ESMAP

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GENDER EQUALITY IN THE GEOTHERMAL ENERGY SECTOR

ROAD TO SUSTAINABILITY

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ABBREVIATIONS

B-BBEE	Broad-Based Black Economic Empowerment
CSO	civil society organization
CSR	corporate social responsibility
EEP	Ethiopian Electric Power (formerly Ethiopian Electric Power Corporation [EEPCo])
EEU	Ethiopian Electric Utility (formerly Ethiopian Electric Power Corporation [EEPCo])
EIRR	economic internal rate of return
ESF	Environmental and Social Sustainability Framework
ESIA	Environmental and Social Impact Assessment
ESMF	Environmental and Social Management Framework
ESS	Environmental and Social Standards
FGD	Focus Group Discussion
FI	financial intermediary
FIRR	financial internal rate of return
GAP	Gender Action Plan
GBV	gender-based violence
GDC	Geothermal Development Company
GHG	greenhouse gas
GRM	Grievance Redress Mechanism
ICT	information and communications technology
IPP	Indigenous Peoples Plan
LAC	land acquisition committee
M&E	monitoring and evaluation
PAD	Project Appraisal Document
PGE	Pertamina Geothermal Energy
PPE	personal protective equipment
PSIA	Poverty and Social Impact Analysis
RAP	Resettlement Action Plan
REIPPP	Renewable Energy Independent Power Procurement Program
RPF	Resettlement Policy Framework
STEM	science, technology, engineering, and mathematics
STI	sexually transmitted infection
UNU-GEST	United Nations University Gender Equality Studies and Training Programme
UNU-GTP	Geothermal Training Programme of the United Nations University

GLOSSARY

Agency	The capacity to make decisions about one's own life and act on them to achieve desired outcomes free of violence, retribution, or fear.
Balneology	Branch of medical science concerned with the therapeutic value of bathing in geothermal and mineral waters for the treatment and cure of disease.
Cascaded use	Same geothermal resources used multiple times in succession (for example, for power generation followed by greenhouse heating).
Condemnation proceedings	Proceedings initiated by a state, municipality, private person, or corporation (that is, the eminent domain) to commit private property to public use with adequate compensation for the property owner.
Direct use	Nonelectricity generating application for geothermal energy; examples include space heating, spas, and bathing pools.
Empowerment	A process of enhancing the capacity of individuals or groups to make strategic choices and transform those choices into desired actions and outcomes; this involves improving their assets and capabilities so they can become agents of positive social change on their own behalf.
Endowments	Resources that allow people to use social, political, and economic opportunities to be productive and protect themselves (against shocks); endowments can be human (education- or health-related, psychological, and organizational) or physical (assets) and are critical inputs for agency.
Gender gaps	Societal differences in opportunities, influence, decision-making power or status, and attitudes between men and women and/or boys and girls.
Gender-based violence	Umbrella term for any harmful act perpetrated against a person's will that is based on socially ascribed (that is, gender) differences between males and females. It includes acts that inflict physical, sexual, or mental harm or suffering; threats of such acts; coercion; and other deprivations of liberty. These acts can occur in public or in private.
Job/occupational sex segregation	Differences in labor-force participation by men and women due to gendered opportunities and expectations exemplified by male- and female-dominated sectors or positions; those dominated by women tend to be undervalued and underpaid.

EXECUTIVE SUMMARY

Geothermal energy is globally recognized as a clean and reliable source of heat and electric power supply. The environmental and social risks posed by geothermal energy projects share common features with those of mining and extractive projects, as well as other large-scale energy infrastructure projects. Because men and women can be affected differently by such risks, geothermal projects may inadvertently lead to adverse outcomes that disproportionately disadvantage women. However, analysis of such discrepancies is often hindered by the lack of sex-disaggregated data collection and analysis of the socioeconomic, environmental, and health risks of projects and access to benefits. The World Bank recognizes the risk that ignoring gender gaps poses to geothermal projects' effectiveness, efficiency, and sustainability.

This report is a primer on advancing gender equality in the geothermal energy sector. Based on good practices and lessons learned, it introduces ways that geothermal projects can mitigate risks and pursue opportunities to address gender gaps within the project cycle. The report primarily targets World Bank project teams, project managers, social safeguards specialists, and gender specialists. The report may also be of interest to other development partner organizations, project developers, investors, governments, nongovernmental organizations, and others seeking practical approaches to reducing the gaps between men and women in geothermal projects to ensure their success and improve development outcomes.

The report outlines the risks and opportunities associated with (i) changes in land and natural resource use, (ii) changes to employment and economic patterns, and (iii) changes to environment and health. For each of these identified pathways, the report presents key issues related to project risks and opportunities, such as unequal compensation for land use and women's empowerment through livelihoods benefits, among others. Lessons from recent project experience indicate that developers who approach the affected communities as partners rather than adversaries and are willing to adjust siting decisions based on the community's cultural relationship with the land and its uses—including women's experienced impact and grievances—are more likely to build trust, minimize social risks, and ensure successful project outcomes.

Beyond mapping risks and opportunities, the report makes the case for focusing on the gaps between men and women from the project outset. Geothermal projects require strategies that are responsive to social concerns, including disparities between men and women. To get started in assessing projects' differentiated impacts and opportunities, geothermal teams and practitioners may wish to consider interventions in terms of three aspects: (i) analysis, (ii) actions, and (iii) monitoring and evaluation. For each of these aspects, potential entry points for closing gaps between men and women are identified throughout the report. For example, during project design, sex-disaggregated data could be collected on prevailing local gender norms for families, household activities, and wage work to inform possible options for informal employment or direct-use opportunities for men and women associated with the geothermal project.

Once gaps, key stakeholder risks, and additional development opportunities have been identified, project teams have an opportunity to address them through actions. The earlier in the project cycle that these actions are discussed, planned, and budgeted for, the greater their chances of being implemented and monitored. For example, project developers could signal intolerance for harassment and gender-based violence through amending existing human resource policies to include

codes of conduct and a Grievance Redress Mechanism with safe and ethical reporting. Other actions may include promoting inclusive procurement practices by tracking how many bidders and awardees are women-headed firms and setting up a mechanism to provide bid-readiness support for women majority–owned firms and small businesses. It is recommended that projects include specific monitoring and evaluation indicators in the results framework that measure progress toward closing gaps between men and women. The results framework can include quantitative indicators based on sex-disaggregated statistical data from surveys or human resource records, such as educational attainment or percent of women employed. It may also include qualitative indicators that capture people's experiences, perceptions, attitudes, or feelings, such as assessment of feedback on the community-level impact of construction or the community's perception of the ancillary infrastructure benefit.

In addition, the report contains an overview of guidance and toolkits developed, selected global case studies, and other resources so that project teams, governments, and geothermal developers have additional guidance on hand to prepare more equitable projects. Addressing these moral imperatives puts projects on a more sustainable path. By adopting the integration of approaches that focus on closing gaps between men and women from the outset, geothermal projects can improve risk management and performance, increase community buy-in and thus reduce the likelihood of social discord, and achieve a more balanced allocation of employment opportunities, contributing to an expanded talent pool and more successful, equitable project outcomes.

1. OVERVIEW

Geothermal energy is a clean and reliable source of heat and electric power supply. For many of the world's low- and middle-income countries, geothermal power has the potential to contribute substantially to the renewable energy transition (Appendix A). Unlike wind or solar, geothermal energy is constantly available year-round, making it an important source of low-carbon baseload power. Also, geothermal energy is more resilient than hydropower to climate variability. Increasingly, development and commercial financial institutions, private-sector developers, and national governments are keen on expanding the geothermal sector to increase domestic energy supply, stabilize costs, and reduce greenhouse gas (GHG) emissions. Scaling up will require mitigating the risks of such projects, especially during the exploratory and drilling stages.

The environmental and social risks posed by geothermal energy projects share common features with those of mining and extractive projects, as well as other large-scale energy infrastructure projects. The direct environmental risks are similar to those of mining and extractive projects, but are lesser in extent. These include induced earthquakes, release of hazardous materials, and GHG emissions.[1] The social and health-related risks, like those of other large-scale energy infrastructure projects, are related to land acquisition and alteration, contamination of natural resources, influx of migrant construction workers, and building of ancillary roads, among others (ESMAP 2012, 2018; World Bank 2018).

Because men and women can be differently affected by such risks, geothermal projects may inadvertently lead to adverse outcomes that disproportionately disadvantage women. For example, if drinking water in the project-affected community is contaminated by geothermal operations, women may need to walk longer distances to fetch it, increasing their time allocated to water collection and exposure to gender-based violence (GBV). If a project requires community resettlement, a country's social customs may disadvantage women during the compensation process. In addition, a country's sociocultural norms or legal restrictions may prevent women from seeking geothermal sector employment or lead to backlash, hindering long-term outcomes, such as economic growth and poverty reduction.

The geothermal sector lacks sex-disaggregated data collection and analysis on the socioeconomic, environmental, and health risks of projects and access to benefits. In the past, few if any geothermal projects pushed for sex-disaggregated data collection and monitoring and evaluation (M&E) that pays attention to gender gaps. Without systematic data collection and analysis that is disaggregated by sex and demographics, the design of geothermal projects may overlook the need for specific interventions tailored to the needs of men and women, which, in turn, could prevent the project from achieving its development objective. At the community level, sex-disaggregated data are needed in the areas of compensation payments, livelihood restoration outcomes, and logged grievances, in addition to input from community consultations that include women. At the industry level, such data are needed on workforce composition, pay gaps, and job satisfaction.

The World Bank recognizes the risk that ignoring gender gaps poses to geothermal projects' effectiveness, efficiency, and sustainability. As part of the broader World Bank Group Gender Strategy (Fiscal Years 16–23), the World Bank has developed the Gender Tag and has rolled out a new Environmental and Social Sustainability Framework (ESF) (Appendix B). The Gender Tag distinguishes projects and programs that identify relevant gaps between men and women in the analysis and addresses those gaps through specific project-supported actions linked to indicators in the results

framework. To better manage project risks and improve development outcomes, the ESF has established a set of environmental and social safeguards standards to be met by the borrower and project developer.

This report is a primer on advancing gender equality in the geothermal energy sector. Based on good practices and lessons learned, it introduces ways that geothermal projects can mitigate risks and pursue opportunities to address gender gaps within the project cycle. The report primarily targets World Bank project teams, project managers, social safeguards specialists, and gender specialists. However, it may also be of interest to other development partner organizations, project developers, investors, governments, nongovernmental organizations, and others seeking practical approaches to reduce the gaps between men and women in geothermal projects to ensure their success and improve development outcomes.

NOTE

1 The estimated global GHG emissions for geothermal power plants average about 10 percent that of coal and less than 25 percent that of natural gas, although some individual plants may equal coal emissions due to the unique geology of the reservoir. In Turkey, for example, high CO_2 concentrations in the geothermal fluids from power plants in the Buyuk Menderes and Gediz grabens result from a thermal breakdown of minerals in the reservoir's unique carbonate sedimentary and metamorphic rocks (ESMAP 2016).

REFERENCES

ESMAP (Energy Sector Management Assistance Program). 2012. "Geothermal Handbook: Planning and Financing Power Generation." Technical Report 002/12. Washington, DC: World Bank. https://www.esmap.org/sites/esmap.org/files/DocumentLibrary/FINAL_ Geothermal%20Handbook_TR002-12_Reduced.pdf

———. 2016. "Greenhouse Gases from Geothermal Power Production." Washington, DC: World Bank. https://doi.org/10.1596/24691

———. 2018. *Getting to Gender Equality in Energy Infrastructure: Lessons from Electricity Generation, Transmission, and Distribution Projects*. Washington, DC: World Bank.

Sanyal, Subir Kumar, Ann Robertson-Tait, Migara Jayawardena, Gerry Huttrer, and Laura Wendell Berman. 2016. *Comparative Analysis of Approaches to Geothermal Resource Risk Mitigation: A Global Survey*. ESMAP Knowledge Series, 024/16. Washington, DC: World Bank Group. https://www.esmap.org/node/56863

World Bank. 2018. "Good Practice Note: Addressing Gender Based Violence in Investment Project Financing Involving Major Civil Works." September 28. World Bank, Washington, DC. http://pubdocs.worldbank.org/en/399881538336159607/Good-Practice-Note-Addressing-Gender-Based-Violencev2.pdf

2. AVOIDING RISKS, PURSUING OPPORTUNITIES

Communities living near geothermal project development sites face a variety of risks and opportunities, some of which are common to large-scale power generation and transmission projects and others that are unique to the geothermal sector. These risks and opportunities are associated with (i) changes in land and natural resource use, (ii) changes to employment and economic patterns, and (iii) changes to environment and health. For each of these identified pathways, this section presents key issues related to project risks and opportunities for integrating women's empowerment to meet the project objective and create equitable benefits for men and women.

CHANGES IN LAND AND NATURAL RESOURCE USE

The average land requirements for geothermal projects are moderate compared to those for other types of energy production technologies (table 2.1). The most land-intensive stage is construction of power plants, which requires cleaning and grading of large tracts of land, possibly resulting in soil compaction, subsidence, alteration of drainage channels, and increased runoff and erosion (World Bank 2007). Building of access roads and storage facilities during earlier drilling stages may also cause

TABLE 2.1: LAND REQUIREMENTS FOR ENERGY PRODUCTION, BY SOURCE TYPE

PRIMARY ENERGY SOURCE	LAND-USE INTENSITY (m^2/MWh)
Nuclear	0.1
Natural gas	0.2
Coal	
Underground	0.2
Surface (open-cast)	5.0
Renewables	
Wind	1.0
Geothermal	2.5
Geothermal[a]	0.54 to 3.77
Hydropower	10
Solar photovoltaic	10
Concentrated solar power	15
Biomass (from crops)	500

Sources: Fritsche et al. 2017; Maxim 2014.
a. 2008 estimate of the Bureau of Land Management, United States Department of the Interior.

