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HARNESSING THE RING OF FIRE: POLITICAL ECONOMY OF CLEAN ENERGY DEVELOPMENT FINANCE ON GEOTHERMAL DEVELOPMENT IN INDONESIA AND THE PHILIPPINES

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22 January 2018

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Keywords clean energy development, development finance, energy policy, geothermal energy

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1. Introduction

Located in the Ring of Fire, a seismically active area in the Asia Pacific, Indonesia and the Philippines are two of the world's largest producers of geothermal energy after the US, yet both countries demonstrate different trajectories of geothermal development. Despite Indonesia's superior geothermal reserves (~29GW) it has only developed 5% of its potential compared to the Philippines, which has developed 56% of potential capacity (~4GW) (Koch, 2015; IEA, 2014a; Fronda, Marasigan and Lazaro, 2015). This puzzle raises the question of why there are disparities in the advancement of geothermal development, and namely why the Philippines is ahead of Indonesia, despite Indonesia's greater advantage. Geothermal technology is the technology of focus because it both Indonesia and the Philippines have an abundance in geothermal resources, and developing geothermal technology requires overcoming several difficult barriers to development in comparison to other renewable energy technologies. Both countries have received substantial international development finance for renewable energy development, but many barriers to deployment remain in both countries. Bilateral and multilateral development finance is playing an increasingly important role in driving clean energy development in emerging economies. Multilateral development banks have financed more than US $131 billion in climate action between 2011 and 2015; over half of mitigation finance was earmarked for energy related sectors and 30% for renewable energy (approximately US$39 billion) (AfDB et al, 2016). This paper investigates the impact of international development assistance for clean energy in addressing barriers to geothermal development in Indonesia and the Philippines.

The main research question leading this research is: how has clean energy development finance impacted geothermal development in Indonesia and the Philippines? Have the financial mechanisms addressed the major financial barriers to development of geothermal technology? How have domestic political interests impacted the effectiveness of financing? To answer these questions, qualitative analysis is used, namely process tracing and data analysis of clean energy development finance for geothermal energy. The majority of data was collected through primary and secondary data sources, including interviews during field research in Indonesia (2014 & 2015) and the Philippines (2016).

2. Literature on renewable energy barriers and development financing

There are several barriers to renewable energy development faced by developing countries, and development finance attempts to fill the gaps to address some of these barriers. There is an extensive literature – mainly coming from economic literature – examining technology transfer and the specific barriers to renewable energy development in developing countries and those specific to geothermal technologies. These studies focus mainly on the barriers to renewable energy development. A set of further studies in political science have investigated the role of development finance in fostering renewable energy development. This literature explores for example how the

Clean Development Mechanism (CDM) and Global Environment Facility (GEF) funding as well as renewable energy project development finance has impact renewable energy policy adoption and in some cases, technology development. However, one of the gaps in this literature is an analysis of how the development financing addresses specific barriers. These major research studies exploring these themes will be explored in this section.

While there are numerous opportunities to use clean energy technologies to bridge the gaps between economic growth and emissions reduction, the innovation, adoption and diffusion of clean energy technology innovations has been slower than that of other technologies, particularly in developing countries (Worrell et al, 2001). The slow pace of innovation, adoption and development of clean technology innovations in developing countries is largely attributed to market and institutional failures such as lack of information, transaction costs, weak financing institutions, poor technological adaptability to the developing country's absorptive capacity or technological sophistication (Acemoglu et al, 2012; Dechezleprêtre et al, 2012; Stoneman and Diederen, 1994). Specific to geothermal energy, major barriers include land use, high risks and costs for exploration and development, complex regulatory barriers and technology transfer (WWF, 2012). Additional governance measures such as incentives or development aid may be required to overcome the multiple barriers that exist in diffusing said technologies across developing countries (Popp, 2010; Popp, 2011; Johnstone et al 2010).

To address the financial barriers to renewable energy development and to incentivize policy reform and reduce risks, development aid targeted to clean energy development has been used widely in developing countries. The growing flows of clean energy development finance originate from multilateral, bilateral, transnational and regional agencies. However, there is limited literature that analyzes the effectiveness of clean energy development finance in empirical case studies, as well as the effectiveness of clean energy development assistance in addressing the barriers to renewable energy development in developing countries. Analyses of what works in terms of clean energy finance will be increasingly relevant moving forward in the post- Paris Agreement as the climate finance mechanisms are designed.

The literature analyzing the impacts of climate finance finds variable impacts at the macro-level, and in general studies at the micro-level (or field-level) seem to find limited effectiveness. Studies on the Clean Development Mechanism's (CDM) effectiveness have been carried out by authors such as Michaelowa and Jotzo (2005), Castro (2014), and Chan (2015). Their overall findings show that the CDM instrument is limited in its ability to address renewable energy barriers to development in developing countries. Michaelowa and Jotzo find that there are substantial transaction costs associated with the CDM and various information barriers that may limit its effectiveness as a financial mechanism for emissions reduction (Michaelowa and Jotzo, 2005). Castro's monograph on CDM impact in the Global South highlights limitations of the CDM, including the unequal distribution of CDM projects, the questionable additionality of achieved emissions reduction, and the social and environmental integrity of CDM projects (Castro, 2014). Likewise, in his analysis of CDM financing for wind energy in China, Chan raised doubts as to the CDM's impact on Chinese decision-making in the wind energy sector, and highlights the questionable additionality of various CDM projects (Castro, 2014).

Looking at other forms of clean energy development assistance, authors such as Marquardt (2016) and Heggelund, Andresen and Sun (2005), focus on case study analysis to demonstrate impacts of development assistance, whereas Stadelmann and Castro focus on large-n analysis. In a study on China, Heggelund, Andresen and Sun find that GEF has played an important role in China in raising awareness of environmental problems, promoting technology development and boosting institutional capacity (Heggelund, Andresen and Sun, 2005). Stadelmann and Castro conduct a large-n analysis to explore the determinants of renewable energy policy adoption in the Global South, and find that GEF funding and CDM projects have a positive relationship with the adoption of renewable energy policies or targets, yet comparatively insignificant to other determinants such as socioeconomic and institutional characteristics such as income level and provision of feed-in-tariffs (Stadelmann and Castro, 2014). Official development assistance (ODA) was not found to have a significant relationship on renewable energy policy adoption, aside from an "almost significant at the 10% level" with feed-in-tariffs adoption. In another study, Marquardt, Steinbacher and Schreurs find that while donor driven renewable energy projects do not force energy transitions in developing countries, donor support has helped to drive the integration of renewables into energy development as demonstrated in case studies in Morocco and the Philippines (Marquardt, Steinbacher and Schreurs, 2016). A number of studies examined the limitations of project-based sustainable energy financing on energy transitions and energy access, such as those by Terrapon-Pfaff et al (2014), Bhattacharyya (2013) and Marquardt (2015; 2016).

The literature on transnational governance emerged in the 1970s in parallel to the growing Another strand of research evaluates the institutional innovation emerging to solve climate change governance problems such as transnational governance and polycentric governance. Authors such as Bulkeley et al (2014), Andonova et al (2009), Jordan et al (2015), Shreurs (2016) illustrate the governance evolution in solving public goods problems like climate change through the involvement of non-state and transnational actors, as well as the challenges in addressing the problems. These studies have advanced our understanding of climate change governance, but have not delved into extensive analysis that allows for measures of effectiveness.

These insights are relevant to the study of the adoption of renewable energy policy and development of geothermal installed capacity in Indonesia and the Philippines since they highlight the pathways through which development finance can impact policy and technology adoption.

These studies probe the effectiveness of clean energy development assistance in addressing barriers to renewable energy development in developing countries, finding some support of impacts but limited effectiveness. Some of the important limitations are highlighted by these studies—the failures of development assistance to target countries in need and to address structural power barriers, the questionable additionality of the development projects, and the high transaction costs of some of the finance mechanisms that make participation costly. Nevertheless, the literature measuring effectiveness of clean energy development assistance lacks a sufficient scope of countries and depth in analysis that evaluates the match between the barriers to renewable energy development and the focus of clean energy finance. The literature is also limited in comparative analysis or its exploration of domestic political interests as interfering with the impacts of development finance.

3. Concepts on mechanisms of clean energy development finance impact

To conceptualize how international clean energy development finance might impact domestic interests and institutions, this paper draws upon regime theory and private governance literature to examine the impacts or effectiveness of development finance and projects for clean energy. Effectiveness of a regime can be measured based upon how closely it solves the public goods problem, which it was created to address (Young and Levy, 1999: 4). To create an initial framework for analyzing the different effects of development finance, I adapt Young and Levy's typology of pathways through which regimes affect outcomes and Carbonnier, Brugger and Krause's interpretation of this framework for non-binding agreements as it provides insights to the many ways the formal and informal international institutions can influence state behavior, national policy, and realign domestic interests (Carbonnier, Brugger and Krause, 2011).[1] I focus on three mechanisms of impact through which the clean energy development finance can impact outcomes in renewable energy development in developing countries (or recipient countries of development assistance). These mechanisms include: *utility modifier*, *social learning, and capacity building* (see Figure 1 below for examples of each mechanism). They are evaluated as they relate to policy implementation and renewable energy development, namely by addressing barriers to geothermal energy development. Using Young and Levy's definition, the *utility modifier* mechanism can change actors' cost and benefit analysis as new rules or opportunities are introduced (Young and Levy 1999: 22). *Utility modifier mechanism* is the incentivization of renewable energy development through financial assistance that changes the cost benefit analysis of actors. In the case of geothermal 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 visible in financial assistance provided by the World Bank and other multilateral, regional and bilateral agencies to invest in geothermal capacity and to assist the

[1]Carbonnier, Brugger and Krause applied Young and Levy's framework to voluntary regime as well to measure effectiveness, which they found as a useful framework. I will also look at his application of this framework as reference as well.

government in implementing the Geothermal Laws and carry out construction of geothermal projects. Through these financial resources, critical gaps in financing are filled.

