directorate of Geothermal, EBTKE interview, 2015a, 2015b; National Energy Council interview, 2014a.
[33] Directorate of Geothermal, EBTKE interview, 2015a, 2015b.

regime complex along the way.[34] The lobbying efforts to reform the law represented the interaction between the special interest groups and the clean energy regime complex in promoting social learning and political interest convergence in favor of policy reform.

Addressing Sociocultural Barriers through Compensation Packages and Social Learning

The sociocultural barrier is another major obstacle to geothermal development. This barrier is exemplified by the fears of new technology, cultural barriers, normative contestation, and inherent environmental risks in geothermal energy development. Community protests over clean energy development projects represent legitimate claims and are a significant hurdle to navigate as part of an energy transition. Often in EMDEs, the environmental and human rights regulations and Indigenous protections for ancestral land rights are weakly enforced at the local level, leaving room for developers to marginalize Indigenous and local communities. Social acceptability of renewable energy development is a widespread problem across countries, and just transition norms and best practices are still emerging (Chelminski 2024; Dolšak and Prakash 2022; Elmallah et al. 2022; Mohlakoana et al. 2023; Sovacool and Dworkin 2015). The following section details the norms and practices of international development banks and the clean energy regime complex around managing the social impacts of clean energy projects.

Resettlement Norms of the Clean Energy Regime Complex

Energy or extractive development projects that have received World Bank (or international development aid) funding must follow a set process to determine the environmental and social impacts of the project, including conducting public consultations and receiving prior and informed consent. World Bank standards are either equal to or more stringent than domestic regulations on environmental and social impact assessment. The World Bank resettlement process works as follows. First, a development project contract is awarded and approved by a recipient government. The Environmental and Social Framework (ESF) due diligence would then be completed, often with support from development bank staff. The level of support varies depending on the capacity of local institutions and companies to carry out these procedures and draft reports and/or policies and may require staff training. The ESF due diligence processes are conducted by government

[34] Chevron – Indonesia interview, 2015a; KfW interview, 2015; Pertamina Geothermal interview, 2015b, 2015c; World Bank 2015b, 2015c; WWF Indonesia interview, 2015.

institutions and determine the level of environmental and community impacts; this process can take two years.[35] If the project impacts local communities, the government and company attempt the "willing seller, willing buyer" negotiations, offering a fair compensation for legal claims. Legal claims are dependent on land rights, and often there is a messy process for sorting through legal claims, including contestation over land rights, missing information, unclear landownership, fake property rights claims, and – often – insufficient capacity at the local level.[36] To avoid substantive delays, the resettlement and land rights issues are often decoupled from project development.

Following the land acquisition negotiations, the government proceeds with expropriation under eminent domain. If the government proceeds with expropriation and resettlement, the World Bank's Involuntary Resettlement Policy (OP 4.12) is triggered (see World Bank 2001). Under OP 4.12, an invitation to the local population for a consultation is clearly stated, but there is no follow-up to determine if a representative population is attending. Contentious projects may in some cases lead to lack of representation at official government or industry consultations as a form of protest, but this results in lack of stakeholder representation through official channels.[37] Resettlement will proceed only once the resettlement sites are located that allow continued livelihood, access to basic necessities, and options that are equal to what communities currently have, if not better locations.[38] Resettlement or displacement does not always mean relocating entire communities; it may mean designing projects so only part of a property on the perimeter is impacted, thus not requiring full dispossession.

If Indigenous communities are also present at a site, the World Bank Policy for Indigenous Peoples (OP 4.10) is triggered (see World Bank 2005). The World Bank's Operating Policy on Indigenous Peoples (OP 4.10) diverges from OP 4.12 in the approach to consultation and participation, with a higher bar for consultation and consensus in OP 4.10. While Indigenous peoples receive special protection under international law, as well as domestic regulations typically, there are often minorities that are marginalized, and their interests and land rights cannot be fully decoupled from Indigenous community interests or treated differently at the local level in terms of protections, resettlement, or compensation packages, as noted.[39] The World Bank's approach to compensation packages is based on the fair market value for the land, incorporating the new productive value (energy production or extractives).[40] The World Bank is agnostic to the type of landowner, whether

[35] World Bank interview, 2023.
[36] World Bank interview, 2023. Contestation will be dealt with through local civil courts to sort out who owns the land. In some cases, legal owners cannot be located as they may have relocated.
[37] World Bank interview, 2023. [38] World Bank interview, 2023. [39] See ILO 1989; UN 2007.
[40] World Bank interview, 2023.

Indigenous communities or other minority groups in the valuation.[41] This blanket approach to land value is used to reduce conflicts over perceived special treatment, nepotism, corruption, or inequitable distribution of benefits. All landowners are treated impartially and compensated equivalently according to their landownership.

The World Bank Operational Manual for Involuntary Resettlement (OP 4.12) and the Operational Manual for Indigenous Peoples (OP 4.10) were established as a baseline to ensure environmental and community standards are followed in recipient countries. While standards of sustainable impacts, consultation, and informed consent – as well as fair compensation packages – align with some principles of just transitions, the norm of resettlement itself provokes the question of whether these provisions can be complementary to just transitions. The World Bank policies and recipient country government approaches are often top down and can result in land grabs and dispossession by implementing agencies at the country level.