BOX 2.1: GEOTHERMAL DEVELOPMENT FOOTPRINT, BY PROJECT STAGE

The land requirements for developing geothermal operations vary by project stage. During **reconnaissance and surface exploration,** land impacts are minimal. This initial stage includes desk reviews, chemical analyses, geological structural mapping, and geophysical surface exploration. The second stage, **exploratory drilling,** requires drilling a small number of wells to test assumptions developed in the initial stage. Land must be cleared for access roads, well pads (typically about 70 x 100 m in size), and sump pits for use over a one-to-five-year period, after which land restoration may occur. The third stage, **confirmation or appraisal drilling,** occurs after a resource has been identified. It assesses the resource's viability for commercial exploration; based on the pre-feasibility report, six or more additional wells could be drilled. Land is required for more roads, well pads, sump pits, and worker accommodations.

The next stage, **construction,** is the most land-intensive, lasting two-to-five years or even up to 10 years if project delays occur. It entails drilling production and injection wells to dispose of used geothermal fluids, building power plants and a steam-gathering system, erecting transmission lines, digging sump pits, installing water pipelines, and providing worker accommodations and civil works to support these activities.

After construction, **operations and maintenance** follows. During this period, the footprint of the geothermal project could shrink since some staging areas, storage, construction equipment, and worker villages can be removed. However, a certain portion of land without structures may remain fenced to ensure plant security and the safety of nearby inhabitants and fauna. During the next-to-last stage, **decommissioning,** the project footprint could temporarily expand as structures and equipment are removed. The final stage, full site **restoration,** includes such activities as regrading, afforestation, and cleanup.

Sources: ESMAP 2012; Mackenzie et al. 2017.

short-term disturbances. However, once projects are operational, portions of land can accommodate other uses, such as agriculture and livestock grazing (Hunt 2001; U.S. DOE 2006). Box 2.1 summarizes the land-use requirements of geothermal development by project stage.

Understanding Cultural Heritage and Social Norms

Geothermal sites are found in diverse sociological and ecological contexts, often featuring unique topography to which local populations may attach spiritual and cultural significance. The occurrence of geothermal fields ranges from the arid and semi-arid landscapes of Djibouti to the tropical rainforests of Indonesia. Societal systems may be patriarchal, as in the Maasai tribe of Kenya and Tanzania (Gneezy, Leonard, and List 2009) or matrilineal/matrilocal, as found in the Minangkabau ethnic group in the highlands of West Sumatra, Indonesia (Du 2005). For many of the world's indigenous peoples—ranging from the Māori tribes of New Zealand to the Atacameños of South America—geothermal sites are considered to have sacred and healing properties (Cataldi and Suárez-Arriaga 2016; EEPCo 2013; Kepinska 2003; Power Africa 2018). Such sites may be located near fragile or protected ecosystems with endangered species. In East Africa, for example, local people living near Lake Natron and Lake Nakuru subscribe to a phoenix-like mythology involving a red bird resurrected from the

high-temperature mud pools. The evolutionarily distinct population of flamingos to which the mythological red bird refers has implications for conservation, as well as tourism (Kepinska 2003).

The spiritual and healing significance ascribed to geothermal pools, as well as their practical heating properties, may be tied to specific customs of men and women in project-affected communities. In the Northland region of New Zealand, for example, a famous female historical figure (*tupuna whaea*) is credited with discovery of hot springs located on Ngāpuhi tribal lands and its curative powers for women following childbirth (Clarke 2004). Women in the project-affected communities may also rely on access to hot springs to carry out their daily household activities. In Ethiopia, for example, women in Alalobad depend on hot springs for washing clothes (Pavils 2011), while women in the geothermal area of Whakarewarewa Valley, New Zealand have traditionally utilized hot pools for cooking food and boiling water for tea (box 2.2).

BOX 2.2: CULTURAL CONNECTION TO GEOTHERMAL LANDS

Geothermal lands have a long history of spiritual significance in numerous traditional cultures of Latin America, East Africa, South Asia, New Zealand, and North America. For millennia, the surface manifestations of geothermal energy, including hot springs and steam vents (fumaroles), have been appreciated and exploited.

Geothermal waters and minerals have traditionally had a wide array of uses, some of which persist to the present day. These range from bathing, washing, cooking, and heating to such specialized applications as fiber processing and paint pigment production (photo B2.2.1).

Photo B2.2.1: Māori women with kettles alongside hot springs

Ref: 1/2-066389-F. Alexander Turnbull Library, Wellington, New Zealand. /records/23148996. Used with permission. Further permission required for reuse.

Sources: Cataldi and Suárez-Arriaga 2016; Kepinska 2003; Smith, Palmateer, and Stonehill 2017.

Land Acquisition, Resettlement, and Compensation

Women may suffer disproportionately from the project if required land-use changes or land acquisition adversely affect household roles and responsibilities (ESMAP 2018). Women may be disadvantaged if land is no longer available for their small-scale agricultural activities or livestock grazing. If the project affects the availability of water and fuelwood in the affected community, women, who are often household managers of natural resources, may have to travel farther to collect them, increasing the daily hours spent on such chores and possibly increasing the risk of gender-based violence (GBV) (box 2.3).

BOX 2.3: IMPORTANCE OF ADDRESSING PROJECT IMPACTS ON WOMEN

Ignoring women's issues linked to the geothermal resource, for example, can create negative perceptions, leading to project delays or failure. In Kalinga, Philippines, for example, indigenous women in Western Uma blocked development of a Chevron geothermal energy project, which caused the company to abandon the site. The women's grievances included disregard for cultural beliefs linked to the resource; loss of tiger grass, an important cash crop for women; fear of gender-based violence (GBV) from an anticipated increase in military presence to protect assets at the project site; and gender-unequal compensation and benefits, including scholarships and employment opportunities.

Sources: Chakma 2016; CWEARC and APWLD n.d.

Geothermal projects may be situated in areas with land tenure and titling issues unfavorable to women because of cultural norms or legal barriers. Among ethnic groups living in the East African Rift Valley, for example, a woman's right to land is mediated through her spouse or kinship networks according to customary or religious traditions. In Ethiopia, pastoral communities living in geothermal areas in the Afar region have complex, clan-based land-rights systems, which can diminish women's agency in buying, selling, or inheriting land or using it as collateral (Flintan 2010; Flintan et al. 2008). In Kenya's Olkaria geothermal area, the Maasai ethnic group does not traditionally recognize women's right to own land, even though women are legally able to do so under the 2010 Constitution and 2012 Land Act (Dancer 2017). In cases of divorce, widowhood, or inheritance, women's rights may be protected only weakly, if at all.

Lack of joint land ownership by men and women, resulting from poorly designed reform programs, can persist for years; but some countries are correcting such imbalances. For example, during post-Soviet land privatization in Armenia in 1991–92, most land was registered to males as heads of households, an outcome reinforced and perpetuated by patrilocal marriage and inheritance norms (FAO 2017). This also occurred in Kenya in the 1990s during a much criticized, internationally supported push for increased land titling (Dancer 2017). Once such a land reform is enacted, inequities can persist for years. But such countries as Rwanda have made progress in correcting the imbalance through legal reform, making communal property the default marital property regime; as of 2014, 81 percent of land was owned jointly by men and their wives, 11 percent was owned by women only, and 6 percent by men only (Bayisenge 2018).

Women may struggle disproportionately during site-acquisition negotiations, condemnation proceedings, resettlement planning, and compensation procedures. The reasons for this stem from women's lack of agency and social exclusion. Usufruct rights,[1] as well as customs or informal easements,[2] may be exercised disproportionately by men. Also, polygamous marriages may complicate the fair allocation of land and resource-based claims among co-wives. Other issues that may disadvantage women include illiteracy; lack of fluency in the language used during negotiations; time poverty; and lack of access to transportation, information technology, and media (ESMAP 2016, 2018).

Pursuing Opportunities to Improve Equitable Outcomes

By engaging with stakeholders early on, utilizing participatory approaches that engage both men and women, geothermal developers are more likely to build trust and thus minimize project risks. Geothermal project developers' flexibility in siting decisions creates an opportunity to conduct

pre-feasibility consultations with men and women in the affected communities on where to drill wells and build the power plant and transmission lines. Equipped with a better understanding of the community's land-use patterns and land-linked income generation, developers can adjust their design to minimize social risks (box 2.4, Appendix C).

BOX 2.4: INTEGRATING A GENDER EQUALITY FOCUS INTO PROJECTS

Geothermal projects that demonstrate good practices for addressing gender gaps could increase their likelihood of success. In Indonesia, Pertamina Geothermal Energy (PGE), the implementing agency for the World Bank–supported Geothermal Clean Energy Investment Project, has focused on women's agency and voice during project design and implementation. Under its Resettlement Policy Framework (RPF), PGE is willing to relocate parts of its operation if landowners do not wish to sell their property. Importantly, it has promoted the inclusion of women on land acquisition committees (LACs), which has given women in the affected communities the opportunity to raise their specific concerns.

Source: PGE 2011.

Opening geothermal areas to tourism could create local jobs for project-affected communities, but should be preceded by inclusive consultations and analyses. In Ethiopia, for example, the Afar Region Culture and Tourism Bureau classifies the Alalobad hot springs, where a World Bank–financed geothermal project site is located, as a potential tourist attraction (EEPCo 2013). Development of ancillary infrastructure, such as access roads, along with corporate social responsibility (CSR)–linked site improvements could help realize this potential. But such opportunities should only be pursued after inclusive consultations with men and women and rigorous analysis show that opening up new areas to tourism will not expose women to unnecessary risks, curtail existing uses of the hot springs,[3] or lead to inequitable capture of the majority of tourism-related profits.

Balancing the developer's need to ensure site access with the local population's spiritual or cultural attachment to the land can lead to innovative and inclusive policies. One geothermal developer that has learned the value of working in partnership with the local population is Kenya Electricity Generating Company (KenGen), the country's largest power producer. KenGen has developed more than 500 MW of geothermal power generation at the Olkaria field in the Great Rift Valley, which is home to the Maasai and other local tribes. Through a partnership with three New Zealand entities—Contact Energy (a leading electricity provider), Tauhara North No. 2 Trust (TN2T), and Ngati Tahu Tribal Land Trust (NTTL)—KenGen learned about the New Zealand developer's successful partnership with the indigenous Māori people, which has served as a model for it to emulate with the Maasai people of Kenya. Four learning exchanges between KenGen, Maasai representatives, and their New Zealand counterparts focused on resettlement, land ownership, and community engagement (Smith, Palmateer, and Stonehill 2017) (box 2.5).[4]

Leasing arrangements, negotiated in good faith with an eye toward providing meaningful protections for and input from local populations, are also an option. Whether through cooperative ownership and management or leasing, care must be taken to ensure that women are fairly represented in negotiations, decision making, and final consideration of such agreements.

BOX 2.5: WIN-WIN PARTNERSHIPS IN GEOTHERMAL RESOURCE MANAGEMENT

In New Zealand, all uses of geothermal resources are governed by the country's 1991 Resource Management Act. Conforming to its principles has not hindered the development of geothermal projects. On the contrary, it has led to a high level of commitment and pride among stakeholders, including the indigenous Māori (*tangata whenua*), who are considered custodians of the land and its resources. Māori collectively own and manage much of the land situated above geothermal systems through land trusts. Ownership of the land gives Māori the opportunity to participate in geothermal projects. The various participatory models developed range from full participation to receiving royalties from a developer.

Source: McLoughlin, Campbell, and Ussher 2010.

CHANGES TO EMPLOYMENT AND ECONOMIC PATTERNS

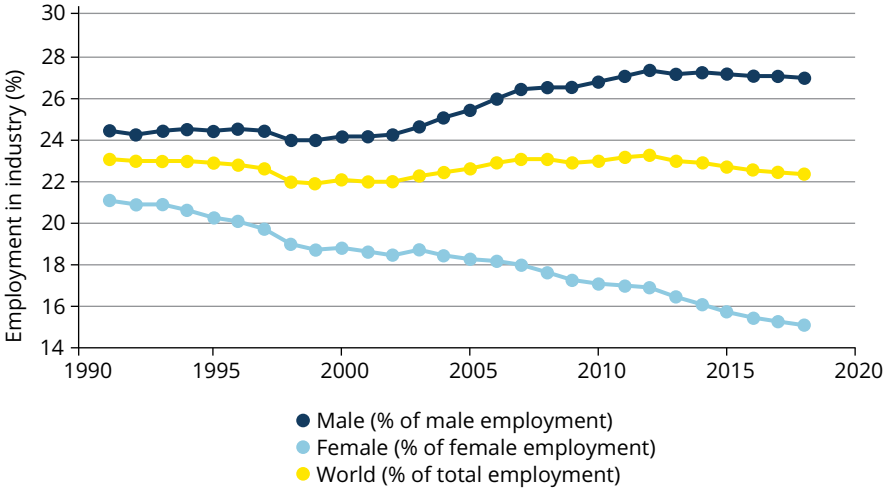
Labor market estimates show that geothermal projects generally sustain slightly less than one permanent job per megawatt of installed capacity. These estimates vary between countries and the types of employment compared, such as permanent or temporary jobs, university professionals or skilled technical operators, and direct or indirect labor. The Geothermal Energy Association (GEA), a U.S.-based trade association, estimates that, at the level of the operating company, a 50 MW geothermal project would support about 35–60 permanent jobs over a period of 30–50 years. During construction, 155 person-years of employment would be created (Matek 2015).[5] The International Renewable Energy Agency (IRENA) estimates 93,000 jobs in geothermal energy globally (IRENA 2018).