The *social learning* mechanism can occur through the provision of information that produces a clearer picture of a problem, which can lead to a new perspective on solving a problem or alternative measures for problem solving and implementation (Young and Levy, 1999; Haas, 1989). Social learning requires a cognitive change such as the beliefs of cause and effect to change, not merely through the transfer and reproduction of existing policies (Elkins and Simmons, 2005; Dobbins, Simmons and Garrett, 2007; Sabatier, 1988; Clark, Jager and van Eijndhoven, 2001: 14). The social learning mechanism would be evident through development financing for policy advising and capacity building for policymakers to help reform policies to better facilitate development of geothermal and diffuse norms prioritizing renewable energy development. The *capacity building* mechanism is the provision of resources directed to building human capacity—through training and education. For this paper, the capacity building mechanism can take the form of international development assistance for training the technical workforce, or scholarships for skills related to geothermal development.

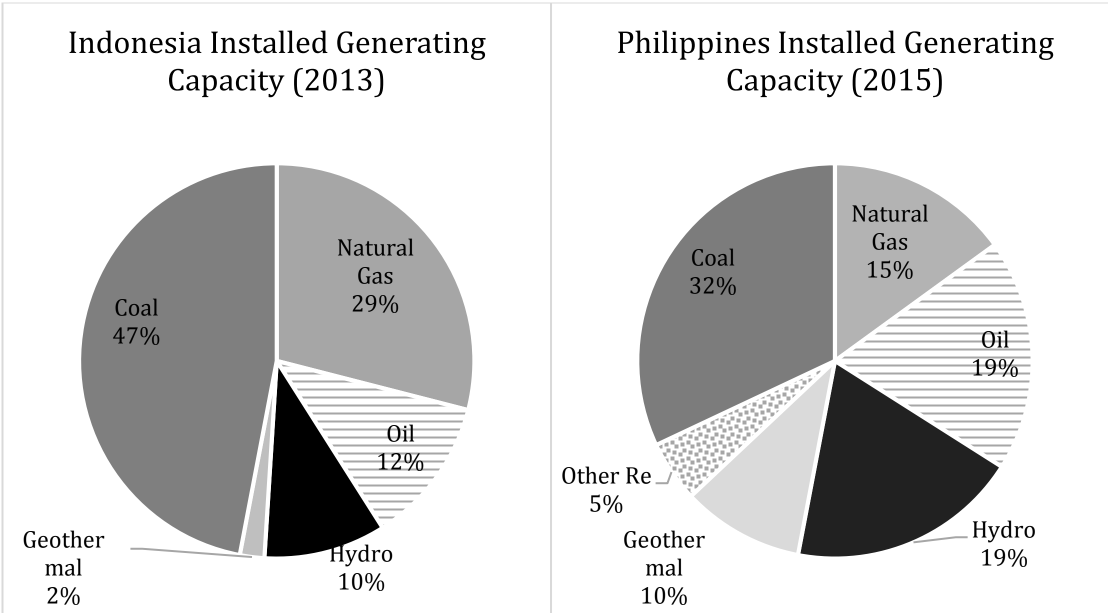
Figure 1: Mechanisms of clean energy finance and barriers to geothermal development

	Financial barriers:	Regulatory barriers:	Human or institutional capacity barriers:
Barriers to clean energy dev	Lack of access to finance, high risk investments, risk-adverse banking sector	Permitting and contracts, contradictory legal frameworks (ie forestry and energy dev or federal and local)	Knowledge and information gaps, lack of institutional capacity to implement policy
	Utility modifier	Social learning facilitator	Capacity building
Clean energy development finance effects	Access to finance and capital markets, increasing incentives for cooperation	New facts and info create more accurate picture of problem, leading to alt measures for problem solving and implementation	Training and education to build human capital through workshops, training programs and international forums.

4. Renewable energy in Indonesia and the Philippines

The political economic history in both Indonesia and the Philippines provides insights into their current status of geothermal energy development. The Philippines is the world's second largest producer of geothermal energy after the U.S. and Indonesia follows at the world's third largest producer (Think Geoenergy, 2016). This is significant since Indonesia holds 40% of the world's reserves in geothermal energy, far surpassing the Philippines, but Indonesia has only developed a fraction of its potential resources, unlike the Philippines.

Figure 2: Installed Generating Capacity in Indonesia and the Philippines

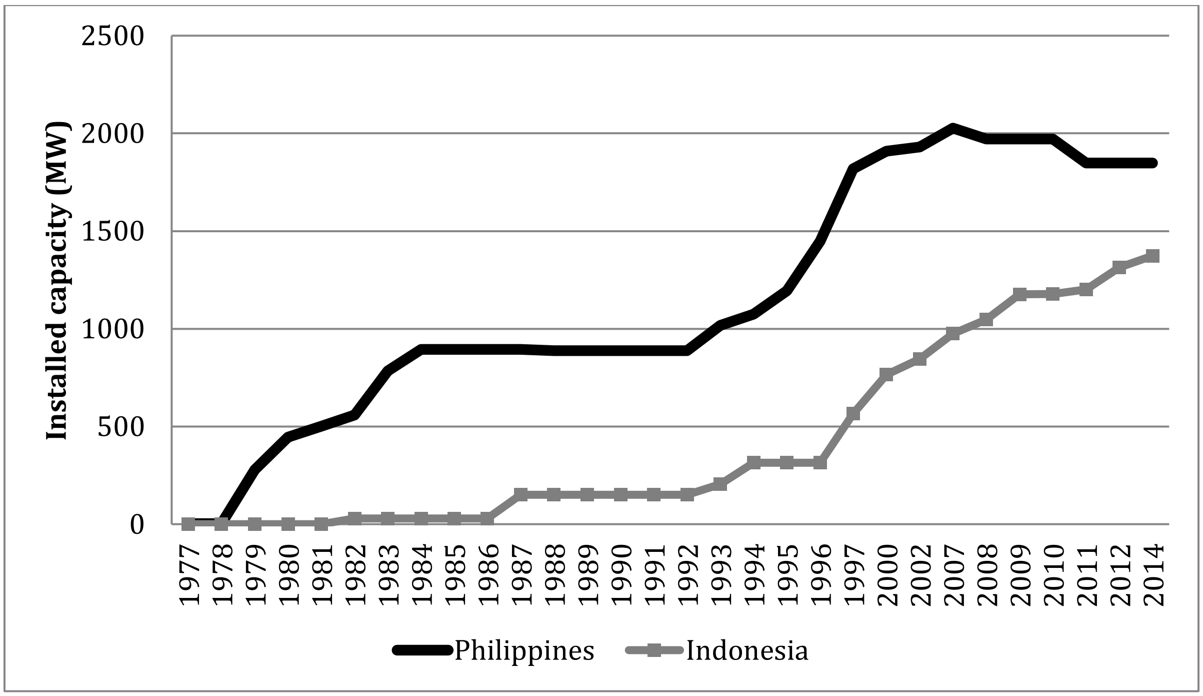


Source: Indonesia: EIA (2015), Philippines: DoE (2015)

As further demonstrated in Figure 2 above, Indonesia's renewable energy only makes up 4% of its overall installed capacity, whereas in the Philippines, the share is over one-third of installed capacity (34%). In the case of Indonesia and the Philippines, the installed generating capacity is also representative of the natural resource abundance in the country—whereby Indonesia has an abundance of fossil fuels and the Philippines does not. Under the Suharto regime, Indonesia made use of its energy abundance by investing in oil development and profiting from the rising oil prices in light of the 1973 Oil Crisis; it later joined the Organization of the Petroleum Exporting Countries (OPEC) as a member in 1962 (OPEC, 2017). In contrast, the Philippines was rocked by global and national energy crises, such as the 1973 Oil Crisis and the 1990s Power Crisis, and the energy insecurity drove the Marcos and Aquinos/Ramos regimes to prioritize geothermal energy in their energy development plans. The 1990s Power Sector Crisis was caused by poor energy development planning when the Bataan Nuclear Power Plant was cancelled due to corruption concerns; no other energy development strategies were planned to fill the missing capacity to meeting growing demand, leading to major supply shortages and massive failures across the Philippines in the 1990s (KPMG, 2014; Cham, 2007).

Focusing more specifically on geothermal installed capacity, Figure 3 below depicts the trends in the development of installed geothermal capacity over time in Indonesia and the Philippines. Indonesia clearly lags behind the Philippines in total installed capacity, and success in the Philippines' development of geothermal energy preceded Indonesia's despite the fact that both countries began exploring geothermal resources in the 1960s and 1970s. The energy mixes of both countries has played a fundamental role in impacting the priority placed on energy diversification and renewable energy development, echoing findings from Houle et al that material resources affect policy choices (Houle et al, 2015). Endowed with oil resources, Indonesia benefitted greatly from the 1973 Oil Crisis and the increasing price of oil supported economic growth in the country throughout the 1970s to 1990s. The Philippines in contrast relied on oil imports to meet its fossil fuel demand, and was severely impacted by the oil embargo of the 1973 crisis. As a result, the Philippines government under Marcos first imposed Martial Law and then redirected government resources to developing geothermal energy to meet energy needs. Of course, individual actors have influenced the energy development choices that Indonesia and the Philippines have taken in response to the external shocks and the respective natural resource abundance.

Figure 3: Installed geothermal capacity in Indonesia and the Philippines



Source: Fronda et al (2015), IEA (2014)

In Figure 3 above, spurts of growth in installed capacity are visible in the Philippines between the late 1970s and early 1980s and then again in the early 1990s. There is a dip in Philippines geothermal installed capacity from 2010-2013 (decrease from 1,972 MWe to 1,847 MWe) as a set of geothermal plants were decommissioned, including Northern Negros, Tiwi and Bacman (Fronda et al, 2015). Likewise in Indonesia, there is a jump in installed geothermal capacity developed starting in the mid-1990s through the early 2000s. These growth rates in installed capacity are linked to major energy and economic crises and external shocks, including the 1973 Oil Crisis and the 1997 Asian Financial Crisis. In the Philippines, the Oil Crisis in the 1970s and the

Power Sector Crisis in 1990s led to rapid geothermal energy development. Whereas in Indonesia, the shift from being a net-exporter of oil to net-importer of oil in 2004, and formal withdrawal from OPEC marked a shift in the government's prioritization of geothermal development in additional to other renewable energy technologies. The overall system capacity in Indonesia is dramatically higher than shown in this figure, yet due to barriers to development—full potential has yet to be reached.