Beyond the limitations of operational policies in terms of incorporating principles of just transitions, the World Bank also struggles with oversight of resettlement policies ensuring compliance with these standards. The World Bank's internal audits through the Internal Audit Department Advisory Review of the Bank's Environmental and Social Risk Management have revealed "serious shortcomings in the implementation of its resettlement policies" over the decades of projects reviewed, finding that oversight of these projects "often had poor or no documentation, lacked follow through to ensure that protection measures were implemented, and [that] some projects were not sufficiently identified as high-risk for populations living in the vicinity" (World Bank 2015: 1).[42]

Cases of Contestation

Local opposition to geothermal energy development in Indonesia has taken many forms, such as community protest, resistance from local governments, or Indigenous contestation over projects as depicted in Figure 5.5. Local communities have opposed geothermal energy development due to environmental and health concerns, and they are represented by village chiefs. Likewise, Indigenous communities may protest the infringement on their land and seek compensation or retribution for damages. Lastly, local government opposition to geothermal projects depends on relationships between the project developers and the local government. Examples of opposition are further detailed in what follows along with methods the regime complex uses to address the opposition.

[41] World Bank interview, 2023.
[42] While the World Bank put in place a new policy to remedy these findings, the audit reports are not currently publicly available.

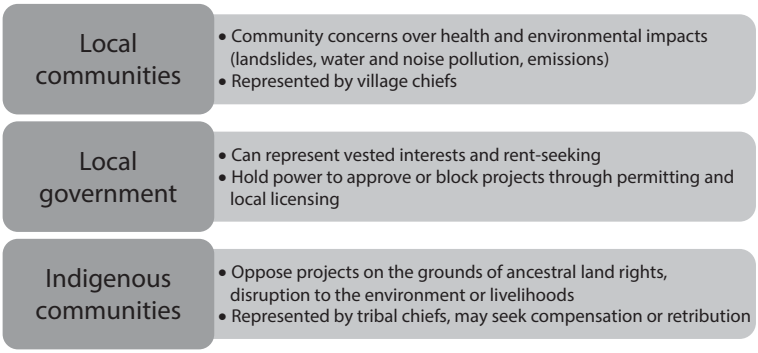

Figure 5.5 Local-level opposition to geothermal energy development in Indonesia. Source: KPPIP interview, 2015; WWF 2012b, 2013; WWF Indonesia interview, 2015

The clean energy regime complex addresses sociocultural barriers through capacity building, community outreach, and compensation packages. In 2011, BAPPENAS and the MEMR created a bilateral agreement with the Netherlands to establish the National Geothermal Capacity Building Program, which involves universities, think tanks, and geothermal companies. The objective is to "increase the capacity of Indonesia's ministries, local government agencies, public and private companies and knowledge institutions in developing, exploring and utilizing geothermal energy resources, and to assess and monitor its impact on the economy and environment."[43] These initiatives boost local expertise and capacity to handle administrative issues, and to develop and operate geothermal projects.

Many rural communities are distrustful of new technologies and exploration of local land, fearing that geothermal energy development could cause natural disasters. The fear associated with new technology followed several disasters triggered by oil and gas drilling, including the landslide caused by the company Lapindo Brantas in East Java in 2006, which displaced more than 12,000 people (Evers 2006). The concerns connecting natural disasters to drilling are legitimate since geothermal drilling is linked to earthquakes like the one in Switzerland in 2009 (Gabbatt 2009; Harmon 2009; WWF 2013). Nevertheless, the relationship between mudslides and geothermal drilling is contested (Nuwar 2015).

One example of community fears related to geothermal energy development is the case of Supreme Energy's development in Lampung, Sumatra, where the project was delayed due to community protests (Azward 2013). Community members feared the potential for natural disasters as the drilling was close to their

[43] See GEOCAP: www.geocap.nl/handbook.

settlement sites. To assuage community fears, Supreme Energy carried out community outreach activities, including going door to door to meet with community members to provide information on the benefits of the project, as well as organizing site visits to share information about the technology and safety measures.[44]

Indigenous community protests against geothermal projects are another form of contestation. Often Indigenous protests are motivated by deeply held cultural and religious beliefs about the sacredness of the Earth. The Bedugal geothermal project in Bali was shut down by the local parliament on religious and environmental grounds after massive community protests from Balinese Indigenous communities (Erviani 2013). This normative contestation speaks to a conflict between local values and the aims of clean energy development. Despite social outreach efforts and explanations of geothermal energy's benefits for Bali, an island with high energy demands and a need for energy transition, the local communities held fast to their own norms and cultural values against geothermal exploration disturbing the environment. While the community did not reject energy development outright, it contested the processes involved with geothermal energy development since the drilling and exploration and steam production associated with geothermal energy would negatively impact the environment. Several efforts to revive this project in 2015 and 2019 were met with continued resistance from the local government (Richter 2019).