Women's rate of global labor-force participation in 2018 was about 48 percent, compared to 75 percent for men, but their share of global employment in industry has been on the decline (International Labour Office 2019) (figure 2.1). Women account for only 25 percent of jobs in the energy and mining sector overall (WEF 2017). However, their representation in renewable energy is higher; a 2018 survey conducted by IRENA, for example, shows that women account for an average of 32 percent of renewable energy jobs (IRENA 2019), suggesting that more women may be drawn to sustainability-related fields (IUCN and USAID 2018).

Drivers of the Women's Employment Gap

Anecdotal reports in the geothermal sector point to significant gaps in employment between men and women, which can have negative spillover effects.[6] It is likely that many international geothermal companies are subject to an industry-wide workplace culture that limits the engagement and retention of women employees. Male domination of the sector is perpetuated by professional networks and local employment norms and practices biased toward hiring men for both skilled and unskilled jobs. When designing women's employment interventions, it is key to look at the underlying intra-household bargaining and power dynamics, especially at the community level; these include such factors as women's existing domestic and agricultural chores, travel constraints and other possible barriers to participation, and preferred methods of payment (FAO, IFAD, and International Labour Office 2010).

FIGURE 2.1: ESTIMATED SHARE OF WORKING POPULATION IN INDUSTRY, BY SEX



Source: Adapted from ILO 2018.

Social expectations and norms about roles and abilities can discourage women's employment in the geothermal industry.[7] Such expectations commonly result in underinvestment in girls' education; occupational selection that discourages pursuit of careers in the fields of science, technology, engineering, and mathematics (STEM) (Wang and Degol 2017); early marriage and female seclusion (Bahrami-Rad 2018; ODI 2015); and division of unpaid care and subsistence work.[8] Recent linguistic research suggests that the structure of certain languages may shape gender norms in ways that limit girls' educational achievement and women's labor-force participation (Jakiela and Ozier 2018).

Women who pursue professional careers in the geothermal sector face many barriers along the way. At the university level, women students may find themselves isolated or face subtle forms of discrimination. Martha Mburu, one of today's leaders in Kenya's geothermal sector, reports that, out of 62 classmates in her mechanical engineering program, she was the only woman (UNU-GEST 2017).[9] Not surprisingly, it is difficult for women to find allies, mentors, or role models in the sector (IUCN and USAID 2018). As women's careers in the geothermal sector progress, they often face the added challenge of reconciling demanding work schedules—including shift work, travel, and posting to remote sites, which is often necessary for advancement within the organization—with competing personal demands on their time, including but not limited to childbearing and caregiving.

The lack of an inclusive workplace environment—including discrimination, harassment, and gender-based violence (GBV)—can push women away from the sector. Women represent only a small share of field-based scientists and staff, who play an important role during a geothermal project's pre-feasibility and exploratory stages, and engineers, who are needed throughout the project cycle. Anecdotal evidence shows that the sector lacks a safe work environment for skilled and unskilled women workers in both the field and office, which deters new hires (Clancy et al. 2014). In addition, companies may lack sanitary facilities and living quarters for women and may even need to be convinced that purchasing appropriate personal protective equipment (PPE) for women is a good investment.

Pursuing Opportunities to Improve Equitable Outcomes

Establishing a safe, friendly workplace environment is essential for advancing gender equality in the geothermal sector. Assurance of a safe workplace environment would likely attract more women to the sector, who, in turn, could serve as role models for younger women entering the field, thus establishing a virtuous circle of enhanced gender balance. Reaching gender balance in the sector may also help curb the more problematic behaviors associated with occupational segregation by sex (box 2.6).[10]

BOX 2.6: CLOSING GENDER GAPS AT REYKJAVÍK ENERGY

Reykjavík Energy is a public utility in Iceland that operates two geothermal plants. The company generates revenue by supplying electricity, providing hot and cold water, treating wastewater, and providing telecommunications infrastructure. Its service area extends to 20 municipalities, covering 67 percent of the Icelandic population. Its legacy culture was male-dominated, featuring long work days and shift work. To create a more equitable work environment and attract more women to the company, its leadership decided in 2011 to tackle various gender gaps, including the gender pay gap of about 7 percent in favor of men and issues around work hours with caregiver responsibilities. These policy changes resulted in greater job satisfaction for both female and male employees with no drop in productivity. In 2017, the company closed the gender pay gap and has since managed to keep it near zero percent.

Sources: Bjarni Bjarnason, personal communication, February 2018; CHARGE Energy Branding 2017; Government of Iceland 2019.

Key measures can be taken to ensure that geothermal projects provide a safe and professional work environment for both women and men. Top leadership must exhibit strong, personal commitment to gender equality and openly recognize the potential dangers of harassment and GBV. Leaders' commitment can produce a company-wide effect on attitudes and behaviors, and can be complemented by such actions as amending human resource policies and establishing Grievance Redress Mechanisms (GRMs) with safe and ethical reporting (NASEM 2018). Also needed are separate living and sanitary facilities with adequate security in the form of door locks and, in some cases, guards or security staff. In addition, protective gear suitable for female bodies and responsive to local customs for modesty should be designed by and in consultation with women.

Targeted efforts to increase women's participation in the geothermal workforce can include a mix of compulsory measures and broader programmatic support. Compulsory measures might include hiring and training quotas and preferential scoring in the public and private procurement and tendering of goods and services (box 2.7).[11] However, evidence on the effectiveness of these requirements is mixed. With political will and enforcement, results may be quickly realized; but if improperly implemented, backlash may result. To create buy-in, the rationale and positive impact of quotas and preferential scoring must be appropriately communicated to all stakeholders, especially senior leaders in the sector, relevant human resource managers, and the existing male workforce. On specific quotas for women's employment, Kenya is leading the way. The country's new constitution mandates 30 percent employment by women in the public sector, and geothermal projects developed by its government-owned Geothermal Development Company (GDC) are implementing this requirement. Accompanying measures to bring more women into the sector include outreach programs at schools and for workers' families, professional support networks, leadership and apprenticeship programs, and scholarships. Additional supporting measures include ensuring gender balance on selection committees and maintaining sex-disaggregated reporting on rates of labor-force participation between men and women by position.

BOX 2.7: SOUTH AFRICA'S PREFERENTIAL PROCUREMENT FRAMEWORK

South Africa has a preferential procurement policy framework and regulations for considering nonprice factors for 10–20 percent of its bid scoring. In 2011, these regulations were amended to reflect the Broad-Based Black Economic Empowerment (B-BBEE) Act of 2003, which ties award points to B-BBEE status levels, adding verification and remedies for fraudulent representation.

In South Africa's power sector, bidding documents under the Renewable Energy Independent Power Procurement Program (REIPPP) include nonprice bid-evaluation factors. The bidding documents outline requirements for job growth promotion, domestic industrialization, community development, black economic empowerment, and women-owned vendor expenditure. The socioeconomic requirements go beyond the customary nonprice criteria in the government's preferential procurement policy—accounting for 30 percent of total bid value.

Sources: ITC 2014; Eberhard, Kolker, and Leigland 2014.

Geothermal energy projects should develop a detailed employment strategy for categories of direct hire, and analyze the functions of worker categories, as well as career development pathways for recruitment, retention, and promotion (box 2.8).[12] To overcome the hiring bottleneck, a strong focus on women's recruitment may pay off.[13] Given the value the geothermal sector assigns to hands-on experience and training, programs that rotate women through field positions and various company divisions could help prepare them for promotions, as could specialized educational opportunities, such as the Geothermal Training Programme of the United Nations University (UNU-GTP). Projects should consider earmarking funding for such initiatives.

BOX 2.8: DIRECT EMPLOYMENT CATEGORIES AND WOMEN'S ASSOCIATED BARRIERS TO ENTRY

Worker categories in geothermal energy projects are loosely associated with stages in the project cycle. Typically, these include earth scientists, business and administrative staff and consultants, engineers, drilling operators, construction workers, and plant operators. Each category has unique challenges and opportunities for increasing women's labor-force participation.

Earth scientists. Geologists, geophysicists, hydrologists, environmental specialists, and geochemists maintain a heavier presence during a project's pre-feasibility and exploratory stages. Positions that are mainly laboratory-based have a better chance of being filled by women. Fieldwork, travel, and safety concerns pose potential hardships.

Business and administrative staff and consultants. These positions are more likely to be filled by women, given the larger talent pool that can likely be drawn from, among other reasons. Even so, gaining employment can often depend substantially on the reach and strength of professional networks.

Engineers. Positions in engineering (civil and construction, mechanical, electrical, computer, and electronic) are important throughout the project cycle. Women's underrepresentation in university engineering programs and high attrition rates in the sector pose special challenges for local or international project hiring. Focusing on the development of technical education and career paths for women as part of a broader strategy to reduce dependence on foreign labor can create mutually reinforcing benefits over the long term.

(continued)

BOX 2.8: CONTINUED

Drilling operators and support. Drilling operators, along with workers in support positions (derrick operators, roustabouts, mud loggers, cement and casting crews, and rig transporters), are active during the project's drilling stage. These jobs are amenable to vocational training and on-the-job learning. Women with a secondary education or sometimes less could be recruited and trained for such positions, which also provide entry into more advanced careers. Women in these jobs face hardships of work-life balance and safety issues. To minimize such risks, project developers could provide wage premiums and extra days off for assignments in difficult-to-access sites, as well as generous worker compensation and life insurance policies. During travel, companies could provide transport and security escorts when needed.

Construction workers. Construction jobs at geothermal project sites are male-dominated. They include skilled and semi-skilled positions (carpenters, laborers, managers, heavy equipment operators, electricians, welders, pipe fitters, plumbers, and steamfitters), as well as unskilled laborers. Workers may be brought in from other in-country locations or abroad to fill skilled and semi-skilled positions. To the extent possible, local laborers can fill unskilled positions. The construction industry holds promise for bringing in large numbers of unskilled—even illiterate—women to achieve a critical mass for such tasks as road building. The success of India's National Rural Employment Guarantee Act (NREGA) shows how unskilled rural female labor can be mobilized; in this case, the wages paid to women were arguably transformative (Farooqi and Saleem 2015).

Plant operators. Though relatively few in number, plant operators hold long-term positions that are active for the duration of the power plant life. These jobs include control room operators, technicians, and maintenance workers. Much time is spent by operators in the control room, with occasional excursions for maintenance, troubleshooting, and repair. The jobs involve a fair amount of on-the-job learning and apprenticeships. They can be performed by women, although long hours at remote site locations can pose conflicts if families are not supportive. Mentoring and apprenticeship relationships between plant operators of the opposite sex should be well managed so that women remain safe and are not subject to unwanted advances, among other issues. This issue also applies to all other skilled positions.

Aside from project employment, businesses and services linked to the direct use of geothermal resources can create entrepreneurial and livelihood opportunities for men and women. Many geothermal sites are popular tourist attractions that provide employment opportunities for men and women. The well-known Blue Lagoon spa in Iceland may be the most successful example, attracting more than 1.3 million guests in 2017, and providing employment to more than 600 people (Blue Lagoon 2017). Located near the Svartsengi geothermal power plant, the Blue Lagoon offers baths in mineral-rich geothermal brine from the power plant. In central New Zealand, Māori women have a long and proud history of geothermal leadership, having shared their knowledge as geothermal guides since the mid-1880s (box 2.9).

Opportunities for direct and cascaded uses of geothermal energy in the agriculture sector can also contribute to the affected community's employment and empowerment. Geothermal projects collaterally benefiting the cut-flower sector through greenhouse heating can save costs, boost productivity, and, in theory, provide a future entry point for improving working conditions in such industries, which are sometimes unfavorable for women (Lowthers 2017; Mburu 2014).[14] In El Salvador, the Berlin and Ahuachapán power plants provide employment for dozens of women who use geothermal condensates for nursery irrigation, geothermal heat for fruit dehydration, and are employed as park rangers and in reforestation efforts in surrounding fields (UNFCCC n.d.) (box 2.10). A 2015 pilot project in the Menengai

BOX 2.9: WOMEN'S HISTORY AS GEOTHERMAL GUIDES IN NEW ZEALAND

Since the emergence of geothermal tourism in central New Zealand in the mid-1800s, Māori women have served as geothermal guides, sharing their wealth of knowledge with visitors to the geothermal regions (photo B2.9.1). From these early beginnings, Māori women have developed a strong and proud history of geothermal leadership, which continues even today. Aroha Campbell, recipient of the Queen's Service Medal, is chief executive of one of New Zealand's large Māori trusts, which invests in geothermal power stations; cash flow from the trust's businesses helps fund an array of support programs for its beneficiaries.