The political and socioeconomic histories in Indonesia and the Philippines have created a set of vested interests and subsequent barriers to geothermal energy development. The fact that the current ownership of power sector assets in both countries is still dominated by state-owned enterprises despite power sector reforms is demonstrative of barriers to private investment. The variety of interests and institutions impacting energy development, particularly relevant to geothermal energy, are summarized in Table 1.

Table 1: Political economy of Indonesia and the Philippines

	Indonesia	**Philippines**
GDP (2016) **(per capita)** **Growth rate**	USD 932 billion (USD 3,570.3) 5%	USD 304.9 billion (USD 2,951.1) 6.9%
Political regime	Democratic since 1999 Historical authoritarian dictatorship under Suharto and Sukarno	Democratic since 1986 Historical authoritarian dictatorship under Marcos
Major state actors (domestic institutions)	**Ministry of Energy (MEMR/EBTKE)** **PLN:** SOE electricity utility **Pertamina Geothermal (PGE):** SOE geothermal producer (63% assets) **Local gov**	**Dept of Energy** **National Power Corporation:** SOE electricity utility **EDC*:** SOE Energy developer until 2007 when privatized
Major private players	**Chevron, Supreme Energy, Geodipa, INAGA, Oil and Gas Mafia**	**EDC*, PGI (Chevron/Unocal), NGAP, Catholic Church**
International institutions	**KfW, ADB, JICA/JBIC, CTF/CIFs, World Bank, IMF, USAID, UNFCCC CDM, WWF,**	**KfW, ADB, IMF, New Zealand, UNFCCC CDM, WWF**

Looking first at the institutions, actors and interests in Indonesia and then in the Philippines, there are a plethora of conflicting and vested interests that are involved in energy development planning. The list shown in Table 1 is not comprehensive, but provides a summary of some of the major institutions and players.

Indonesia's institutions, actors and interests

In Indonesia, the needs and interests of regional and central government, ministries, independent power producers, and Perusahaan Listrik Negara (PLN)—the state-owned electricity utility – are often misaligned (Budiman, 2014). The key actors in governing the power sector include the regional governments, Ministry of Energy and Mineral Resources (MEMR), and the Ministry of Finance, Perusahaan Listrik Negara (state owned electricity utility), and Independent Power Producers. While PLN no longer holds a monopoly over supply, it still holds a monopoly over transmission (DIFFER, 2012). While PLN must make a profit as a company, it is also legally obligated to provide energy services and infrastructure to the poorest regions and populations under Law 30/2007. This creates contradictory objectives and clear challenges to PLN's operations and often places renewable energy at a lower priority. The 2009 report by JICA titled "Study on Fiscal and Non-Fiscal Incentives to Accelerate Private Sector Geothermal Energy Development in the Republic of Indonesia" sums up the institutional interests related to geothermal development well:

> ""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, 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. 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).

The Ministry of Energy and Mineral Resources (MEMR) holds the most central role since it is responsible for developing energy policy, supervising day-to-day activities of the energy sector, as well as the energy planning, funding and regulation (Damuri and Atje, 2013). The MEMR also oversees state-owned enterprises and provides data and analyses. Under the MEMR, the Directorate of Renewable Energy and Energy Conservation (EBTKE) was created as a sub-ministerial agency in 2010. The creation of the Directorate strengthened oversight of renewable energy and energy efficiency activities. Local governments hold significant authority in Indonesia as a result of the 2001 decentralization process under the democratic transition post-Suharto, commonly referred to as "*Reformasi*." They play a key role in the implementation of energy policy by developing regulations and issuing permits for exploration and development of renewable energy projects. However, overlapping jurisdictions, vested interests and lengthy permit procedures have acted as a hindrance to implementation (EIA, 2015; Fox et al, 2006). They have an interest to maintain the authority over geothermal concession bidding, despite the inefficiencies, owing to the rent seeking benefits (Cahyafitri, 2015; Winters and Cawvey, 2015).

In terms of power producers, Pertamina Geothermal (and PLN) own 63% of the geothermal assets (Yunis, 2015). Pertamina Geothermal is a subsidiary of Pertamina Persero, the state-owned oil company, but handles the geothermal development. Pertamina has been exploring and developing geothermal projects since the 1970s. However, Pertamina's interest in prioritizing geothermal energy is dependent on profits and energy security concerns, and throughout

Indonesia's history, the priority of geothermal energy has risen and fallen over time. Most recently, PLN is in a discussion of taking over Pertamina Geothermal's geothermal assets, which would be coordinated through the Ministry of SOEs (Amindoni, 2016). The Government of Indonesia has been pushing for this acquisition because it is interested to appoint PLN as the focal point for geothermal development to boost development and progress towards its ambitious energy mix targets.

Private independent power producers (IPPs) are mainly limited to large multinational corporations, like Chevron, but some smaller Indonesian players, such as Supreme Energy have broken through the numerous barriers to build geothermal projects in Indonesia. Their main interests are to remove regulatory and sociocultural barriers to development, such as improving the lengthy permitting process or renegotiating electricity tariffs with PLN. IPPs act through the Indonesian Geothermal Association (INAGA) that lobbies on behalf of the geothermal industry for regulatory reforms.

Beyond the institutions and actors directly involved with geothermal development, it is important to note the actors with vested interests in energy development. First and foremost, the history of oil production in Indonesia has slanted the prioritization in energy development plans towards fossil fuels. The long history of fossil fuel subsidies (and huge share of government expenditures) also means that the government prioritizes investing in fossil fuels instead of infrastructure or subsidies for clean energy development (Chelminski, 2016). The largest barrier to the renewable energy development is seen as the deeply embedded sub-national political interests in coal, oil and natural gas, and corruption related to the "oil and gas mafia", cronyism and rent-seeking (Cahyafitri, 2015; Winters and Cawvey, 2015). Corruption included embezzlement of funds from the Ministry of Energy, extortion, tax fraud and smuggling (Cassin, 2014; Sukoyo, 2014). While fossil fuel subsidies have undergone reforms over time, the reduced fuel subsidy budget has not led to increases in subsidies or investment in renewable energy development.

Philippines institutions, actors and interests

In the public sphere in the Philippines, the Department of Energy is the government ministry charged with the creation of policies and regulations governing energy development. However, historically the majority of geothermal resources were developed under the Ferdinand Marcos and Ramos regimes to maintain energy security during the 1973 Oil Crisis and the 1990s Power Crisis. Following the confirmation of the geothermal resources in Tiwi, the government invested full resources in exploring geothermal potential by creating the Energy Development Corporation (EDC) under the state-owned company, Philippine National Oil Company (PNOC), in 1976. The EDC was tasked with the mandate to "Explore, develop, produce, generate and market indigenous energy sources and lessen the country's dependence on imported fuel."[2] EDC worked with the National Power Corporation under Marcos' direction. EDC was guaranteed offtake by the National Power Corporation for geothermal steam fields and the financing of project exploration and development was guaranteed by the Government.

Still today, the National Power Corporation and EDC (now privatized) are still involved as major players in geothermal development. However, the since power sector privatized and operates as a spot market, there is no guarantee of offtake for geothermal electricity generation and utilities are driven by profits and shorter term PPAs, which puts geothermal at a disadvantage compared to coal and natural gas (Uy, 2016; Hernandez, 2016). Geothermal assets are owned mostly by EDC (75%) and the remaining 25% is owned by Philippines Geothermal, Inc. (PGI is a subsidiary of Chevron/Unocal), demonstrating issues with the competitiveness of the market and the risks facing new geothermal developers to develop geothermal projects (Dolor, 2006). The major barriers facing new geothermal projects in the Philippines are summarized below in Table 2. The Philippines National Geothermal Association (NGAP) lobbies on behalf of the geothermal industry for regulatory reform.

Another non-governmental player that has been active in promoting renewable energy regulations and development is the Catholic Church in the Philippines. The Catholic Church became involved in anti-coal mining and against logging, and had a highly influential voice in the Philippine policy space. The Catholic Church, along with the Renewable Energy Commission—an institutionalized transnational advocacy network consisting of civil society, government and private actors, including Aboitiz, Vestas, EDC, Chevron, Greenpeace, and a variety of renewable energy companies—were instrumental in successfully advocating for the creation of a Renewable Energy Law, eventually adopted in 2002 (Senga, 2016). This law helped establish a new clause ameliorating a barrier to foreign ownership of geothermal assets (discussed in Table 2 and the section below).

Turning to the major barriers to geothermal development, I examine the financial, regulatory and sociocultural barriers, focusing on the financial barriers. Table 2 summarizes some

[2] See: http://www.energy.com.ph/about-edc/milestones/

of the major obstacles and challenges to geothermal energy development (and renewable energy more broadly).

Table 2: Major barriers to geothermal development in Indonesia and the Philippines

Case Study	Financial Barriers	Regulatory Barriers	Human Capacity and Technical Barriers
Indonesia	-Private sector reluctant to invest -Huge exploration risks -Mismatch between finance and needs of project developers -Issues with PPA and tariffs	-Forestry Law and the 2003 Geothermal Law -Foreign ownership 45 (1>10 MW)/ 95 (<10 MW)	-Historical lack of technical workforce -Limited institutional capacity to implement laws
Philippines	-Tariffs – FIT -High costs of development with new technology (lack of quality resources) -Risks of no offtake- Power sector regime (EPIRA)	-Protected areas and ancestral lands -Slow and contradictory permitting leads to project delays -Foreign ownership vs 40/60 clause	-Historical lack of technical workforce -Lower quality resources remaining -Need for newer technology increases costs (Expensive binary turbines are needed to extract lower quality geothermal resources)

This section provides a summary of the major barriers to geothermal development, first in Indonesia and then in the Philippines.

Indonesia's high risks and barriers to development

A number of barriers to investment in renewable energy technology have been identified in the literature and by organizations working on the ground in Indonesia, including financial and economic, governance and regulatory, technical and geographic, and lastly, human capacity and technical barriers. Examples of Indonesia's 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 continued investment in fossil fuels, through subsidies. The regulatory framework and governance barriers relate to the contradictory laws and policies—in particular the Forestry and Mining Laws, further complicated by ongoing corruption and lack of coordination among government ministries and local and central government (Transparency International, 2013; WWF, 2012). Knowledge barriers describe challenges related to lack of training of renewable energy technology deployment in local governments and the technical labor force.