One approach that companies and developers have taken in Indonesia to address social barriers is to incorporate community relations into their mission, along the lines of an ethics or corporate social sustainability statement, institutionalized through project development. The WWF worked with communities to create pilot guidelines for geothermal companies and advocated with the government for their approval (WWF 2013).[45] The community outreach and impact assessment, as promoted by international actors and learned through the experiences of the private sector, is becoming increasingly common among geothermal energy developers. However, this is not yet a salient norm in the geothermal industry, nor does the Indonesian government require geothermal companies to offer community impact packages. The clean energy regime complex is furthermore not yet promoting norms around just and equitable transitions.

Technical Capacity Building

In the realm of geothermal energy development, knowledge and technical capacity barriers historically have not been the major obstacle. This is partly because geothermal energy capacity developed to date has been carried out by either

[44] Supreme Energy interview, 2014. [45] WWF Indonesia – Ring of Fire Program interview, 2014.

multinational corporations like Chevron that boast a highly skilled technical capacity and cutting-edge technology, or by SOEs like Pertamina Geothermal.

Training programs like the one offered by New Zealand have made up only a small fraction of financing for geothermal energy development. This is also in part due to the lower cost of training compared to investment in geothermal project development. However, this is a low priority as demonstrated by the small share of overall development finance. As shown in Figure 5.8, only 6% of funding was earmarked for technical capacity building, demonstrating that knowledge and human capacity barriers were not prioritized by the Indonesian government or by clean energy regime complex elemental institutions.

In 2010, the US Trade and Development Agency (USTDA) launched the US–Indonesia Geothermal Development Initiative, which aimed to develop Indonesia's estimated 24 GW of geothermal reserves through assistance to the private sector and government. The USTDA funded private sector feasibility studies for several geothermal energy projects. Working with BAPPENAS and MEMR, and Indonesian and US geothermal industry leaders, the USTDA provided a geothermal power development training program and follow-up trade mission to the United States for senior Indonesian energy officials (USTDA 2010). These efforts also led to the engagement of specialized US companies in geothermal field exploration and development.

Trends in Geothermal Financing

In order to better understand trends in financial assistance to the geothermal industry over time, data were collected from multilateral development banks, including the World Bank and the ADB, as well as bilateral aid data from the OECD Development Assistance Committee database and other bilateral development banks and foreign affairs agencies, such as KfW, New Zealand Foreign Affairs and Trade, JICA, Netherlands Ministry of Foreign Affairs, Australian Agency for International Development (AusAID), and the USTDA, among others.[46] Figure 5.6 shows overall trends in bilateral and multilateral development aid to the geothermal energy industry in Indonesia over time.

As seen in Figure 5.6, during Period 1 (1980–2001), substantial multilateral development assistance flowed to Indonesia's geothermal energy industry, but

[46] The analysis of international public financing from bilateral and multilateral sources is representative of the flows to support geothermal energy development in Indonesia over time. The data are not a comprehensive list of all funding, but capture major projects earmarked to support geothermal energy development, whether geothermal project funding, development of the power sector for distribution and transmission build-out, policy advising, or technical assistance and capacity building focused on removing barriers to geothermal energy development. Data were sourced from ADB 2016, 2024; JICA 2008, 2024; KfW et al. 2015; OECD 2024; UNEP DTU 2016; World Bank 2016a, 2024b.

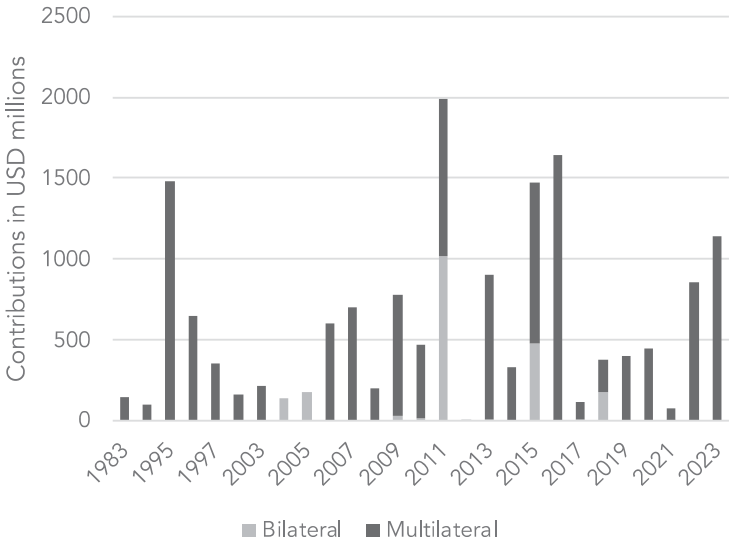

Figure 5.6 Flows in international development assistance to Indonesia's geothermal energy development over time.
Source: ADB 2016, 2024; JICA 2008, 2024; KfW et al. 2015; OECD 2024; UNEP DTU 2016; World Bank 2016a, 2024b

minimal bilateral funding was provided. Period 2 (2002–2008) did not reflect large flows of financing to the geothermal energy industry overall, and multilateral development aid was minimal. But there is a clear increase in the overall levels of bilateral and multilateral funding starting in 2010, which coincides with Period 3 (2009–2023) of the regime complex evolution. This evidence further supports the evolution of the clean energy regime complex across the three periods as outlined in Chapter 3. Figures 5.7 and 5.8 show trends in financial aid flows to geothermal energy development, power sector development, technical capacity building, policy advising and institutional capacity building, and technical assistance, as these tranches of funding address relevant barriers.