Photo B2.9.1: Pulman, Elizabeth, 1836–1900. Sophia Hinerangi, Kate Middlemass (Kati), and another guide, outside Hinemihi meeting house, Te Wairoa

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BOX 2.10: LESSONS FROM APPROACHES IN EL SALVADOR

LaGeo, a majority state-owned energy company in El Salvador, operates two geothermal plants that contribute more than one-quarter of the country's electricity. LaGeo uses geothermal by-products for productive uses and income-earning potential, benefiting women living in 15 nearby rural communities. Women use the waste heat to dehydrate fruit that they consume and sell. They also grow and sell plants watered with geothermal condensates and benefit from a constructed reservoir that can be used for fishing.

Through the LaGeo project, women run productive businesses while earning a sustainable income. Depending on demand, the profit of female fruit processors is about US$75 per month, in a country where minimum wage from agriculture is estimated at just US$47 per month. The project employs four women as rangers in a wildlife protection park established near the geothermal project site, at per-person salaries of US$400 per month. Another 15 women have been hired to work half of the year planting cocoa and coffee trees as part of a reforestation program, earning about US$103 per month.

Within the utility company, LaGeo implements progressive recruiting, training, and human resource policies, and has established daycare facilities. Women hold 35 percent of company jobs and represent 32 percent of locally hired and trained, temporary maintenance workers. For more than two decades, LaGeo has fostered a workplace culture of equity and inclusion. Company values, not outside pressure, and leadership from the top echelons have been the driving force behind LaGeo's evolution into a global leader on inclusive geothermal development.

Sources: González 2018; González et al. 2019; IUCN and USAID 2018; UNFCCC n.d.

area of Kenya's Great Rift Valley used geothermal heat for milk pasteurization, laundry, fish farming, and irrigation, as well as greenhouse heating (Nyambura 2016) (box 2.11). In Tunisia, direct-use applications included irrigation and greenhouse heating (Ben Mohamed and Saïd 2008), as well as desalinization (Mahmoudi et al. 2010).

BOX 2.11: PILOTING DIRECT-USE GEOTHERMAL APPLICATIONS IN KENYA

Geothermal fields in Kenya are used for a variety of direct-use applications, ranging from the health spas of Olkaria and Bogoria to crop drying for cereals in Eburru and greenhouse heating for the Oserian flower farm. However, a pilot project at the Menengai power plant in the Great Rift Valley demonstrates an even wider variety of productive-use applications. The plant uses a low-temperature, low-pressure well as the energy source to increase water temperatures via a water-bath heat exchanger. The heated water is circulated to a 150-liter milk pasteurizer capable of meeting the needs of local dairy producers. It is also used to regulate the temperature of tilapia ponds, producing optimal fish growth and reproduction. The nutrient-rich water from the fish farm is used in the greenhouse cultivation of tomatoes and bell peppers; these plants benefit from geothermal heating and humidity control, which reduce fungal infections and the need for chemical applications. Lastly, a laundry facility connected to the system uses geothermally heated water, saving significantly on energy costs. The government of Kenya and the Geothermal Development Company (GDC) are awaiting financing to further scale up industrial direct-use applications.

Sources: GDC 2018; Nyambura 2016; Ole Nchoe 2018.

Direct and cascaded uses of geothermal energy should be identified and integrated from the outset rather than later as a project add-on. In this way, the technical efficiency and positive development outcomes of such uses, including those for women, can be maximized. Government entities, donors, investors, and project developers should actively seek to identify, support, and collaborate with local counterparties to innovate and drive efforts to optimize geothermal resource use. The required financial commitment relative to all-in capital project expenditures is minimal; but it can result in long-term benefits for the project-affected community that otherwise would not be realized.

CHANGES TO ENVIRONMENT AND HEALTH

The environment and health risks of geothermal energy projects may impact men and women differently. These risks are linked mainly to potential water and air pollution, environmental degradation, and the influx of large groups of migrant construction workers. But thoughtful investments in risk mitigation and remediation can enhance, reduce, or even eliminate these concerns.

Geothermal exploitation can result in the release of chemicals and pollutants that, although less toxic than those of fossil fuel plants, can damage the surrounding ecosystems and inhabitants. Common gases released by geothermal systems include hydrogen sulfide (H_2S), which can be toxic in high concentrations, and carbon dioxide (CO_2) and methane (CH_4), which are greenhouse gases (GHGs) (Júlíusson et al. 2015). If aquifers are contaminated during reinjection or if well casings fail, sump pits leak, or effluent is released to surface waters, such harmful heavy metals and metalloids as mercury (Hg) and arsenic (As) may leach into the water and soil. However, following international standards during drilling and well construction significantly reduces the likelihood of such occurrences. Another concern is that geothermal projects may produce waste streams and hazardous materials, including

trash, lubricants, dust, and eroded soil. However, project developers' adherence to environmental standards and regulations can minimize such problems.

Men and women may hold divergent views on the health-related risks of geothermal development, possibly as a function of social status or family caregiver roles. Recent studies on perceptions about the environmental and health impacts from energy-related sources (e.g., power plants, high-voltage power lines, chemical pollution, and fracking, among others) find that women and minorities are more averse to such risks (Ansolabehere and Konisky 2009; Boudet et al. 2014; Flynn, Slovic, and Mertz 1994; Satterfield, Mertz, and Slovic 2004). These findings underscore the need for geothermal project developers to hold consultations with and seek input from both men and women in the affected communities to capture potentially divergent perspectives on risk management.

Local natural-resource contamination can impact men and women or boys and girls differently, even when that natural resource is replaced or the damage remediated. For example, if drinking water is contaminated by geothermal operations, women who previously collected it from nearby sources might have to purchase it or, if unaffordable, walk longer distances to fetch it, which could pose safety risks (box 2.12). Also, a project's need for freshwater during drilling stages might compete with local needs, especially in times of drought.

BOX 2.12: IMPACTS OF GEOTHERMAL ACCIDENTS ON MEN AND WOMEN

In 2017, the Prukut River in Central Java, Indonesia, was twice contaminated from site accidents at the nearby Baturraden Geothermal Development Project, a large-scale, US$1 billion investment. Residents in nearby Karangtengah village previously depended on the river for freshwater and fishing, as well as tourism. Once polluted, the river water could no longer be used to meet villagers' daily household needs. The poorest households could not afford to purchase water, and street protests ensued. More research is needed on the impacts of geothermal environmental accidents and the impact on men and women in subsequent protests and negotiated settlements.

Source: Darmawan 2017.

The adverse health effects of geothermal-related pollutants may affect men and women differently. Owing to their larger numbers in the geothermal workforce, men are more likely to suffer frequent exposure to heavy metals, solvents, or other toxic substances that can impact fertility (Chalupka and Chalupka 2010). Also, men may be more vulnerable than women to the adverse effects of hydrogen sulfide (H_2S) (Chou 2003) and arsenic (As) (Lindberg et al. 2008). Sex-specific reproductive health issues include men with sperm DNA fragmentation (Rubes et al. 2005) and women affected by intrauterine growth restriction (IUGR) in pregnancy (Ritz and Wilhelm 2008).[15]

The influx of predominantly male construction workers into the local community can increase the risk of gender-based violence (GBV) and human trafficking. The risk of GBV has been documented for large-scale energy infrastructure projects generally (ESMAP 2018) and related renewable energy sectors (IDB 2014), mining and extractives (Eftimie, Heller, and Strongman 2009), and transport (ADB 2009).[16]

Other public-health risks distinct from, but sometimes interlinked with GBV, include substance abuse, criminality, and the spread of sexually transmitted infections (STIs). To ensure uninterrupted operations, shift workers in large-scale infrastructure projects put in long hours spanning multiple weeks (Carrington, Hogg, and McIntosh 2011). Oftentimes, they have gained elevated wages at the expense of increased risk for loneliness and depression, excessive alcohol consumption and illegal drug use,

gambling, motor vehicle accidents, and male-on-male violence (ESMAP 2018; IUCN and USAID 2018). Short-lived intimate relationships with multiple partners, some of whom may lack the power to successfully negotiate condom use, are not uncommon at project sites, and these relationships can have negative impacts, including the spread of STIs, in the local community and disruptions to the social fabric.

Pursuing Opportunities to Improve Equitable Outcomes

Raising awareness about the environmental and health risks of geothermal projects is the foundation for trust building, cultural adaptation, and positive development outcomes.[17] The information that project developers provide the affected communities must be accurate, credible, transparent, and equally accessible to men and women. For example, developers are likely to have knowledge about the presence of toxins in the geothermal resources—such as dangerous levels of mercury found in hot springs traditionally used for bathing (Davey 1979; Glover and Scott 2005). They should be obligated to communicate this information to the communities in a respectful way that is well received and possibly problem-solve with them to mitigate the impacts. Innovative data and information-sharing solutions can strengthen community buy-in. In the United States, for example, a project in Oregon developed a mobile application to make real-time environmental sampling data available to the local community and regularly hosted community consultations to answer questions.[18] An independently certified baseline of environmental conditions at the site and permanent on-site risk monitoring can further strengthen community cooperation.[19] It is also important to separately identify the risks of greatest concern to men and women and continually monitor those variables.

Beyond information sharing, geothermal developers should seek opportunities to enhance equitable access to environmental and health services. Providing the local community pumped or piped water can ensure clean drinking water while reducing women's time burden for water collection. Water supply systems for drilling and plant operation can provide water for crop irrigation.[20] For such heat energy–intensive local businesses as beer brewing, a traditionally female-dominated sector in some countries (Nyuur and Sobiesuo 2016), switching from polluting biomass to cleaner geothermal heat could improve health outcomes. Access to health clinics in the local community, established in parallel to power plant installation, can have far-reaching positive impacts for women by making prenatal care and delivery safer (WHO and World Bank 2014). Clinics established at project sites, if accessible by community members, could reduce the time spent transporting sick children to and from clinics located far away. Finally, geothermal spas for tourists can be developed to provide health benefits to local communities if care is taken to respect cultural and gender norms for facility use and hours of attendance (Mangi 2013).

Project developers must ensure that prevention and response measures for GBV and other public health concerns are adopted across the project cycle to minimize negative impacts on women and girls and men and boys.[21] They must sensitize contractors and the local community to the potential risks associated with a large influx of male construction workers in the project area, ensure the adoption of codes of conduct agreements with workers, and support regular safeguards monitoring and reporting, along with a robust Grievance Redress Mechanism (GRM). In high-risk project areas, developers may consider partnering with service providers who can provide health and counseling services and access to contraception.[22]

SUMMARY RECOMMENDATIONS

To address the risks and opportunities for each identified pathway, stakeholders in the geothermal sector should adhere to recommendations based on accepted best practices and lessons learned.

Changes in Land and Natural Resource Use[23]

- Engage with local stakeholders early on before drilling begins. Conduct early consultations with local men and women to understand their cultural relationship with the land and its uses, including customs and norms, which can help to identify appropriate sites.
- Conduct analyses on rates and extent of land ownership, incidence of titling, and patterns of natural resource use.
- Make adjustments to sale negotiations, compensation, and resettlement actions to account for differences between men and women and ensure equitable outcomes.
- Based on the geothermal resource's cultural significance, consider the appropriateness of different land ownership and management structures involving local men and women.
- Ensure that critical land improvements mandated by the project and additional voluntary land improvements, such as supplying potable water or supporting tourism, provide equitable benefits in the affected communities.

Changes to Employment and Economic Patterns[24]

- Create a safe, inclusive work environment and protocols for occupational safety that respect men and women equally.
- Consider hiring and training quotas and preferential scoring in procurement and tendering; to avoid backlash, communicate with all stakeholders about the rationale and positive impact for implementing them.
- Develop a strategy to enhance women's employment for all direct employment offered; analyze the functions of worker categories and career development pathways for recruitment, retention, and promotion.
- Seek opportunities to tie project funding to programs that prepare women for promotions in geothermal companies, as well as specialized educational programs.
- From the project outset, identify opportunities linked to direct and cascaded uses of geothermal resources to create jobs for women entrepreneurs, increase women's agricultural productivity, and improve women's overall working conditions.

Changes to Environment and Health[25, 26]

- Raise community awareness about the presence of known toxins in traditionally used geothermal resources, and look for culturally appropriate ways to problem-solve with communities.
- Conduct consultations with men and women in the affected communities to capture their potentially divergent perspectives on project risks to the environment and human health. Share monitoring data with them on a regular basis to minimize possible concerns and build trust.
- Design project benefits from direct-use applications of geothermal energy and water supply installations in ways that can reduce women's time burdens, enhance livelihoods, and result in better health outcomes for families.
- Sensitize contractors and the local community to the potential risks associated with the influx of male construction workers, ensure codes of conduct agreements are adopted with workers, and support regular safeguards monitoring and reporting, along with a robust GRM. Consider partnering with service providers who can provide health and counseling services and access to contraception.

NOTES

1 UN-HABITAT defines the term *usufruct rights* as "user and access right, which do not confer ownership." See United Nations Human Settlements Programme, *Policy Makers Guide to Women's Land, Property and Housing Rights across the World* (Nairobi: UN-HABITAT, 2007).

2 Defined in this report as the "right to cross or otherwise use someone else's land for a specified purpose."

3 International tourism involving thermal pools for personal bathing should respect local traditions, ensure fairness, and promote equity in access (Swarbrick 2006).

4 The Kenya and New Zealand partnership was facilitated by the United States Energy Association (USEA) and the Geothermal Energy Association (GEA).