Looking more specifically at the financial barriers to geothermal development in Indonesia, high risks and costs of exploration and development, a mismatch of financial support for project developers, reluctance of PLN to sign geothermal contracts, and market failures such as the negative externalities of fossil fuel subsidies, are all obstacles to be overcome. Indonesia is unique because the costs of exploration are born by the project developer instead of the government or state-owned enterprises, which is common practice around the world. The high costs and risks are associated with the four phases of exploration and development in Indonesia including surface exploration, temperature-gradient drilling, deep-exploratory drilling and long-term flow testing. The first stage of geoscientific exploration and baseline environmental studies (pre-drilling) costs USD 1 million; the second stage includes the feasibility study, exploration drilling and well testing and can cost between USD 25-50 million; the third and final stage is the delineation drilling and technical feasibility studies, which costs around USD 1.26 million per MW (Tharakan/ADB, 2015). The average cost of a 110 MW plant is around USD 175 million.

JICA's 2009 report on fiscal and non-fiscal incentives for geothermal energy development established a benchmark for the Internal Rate of Return (IRR) for geothermal projects in Indonesia, considering the high commercial and resource development risks associated with development, should be 17% compared to 11% IRR for coal-fired plants (JICA, 2009). The 17% IRR is now used as a benchmark for geothermal projects by the UNFCCC, to determine when a project is commercially viable and in all other cases, the projects are viable to receive CDM funding for instance (UNFCCC, 2012).[3] In cases where the IRR of geothermal projects is lower than 17%, policies need to bridge the price gap through fiscal and non-fiscal incentives. In Table 3 below, CDM project documents estimated the expected IRRs for geothermal projects before CDM funding was allocated compared to the IRR benchmark for each project based on exploration and production costs and risks.

[3] This benchmark was used for the Rantau Dedap geothermal plant for example.

Table 3: Geothermal IRRs for CDM projects in Indonesia

Date of CER allocation	Project title	IRR % excl. CER	IRR benchmark	Investment in USD mln
2008	Sibayak Geothermal Power Plant	N/A	N/A	12.6
2009	Lahendong Unit 5 & Unit 6 Geothermal Project	8.71	17.1	211
2010	Wayang Windu Phase 2 Geothermal Power Project	17.62	18.96	181.4
2010	Kamojang Geothermal	15.31	N/A	84
2014	Patuha Geothermal Project	6.73	14.71	109.7
2014	Project Ulubelu Unit 3 – 4 PT. Pertamina Geothermal Energy	15.98	19.67	271
2014	Project Kamojang Unit 5 PT. Pertamina Geothermal Energy	14.47	17.91	83.2
2014	Project Karaha Unit 1 PT. Pertamina Geothermal Energy	14.92	17.91	81.6
2015	Project Lumut Balai Unit 1 – 2 PT. Pertamina Geothermal Energy	13.99	20.09	281.6
2015	Liki Pinangawan Muaralaboh Geothermal Power Plant	11.36	17.1	794
2016	Gunung Rajabasa Geothermal Power Plant	12.18	17.1	682
2016	Rantau Dedap Geothermal Power Plant	10.07	17.1	755.6
2017 (expected)	Project Lumut Balai Unit 3 – 4 PT. Pertamina Geothermal Energy	16.08	17.92	276.4
Total investment				**3740.1**

Source: UNEP DTU (2016)

Based on these numbers, there are huge gaps between project IRRs and the benchmarks, necessitating international development assistance to make projects financially viable, demonstrating the additionality of the projects. Bilateral, regional and multilateral organizations have tried to address the financial barriers through a variety of types of finance and policy advising.

Philippines power sector uncertainty and major financial barriers

The first major barrier in the Philippines is regulatory. Many of the remaining geothermal resources are located in either ancestral lands or protected areas, and often times overlapping both issues (Pascual, 2016; Cerezo, 2016; Marasigan, 2016; van Campen, 2015). These areas are prohibited to energy development under the National Integrated Protected Areas System Act, but certain territories can be exempt from this law to request for amendments and/or rezoning to territories governed under these regulatory frameworks (Lim, 2016; NIPAS, 1992). Procedures to rezone protected areas or apply for access to ancestral lands are costly in time and resources—stalling project development for years until due diligence requirements, sustainability guidelines, and approval at various levels of government are fulfilled. Another regulatory barrier of geothermal development in the Philippines is the foreign ownership rule. In renewable energy development, foreign companies are only allowed to own 40% of the assets and need to “Filipinize” their companies by partnering with a local company that would then own 60%, coproducing with the government or other production sharing agreements.

The second major barrier in current geothermal development is technical barriers. There is a limited amount of high quality resources remaining (low enthalpy or heat, and high acidity), which makes extraction and production more costly and difficult for lower quality resources. Policymakers and developers refer to the resources that remain as "secondary resources." The development of these resources requires more expensive technology, such as binary turbines, which raises production costs. It is difficult to get a competitive electricity tariff that will cover costs let alone compete with other energy sources, which raises questions of whether a feed-in-tariff is needed.

Lastly, the third major category of barriers to geothermal development is financial barriers. The first financial barrier to current geothermal development in the Philippines is that the extraction process now requires a more advanced geothermal drilling technology, which is more expensive. Project developers argue that a feed-in-tariff may be needed to cover the costs of new technology, exploration and development of these secondary resources since the production costs cannot compete on the spot market against coal (Hernandez, 2016).

The competitiveness gap is well illustrated by CDM documents. As shown in the Philippines projects registered with the CDM, the IRRs fall below the benchmark and require international finance to be financially viable (see Table 4 below). The project IRR benchmark in the Philippines is substantially lower (12-13%) compared with Indonesia (where the IRR benchmark is 17%), owing to the lower risk and cost of development in the Philippines. Nevertheless, the project documents show gaps between the expected IRRs and IRR benchmarks, necessitating further financing.

Table 4: Philippines Geothermal Projects IRR and CDM finance

Year	Title	IRR % excl. CER	IRR benchmark	Investment in US$ millions
2006	20 MW Nasulo Geothermal Project	9.65	13.2	40.2
2012	Bac-Man 3 Geothermal Power Project	8.66	12.75	114.3
2012	Maibarara Geothermal Power Project	8.42	12.0596	79.67
2013	50 MW Mindanao Geothermal Power Plant 3 Project	8.16	12.75	109.9
Total				**344**

Source: UNEP DTU (2016)

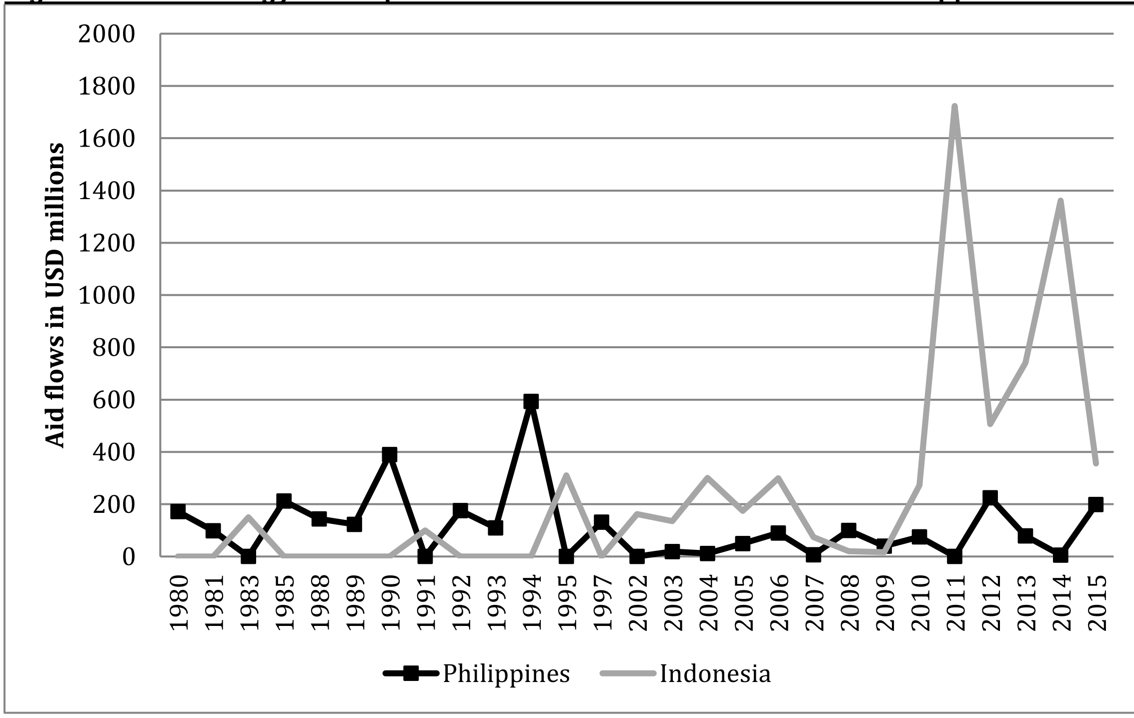
The second financial barrier to geothermal development is the electricity regime. The electricity prices in the Philippines are some of the highest in Asia – second highest after Japan (KPMG, 2014). Some argue that the high prices are attributed to the remaining independent power producer agreements from the Ramos regime (late-1990s) (Hernandez, 2016; KPMG, 2014; Cham, 2007). Many of the remaining independent power producer contracts are set to expire in 2020, which may drive prices back down (Hernandez, 2016). In the current spot market, it is difficult for geothermal developers to compete with coal for three main reasons: first, contracts are short and there is no guarantee of offtake; second, tariffs are too low at current coal prices and current geothermal production costs; and third, distributed utilities are renegotiating tariffs (Uy, 2016; Hernandez, 2016). A feed-in-tariff could help provide more certainty from the government to solve some of these issues, but there is still a great deal of uncertainty created by the power sector regime.

There are a number of financial barriers to geothermal development in Indonesia and the Philippines that make geothermal projects less competitive comparatively and high-risk investments for private interests. This raises doubts as to the economic viability of geothermal energy. Despite these limitations, the interest in geothermal energy development remains, particularly in Indonesia owing to the potential capacity. In order to bridge the financial gaps in light of the reluctant private investment, international development financing has played a key role in addressing financial barriers.