These data show a clear prioritization of financial assistance to investment in geothermal energy and power transmission (66%), demonstrating the impact of the clean energy regime complex through the utility modifier mechanism (also see Figure 5.8). Nearly one-third of funding (28%) was earmarked for policy advising and regulatory governance, suggesting that social learning was a significant priority for the clean energy regime complex and Indonesia. Technical assistance and technical capacity building represented a smaller share of funding at 6%, evidencing the lower prioritization for building technical capacity.

International development assistance makes up a significant part of finance for geothermal energy development in Indonesia. Between 1983 and 2023,

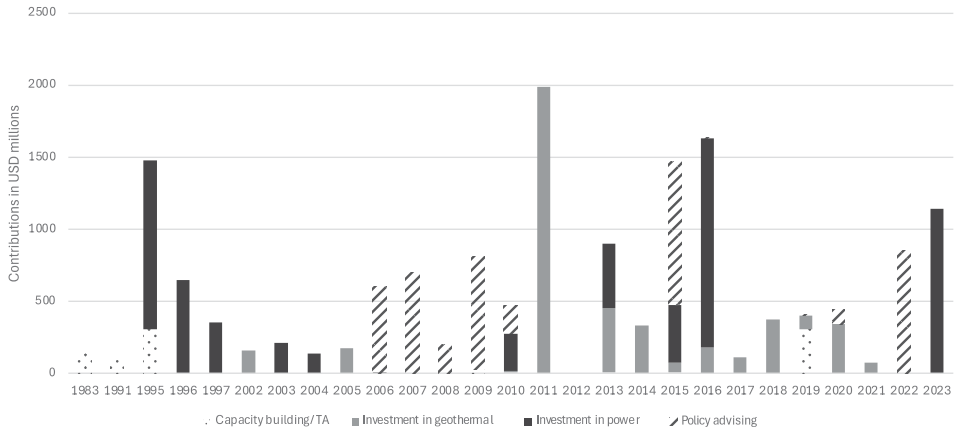

Figure 5.7 Earmarked international development assistance for geothermal energy over time in Indonesia.
Source: ADB 2016, 2024; KfW et al. 2015; JICA 2008, 2024; OECD 2024; UNEP DTU 2016; World Bank 2016a, 2024b

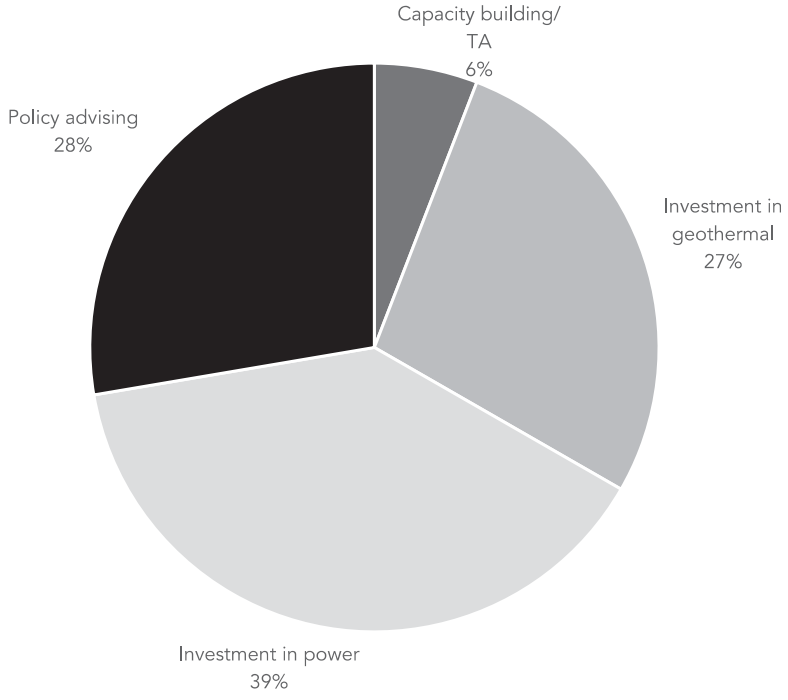

Figure 5.8 Breakdown of total earmarked international aid for geothermal energy development in Indonesia.
Source: ADB 2016, 2024; JICA 2008, 2024; KfW et al. 2015; OECD 2024; UNEP DTU 2016; World Bank 2016a, 2024b

approximately 78% of total geothermal projects benefited from some level of the USD 15.9 billion in bilateral and multilateral finance allocated to the country's geothermal development (ADB 2016, 2024; JICA 2008, 2024; KfW et al. 2015; MEMR 2023; OECD 2024; UNEP DTU 2016; UNFCCC 2024; World Bank 2016a, 2024b).[47] Development finance is used to set examples, promote best practices, and mobilize increasing private investment in the geothermal industry. However, in order to catalyze private investment, major regulatory reforms are needed to remove investment barriers (UNDP 2015; World Bank 2009a). In the interim period, international development assistance will need to fill in the gaps and de-risk projects. The next section examines the impact of both the clean energy regime complex – encompassing multilateral and bilateral development actors and transnational actors – and domestic political interests on clean energy development in Indonesia.