5 Over 30–50 years, the GEA estimates 0.74–1.17 jobs per MW at the geothermal operating plant, which is up to 19 times higher than on-site job creation for solar PV or wind. The estimate rises to 2.13 jobs per MW if government, technical, and administrative positions are included. For short-term jobs at geothermal construction plants, the GEA estimates are 3.1 person-years per MW and 6.4 person-years if manufacturing jobs are included; however, it should be noted that manufacturing of turbines and other specialized equipment may not occur in the project country context.

6 In the oil and gas industry, 22 percent of jobs are held by women. This percentage is generally stable across countries, despite varying intra-country rates of female labor-force participation. This finding suggests that international industries with many mobile workers may have an outsized influence on female participation rates compared with local norms and market conditions (Rick, Martén, and Von Lonski 2017).

7 Susan Muska, personal communication, December 2017.

8 Giuliano (2017) argues that some present-day gender norms are rooted in exogenous historical experiences stretching back millennia; such factors as colonial religious practices, environmental conditions, and catastrophic demographic events (e.g., slave trade and wars) are correlated with female labor-force participation.

9 In Sub-Saharan Africa, less than 20 percent of engineering graduates are women; however, the percentages in the United States and Canada are not much higher (UNESCO 2015).

10 Dahlerup (1988) posited the required critical mass as 30 percent; however, this figure it not empirically supported as a universal threshold for all types of outcomes. Also, critical-mass arguments can be reductionist, ignoring other important dynamics at work (Childs and Krook 2008; Kurebwa and Ndlovu 2017).

11 One should note that the project borrower must obtain prior approval from the World Bank in order to apply its Sustainable Procurement strategy.

12 At present, the opportunities for women in the geothermal sector are similar to those of the oil and gas sector, where there are 2.5 times as many women in corporate support functions as in technical and field roles (Rick, Martén, and Von Lonski 2017).

13 Khazan (2018) makes the counterintuitive observation that, in strongly patriarchal societies with apparently less gender equality, more women are studying in STEM fields, and STEM employment is perceived as an important avenue to women's greater financial freedom.

14 For example, if the greenhouse operator is a directly owned subsidiary or lessee, the geothermal developer could stipulate that gender pay equity be achieved, management teams be balanced, policies and human resource reporting procedures be put in place that enhance gender equality, training provided, and an analysis conducted of any company-provided housing or transportation services.

15 This topic has been little studied and merits further research.

16 The World Bank has created a task force to strengthen the institutional risk response to GBV (World Bank 2016) and an action plan to prevent and respond to all types of GBV across its operations (World Bank 2017).

17 ESS8 offers detailed guidance on cultural heritage (http://pubdocs.worldbank.org/en/837721522762050108/Environmental-and-Social-Framework.pdf#page=99&zoom=80).

18 Susan Petty, personal communication, December 2017.

19 Such data were lacking when the El Tatio blowout occurred in Chile in 2009; for some time, residents nearby the site were left in the dark about the effect the blowout was having on water quality and the thermal reservoir (Malin 2013).

20 Care must be taken to ensure that irrigation is not dominated by monoculture production and that women farmers have equal access to equipment (Parker et al. 2016).

21 GBV seriously affects all aspects of women's health—physical, sexual and reproductive, mental, and behavioral.

22 For guidance, geothermal project developers should consult World Bank (2018).

23 Environmental and Social Standard 5 (ESS5) under the World Bank's new Environmental and Social Framework (ESF) provides detailed guidance on land acquisition, restrictions on land use, and involuntary resettlement (http://pubdocs.worldbank.org/en/837721522762050108/Environmental-and-Social-Framework.pdf#page=67&zoom=80).

24 ESS2 offers detailed guidance on labor and working conditions (http://pubdocs.worldbank.org/en/837721522762050108/Environmental-and-Social-Framework.pdf#page=45&zoom=80).

25 ESS6 provides detailed guidance on biodiversity conservation and sustainable management of living natural resources (http://pubdocs.worldbank.org/en/837721522762050108/Environmental-and-Social-Framework.pdf#page=81&zoom=80).

26 ESS4 offers detailed guidance on community health and safety (http://pubdocs.worldbank.org/en/837721522762050108/Environmental-and-Social-Framework.pdf#page=59&zoom=80).

REFERENCES

ADB (Asian Development Bank), ed. 2009. *Intersections, Gender, HIV, and Infrastructure Operations: Lessons from Selected ADB Finance Transport Projects*. Mandaluyong City, Philippines: ADB.

Ansolabehere, S., and D. M. Konisky. 2009. "Public Attitudes towards Construction of New Power Plants." *Public Opinion Quarterly* 73 (3): 566–77.

Bahrami-Rad, D. 2018. "Keeping It in the Family: Female Inheritance, Inmarriage, and the Status of Women." Working Paper. Cambridge, MA: Harvard University, Department of Human Evolutionary Biology. https://scholar.harvard.edu/files/JMP_Bahrami-rad_2018.pdf.

Bayisenge, J. 2018. "From Male to Joint Land Ownership: Women's Experiences of the Land Tenure Reform Programme in Rwanda." *Journal of Agrarian Change* 18 (3): 588–605.

Ben Mohamed, M., and M. Saïd. 2008. “Geothermal Energy Development in Tunisia: Present Status and Future Outlook.” Paper presented at the United Nations University Geothermal Training Programme Anniversary Workshop, Reykjavík, August 26–27.

Blue Lagoon. 2017. *Annual Report*. https://arsskyrsla2017.bluelagoon.is/avarp-stjornarformanns/

Boudet, H., C. Clarke, D. Bugden, E. Maibach, C. Roser-Renouf, and A. Leiserowitz. 2014. “‘Fracking’ Controversy and Communication: Using National Survey Data to Understand Public Perceptions of Hydraulic Fracturing.” *Energy Policy* 65 (February): 57–67.

Carrington, K., R. Hogg, and A. McIntosh. 2011. “The Resource Boom’s Underbelly: Criminological Impacts of Mining Development.” *Australian & New Zealand Journal of Criminology* 44 (3): 335–54. https://doi.org/10.1177/0004865811419068

Cataldi, R., and M. Suárez-Arriaga. 2016. “Our Geothermal Legacy: A Historic Overview.” *IGA News* 92 (September): 2–70.

Chakma, T. 2016. “Feminist Participatory Action Research (FPAR): An Effective Framework for Empowering Grassroots Women & Strengthening Feminist Movements in Asia Pacific.” *Asian Journal of Women’s Studies* 22 (2): 165–73.

Chalupka, S., and A. Chalupka. 2010. “The Impact of Environmental and Occupational Exposures on Reproductive Health.” *Journal of Obstetric, Gynecologic & Neonatal Nursing* 39 (1): 84–102. doi:10.1111/j.1552-6909.2009.01091.x

CHARGE Energy Branding. 2017. “Closing the Energy Gender Gap (blog). April 3. https://blog.branding.energy/closing-the-energy-gender-gap/

Childs, S., and M. Krook. 2008. “Critical Mass Theory and Women’s Political Representation.” *Political Studies* 56: 725–36.

Chou, S. 2003. *Hydrogen Sulfide: Human Health Aspects*. Concise International Chemical Assessment Document 53. Geneva: World Health Organization.

Clancy, K., R. Nelson, J. Rutherford, and K. Hinde. 2014. “Survey of Academic Field Experiences (SAFE): Trainees Report Harassment and Assault.” *PLoS ONE* 9 (7): e102172. https://doi.org/10.1371/journal.pone.0102172

Clarke, E. 2004. “The Taniwha’s Exile: The Exclusion of Maori Women from Environmental Policy and Decision-Making in Aotearoa/New Zealand.” *Hecate* 30 (1): 119–40.

CWEARC and APWLD (Cordillera Women’s Education Action Research Center and Asia Pacific Forum on Women, Law and Development). n.d. “Philippines: Indigenous Women in the Struggle against Chevron’s Geothermal Project in Western Uma, Lubuagan, Kalinga.” Rural and Indigenous Women Claiming Rights. http://apwld.org/wp-content/uploads/2014/07/BOOM-Brief-Philippines-21-May.pdf. Accessed February 27, 2018.

Dahlerup, D. 1988. “From a Small to a Large Minority: Women in Scandinavian Politics.” *Scandinavian Political Studies* 11 (4): 275–98.

Dancer, H. 2017. “An Equal Right to Inherit? Women’s Land Rights, Customary Law and Constitutional Reform in Tanzania.” *Social & Legal Studies* 26 (3): 291–310.

Darmawan, L. 2017. “Protests over Geothermal Development Heat Up in Central Java.” *Mongabay*, August 22. https://news.mongabay.com/2017/08/protests-over-geothermal-development-heat-up-in-central-java/

Davey, H. 1979. “The Geochemistry of Mercury at Ngawha Springs, New Zealand.” PhD Thesis, University of Tasmania.

Du, S. 2005. “Frameworks for Societies in Balance: A Cross-Cultural Perspective on Gender Equality.” Presentation at Societies of Peace, 2nd World Congress on Matriarchal Studies, San Marcos and Austin, Texas, September 29/30–October 1/2. http://www.second-congress-matriarchal-studies.com/du.html

Eberhard, A., J. Kolker, and J. Leigland. 2014. “South Africa’s Renewable Energy IPP: Procurement Program—Success Factors and Lessons.” Washington, DC: World Bank Group.

EEPCo (Ethiopian Electric Power Corporation). 2013. “Environment and Social Impact Assessment of Geothermal Sector Development Project for Alalobad Geothermal Site Development.” Prepared for the World Bank, Addis Ababa. http://documents.worldbank.org/curated/en/147521468025162023/pdf/867940BR0P1336070Box385183B00OUO090.pdf

Eftimie, A., K. Heller, and J. Strongman. 2009. “Gender Dimensions of the Extractive Industries: Mining for Equity.” Extractive Industries and Development Series, No. 8. Washington, DC: World Bank. https://openknowledge.worldbank.org/handle/10986/18236

ESMAP (Energy Sector Management Assistance Program). 2012. “Geothermal Handbook: Planning and Financing Power Generation.” Technical Report 002/12. Washington, DC: World Bank. https://www.esmap.org/sites/esmap.org/files/DocumentLibrary/FINAL_ Geothermal%20Handbook_TR002-12_Reduced.pdf

———. 2016. “Focus on Gender in Energy and Extractives Operations: A Source Book for TTLs.” World Bank, Washington, DC.

———. 2018. *Getting to Gender Equality in Energy Infrastructure: Lessons from Electricity Generation, Transmission, and Distribution Projects*. Washington, DC: World Bank.

FAO (Food and Agriculture Organization of the United Nations). 2017. *Gender, Agriculture and Rural Development in Armenia*. Rome: FAO. http://www.un.am/up/library/Gender_Agriculture_and_Rural_Development_in_Armenia_Eng.pdf

FAO (Food and Agriculture Organization of the United Nations), IFAD (International Fund for Agricultural Development), and International Labour Office. 2010. *Women in Infrastructure Works: Boosting Gender Equality and Rural Development*. Gender and Rural Employment Policy Brief # 5. Rome: FAO. http://www.fao.org/3/i2008e/i2008e05.pdf

Farooqi, S., and I. Saleem. 2015. “Impact of Mahatma Gandhi National Rural Employment Guarantee Act (MGNREGA) on the Life of Women Living under Poverty: A Study of District Aligarh, Uttar Pradesh.” *Pacific Business Review International* 8: 09–16.

Flintan, F. 2010. “Sitting at the Table: Securing Benefits for Pastoral Women from Land Tenure Reform in Ethiopia.” *Journal of Eastern African Studies* 4 (1): 153–78. https://doi.org/10.1080/17531050903556709

Flintan. F., S. Demlie, M. Awol, Z. Humed, Y. Belete, and H. Lemma. 2008. “Study on Women’s Property Rights in Afar and Oromiya Regions, Ethiopia.” USAID & CARE Report. https://landwise.resourceequity.org/records/708

Flynn, J., P. Slovic, and C. Mertz. 1994. “Gender, Race, and Perception of Environmental Health Risks.” *Risk Analysis* 14 (6): 1101–8. https://doi.org/10.1111/j.1539-6924.1994.tb00082.x

Fritsche, U., G. Berndes, A. Cowie, V. Dale, K. Kline, F. Johnson, H. Langeveld, N. Sharma, H. Watson, and J. Woods. 2017. *Energy and Land Use*. Global Land Outlook Working Papers Series. Bonn, Germany: United Nations Convention to Combat Desertification. doi:10.13140/RG.2.2.24905.44648

GDC (Geothermal Development Company). 2018. “Beyond Electricity” (video). April 1. https://www.youtube.com/watch?v=6pKF6NQGFj8&feature=youtube. Accessed September 18.

Giuliano, P. 2017. “Gender: A Historical Perspective.” In *The Oxford Handbook of Women and the Economy*, edited by S. Averett, L. Argys, and S. Hoffman. doi:10.1093/oxfordhb/9780190628963.013.29

Glover, R., and T. Scott. 2005. “Geochemical Monitoring Before and During Six Years of Power Generation at Ngawha, New Zealand.” In *Proceedings of the World Geothermal Congress 2005*, Antalya, Turkey, April 24–29.

Gneezy, U., K. Leonard, and J. List. 2009. “Gender Differences in Competition: Evidence from a Matrilineal and a Patriarchal Society.” *Econometrica* 77 (5): 1637–64. https://doi.org/10.3982/ECTA6690

González, A. 2018. “Gender Responsive Geothermal Generation—Harvesting Energy and Social Benefits in El Salvador. Presentation at Gender Implications for Energy Infrastructure webinar, March 20.