5. Addressing barriers through clean energy development aid

The landscape of clean energy development finance in Indonesia and the Philippines consists of the following key actors: multilateral development banks and international organizations, such as the Clean Technology Fund (CTF)/CIF, Clean Development Mechanism (CDM), World Bank, International Finance Corporation (IFC); regional development banks, such as the Asian Development Bank (ADB), European Bank of Reconstruction and Development (EBRD); and bilateral development agencies, such as German Federal Enterprise for International Cooperation (GIZ), German Development Corporation (KfW), Japanese International Cooperation Agency (JICA)/ Japanese Bank for International Cooperation (JBIC), United States Agency for International Development (USAID), New Zealand's International Aid & Development Agency (NZAID) , Agence Française de Développement (AFD). In an analysis of the overall flows in geothermal energy development aid to Indonesia and the Philippines between the 1980 and 2015, the funding totalled USD 6.7 billion in Indonesia and USD 3 billion in the Philippines (KfW et al, 2015; World Bank, 2016; ADB, 2016; JICA, 2016; UNEP DTU, 2016). The funding for geothermal energy development varied from financial assistance, pilot projects, technical assistance and policy advising to training and workshops to address the diversity of barriers to geothermal development. See Figure 4 for a depiction of overall trends in clean energy development finance to geothermal energy development in Indonesia and the Philippines over time.

Figure 4: Clean energy development assistance to Indonesia and the Philippines over time

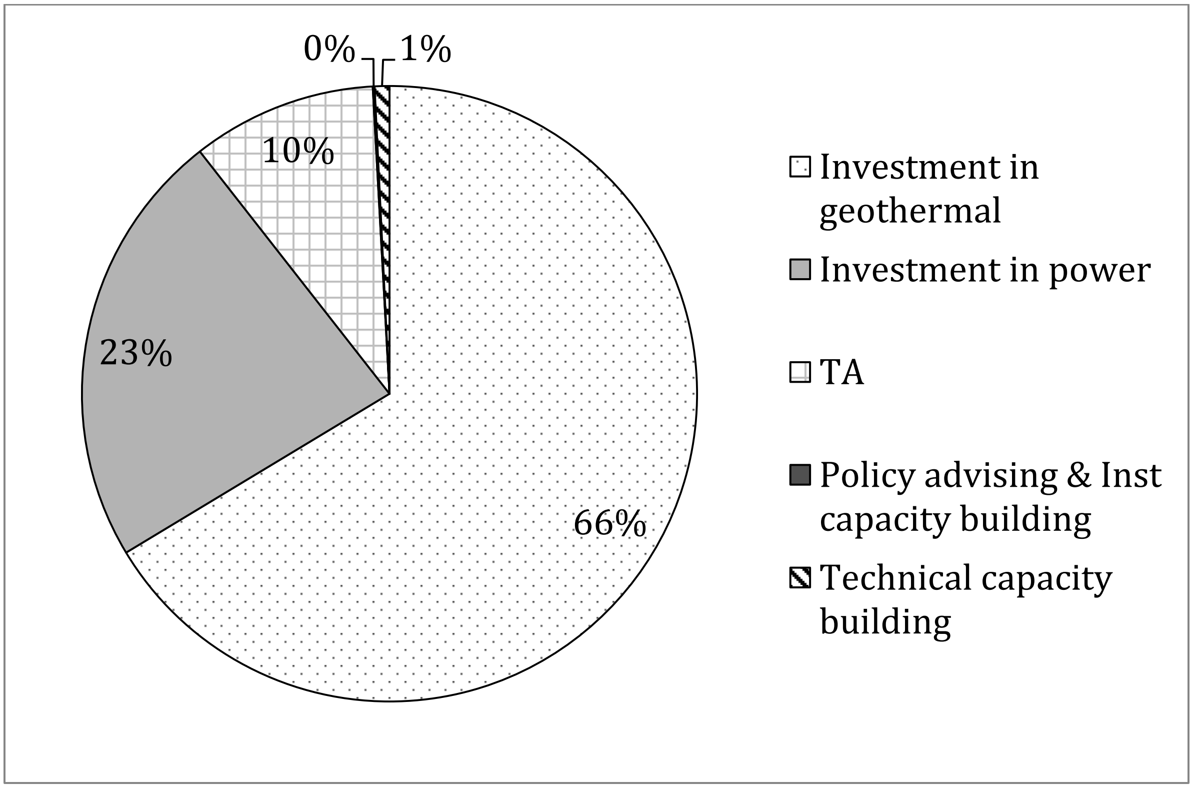


Source: KfW et al (2015), World Bank (2016), ADB (2016), JICA (2016), UNEP DTU (2016)

Indonesia geothermal financing

In order to better understand trends in financial assistance to the geothermal industry in Indonesia, data was collected on bilateral, regional and multilateral aid, including World Bank, CDM, CTF, ADB, IBRD as the multilateral development banks, and KfW, New Zealand, JICA, Netherlands, and Australia Agency for International Development (AusAID). Figure 5 shows trends in financial aid flows to geothermal development, power sector development, technical capacity building, policy advising and institutional capacity building, and technical assistance, as these tranches of funding address relevant barriers.

Figure 5: Breakdown of total earmarked international aid for geothermal development in Indonesia



Source: KfW et al (2015), World Bank (2016), ADB (2016), JICA (2016), UNEP DTU (2016)

From this analysis, there is a clear prioritization of financial assistance to investment in geothermal and power transmission (89%). However, less than 1% of funding was provided to policy advising and institutional capacity building, suggesting that social learning was not as high a priority for the international development institutions or the Government of Indonesia. Technical assistance and technical capacity building represented a more significant share of funding at 11%, representing the presence of the capacity building mechanism.

Financial and technical barriers and utility modifier mechanism

To better understand how international institutions interact with domestic political interests at the field level, it is important to analyze how the varieties of financial assistance provided address the financial and technical barriers. To directly address one of the major financial barriers in Indonesia—the lack of government funding for exploration—KfW, ADB and JICA worked with the Government of Indonesia to design a revolving fund to finance geothermal projects—the Geothermal Fund Facility. The ADB had expressed interest in matching the Government's contribution to the Fund with conditionality that the risk of exploration would be taken on by the government; however, the Government was unwilling to agree to these terms for years. 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 (Rahman, 2015).

The Government contributed IDR 1.2 trillion (USD 102.4 million) to the 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 will 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. In theory, developers can borrow up to USD 30 million – and the loan is only to be repaid if the site is proven to be productive, which would reduce financial risks during early stages of geothermal development. However, the government is undergoing a process of merging the PIP with the state infrastructure financing company (Sarana Multi Infrastruktur) after finding that the PIP was unable to function optimally in various investment financing scenarios (Cahyafitri, 2015; Halim, 2015). This put the Geothermal Fund in limbo, and created a further impasse to financing geothermal development. Finally, in 2017, the Finance Minister Sri Mulyani Indrawati issued a regulatory directive on the use, management and accountability of the Geothermal Fund Facility, thereby implementing the revolving fund (Jakarta Post, 2017).

Irrespective of the administrative and political obstacles there are practical concerns since the Geothermal Fund is not well fit to the needs of small project developers that need finance the most; the Fund requires proof of collateral, which most small project developers do not have (Tharakan, 2014). Whereas large project developers have collateral, but the loan offered by the Fund is not of interest to these companies since they would not use borrowed money for such a high-risk activity, and would use equity instead. Now that the Geothermal Fund is implemented, it does have some potential to reduce the expected risk and elimination of the financial barrier to geothermal exploration ventures (Wahjosoedibjo and Hasan, 2012). Yet the Fund is not matched to the needs of smaller project developers.

Turning to multilateral funding sources, the CTF and CDM, these finance mechanisms have had variable impacts in addressing financial barriers to development. Looking first at the CDM, the additionality and motive for CDM registration are both in question in Indonesia. 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 International Bank of Reconstruction and Development (UNFCCC, 2013). As outlined in the CDM project document for the Lahendong Project, the CDM project was considered “additional” not necessarily because of there were no other viable alternatives or that the project represented a real financial need; rather the project was selected because it presented an opportunity to demonstrate the viability of geothermal energy projects to build confidence within the government and state-owned enterprises (PLN in particular) of the viability of geothermal energy as a solution to energy demands. This demonstrates the 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 Emissions Reduction Credits from meetings with UN actors, PLN, consultancy firms and private sector actors (Harahap and Wicaksono, 2015). 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's repute and global recognition "raised Pertamina's profile", made geothermal projects more economical and helped cover the cost of exploration (Harahap and Wicaksono, 2015). The reputational benefit and financial incentive provided by the CDM projects incentivized the government and private sector to register CDM projects. The process of registering CDM projects involved multiple stakeholders in the public and private sector, and allowed for social learning to take place, which drew the line between renewable energy development and emissions reduction. The Pertamina CDM project provides support for social learning owing to the transfer of information and ideas through multiple layers of domestic political actors. However, as this is not the main objective of the CDM in accordance with the additionality methodology, which casts doubts on the effectiveness of the CDM in selecting projects with real financial need.[4]

The additionality of other projects is also questionable—such as the CDM projects that are funding geothermal projects developed by Pertamina Geothermal in addition to Chevron. These two companies have the resources to develop geothermal projects, as demonstrated by the numerous projects that were developed successfully without CDM financing. Other CDM projects that funded smaller Indonesian geothermal developers such as Supreme Energy, more readily demonstrate the financial need and additionality of the project, such as the Supreme Energy's Rantau Dedap project.

The CTF approved an investment plan for Indonesia of USD 400 million in concessional financing through the ADB, World Bank and IFC to directly support public-private sector geothermal development in 2010 (CIF, 2010; Polycarp et al/WRI, 2013). One project to which the CTF allocated funding is to PT Supreme Energy, one of the few private Indonesian companies that managed to break through the tangled legal regulations, permitting, exploration and finance issues to develop geothermal projects (Shanghai Daily, 2014). One of Supreme Energy's projects, the Rantau Dedap geothermal working area in South Sumatra, was allocated finance from both CDM and the CTF.