Regime Complex Impacts on High-Risk Geothermal Energy Development in Indonesia

The clean energy regime complex's impacts on Indonesia's geothermal energy industry are evident in the direct support of geothermal energy projects, policy reform, policy implementation, and capacity building. The clean energy regime complex utility modifier, social learning, and capacity-building mechanisms conceptualize the projects and programming carried out by international actors or elemental institutions of the regime complex working in the domestic context in Indonesia. Several indicators demonstrate the influence of the regime complex on geothermal energy development in Indonesia: the sheer size of development aid channeled to geothermal energy development to address financial barriers, the successful reforms of regulatory barriers, as well as technical assistance and training to address knowledge barriers, which support the change in geothermal energy capacity over time (Figure 5.1). Nevertheless, the clean energy regime complex is not the sole influence in the country's transition toward sustainable energy. Intervening variables like external energy shocks, domestic political interests, and political will are critical predictors of change in the energy sector (Chelminski 2022). The following section examines the impact of the regime complex on the barriers to geothermal energy development in Indonesia through the three mechanisms, along with the intervening variables, before the chapter

[47] "Benefited from" includes received earmarked funding for project-level finance, technical assistance, or policy advising; it also includes projects that moved forward due to reforms resulting from international development support. For example, projects listed in World Bank Geothermal Power Generation Development Implementation Results (World Bank 2012c). The CDM funding was included in this calculation. The project list derived from projects in MEMR (2023) and other projects not in current operation but listed in development funding lists – for example, projects in development at the time of publication that were listed but not yet in operation, like Rajabasa.

concludes with a discussion of the overall impacts of the clean energy regime complex in addressing barriers to energy transitions in Indonesia.

Utility Modifier Mechanism

This chapter finds support for the idea that the clean energy regime complex provides a strong incentive for geothermal energy development in Indonesia through the utility modifier mechanism, particularly when coupled with social learning. International actors operating in Indonesia offer assistance that includes financial resources (i.e., soft loans), pilot projects, policy recommendations, and often some form of conditionality, requiring policy or institutional change. International finance (i.e., CTF and CDM funding) is also allocated to programs within Indonesia that disburse finance to specified projects. These resources change the cost–benefit calculation of renewable energy development for the country's government; they also open up an opportunity for social learning to take place. The utility modifier mechanism aimed to address the financial barriers to technology deployment, and empirical analysis finds that the regime complex has had an impact on key projects and helped create a long-term solution to major exploration risks. Nevertheless, some financial barriers remain.

The high risks and project costs of geothermal energy development are major barriers in Indonesia. Through the creation of the GEUDP and GREM financing mechanisms, a major financial barrier has been addressed, reducing the risks of exploration drilling. Clean energy finance for geothermal energy development has made several attempts throughout the years to fill in gaps for projects and improve IRRs, while incentivizing geothermal power over other energy sources. The CDM project documents demonstrate that geothermal energy was not cost competitive compared to alternatives such as coal or oil projects, but the overall benefits of emissions reduction and climate change mitigation justified the continued development of geothermal energy given Indonesia's advantage of abundant and underdeveloped geothermal resources. The CDM financing was therefore used as a utility modifier in order to incentivize the PLN and Pertamina to develop geothermal projects. The Geothermal Fund was not well matched to the financial needs of project developers and did not overcome issues with political will to support exploration drilling. However, after policy dialogues between the World Bank and government ministries, the creation of the GREM's risk-sharing facility appeared to start resolving this issue through the creation of a database on exploration drilling to inform lending for geothermal energy development moving forward. These efforts succeeded in shifting the government's approach to exploration drilling, as detailed under the social learning mechanism.

Furthermore, the trends in financial assistance over time (Figures 5.6 and 5.7) show that funding for geothermal energy began with regional development aid in

1983, during Period 1 of the regime complex's development, followed by a rise in bilateral and multilateral funding during Period 2. The funding trends coincided with the implementation of clean technology financing mechanisms in the climate change regime architecture. The most dramatic increase in financial flows for geothermal energy development occurred during Period 3. The funding flows over time also show that the utility modifier was not only a priority through which the clean energy regime complex incentivized development (representing 66% of overall financing for geothermal and power sector installed capacity development), but that it was an increasing priority during Periods 2 and 3 (see Figure 5.7).

There is evidence that the utility modifier mechanism of the clean energy regime complex is the most heavily funded mechanism to incentivize geothermal capacity development and implementation of policy targets, but this follows naturally since project development is the most cost-intensive activity relative to capacity building and policy advising. The priority of financing needs to spur geothermal growth was clearly outlined by elemental institutions of the clean energy regime complex. Nearly all the resources throughout all three periods were directed to accelerating geothermal capacity development, but only recently were the major financial barriers to geothermal development addressed through financing to cover the cost of exploration and reduce risks for developers. Results of the various financing mechanisms will be inconclusive until projects supported with these funds are completed, which can take 5 to 10 years. The government-led geothermal drilling program will have further impacts on expediting geothermal energy development in the future.