González, A., J. Siles, A. Rojas, J. Wen, and M. Prebble. 2019. *Advancing Gender in the Environment: Gender-Responsive Geothermal Generation—Powering Energy and Social Benefits in El Salvador*. Washington, DC: IUCN Global Gender Office and USAID.

Government of Iceland. 2019. “Geothermal Perspectives: Experiences from Iceland.” PowerPoint presentation by Erla Hlín Hjálmarsdóttir, Ministry for Foreign Affairs, March 25.

Hunt, T. M. 2001. “Five Lectures on Environmental Effects of Geothermal Utilization.” Geothermal Training Programme of the United Nations University (UNU-GTP) Reports 2000, 1. Reykjavík: UNU-GTP.

IDB (Inter-American Development Bank). 2014. *Gender and Renewable Energy: Wind, Solar, Geothermal, and Hydroelectric Energy*. Washington, DC: IDB.

ILO (International Labour Organization). 2018. “Data Finder—World Employment and Social Outlook.” Geneva: ILO.

International Labour Office. 2019. “World Employment and Social Outlook: Trends 2019.” Geneva: ILO.

IRENA (International Renewable Energy Agency). 2018. *Renewable Energy and Jobs—Annual Review 2018*. Abu Dhabi: IRENA. https://www.irena.org/publications/2018/May/Renewable-Energy-and-Jobs-Annual-Review-2018

———. 2019. *Renewable Energy: A Gender Perspective*. Abu Dhabi: IRENA. https://www.irena.org/publications/2019/Jan/Renewable-Energy-A-Gender-Perspective

ITC (International Trade Centre). 2014. *Empowering Women through Public Procurement*. Geneva: ITC.

IUCN and USAID (International Union for the Conservation of Nature and United States Agency for International Development). 2018. *Advancing Gender in the Environment (AGENT): Making the Case for Women in the Energy Sector*. Washington, DC: IUCN Global Gender Office and USAID.

Jakiela, Pamela, and Owen Ozier. 2018. *Gendered Language (English)*. Policy Research Working Paper, No. WPS 8464. Washington, DC: World Bank Group. http://documents.worldbank.org/curated/en/405621528167411253/Gendered-language

Júlíusson, B., I. Gunnarsson, K. Matthíasdóttir, S. Markússon, B. Bjarnason, O. Sveinsson, T. Gíslason, and H. Thorsteinsson. 2015. “Tackling the Challenge of H2S Emissions.” In *Proceedings of World Geothermal Congress* 2015. Melbourne, Australia, April 19–25.

Kepinska, B. 2003. “Geothermal Energy in Human History, Culture, and Practices: Selected Highlights.” *Geothermal Resources and Utilization in Poland and Europe Reports* 2: 1–27.

Khazan, O. 2018. “The More Gender Equality, the Fewer Women in STEM.” *The Atlantic*, February 18. https://www.theatlantic.com/science/archive/2018/02/the-more-gender-equality-the-fewer-women-in-stem/553592/

Kurebwa, J., and S. Ndlovu. 2017. “The Critical Mass Theory and Quota Systems Debate.” *International Journal of Advanced Research and Publications* 1 (1): 48–55.

Lindberg, A.-L., M. Rahman, L.-A. Persson, and M. Vahter. 2008. “The Risk of Arsenic Induced Skin Lesions in Bangladeshi Men and Women Is Affected by Arsenic Metabolism and the Age at First Exposure.” *Toxicology and Applied Pharmacology* 230 (1): 9–16.

Lowthers, M. 2017. “On Institutionalized Sexual Economies: Employment Sex, Transactional Sex, and Sex Work in Kenya’s Cut Flower Industry.” *Signs: Journal of Women in Culture and Society* 43 (2): 449–72.

Mackenzie, K., G. Ussher, R. Libbey, P. Quinlivan, J. Dacanay, and I. Bogie. 2017. “Use of Deep Slimhole Drilling for Geothermal Exploration. In *Proceedings of the 5th Indonesia International Geothermal Convention and Exhibition*. http://www.geothermal-energy.org/pdf/IGAstandard/Indonesia/2017/Mackenzie.pdf

Mahmoudi, H., N. Spahis, M. Goosen, N. Ghaffour, N. Drouiche, and A. Ouagued. 2010. “Application of Geothermal Energy for Heating and Fresh Water Production in a Brackish Water Greenhouse Desalination Unit: A Case Study from Algeria.” *Renewable and Sustainable Energy Reviews* 14 (1): 512–17.

Malin, R. 2013. “Geoscience and Decision Making for Geothermal Energy: A Case Study.” Master’s Thesis, The University of Texas at Austin. https://repositories.lib.utexas.edu/handle/2152/21770

Mangi, P. 2013. “Direct Utilisation in Kenya: A Case of a Geothermal Spa and Demonstration Centre at Olkaria.” Paper presented at Short Course VIII on Exploration for Geothermal Resources, organized by UNU-GTP, KenGen, and GDC, Lake Bogoria and Lake Naivasha, Kenya, October 31–November 22.

Matek, B. 2015. “Additional Economic Values of Geothermal Power.” Geothermal Energy Association. http://geo-energy.org/events/Geothermal%20Energy%20Association%20Issue%20Brief_Economic%20Values%202015_Final.pdf

Maxim, A. 2014. “Sustainability Assessment of Electricity Generation Technologies Using Weighted Multi-Criteria Decision Analysis.” *Energy Policy* 65 (February): 284–97.

Mburu, M. 2014. “Geothermal Energy Utilization at Oserian Flower Farm-Naivasha.” Paper presented at Short Course VI on Utilization of Low- and Medium-Enthalpy Geothermal Resources and Financial Aspects of Utilization, organized by UNU-GTP and LaGeo, Santa Tecla, El Salvador, March 23–29.

McLoughlin, K., A. Campbell, and G. Ussher. 2010. “The Nga Awa Purua Geothermal Project, Rotokawa, New Zealand.” In *Proceedings of World Geothermal Congress 2010*, Bali, Indonesia, April 25–30.

NASEM (National Academies of Sciences, Engineering, and Medicine). 2018. *Sexual Harassment of Women: Climate, Culture, and Consequences in Academic Sciences*. Washington, DC: The National Academies Press. https://doi.org/10.17226/24994

Nyambura, E. 2016. “Direct Use of Geothermal Energy: Menengai Direct Use Pilot Projects in Kenya.” Presentation by Geothermal Development Company, Addis Ababa, November 3.

Nyuur, R., and P. Sobiesuo. 2016. “The History and Development of Brewing and the Beer Industry in Africa.” In *Brewing, Beer and Pubs*, edited by I. Cabras, D. Higgins, and D. Preece, 145–161. Basingstoke, UK: Palgrave Macmillan.

ODI (Overseas Development Institute). 2015. *Social Norms, Gender Norms, and Adolescent Girls: A Brief Guide*. London: ODI. https://www.odi.org/sites/odi.org.uk/files/odi-assets/publications-opinion-files/9818.pdf

Ole Nchoe, J. 2018. "Direct Use of Geothermal Energy for Food Security: Towards Achieving Kenya's BIG4 Agenda." Presentation, Geothermal Direct Utilization and Food Security, Reykjavík, April 24. https://irena.org/-/media/Files/IRENA/Agency/Events/2018/Apr/IGC2018/GGA-food-2a-GDC.PDF?la=en&hash=3F5BFBFA00BB11DA934CCA69216296B043C3E8F4

Parker, H., N. Oates, N. Mason, R. Calow, W. Chadza, and E. Ludi. 2016. "Gender, Agriculture and Water Insecurity." *ODI Insights*. London: Overseas Development Institute.

Pavils, G. 2011. "Allalobed Geysers and Hot Springs." *Wondermondo*, June 12. https://www.wondermondo.com/allalobed-geysers-and-hot-springs/

PGE (Pertamina Geothermal Energy). 2011. *Land Acquisition and Resettlement Policy Framework: Proposed Geothermal Clean Energy Investment Project.* Jakarta: PGE.

Power Africa. 2018. *Guide to Community Engagement for Power Projects in Kenya*. Washington, DC: United States Agency for International Development. http://www.usaid.gov/powerafrica/kenya

Rick, K., I. Martén, and U. Von Lonski. 2017. *Untapped Reserves: Promoting Gender Balance in Oil and Gas*. Boston: The Boston Consulting Group. http://image-src.bcg.com/Images/BCG-Untapped-Reserves-July-2017_tcm9-164677.pdf

Ritz, B., and M. Wilhelm. 2008. "Ambient Air Pollution and Adverse Birth Outcomes: Methodologic Issues in an Emerging Field." *Basic & Clinical Pharmacology & Toxicology* 102(2): 182–90. https://doi.org/10.1111/j.1742-7843.2007.00161.x

Rubes, J., S. Selevan, D. Evenson, D. Zudova, M. Vozdova, Z. Zudova, W. Robbins, and S. Perreault. 2005. "Episodic Air Pollution Is Associated with Increased DNA Fragmentation in Human Sperm without Other Changes in Semen Quality." *Human Reproduction* 20 (10): 2776–83. https://doi.org/10.1093/humrep/dei122

Satterfield, T., C. Mertz, and P. Slovic. 2004. "Discrimination, Vulnerability, and Justice in the Face of Risk." *Risk Analysis* 24 (1): 115–29. https://doi.org/10.1111/j.0272-4332.2004.00416.x

Smith, C., A. Palmateer, and D. Stonehill. 2017. "The Sacred Nature of Geothermal Energy: How Power Africa Is Sharing Best Practices on Community Engagement Across Cultures and Continents." *Power Africa* (blog). August 15. https://medium.com/power-africa/the-sacred-nature-of-geothermal-energy-9f5f9f0de532

Swarbrick, N. 2006. "Thermal Pools and Spas." Te Ara—The Encyclopedia of New Zealand, June 12. https://teara.govt.nz/mi/thermal-pools-and-spas/print

UNESCO (United Nations Educational, Scientific and Cultural Organization). 2015. "Is the Gender Gap Narrowing in Science and Engineering?" *UNESCO Science Report: Towards 2030*, 84–103. Paris: UNESCO Publishing.

UNFCCC (United Nations Framework Convention on Climate Change). n.d. "Harvesting Geothermal Energy: El Salvador." *Momentum for Change* (blog). Bonn, Germany: UNFCCC. http://unfccc.int/secretariat/momentum_for_change/items/9259txt.php

UNU-GEST (United Nations University Gender Equality Studies and Training Programme). 2017. *Women in Geothermal*. https://www.youtube.com/watch?v=pCEQ9ZJjDhY

U.S. DOE (United States Department of Energy). 2006. "Geothermal Power Plants—Minimizing Land Use and Impact." http://www1.eere.energy.gov/geothermal/geopower_landuse.html

Wang, M.-T., and J. Degol. 2017. “Gender Gap in Science, Technology, Engineering, and Mathematics (STEM): Current Knowledge, Implications for Practice, Policy, and Future Directions.” *Educational Psychology Review* 29 (1): 119–40. https://doi.org/10.1007/s10648-015-9355-x

WEF (World Economic Forum). 2017. *The Global Gender Gap Report 2017*. Geneva: WEF.

WHO (World Health Organization) and World Bank. 2014. *Access to Modern Energy Services for Health Facilities in Resource-Constrained Settings: A Review of Status, Significance, Challenges and Measurement*. Geneva: WHO.

World Bank. 2007. “The Nexus between Infrastructure and Environment.” Evaluation Brief 5. Evaluation Cooperation Group of the International Financial Institutions. Washington, DC: World Bank. http://siteresources.worldbank.org/INTOED/Resources/infrastructure_environment.pdf

———. 2016. “World Bank Launches Global Task Force to Tackle Gender-Based Violence.” Text/HTML. *World Bank Press Release* (blog). October 13. http://www.worldbank.org/en/news/press-release/2016/10/13/world-bank-launches-global-task-force-to-tackle-gender-based-violence

———. 2017. “New Action Plan Addresses Gender-Based Violence in World Bank Operations.” *World Bank Press Release* (blog). November 8. http://www.worldbank.org/en/news/press-release/2017/11/08/new-action-plan-addresses-gender-based-violence-in-world-bank-operations

———. 2018. “Good Practice Note: Addressing Gender Based Violence in Investment Project Financing Involving Major Civil Works.” September 28. World Bank, Washington, DC. http://pubdocs.worldbank.org/en/399881538336159607/Good-Practice-Note-Addressing-Gender-Based-Violence2.pdf

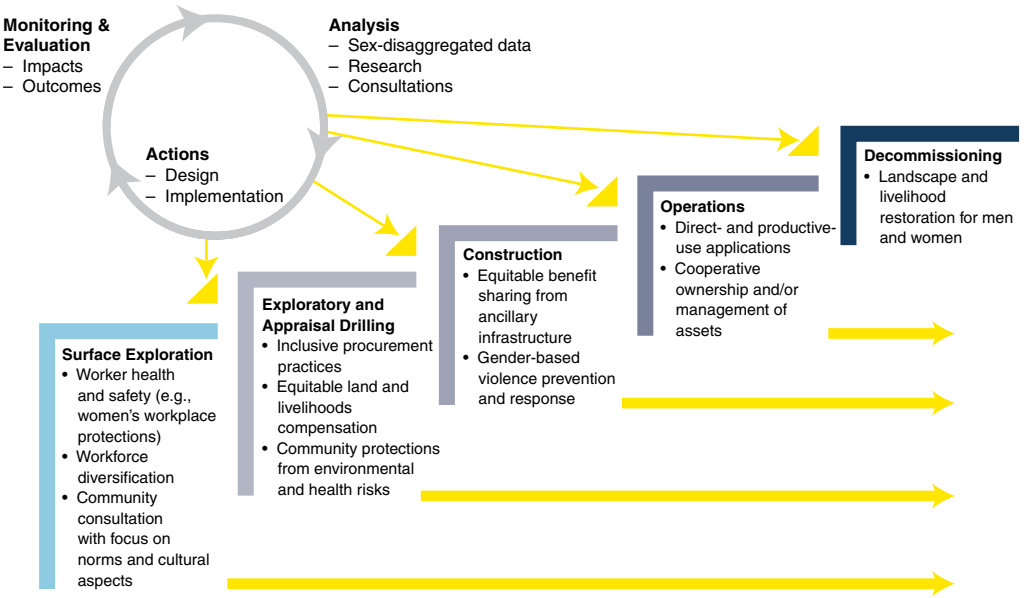
3. CLOSING GENDER GAPS IN PROJECTS

To date, limited efforts have focused on closing gaps between men and women in geothermal projects. Ensuring women's inclusion in project governance, design of benefit-sharing schemes, and hiring and promotion is usually an afterthought rather than an integral part of project analysis and design. Such oversights are difficult to remedy later on, resulting in missed opportunities to work together toward achieving the project objective in ways that reduce disparities between men and women and improve overall development outcomes (ESMAP 2013) (Appendix B).