[4]Further literature on CDM additionality and flaws with the financial mechanism can be found by Chan (2015) and Castro (2014)

The project activity is expected to have an installed capacity of 2x117 MW (234 MW). As written into the UNFCCC Project Document, the project would not be commercially viable without climate finance (UNFCCC, 2012: 14). CTF financing totaling USD 755.6 million was then allocated to Supreme Energy to fill gaps in finance for exploration for its second geothermal working area, Rantau Dedap in South Sumatra (Rahman, 2015; ADB, 2014). Supreme Energy, along with GDF Suez and Marubeni Corporation (other shareholders in the project) benefitted from a USD 50 million non-recourse loan, with security pledged of shares, allocated through the ADB (Rahman, 2015). This is the first time a multilateral bank has issued funding for exploration in Indonesia. This represents a change in practice of international organizations in the clean energy development finance in response to needs on the ground.

The CTF successfully allocated financing to a couple projects and does not succumb to the same limitations of the Geothermal Fund, as it allows for borrowing without requiring a government guarantee or collateral. The CTF funding, such as the Indonesia & Philippines Private Sector Geothermal Program, provides finance to foster synergies with the existing government regulations—in particular, the Fast Track Program II—while attempting to remove the financial barriers to technology development. Nevertheless, the CTF is only a short-term solution since it has a 'sunset clause' that it will expire once the new UNFCCC Paris Agreement financial architecture is implemented.

Turning to regulatory barriers in Indonesia, forestry, mining and geothermal laws have been one of the most critical obstacles to geothermal development, and the decentralized authority of the government adds further complications. Geothermal development was legally considered part of the mining sector according to Article 38(4) of the Forestry Law No. 41/1999, and open pit mining is prohibited in Protected and Conservation Forests, aside from a few negotiated exemptions under Article 28 (Damuri and Atje; 2012: 21; Harahap and Wicaksono, 2015). This regulation was a bulwark to geothermal development because 57% of geothermal resources are thought to be located in conservation forests (WWF, 2013: 38). Often higher quality resources – in terms of high heat and steam and 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, World Bank, USAID, and WWF have lobbied for reform of the geothermal laws, but it has taken over 10 years for any of these changes to be approved by the Government (Soesilo, 2014; Poernomo, 2014, Wardhani, 2014).

The reforms of Geothermal Law 2003 took over 10 years after its implementation. Once domestic political interests shifted in favor of geothermal development, the new Geothermal Law was adopted in 2014. One of the major changes in the new law was the change of the legal definition of geothermal development, which was declassified as "mining" to allow for development in forested areas (Cahyafitri, 2014). Another major change was the shift of the tendering authority from local governments to the central government, removing the possibility for rent seeking. So to incentivize political convergence of this tenet in the new law, tradeoffs were provided to local governments who would still receive a production bonus for geothermal projects (as a substitute for rent-seeking).[5]

The international development assistance makes up a significant part of finance for geothermal energy development in Indonesia. Between 1983 and 2015, approximately 62% of total geothermal projects (and approximately 45% of individual units) benefitted from the USD 6.7 billion in bilateral, regional and multilateral finance allocated to geothermal development in Indonesia (KfW et al, 2015; World Bank, 2016; ADB, 2016; UNEP DTU, 2016) (See Annex I). While the "pilot projects" and development finance are used to set examples and promote best practice, they are not a permanent solution to geothermal development or a substitute for private finance. However, access to private finance for geothermal development is limited in Indonesia due to the high risks for development. The World Bank echoes the finance needs in the geothermal sector in its 2009 project document for the Geothermal Clean Energy Investment Project:

> "The investment needs in the sector are momentous, and it is highly unlikely that the private sector alone can meet them. It is estimated that over $12 billion in up-front financing may be required to achieve the GoI geothermal target, while private investments in the entire power sector in Indonesia have only averaged about $350 million over the past five years" (World Bank, 2009).

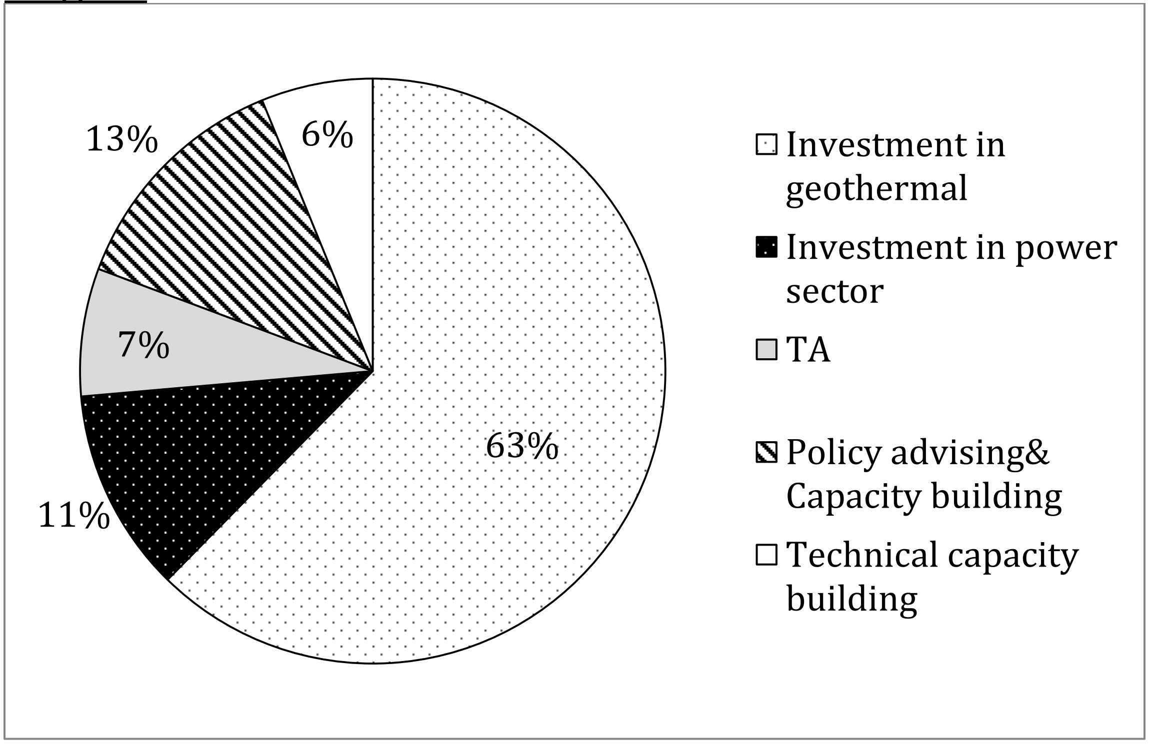
There is a need for growth in levels of private investment in the geothermal industry, but this requires major regulatory reforms to remove investment barriers (World Bank, 2009; UNDP, 2015). In the interim period, international development assistance may need to fill in the gaps.

Overview of clean energy financing for geothermal development in the Philippines

To analyze the overall trends in clean energy financial assistance to geothermal development, data was collected from multilateral, regional and bilateral sources. Figure 5 below depicts the overall breakdown of earmarked funding for geothermal development in the Philippines.

[5] See Winters and Cawvey (2015) for description of rent-seeking in Indonesia

Figure 5: Breakdown of total earmarked funding allocated to geothermal development in the Philippines



Source: World Bank (2016), ADB (2016), JICA (2016), UNEP DTU (2016)

The majority of development assistance was focused on geothermal installed capacity, representing a share of 63% of funding, with an additional 11% focused on investments in the power sector. The remainder of development assistance was dispersed among policy advising and institutional capacity building (13%), technical assistance (7%) and technical capacity building (6%). This disbursement shows a priority for the utility modifier mechanism through the prioritization of building installed capacity in geothermal power plants, as well as installed capacity in the power sector (74% of overall funding). Investment in geothermal and power capacity development during the 1990s was prioritized by the government of the Philippines in response to the power sector crisis. Development actors responded by providing financial assistance for installed capacity to meet energy demands. Nonetheless, there was also a sizeable tranche of funding devoted to policy advising that represented the social learning aspect of development assistance. This funding was specifically targeted to policy advising and institutional capacity building to catalyze private investment in the energy sector and to strengthen regulatory capacity for pricing and policy implementation, particularly for geothermal field development and power transmission and distribution.

Looking first at bilateral aid, New Zealand played a large role in early geothermal development in the Philippines. Under the Marcos regime, Arturo Alcazar was appointed as the Head of Commission of Volcanology and tasked with leading the investigation of geothermal resources for power generation. Alcazar had experience working in the oil and gas sector, and he recognized that the Philippines had potential for geothermal resources after observing similar developments in New Zealand, Italy and the US. Alcazar is known as the "Father of geothermal energy" in the Philippines owing to his leadership efforts to promote the development of these resources (Clement, 2016; Ogena, 2016). Alcazar first approached New Zealand with the potential for geothermal development in the Philippines. Through cooperation between New Zealand and the Philippines through a bilateral agreement, New Zealand provided financial and technical assistance and technology transfer to assist in exploration and development of the first geothermal sites. The initial group of people with geothermal experience came from the New Zealand Department of Scientific and Industrial Research (Mendiez, 2016). Then following the bilateral agreement between New Zealand and the Philippines on geothermal development, the private New Zealand consulting company "Kingston, Reynolds, Thom and Allardice," commonly known KRTA, was appointed as the executing agency for the bilateral aid agreement (KRTA, 1979; NZ Listener, 1981). Between 1973 and 1985 the Philippines received a total of NZ 21.5 million (roughly equal to USD at the time) as a grant for geothermal exploration from the New Zealand and KRTA carried out the technical assistance in the Philippines in conjunction with the National Power Corporation and the Philippine National Oil Company (PNOC) and later, the PNOC-Energy Development Corporation (Hochstein, 2005; Mendiez, 2016).