It is important to remember that the clean energy regime complex's effectiveness in addressing barriers to geothermal energy development in Indonesia depends on the provision of finance and can only be impactful when other regulatory barriers are addressed. Therefore, climate finance (the utility modifier mechanism) is insufficient by itself but is most effective when it is paired with policy advising (social learning). As assessments of the status of CTF funding in Indonesia have revealed, even when funding is allocated, the projects have been delayed due to legal and contractual issues (ADB, World Bank, and IFC 2013).

While the change in geothermal installed capacity over the periods studied can be traced to impacts from the clean energy regime complex's financial assistance (the utility modifier mechanism) and policy advising (social learning), political will is a necessary condition to enable change. The regime complex's impact is conditional on the government's openness to receiving financial assistance and making necessary regulatory reforms to reduce barriers to geothermal energy development. The financing offered by the clean energy regime complex for geothermal energy investment has often been coupled with policy advising or recommendations for

regulatory reform. However, it took more than 10 years for the government to make necessary regulatory changes in the case of government support of exploration drilling. While financial assistance incentivized the development of geothermal capacity to address financial barriers, it alone was insufficient to motivate long-lasting regulatory change to spur investment in the geothermal energy industry.

The amelioration of financial and regulatory barriers and subsequent growth in geothermal energy capacity in Indonesia is unlikely to have been as successful in the absence of financial and technical support from the clean energy regime complex. The USD 10.6 billion that Indonesia received in international public finance for geothermal and power sector projects between 1983 and 2023 is substantial as stand-alone aid. It was also combined with USD 934 million in technical assistance and technical capacity building, and USD 4.4 million in policy advising that gradually reformed policy and ameliorated some of the persistent barriers to geothermal energy development (ADB 2016, 2024; JICA 2008, 2016, 2024; KfW et al. 2015; OECD 2024; UNEP DTU 2016; World Bank 2016a, 2024b). The nearly USD 16 billion in international public funding could not have been mobilized by the country's government or domestic companies or provided solely through direct foreign investment, considering the unresolved regulatory barriers, high-risk investment environment in Indonesia, and reluctant private sector. Therefore, the clean energy regime complex's utility modifier had an important impact on Indonesia's geothermal energy development by ameliorating major financial barriers to technology development.

Furthermore, when considering the impact of the regime complex without the utility modifier mechanism – focusing instead on capacity building and social learning – visible impact on geothermal energy growth is highly unlikely due to the enormous risks and financial hurdles involved with geothermal energy development, particularly during the exploration phase, and private funding alone is insufficient to fill the gaps (World Bank 2009b). This counterfactual provides further support for the argument that the regime complex via the utility modifier mechanism (financial assistance alone) had the strongest relative impact on geothermal energy development, but also points to how these mechanisms are intertwined. While the financial assistance earmarked for investment in geothermal energy capacity directly impacts generation capacity, it is unlikely that this growth can be sustained without the addition of technical capacity building and social learning to carry out sustainable energy development in the long term.

Social Learning Mechanism

Social learning is a necessary element of clean energy governance to ensure effective and long-lasting normative, policy, and behavior change. Through social

learning, problems are redefined and alternative solutions are seen in new light, often leading to normative change. The clean energy regime complex's financing for social learning earmarked 28% for policy advising and regulatory governance (see Figure 5.8). The amount of support allocated to policy advising is much greater than that calculated by the earmarked funding since policy advising is interwoven with other forms of funding from multilateral development banks, including project financing and technical assistance.

Despite the minimal flows of finance specifically earmarked for policy advising or technical capacity building, Period 3 shows most evidence of prioritization of geothermal energy by policymakers and demonstrates social learning. The reform of the 2003 Geothermal Law is an example. Despite ongoing lobbying efforts by various stakeholders, the reform took more than a decade, which can be attributed to a low prioritization of geothermal power as a potential energy source prior to 2004 and 2008 when Indonesia shifted to become a net importer and left OPEC, respectively. The long process could also be due to domestic political interests and special interest groups, as discussed later. Despite delays, the geothermal law was eventually replaced in 2014, and nearly all problems in the old law had been addressed as recommended by the clean energy regime complex and domestic actors. Domestic political interests converged in favor of the reform of the geothermal law, demonstrating cognitive changes in line with the clean energy regime complex's objectives. This provides support for the social learning mechanism.

Furthermore, the policy dialogues between the World Bank and the Government of Indonesia regarding the risks associated with exploration drilling eventually led to changes in norms around risk and reframing loss associated with exploration drilling data. The policy dialogues first succeeded in shifting the government's involvement in a finance mechanism to reduce the risks of exploration drilling. Subsequently, the government launched a drilling program aiming to remove the risks associated with exploration drilling. The program represents a transformation in how the government views its role in reducing risks associated with exploration drilling and furthermore demonstrates successful social learning and cognitive shifts. The normative change surrounding risk sharing shows the government's learning of the conditions necessary to spur investment and dedication to improving the investment climate for geothermal energy developers.

The CDM geothermal project processes provide another example of social learning. Through international forums and meetings with government ministries, project developers acquired information regarding the benefits of and the process for registering CDM projects, as discussed in Chapter 3. Project developers specifically cite economic benefits related to CDM projects (e.g., ERCs covering costs related to investment in renewable energy projects); this demonstrates newly learned approaches to solving problems (Elkins and Simmons 2005; Haas 1989).