New strategies are needed to create geothermal projects that are responsive to social concerns, including disparities between men and women. Overlooking these moral imperatives also risks undermining projects' effectiveness, efficiency, and ultimately sustainability. By adopting the integration of approaches that focus on closing gaps between men and women from the outset, geothermal projects can improve risk management and performance, increase community buy-in and thus reduce the likelihood of social protests, and achieve a more balanced allocation of employment opportunities, contributing to an expanded talent pool and more successful, equitable project outcomes.

To get started in assessing projects' differentiated impacts and opportunities, geothermal teams and practitioners may wish to consider interventions in terms of three aspects: (i) analysis, (ii) actions, and (iii) monitoring and evaluation (M&E).[1] For each of these aspects, potential entry points for closing gaps between men and women can be identified (figure 3.1).[2] Many of the entry points

FIGURE 3.1: ENTRY POINTS FOR CLOSING GAPS BY PROJECT PHASE



Note: Horizontal arrows indicate the continuation of entry points across project phases.

continue across several or more project phases, with some, including workforce diversification, extending throughout the project; that is, from surface exploration to decommissioning.[3]

ANALYSIS: RESEARCH AND CONSULTATIONS

The starting point for integrating a focus on gaps into World Bank projects is sex-disaggregated data and gender analysis. This should begin at the project's design stage and continue throughout all phases of development activities to post-implementation M&E and reporting. During project design, analysis can be used to determine the needs and values of, opportunities for, and constraints experienced by men and women in the project-affected community. Determining these early on in the project cycle increases the likelihood they will be well-integrated into the project's design and implementation. As the project evolves, parameters may change as new facts may come to light; in projects employing a financial intermediary, for example, site locations and drilling or plant specifications may be unknown at the outset, making it difficult to conduct fully relevant assessments at the earliest stage. Thus, analysis will play an ongoing role throughout the project cycle.

Analysis should begin by gathering background information to support the establishment of a baseline and by identifying risks and opportunities. Analysis of both risks and opportunities can possibly enhance project performance and lower the chance of work stoppage and project cancellation (table 3.1).

Analysis should include a desk review to evaluate existing relevant data, but will likely need to rely heavily on primary data collection. Because of the dearth of relevant literature and a limited evidence base, early consultations with both women and men are especially critical for identifying project risks and related mitigation and setting the stage for inclusive stakeholder engagement as the project moves forward. In addition, both men and women must be fully informed of the project's plans in order to grant consent. An example of equitable benefit sharing is the model from New Zealand, which includes the participation of indigenous Māori people as owners or co-owners of geothermal energy developments and ensures that key economic benefits accrue to men and women in the project-affected communities. As a result, between 2007 and 2014, trusts earned US$4.1 million, which is invested in education and health of the community (Blair 2016).

Early consultations and Focus Group Discussions (FGDs) can help to inform project design, proposed actions, and interventions. Early consultations with women's community groups, the utility company, and other project-related businesses can help to inform project design. For example, consultations held with Ethiopian Electric Power (EEP),[4] the implementing agency for the World Bank–supported Ethiopia Geothermal Sector Development Project, revealed information about the agency's commitment to ensuring women's fair compensation during resettlement and the goal of reaching 30 percent employment for women (Appendix C) (table 3.2).This information helped to inform the World Bank's strategy to support the client in closing gender gaps across the Ethiopia energy portfolio. FGDs with local stakeholders can bring otherwise overlooked community issues to the attention of the project team and thus help to inform proposed actions and interventions.

Consultations should be held in a transparent and open manner, be considerate of the local social constructs, and engage people from a variety of demographics. The Olkaria geothermal project in Kenya is notable in that it organized a range of consultations that were important for the project's success (box 3.1).

TABLE 3.1: SEX-DISAGGREGATED DATA AND GENDER ANALYSIS: KEY ELEMENTS

FOCUS AREA	ISSUES	TASKS
Background	Presence of local religious, cultural, medicinal, industrial, touristic, and other relationships to geothermal surface features, or the unique surrounding ecosystems and biodiversity. Specific norms around family household tasks and wage work.	Collate information on diverse local relationship to land. Gather information on prevailing local gender norms for family, household activities, and wage work; sex-disaggregated statistics on demography, labor, health, land tenure, education, migration, legal status, and time use.
Stakeholder risks	Community relationships to geothermal surface resources, which may differ for men and women. Lack of acceptable substitutes for local land with culturally significant geothermal resources. Risk of an increase in gender-based violence (GBV) and industrial accidents (limited to site or in the broader environment), which may affect women or men more frequently or with greater severity.	Possibly impose land-use restrictions and explore alternative sites and mitigation measures (for example, compensation, involuntary resettlement, and livelihood restoration to mitigate impact on community relationship to land and resources). Other aspects to monitor may include quality of land, air, water, and noise. Identify potential negative impacts for communities and workers from influx of labor during drilling and construction. Research the effectiveness and costs of mitigation measures (for example, workplace codes of conduct). Enhance safety mechanisms and occupational hazards to reduce industrial accidents.
Opportunities to produce benefits	Possible benefits to men and women from employment and direct-use applications of geothermal energy (greenhouse heating, crop drying, fish farming, and process heat for food sector) and freshwater supply. Potential benefits to men and women from investment in balneological or other geothermal tourism infrastructure and promotion.	Consider the feasibility of apprenticeships, scholarships, trainings, and other ways to increase the project's positive impacts in terms of employment or livelihood creation Scope opportunities and entry points, including the costs and likely outcomes; this may involve Focus Group Discussions (FGDs), consultations, and survey work at the project site. Piggyback on project plans to build community infrastructure, such as low-voltage power lines, potable water sources, schools, health clinics, and roads, at a potentially reduced cost.

Choosing where, when, and how consultations take place has important implications for whether women actively take part. In many developing countries, women may have difficulty taking part in consultations due to mobility/transport constraints, competing time demands, or literacy issues. For example, women may be culturally discouraged from riding bicycles or motorcycles, may not be allowed to travel outside their village without a male relative, or lack time to travel beyond their village due to household work demands. In contexts where women have low literacy levels, they may not actively participate depending on how the information is presented. The use of national versus local languages can also discourage women's active participation.

TABLE 3.2: ILLUSTRATIVE TASKS FOR CONDUCTING ANALYSIS FOR A PROJECT

ANALYTIC TASK	OBJECTIVE	TIME REQUIRED	COST LEVEL	EXPERTISE REQUIRED
Preliminary desk review	Provide initial information to allow for identification of gender gaps and mapping of organizations and community norms to inform project design and in-country consultation.	2–4 weeks	Low	Experience in gender and energy
Stakeholder identification	Identify categories of stakeholders to engage; collect contact information for specific individuals.	2–4 weeks	Low (group identification); moderate (individual identification)	Networks and contacts (usually requires travel in-country)
Focus Group Discussions (FGDs)	Identify issues of importance to local stakeholders and begin process of identifying project-level actions with local buy-in.	1–2 months	Moderate	Local language and knowledge of customs; mastery of participatory methods
Primary surveys	Fill important gaps not addressed by preliminary desk research and first-round consultations; respond to need for robust data and evidence.	1–6 months (longer for longitudinal studies and depending on degree of rigor required)	Moderate–high	Statisticians; enumerators
Baseline report covering background information, risk assessment, remediation options, and development opportunities that consider men and women	Integrate desk research and FGDs to provide a snapshot of current status; raise key issues for project inclusion.	3–6 months	Moderate	Experience in gender and energy
Integration of analysis into project design (examples include Environmental and Social Framework and Project Document)	Ensure project documents cover highlights from the most salient analyses (background, risk, and development opportunities) and include actions, linked indicators, and monitoring and reporting plan.	1 month	Low	Experience in gender and energy; familiarity with project cycle and public sector/ government institutions and operations
Periodic analysis of results from project monitoring activities	Interpret findings from any monitoring and, if needed, suggest course corrections and document lessons learned.	Variable	Low	Familiarity with project

BOX 3.1: IMPORTANCE OF INCLUSIVE COMMUNITY CONSULTATIONS TO PROJECT SUCCESS

At Kenya's Olkaria geothermal area, which is inhabited by the patriarchal Maasai tribe, it was important to create a dialogue with women and youth, as well as men, in the project-affected villages. To ensure this happened, the developer, Kenya Electricity Generating Company, known as KenGen, created a comprehensive process for conducting separate, same-sex meetings for the three groups. However, the process did not run smoothly. Local communities lodged formal complaints regarding project approvals, land rights, compensation, and consultations. The project delays that resulted ultimately led to improvements in processes for conducting and implementing the Environmental and Social Impact Assessment (ESIA) and the Resettlement Action Plan (RAP).

KenGen created a Stakeholders Coordination Committee (SCC), a RAP Implementation Committee (RAPIC), a Community Welfare Society, and a Council of Elders Advisory Committee. The SCC included representatives of government ministries, practitioners, local administration, women representatives, project-affected persons, nongovernmental organizations (NGOs), politicians (Members of County Assembly), vulnerable groups, youth representatives, subcounty representatives, and KenGen staff. RAPIC membership included village representatives, the provincial administration, government line ministries, and KenGen. Community representatives were elected by their communities, and each village was represented by three men and two women to help ensure women's voices were heard. Through this learning process, KenGen's leadership shifted its mindset to approach project-affected communities as partners rather than adversaries.

Sources: Koissaba 2017; World Bank 2018a.

To increase women's meaningful participation in FGDs and other consultations, project teams may consider the following:

- Employ both men and women with preexisting ties to the local community as liaison officers to ensure communities are more at ease sharing experiences and to avoid male-only consultations. Prepare moderators to ensure that no one group dominates the discussion.
- Contact local women's groups, cooperatives, industry associations, religious organizations, schools, municipal governments, and civil society organizations to help identify vulnerable or disenfranchised groups and extend them invitations.
- Advertise meetings through appropriate media to reach both women and men, taking into account how gender intersects with such variables as ethnic group, income, location, and language (IFC 2007); examples of the selected media could include radio, word of mouth, verbal and written announcements in areas where men and women gather, or flyers with both written text and clearly descriptive pictures.
- Choose meeting places and times sensitive to the time use and travel constraints of both women and men. Offer transportation stipends to those who need them. Hold separate consultations with men and women, if necessary.
- Pay attention to how project-related issues are framed. For example, informing communities about the potential impact on their families' health or the sustainability aspects of geothermal development

could draw more women to attend consultative meetings, or emphasizing equal-opportunity hiring could interest more women in applying for jobs (IFC 2007).

- Explore whether childcare can be provided during the meetings.

The required Environmental and Social Impact Assessment (ESIA) framework is useful for incorporating sex-disaggregated data and other relevant information into baseline and impact analyses (box 3.2). In Indonesia, for example, geothermal projects have effectively addressed gender issues through ESIAs and the Resettlement Policy Framework (RPF) (Appendix C). Other planning documents to consider are the Poverty and Social Impact Analysis (PSIA), the Resettlement Action Plan (RAP), and the Indigenous Peoples Plan (IPP).

BOX 3.2: ILLUSTRATIVE QUESTIONS FOR ESIAs AND OTHER PROJECT PLANNING DOCUMENTS

- How are women's and men's livelihoods considered in the resettlement compensation?
- Are men and women consulted on siting decisions for drilling and infrastructure so as to minimize the impact on more desirable or profitable agricultural land?
- Are women included in the public meetings and trainings? Does the project consider how women may be affected by the project—in terms of livelihoods, environmental impacts, gender-based violence (GBV), and safety?
- Are women given opportunities to obtain local construction and service jobs?
- Are workplace safety measures in place for men and women working on-site?
- Are GBV prevention and response measures in place for communities near a large labor influx?
- Does worker-safety training include all employees working at or near the site?
- What is the project developer's track record and best practices with regard to gender and social impact considerations throughout the geothermal project cycle?