The geothermal development operated under a service contract system written into the 1972 Presidential Decree 87, known as the "Oil Exploration and Development Act," which upheld the sovereignty issues of producer-country over the natural resources, and guaranteed a share of the product (Velasco, 2006). Under this structure, the Philippines quickly developed 446 MW of installed geothermal capacity by 1980. By 1983, the Philippines had already become the second largest geothermal producer in the world with the commissioning of Tongonan Unit 1 and Palinpinon Unit 1 each with 112.5 MW installed capacity.[6] The New Zealand development assistance, representative of the utility modifier and capacity building mechanisms of clean energy development finance, was fundamental in assisting the Philippines government in developing its geothermal installed capacity, technical workforce and institutional capacity.

The majority of the Philippines geothermal capacity was developed under the Marcos regime with full government resources and state-owned enterprises dedicated to accelerating geothermal development. There was not as great a need for development finance. There are increasing flows of development funding during the Ramos era during the 1990s Power Sector Crisis when blackouts and energy supply shortages plagued the country; development finance helped facilitate reform and incentivize private investment. More recently, the Philippines has struggled to develop remaining resources due to dwindling quality of reserves and increasing costs of production. The government's interest in developing remaining resources is diminishing along

[6]See: http://www.energy.com.ph/about-edc/milestones/

with private sector interest. Newer renewable energy technologies such as solar and wind are benefitting from the feed-in-tariff scheme. The Philippines National Geothermal Association is still lobbying for newer geothermal technologies to also be included in the feed-in-tariff scheme, but this has not yet passed.

The CDM project for the Nasulo geothermal project is one example of the diminishing interest and increasing barriers to geothermal development. The 20 MW Nasulo Geothermal Plant, owned and operated by EDC, was registered as a CDM project in 2005 and the development assistance was provided to overcome financing barriers. As stated in CDM project documents, “The lending bank has made the financing somewhat contingent on the project attaining CDM status. Without the CDM, the project would have additional difficulties getting financed” (UNFCCC, 2004: 16). The project is located in EDC’s the Second Palinpinon geothermal production fields in Southern Negros, meaning the field supports existing power plants and contributes towards expanding the energy supply in the Visayas grid.

However, EDC lost interest in the project and the offered CDM funding; the project was eventually cancelled in 2012 due to issues related to slow implementation caused by delays with resettlement of communities, lack of engagement by EDC due to its recent privatization, rising equipment costs and uncertainty related to the off-take of electricity as a result of the Electric Power Industry Reform Act (World Bank, 2012). The World Bank was charged with implementing the project in cooperation with EDC, and their assessment of the failure of the project is insightful as to the incentives and domestic political interests: “One of the main arguments for the “additionality” of this project was that it would not happen without CDM because it is financially unattractive…It was estimated that the additional revenues from CDM would improve the project's IRR to 10.30% [from 9.2%]. This engagement demonstrates that additional revenue from CDM helps but is not a sufficient incentive for renewable energy development in the Philippines” (World Bank, 2012: 8).

The Nasulo project is also insightful as to the high transaction costs for geothermal developers participating in CDM projects, because despite the fact that the CDM project was cancelled, EDC moved the project forward to completion without CDM revenue (Manila Times, 2014; Barnett, 2016). This also negates the additionality of the project if the EDC was able to move forward without CDM financing, raising questions on the effectiveness of the CDM in selecting projects with additionality.

6. Clean energy development finance effectiveness in Indonesia and the Philippines

This section provides an overview of the three mechanisms of clean energy development finance impact—utility modifier, social learning and capacity building—while analyzing overall effectiveness in addressing barriers to geothermal development. The most significant way that the clean energy development finance impacts the development of clean energy in a developing country is through financial incentives, such as financial assistance for geothermal capacity development, representing the utility modifier mechanism. In Indonesia, approximately 62% of total geothermal projects (and approximately 45% of units) received international financing, and in the Philippines, over 80% of geothermal projects (and approximately 43% of units) received international financing.[7] The analysis in Indonesia and the Philippines revealed different impacts on policy and geothermal development.

In the case of Indonesia's geothermal energy development, the clean energy development finance played an important role in targeting critical financial barriers to development. Major bilateral donors included JICA (Japan), Netherlands, Germany (KfW), USAID (US), UK and Switzerland. Major multilateral donors included the World Bank, ADB and IFC. The example of the CTF and CDM providing a concessional loan to support the exploratory phase of development for the Rantau Dedap geothermal project when financial resources were not viable is demonstrative of the role of the utility modifier mechanism's direct impact on geothermal development. However, this tranche of funding was not sufficient to fully remove the financial barriers that remain, particularly due to the remaining exploration risks. There is an opportunity for the clean energy development finance to set up a larger fund to reduce exploration risks for geothermal development in Indonesia, which would better address financial barriers than the current ad hoc approach. Furthermore, the additionality of CDM projects in Indonesia was questionable, particularly for the Chevron and Pertamina projects since their other geothermal projects followed a similar trajectory of success without the CDM finance. The development cooperation among bilateral and multilateral donors to reform the Geothermal Fund in Indonesia was well-targeted to financial barriers; however, it was not very effective in incentivizing policy reform since these processes took decades. The funding earmarked for policy advising and institutional capacity building (social learning) was minuscule (1%) compared to financial assistance for installed capacity building (66%).

The domestic political interests are a major intervening variable of the overall effectiveness of the clean energy development financing in achieving renewable energy objectives in both Indonesia and Philippines. There were frequent moments throughout the history of geothermal development in Indonesia and the Philippines when domestic political interests interfered in geothermal development. In Indonesia, domestic political interests and vested interests in fossil fuels have played a role that resulted in the slow implementation of renewable energy policies and slow development of geothermal resources. The vested interests were also demonstrated in the local governments' interests in maintaining authority over geothermal bidding: to assuage these interests and overcome the opportunity for rent-seeking, the reform of the geothermal law transferred the tendering authority to the central government but also included a production bonus for local communities were geothermal projects take place. Similarly, the domestic political interests

[7] Figures calculated by collecting data on all geothermal projects in Indonesia and the Philippines and data on international development finance for geothermal development. See Annex 1 and 2.

in the Philippines shifted away from geothermal energy in the early 2000s - interests in coal and other renewables became more prominent. The Renewable Energy Law passed in 2002, but geothermal was not one of the major renewable energy technologies promoted through the feed-in-tariff scheme. The cases of Indonesia and the Philippines provide support for the argument that convergence of domestic political interests is necessary for significant policy reform to pass and be implemented in order to facilitate geothermal development.

The clean energy development finance earmarked for geothermal capacity development was often coupled with policy advising for regulatory reform of Geothermal Law 2003. However, it took over 10 years for the government to make necessary regulatory changes providing evidence of vested domestic political interests that were not incentivized by development assistance. While the financial assistance and policy advising helped incentivize the development of geothermal capacity to address financial barriers and foster regulatory reform, the financial assistance alone was insufficient to reduce risks enough to spur private investment in the geothermal sector. Clean energy development projects may need to address vested interests to fully remove political barriers and facilitate social learning. International development projects should better incorporate political economy analyses into the financing mechanism, rather than assuming conditions where vested interests do not exist. Furthermore, the development finance could target investments in social learning to train and incentivize local entrepreneurship among leaders and institutions at a sub-national level to overcome vested interests.

Nevertheless, the amelioration of financial and regulatory barriers and subsequent growth in geothermal energy capacity in Indonesia is unlikely to have been possible in the absence of financial and technical support from the clean energy development finance. The development financial support for geothermal development in Indonesia was over USD 6.7 billion between 1983 and 2015 (KfW et al, 2015; World Bank, 2016; ADB, 2016; UNEP DTU, 2016).[8] This funding is substantial as standalone finance, but it was also combined with technical assistance, technical capacity building and conditionality that gradually reformed policy and ameliorated some of the persistent barriers to geothermal energy development in Indonesia. Looking to the financial resources alone, this funding could not have been mobilized by the Indonesian 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. This is echoed by the World Bank project document referenced above which argued that while private finance has averaged USD 350 million a year over the last five years, up-front financing needs are closer to USD 12 billion to achieve geothermal targets, requiring international support (World Bank, 2009).

[8] Calculated from bilateral, regional and multilateral aid data, including World Bank, CTF, ADB, as the multilateral development banks, and KfW, New Zealand, JICA, Netherlands, and AusAID. This does not exclude private finance, but these numbers were not readily accessible.

In the case of the Philippines, financial and technical assistance (utility modifier and capacity building mechanisms) to geothermal projects was vital in early stages of development. Major bilateral donors included New Zealand, JICA (Japan), and multilateral donors included the World Bank, ADB and IFC. Overall, the utility modifier mechanisms appeared to have more of an impact in Indonesia in incentivizing change than in the Philippines, since the political will under Marcos to develop geothermal capacity using government resources predated the clean energy development finance. Since the 1970s, international assistance has been provided to fill in gaps in financing for geothermal projects in the Philippines, representing the utility modifier mechanism. Between 1980 and 2010, financing from JICA, bilateral donors through the CDM, World Bank, ADB and IFC to support geothermal development in the Philippines amounted to USD 3 billion (World Bank, 2016; ADB, 2016; JICA, 2016; UNEP DTU, 2016). Financial barriers are rising in the Philippines as the costs of geothermal development increase as quality resources become scarce and more expensive technology is needed to develop resources. Furthermore, the CDM project documents cast doubts as to the additionality of projects in the Philippines, as evidenced with the EDC Nasulo project. The clean energy financing in the Philippines no longer matches the needs on the ground. Project developers discuss the need for a feed-in-tariff and development agencies discuss potential financial mechanisms that could fill in financing gaps, such as those used in Indonesia with the CTF. However, clean energy development finance is diminishing in recent geothermal development in the Philippines. The trends in clean energy finance (Figure 4) show an overall decline in financial assistance for geothermal capacity (utility modifier) over time. While there still remain opportunities for development agency engagement in developing secondary geothermal resources in the Philippines, this may be eclipsed by better opportunities for energy development with other renewable energy technologies.

Overall these case studies reveal the clean energy development finance has limited effectiveness in overcoming barriers to geothermal energy development in Indonesia and the Philippines. There was supporting evidence that the major intervening factors in effectiveness were domestic political interests and material resources as influential in determining policy choices supporting particular energy resources and technologies over others. In the Philippines, the government's will (motivated by energy crises) to develop geothermal resources predated flows of clean energy finance so it cannot be claimed that the finance incentivized renewable energy development. It did however fill in gaps in financial and technical assistance. Similarly in Indonesia, external shocks influenced the government's will to prioritize renewable energy development. The financial and technical assistance and policy advising filled in critical gaps in finance and helped to address some financial and regulatory barriers, though there are substantial risks that remain. Without the removal of remaining risks and barriers, the private investment will continue to remain limited and development finance will not be able to fill in the remaining financial gaps necessary to spur geothermal development to its full potential.