While the main purpose of CDM is a financial incentive (utility modifier), the policy advising is intertwined with the project funding. The social learning and capacity building are also a benefit of the CDM funding.

Social learning and regulatory change can spur long-term impacts on geothermal energy development in Indonesia – attracting more private investment, as opposed to short-term geothermal installed capacity additions supported through financing earmarked for geothermal project development. Yet the financial incentive of the utility modifier mechanism worked hand in hand with social learning mechanisms to achieve behavior and policy change in Indonesia.

Capacity-Building Mechanism

The capacity-building mechanism is demonstrated by multilateral and bilateral donors providing training or technical assistance to develop the technical capacity of government officials and the labor force, as well as resources to improve data collection on energy. The clean energy regime complex provides a sizeable share of financial support for technical capacity building and technical assistance to address knowledge barriers in Indonesia, but these programs are only a fraction of the support provided to building generation capacity. Technical assistance and technical capacity building represented a 6% share of the clean energy regime complex's financing in 1983–2023. Technical capacity building is provided by multilateral and bilateral organizations that offer trainings and workshops across Indonesia to develop technical skills relevant to the geothermal energy industry. Some of the technical capacity barriers are addressed by the regime complex through training and education: the bilateral initiatives between Indonesia and the United States as well as the Netherlands, were created to boost geothermal technical training programs to improve skills of the technical workforce and policymakers.

Technical capacity is a necessary factor in achieving long-term sustainable development since a highly technical workforce is needed to develop geothermal energy resources. Therefore, it is important that technical assistance and capacity building are a part of geothermal energy funding from the clean energy regime complex; this will ensure government institutions have the technical capacity to implement relevant regulations and programs and support a robust technical workforce to develop geothermal energy technology.

Domestic Political Interests and Intervening Variables

The impacts of the regime complex cannot be completely disentangled from the energy crisis, external shocks, or domestic political interests as intervening

variables. The series of energy crises in Indonesia in 2004 and 2008 have shown the importance of energy diversification, placing a greater priority on renewable energy as a solution to energy security concerns. Without domestic pressures for reform from industry leaders and the government's willingness to carry out reforms and implement policy, the impact of the regime complex would be insignificant. The major example is the four-year process of implementing the 2003 Geothermal Law, which eventually happened following the energy crisis in 2004 with the aid of the political leadership of Chairman Prayitno to illustrate the environmental security benefits of renewables.

The impact of the clean energy regime complex in converging domestic political interests can be viewed through two perspectives: (i) the local communities' contestation over geothermal energy development and (ii) the diverging interests of domestic political actors regarding other technology choices. In the first perspective, in response to community opposition over geothermal energy development, the clean energy regime complex has advanced norms around environmental and social impact assessments and compensation packages to ameliorate impacts for local communities, as outlined by the World Bank protocols. Often in cases of protest with local communities over environmental impact concerns, community concerns were assuaged through community outreach and compensation packages offered by project developers. However in the cases studied of contestation from Indigenous communities over ancestral land rights and environmental concerns linked to cultural beliefs, project developers could address concerns while also continuing with development without marginalizing Indigenous community interests. In some cases, this led to cancelled or indefinitely stalled projects, such as in the case of the Bedugal project in Bali. In the event of protracted unresolved contestation, developers can change the siting location of the geothermal energy project to avoid impacts to the local environment. The clean energy regime complex has not yet developed a robust just transition framework to outline best practices in community negotiations, compensation packages, just and equitable benefits, or mediation of conflicts over land use. The clean energy regime complex norms surrounding contestation and resettlement packages are elaborated in further detail in Chapter 6 with the Philippines case study.

The second perspective of contestation can be viewed through the contrast between domestic political interests and the clean energy regime complex's objectives. The clean energy regime complex was limited in its ability to incentivize convergence of domestic political interests in favor of geothermal energy technology development to fully ameliorate barriers and catalyze tremendous growth in this industry. Following full implementation of the 2003 Geothermal Law in 2008, the process of reforming it took more than six years, showing further divergence between domestic political interests and the objectives of the clean

energy regime complex. The stalling of the tendering processes was not only slowing geothermal energy development, but also showed evidence of rent-seeking by local authorities in charge of tendering. The resistance to changing the law and shifting authority for tendering from the local level to the central government demonstrates vested interests at the local level. The new Geothermal Law of 2014 incentivizes subnational interests and special interest groups through the production bonus quota. This supports the argument that the clean energy regime complex is most effective in achieving goals when it can incentivize the convergence of domestic political interests. While the regime complex did not incentivize the special interest groups directly, the policy advising and social learning that it initiated supported the decision to shift the tendering process to the central government while incentivizing special interest groups indirectly by providing compensation to local governments. However, in the bigger picture, the slow development of geothermal energy and reform of regulations necessary to catalyze geothermal development cast doubts on the regime complex's overall effectiveness in incentivizing the convergence of domestic interests in favor of geothermal technology over other alternatives. This is in part due to lack of political will to choose geothermal technology over other alternative technologies to solve energy security concerns.