7. Conclusions and policy insights

The literature analyzing clean energy governance lacks a depth of analysis in how effective the clean energy finance addresses specific barriers to renewable energy development in developing countries. This paper attempts to contribute to gaps in the literature by focusing on two under-researched case studies and delving into an in-depth comparative analysis of barriers renewable energy development, and the extent to which development finance matches and addresses these barriers.

Major findings indicate that while clean energy development finance targeted major barriers to geothermal energy development, it was not effective in removing fully removing the barriers or addressing major domestic political interests in Indonesia. In both cases, political will is a pre-determinant of development finance effectiveness, as opposed to expectations that the clean energy development finance would incentivize renewable energy development. Once the respective governments prioritized geothermal energy development, the clean energy development finance helped address barriers through financial and technical assistance and capacity building. The utility modifier mechanism was overwhelmingly the priority of the clean energy development finance, representing two-thirds of overall funding in Indonesia and the Philippines. Social learning and capacity building was underfunded, particularly in Indonesia, where vested interests remain a barrier to development. Another important insight learned from this research is the challenge of the macro-level approach to international development when the measures of success and effectiveness are determined at a project level; this leads to a micro-level focus as opposed to a systemic approach that incorporates better collaboration and inter-agency coordination to solve macro-level problems.

This research is important in helping to determine the overall impact of renewable energy development finance and policy insights for designing the post-Paris Agreement finance mechanism. The impacts of the clean energy development finance in Indonesia and the Philippines' renewable energy development provide insight into some of the disparities between resources provided by clean energy development finance and the actual needs on the ground. Clean energy development projects may need to better address vested political interests to fully remove political barriers and facilitate social learning and capacity building to empower local entrepreneurs to foster renewable energy development. Moving forward, political economy analyses should be incorporated into the clean energy financing mechanisms, rather than top-down approach across developing countries using assumptions of conditions where vested interests do not exist or do not vary country to country.

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Annex 1: Indonesia Geothermal Development and International Development Aid[10]

Start date/ Funding date	Power Plant	Unit	Capacity (MW)	Steamfield ownership	Geothermal power plant ownership	Type of aid	Aid (in US$ mln)	Donor Org/ Country	Status
1982	Kamojang	Unit 1	30	PLN-PGE	PLN	Investment	69	KfW/Germany	Completed
1987		Unit 2	60	PLN-PGE	PLN			UK	Completed
1987		Unit 3	60	PLN-PGE	PLN				Completed
2008		Unit 4	63	PLN-PGE	IPP	CDM/ CER	84		Completed
2015		Unit 5	35	PLN-PGE		CDM/ CER	83.2	Switzerland	Completed
1993	Gunung Salak	Unit 1	55	IP-Chevron	PLN				Completed
1994		Unit 2	55	IP-Chevron	PLN				Completed
1997		Unit 3	55	IP-Chevron	PLN				Completed
1997		Unit 4	65	Chevron Salak	IPP				Completed
1997		Unit 5	65	Chevron Salak	IPP				Completed
1997		Unit 6	65	Chevron Salak	IPP				Completed
1994	Darajat	Unit 1	55	IP-Chevron	PLN				Completed
2000		Unit 2	90	Chevron Darajat	IPP				Completed
2007		Unit 3	110	Chevron Darajat	IPP	CDM /CER	?	UK	Completed
2000	Wayang Windu	Unit 1	110	Star Energy	IPP	CDM/CER	181.4	UK	Completed
2009		Unit 2	110	Star Energy	IPP				Completed
2002	Lahendong	Unit 1	20	PLN-PGE	PLN	Investment	47.6	JICA	Completed
2007		Unit 2	20 PLN-PGE		PLN	CDM/CER	?	Netherlands	Completed
						Investment	28.75	World Bank	Completed
2009		Unit 3	20	PLN-PGE	PLN	Investment	260	JICA	Completed
2011		Unit 4	20	PLN-PGE	PLN	TA	7.4	New Zealand/World Bank	Completed
2016/2017		Unit 5 &6	40	PLN-PGE		CDM /CER	211		Completed
2008	Sibayak	Unit 1	12	PGE/Dizamarta P	IPP	CDM/CER	12.6	UNFCCC	Completed
2002	Dieng	Unit 1	60	Geodipa Energy	IPP				Completed
2010	Seulawah	Unit 1		Gov of Aceh?		Investment	8.86	KfW	Completed
2010	Mataloko	Unit 1	1.5	PLN	PLN				Completed

[10] Adapted from KfW et al 2015, World Bank 2016, ADB 2016, UNEP DTU 2016; Yunis 2015
Blue= received development aid; White: no development aid

2011	Ulumbu	Unit 2	2.5	PLN	PLN				Completed
2012		Unit 1	2.5	PLN	PLN				Completed
2014		Unit 1 and 2 (ADB)	5	PLN	PLN				Completed
2012	Ulubelu	Unit 1	55	PLN-PGE	PLN	Investment	175	JICA	Completed
2012		Unit 2	55	PLN-PGE	PLN				Completed
2012		Unit 3	55	PLN-PGE	PLN	CDM/CER	271	Switzerland	Completed
2012		Unit 4	55	PLN-PGE	PLN				Completed
2012	Lumut Balai	Unit 1	55	Geodipa Energy	IPP	CDM /CER	109.7	Switzerland	In construction
2012		Unit 2				CDM			In construction
2012		Unit 3				CDM			In construction
2012		Unit 4				CDM			In construction
2012	Gunung Rajabasa	Unit 1				CDM		Netherlands	In construction
2012	Liki Pinangawan Muaralaboh	Unit 1				CDM		Netherlands	In construction
2012	Rantau Dedap	Unit 1				CDM		Germany	Feasibility study
2012	Karaha	Unit 1				CDM		Switzerland	Completion expected (2017)
2012	Patuha	Unit 1	55	Geodipa Energy	IPP	CDM /CER	109.7	UK	Completed
2010	Sorik Merapi	Unit 1	240	KS Orka Renewables Pte Ltd	IPP				Completion expected (2017)
2005	Sarulla	Unit 1	110	PT Medco Energi International (27.5%), Ormat Technologies (12.75%), Itochu (25%) and Kyushu Electric (25%)	IPP				Completed
2005		Unit 2	110		IPP				Completion expected (2017)
2005		Unit 3	110		IPP				In construction

Annex 2: Philippines Geothermal installed capacity and development financing[11]

Start date/ Funding date	Power plant	Unit	Capacity (MW)	Power plant operator	Steamfield operator	Aid (in US$ mln)	Donor Org	Donor Type	Status
1979	Makban (Laguna)	A	126.4	NPC	PGI				Completed
1980		B	126.4	NPC	PGI				Completed
1984		C	110	NPC	PGI				Completed
1995	Makban Modular (Laguna)	D	40	NPC	PGI				Completed
1995		E	40	NPC	PGI				Completed
1994	Makban Binary (Laguna)	Binary I		NPC	PGI				Completed
1994		Binary II		NPC	PGI	60.5	JICA	Bilateral	Completed
1994		Binary III		NPC	PGI				Completed
1979	Tiwi	A	120	NPC	PGI	13.9	NZ	Bilateral	Completed
1980		B		NPC	PGI				Completed
1982		C	114	NPC	PGI	64.4	JICA	Bilateral	Completed
1993	Albay-Sorsogon	Bacman I	110	NPC	PNOC EDC				Completed
1994		Bacman II-Cawayan	20	NPC	PNOC EDC				Completed
1998		Bacman II-Botong		NPC	PNOC EDC				Completed
		Bacman III		NPC	PNOC EDC	114.3	CDM	Multilateral	Completed
1998		Manito-Lowland		NPC	PNOC EDC				Completed
1983	Tongonon (Leyte)	Tongonan I	112.5	NPC	PNOC EDC	171.7	JICA	Bilateral	Completed
1996		Upper Mahiao GCCU** (Main plant)	136.48	CalEnergy/Omat	PNOC EDC	3	NZ	Bilateral	Completed
1996		Upper Mahiao OEC*** (Brine plant)	5.5		PNOC EDC				Completed
1997		Malitbog	232.5	CalEnergy	PNOC EDC				Completed
1997		Mahanagdong	180	CalEnergy/Omat	PNOC EDC				Completed
1997		Tongonan I-optimization	19.5	NPC	PNOC EDC	364.5	World Bank	Multilateral	Completed
1997		Mahandong A - - optimization	13	CalEnergy/Omat	PNOC EDC	126.7	World Bank	Multilateral	Completed
1997		Mahanagdong B - - optimization	6.5	CalEnergy/Omat	PNOC EDC				Completed

[11] Data taken from: World Bank 2016, ADB 2016, JICA 2016, UNEP DTU 2016; Dolor 2006

1997		Malitbong - - optimization	16.7	CalEnergy/Omat	PNOC EDC				Completed
1983		Palinpinon I	112.5	NPC	PNOC EDC	98.6	JICA	Bilateral	Completed
1994		Palinpinon II - Okoy 5	20	NPC	PNOC EDC	57.5	JICA	Bilateral	Completed
1994		Palinpinon II - Nasuji	20	NPC	PNOC EDC				Completed
1995	Southern Negros	Palinpinon II - Sogongon	40	NPC	PNOC EDC				Completed
2007	Northern Negros	NNGP				132	JICA	Bilateral	Failed
1997	Mindanao (Mt Apo)	Mindanao I	54.24	Marubeni	PNOC EDC				Completed
1999		Mindanao II	54.24	Marubeni	PNOC EDC	109.9	CDM		Completed
2014	Laguna/Batangas	Maibarara				79.6	CDM	Multilateral	Completed
2014	Southern Negros - Nasulo	Unit 1			PNOC EDC	2.7	World Bank	Multilateral	Completed
2006						40.2	Netherlands (CANCELLED)	Multilateral	Completed