In summary, the impact of the regime complex is dependent on political will to prioritize geothermal energy development as part of energy diversification efforts and to reduce carbon emissions. Without willingness to address barriers to development, impact is unlikely. The combination of external shocks and energy crisis in Indonesia spurred interest in the government to prioritize energy diversification. The clean energy regime complex capitalized on this shifting prioritization by demonstrating the advantages of renewable energy development. This chapter provides evidence of the important role and limitations of the clean energy regime in fostering convergence of domestic political interests.

To provide a summary of regime complex impact and the conditions under which the mechanisms impacted lock-in, Table 5.2 shows the obstructing and facilitating conditions throughout the three periods of analysis. Under Period 1, the impacts of external shocks from the oil crisis benefit energy security and lead to policy and technology lock-in. Coupled with lack of political will for change, this provides little opportunity for regime complex impact. Period 2 demonstrates that as energy security diminishes, motivation for policy change increases and provides an opportunity for regime complex impact through policy advising and capacity building. During Period 3, political will grows as energy insecurity further increases, yet local-level politics and vested interests limit the impact of the regime complex's financial assistance, social learning, and capacity building.

Table 5.2 *Summary of facilitating conditions of the regime complex's impact on Indonesia's geothermal energy development*

Period factors	Conditions and mechanisms of impact	Summary
Period 1: Suharto's fail and democratization	Condition for impact: • Oil crisis positively impacts energy security and AFC negatively impacts economic security	• Impacts of external shocks benefit energy security and lead to policy and technology lock-in • Lack of political will
1973 Oil crisis and Asian financial crisis	Regime complex impact through mechanisms: • Minimal finance directed to geothermal energy projects, but focus on power sector and capacity building	➢ Regime complex has limited impact in Period 1
Period 2: Rise of energy diversification	Condition for impact: • Energy insecurity is high following failures of domestic oil industry ➢ Motivation to learn alternative energy approaches and diversification	• External shock reduces energy security • Motivation for policy and technology change • Political will for energy transition increases
Indonesia becomes a net oil importer and hosts UNFCCC COP-13 in Bali	Regime complex impact through mechanisms: • Rising support for geothermal development (utility modifier mechanism) • Policy advising and social learning related to regulatory reform (Geothermal Law) ➢ Technical capacity building in the geothermal energy industry	➢ Government receptive to regime complex; regime complex has increasing impact in Period 2
Period 3: Geothermal prioritization	Condition for impact: • Energy insecurity is high • Vested interests at local level • Lack of coordination of finance	• Energy insecurity increases need for diversification • Political will for energy transition increases and prioritization of ameliorating barriers to geothermal development, in particular successes in reforming the geothermal law, creating an exploration drilling program
Indonesia formally leaves OPEC	Regime complex impact through mechanisms: • Large increase in international finance/technical assistance to geothermal projects (utility modifier/capacity-building mechanism) • Policy advising on geothermal risk mitigation, particularly exploration drilling (social learning)	➢ Regime complex has impact, yet limited energy transition due to diverging domestic political interests

Conclusion: Realizing Indonesia's Geothermal Energy Potential

Indonesia is characterized by incredible potential for renewable energy abundance. Despite efforts to develop these resources over the past 40 years and across the three periods of regime complex analysis, growth in installed geothermal energy capacity has been slow. The list of barriers to technology deployment affecting this sector is long, and efforts by the international community, domestic stakeholders, and government officials to reform the economic and regulatory frameworks to ameliorate these barriers have encountered obstacles. Issues related to corruption, complications related to decentralization, and vested interests in oil and coal are difficult to overcome.

This chapter has looked at the clean energy regime complex and the mechanisms through which it has addressed the barriers to clean energy technology deployment in Indonesia. This analysis has shed light on indicators of regime complex effectiveness: utility modifier, capacity building, and social learning. Tracing the evolution of the geothermal energy industry and regulatory framework, the analysis has shown that the regime complex has had a definitive impact in ameliorating some of the barriers to the development of geothermal energy capacity in Indonesia, yet many barriers remain. These impacts increased across Periods 2 and 3, with the greatest impacts occurring through large flows in development assistance to geothermal generation development in 2009–2023 (Period 3). Analysis showed the utility modifier to have the strongest impact on growth in installed capacity, but social learning is necessary for reforming and implementing regulations, and sustaining long-term growth. Social learning through policy advising and institutional capacity building represented 28% of clean energy finance for geothermal energy, demonstrating it was a significant priority for funding. Technical capacity building and technical assistance received 6% of overall funding, suggesting that donors saw technical capacity building as a lower priority for geothermal energy development in Indonesia. The main implications of this finding are that regulatory changes and social learning are still needed to fully address remaining barriers and stagnation in the geothermal energy industry. Financing and capacity building alone have not been sufficient to remove all the barriers to development.

The role of norm contestation and interactions among special interest groups, domestic political interests, and the clean energy regime complex are also important findings. The sociocultural barriers to geothermal energy development underline the necessity of convergence of domestic political interests for regime complex effectiveness. This also represents an opportunity for the clean energy regime complex. Chapter 6 presents the case of the Philippines and analyzes the impacts of the clean energy regime complex in furthering geothermal energy development. Chapter 7 provides a side-by-side comparison of these two case studies.