ACTIONS: DESIGN AND IMPLEMENTATION

Once gaps, key stakeholder risks, and additional development opportunities for men and women have been identified, project teams have an opportunity to address them. The earlier in the project cycle that these actions are discussed, planned, and budgeted for, the greater their chances of being implemented and monitored. The subsections below provide practical suggestions on their implementation during the geothermal development cycle.[5]

Worker Health and Safety

Women's and men's health and safety in the workplace are a concern throughout the project cycle and should be addressed early on given different exposures to physical and psychological risks. The workplace is a key setting where gender issues and organizational structures may influence occupational health and safety practices. Most geothermal development sites are in remote locations that

require staff to live on-site for weeks at a time, making it necessary to have specific provisions for women working in the field. These should include separate toilets and living quarters and measures for personal safety and security, such as guards on premises and while travelling. Also, job task modifications should be available for women employees who are pregnant or nursing mothers. In addition, the enactment of dominant norms of masculinity in high-risk occupations can be particularly problematic, as it exposes men to severe risks for injuries and fatalities. Mitigation measures should be put in place that address such normative expectations and risks between men and women (ILO 2013; Stergiou-Kita et al. 2015).

Project management must create awareness and acceptance of women working at geothermal sites and enforce consequences for those who do not comply with its policies. As more women enter the geothermal field and are promoted, it is necessary to ensure that lines of reporting are clear and enforced. In community consultations near geothermal plants, it is important to clearly communicate that women will be working on-site as, for example, project technicians and managers.

Practical measures that management can take to signal intolerance for harassment and gender-based violence (GBV) and enhance gender equality include the following:

- Amend existing human resource policies to include specific clauses, complaint/investigative procedures, and protocols for grievance redress.
- Create a stand-alone policy promoting a positive vision for gender equality within the institution, with frequent posting/reference to this policy.
- Require workers to sign codes of conduct vowing not to engage in dangerous, unethical, illegal, or abusive behavior and to intercede and report such behavior if they witness it.
- Provide sensitization training on these matters on a regular basis, especially during onboarding.
- Follow through on commitments made and track incidents and outcomes systematically.

Inclusive Procurement Practices

At present, the geothermal sector has no sex-disaggregated tracking of procurement bidders/awardees, and few mechanisms are in place to help women compete.[6, 7] In preparing for surface exploration, exploratory drilling, testing of wells, and commissioning, the following preliminary actions, adjusted to fit the project and country contexts, may be considered as stand-alone interventions or in conjunction with quotas:

- Support bid readiness for majority women-owned firms and small businesses. This can entail both general business development services, such as implementing accounting and invoicing systems, and workshops on the mechanics of finding, scoping, costing, and responding to tenders. Assistance in connecting with financial institutions capable of providing needed financial guarantees could also be useful.
- Help businesses identify new product and service opportunities created by geothermal projects and assist them in being able to respond to those needs. Potential suppliers may be actively reached to attend workshop sessions and receive assistance through women's business associations and word-of-mouth through informal networks.
- Leverage existing frameworks to screen and certify firms as being 51 percent owned or operated by women (or whatever other criteria are decided on). Check whether any other in-country registry maintains a list of such firms. One should also note that striking the right balance between reducing

administrative burdens and certifying that firms are truly qualified according to the selected criteria can pose challenges.[8]

- Include prominently placed language on tender documents stating that majority women-owned firms are encouraged to apply. This is a zero-cost activity that could also reference other marginalized groups, such as people with disabilities and ethnic minorities.[9]
- Offer flexibility in how bids are submitted and how solicitation materials are distributed. Similarly, choose locations and times for bid-related meetings to reduce bidders' travel cost and accommodate their schedules.
- Encourage participation of smaller firms by breaking larger solicitations into smaller ones. For example, separating out the purchase of coveralls from a larger bundled contract including tools, hard hats, and shoes could offer opportunities for local tailors and seamstresses. The provision of snacks or meal components could be separated from a larger catering contract and handled by sole proprietors. In some cases, large-award holders can be encouraged to form consortia with designated small or women-owned businesses and source a percentage of their purchases from such firms.[10]
- Reduce barriers to small-firm participation where feasible. In some cases, the bureaucratic requirements for small contracts differ little from those for large ones. It is worth examining whether such requirements as licenses, certifications, audited accounts, financial guarantees, and warrants are critical at the scale they are being deployed or pose unnecessary barriers to businesses owned or operated by women.[11]
- Alter regulatory frameworks to allow for flexibility on nonprice factors that may benefit smaller or local women-led firms. Such firms may offer nonprice advantages over larger firms in terms of quality, customization, service, short-order delivery, and/or reliability. The World Bank's new procurement framework includes a "value-for-money" principle that allows for selecting higher-priced bids when they offer a greater value proposition.[12]

Preferential scoring systems may award more points to bidding firms that demonstrate a greater degree of focus on gender equality. However, such scoring systems must be well constructed in their logic, not overly confusing to bidders, and come with dedicated resources for ongoing verification and compliance (Eberhard, Kolker, and Leigland 2014) (box 3.3).

BOX 3.3: PROVISIONS FOR PREFERENTIAL LOCAL PROCUREMENT

The Sarulla Geothermal Power Project in Indonesia, financed by the Asian Development Bank (ADB), has key performance indicators that give local businesses preference in the procurement of goods and services. This decision has improved women's ability to access economic opportunities directly linked to the project. Requirements are in place for women to comprise at least 20 percent of technical or laboratory and administrative positions during operations by 2020 and at least 30 percent of unskilled labor for services provided during construction (2013–17). Under its procurement guidelines, Kenya Electricity Generating Company (KenGen) regularly issues tenders for which 30 percent of the budget is reserved for firms owned by disadvantaged groups, including women.

Sources: ADB 2014; KenGen 2016.
Note: The World Bank's procurement guidelines are restricted in preferential bidding; to apply the Sustainable Procurement strategy, project borrowers must obtain prior approval. http://www.worldbank.org/en/projects-operations/products-and-services/brief/procurement-new-framework

Training for Workforce Diversification

Before surface exploration and exploratory drilling begin, project teams can plan for reducing the gaps between men and women in on-site technical positions. This can be achieved by creating scholarships, apprenticeships, and mentoring programs for women at all skills levels. The Geothermal Training Programme of the United Nations University (UNU-GTP) illustrates how adopting a strategy to increase the number of women trained in geothermal-related subjects can increase women's participation in the sector (box 3.4). Training more women in STEM fields can help them gain geothermal sector employment and fill such positions as geophysicists, geologists, engineers, environmental scientists, power plant operators and technicians, and computer programmers. However, helping women remain in those positions entails a constellation of other factors. Among them are the need for childcare and adjusting work and travel schedules when necessary; providing a workplace free from harassment, discrimination, and violence; and ensuring viable pathways for career mobility and eliminating the pay gap.

BOX 3.4: LESSONS FROM THE UNITED NATIONS UNIVERSITY'S GEOTHERMAL TRAINING PROGRAM

Scholarships funded by the Icelandic government, as part of the Geothermal Training Programme of the United Nations University (UNU-GTP), have been vital to increasing women's participation in geothermal development. Between 1979 and 2016, women's enrollment in the UNU-GTP increased from 20 percent to 30–35 percent (NIRAS Indevelop 2017). Women fellows are from developing countries where gender inequalities can be high. The training program not only builds participants' knowledge base; it also builds their confidence—two benefits they carry back home.

Photo B3.4.1: Students in the Geothermal Training Programme of the United Nations University

The program recognizes the importance of complementing classroom training with company-wide mentoring for junior professionals with senior staff, particularly in the field, since geothermal exploration, development, and production involve on-site work (photo B3.4.1). Without on-the-job training, it will not be possible to advance women's careers and retain core staff.

The corporate question of who is eligible for and receives training must be addressed in a systematic way that takes the gaps between men and women into account. Traditionally one-on-one training or mentoring relationships at the power plant or management level could be more formally structured as mixed-gender groups of at least four individuals. Women who already have technical training are likely to require advanced leadership training, greater exposure to large companies, and access to a vibrant (perhaps international) network of similarly minded professionals.

In addition to training, employment targets can increase women's opportunities in the geothermal workforce. In Kenya, for example, design of the Menengai geothermal project, operated by the government-owned Geothermal Development Company (GDC), had a 30 percent target for women to

BOX 3.5: WOMEN AS GEOTHERMAL DRILLING ENGINEERS

Phyllis Gathoni Mathenge, the first female geothermal drilling engineer at Kenya's Geothermal Development Company (GDC), was part of the team that worked on MW1A, one of the world's most powerful geothermal wells, with a capacity of about 30 MW. Mathenge says, "There is nothing more satisfying than drilling a well to completion within the planned duration and seeing it productive . . . I can't express the excitement and satisfaction when you see steam gush out of the deep well."

Note: Bungane 2017.

fill a variety of staff functions in drilling, geoscience, and business. This strategy was key to supporting a focus on women's employment during project implementation, resulting in the company's first-ever female drilling engineer (box 3.5).[13]

Ancillary Infrastructure

Secondary investments in infrastructure, if thoughtfully designed, can benefit men, women, and children in the project-affected communities. During early consultations, project proponents should seek community input from men and women equally on the preferred placement of roads, transmission lines, freshwater sources, and fences since there is usually some degree of flexibility in siting these investments. Feedback from communities may reveal that a slightly alternative siting of plant facilities can avoid negative impacts and allow them to enjoy, and possibly benefit from, the infrastructure while exerting little or no added pressure on project capital expenditures. For example, the marginal cost of extending a road or installing a water source or a low-voltage distribution network may be significantly less than the cost of stand-alone projects (Mwangi-Gachau 2011).

Deciding how to prioritize the investments and design, build, and maintain the infrastructure is best handled through consultations and planning that includes women. Sector-related issues for consideration during participatory planning meetings include the following:[14]

- **Transport**
  - Would roads, bridges, ferries, stairs, or trails enhance connectivity between key areas of interest—residences, schools, clinics, markets, agriculture and agroforestry lands, water sources, nearby population centers—and employment opportunities at the geothermal site?
  - Which areas are a priority to connect and for whom?
  - What new productive or educational opportunities could open up as a result?
  - What quality of infrastructure (paved versus dirt roads, small versus large ferry) is desired and by whom?
  - What are the unintended consequences of increased access, such as having many new entrants into the area, decreased safety, or illicit trade flows?
  - How can both men and women participate in the design, construction, and maintenance of the new transportation infrastructure?
  - Who will own and govern the asset? What measures are in place to prevent one individual or group from appropriating use of the asset?

- **Slope Stabilization and Erosion Control**
  - — Are there slopes that, if stabilized, could reasonably be put to productive use at the community level?
  - — Could landscapes or surface-water quality be improved through erosion control techniques employed at the project site or the surrounding area?
- **Water Supply**
  - — Can water supply facilities, installed for drilling activities, provide water to local communities after drilling has been completed?
  - — How would various configurations for drinking water supply affect the time burden of men, women, and children? What about the disease burden?
  - — How would irrigation schemes affect the productivity, incomes, and relative power dynamics of male and female farmers? What about the nutritional status of community members?
- **Electricity**
  - — Are there nonelectrified homes, institutions, businesses, streets, markets, or other areas where the project could feasibly provide power-sector infrastructure, such as substations, poles, wires, transformers, and meters?
  - — How do men and women compare the relative value of such investments?
  - — Are there cooperative or public-private arrangements to be explored for the ownership and maintenance of electricity distribution assets? What about service provision?
- **Information and Communications Technology (ICT)**
  - — As geothermal companies require reliable and continuous information access and mobile connectivity, could excess bandwidth be sold to people in the surrounding communities?
  - — If so, what are the likely impacts of improved communication for men and women? Could ICT help create a more informed, gender-equitable society?[15] Could it facilitate access to educational opportunities, medical information, remote diagnoses, epidemiological reporting, early warning systems, agricultural extension, and market information?
- **Tourism**
  - — Do local men and women see potential for the construction of spas and bathing pools, accompanied by changing, showering, and hospitality facilities? Would the anticipated balneological benefits and income-generating opportunities accrue equitably to men and women?
  - — Do local men and women view geothermal sightseeing as a potential economic opportunity?
- **Community Development**
  - — Would capital investments in building schools or health clinics, community centers, nature preserves, or market areas serve to increase human endowments and social capital, as well as reinforce the community's resilience to external shocks?
  - — What types of infrastructure would be particularly useful in the face of natural disasters?
  - — How do men and women rate various risks, conceive of resiliency, and prioritize development objectives?

Direct and Productive Use Applications

Planning for direct and productive use applications should occur before or during the feasibility stage since it may be difficult to add such components after design approval. Early on, project developers should engage the services of a productive-use expert to determine potential applications in nearby communities, such as electricity, process heat, liquid water, and steam, along with the technical and economic feasibility for secondary businesses, such as greenhouses, irrigation, food processing, and industrial applications (Appendix A).

It is important to ask the right questions beforehand to ensure that men and women will benefit equitably. These might include the following: Who owns (or formerly owned) the land where the proposed enterprise is situated? Will the geothermal developer build, own, and operate it and hire employees locally or will it execute a lease with a local entrepreneur? Will the enterprise be cooperatively owned and jointly managed by the developer and the community? Does the enterprise include a women's empowerment program and if so, is there a risk of backlash?

Project developers may consider starting small with proposed actions around direct and productive use application, as proof of concept, but leave room for expansion. Adopting a phased, incremental approach can increase the comfort level of stakeholders, including the project developer, financier, and community members. If the concept works, it should be easier to leverage funding for expanding the interventions. A phased approach can reduce risk and improve returns, even if the overall cost envelope may be slightly higher.

Project developers may also explore separating the direct- or productive-use portion of the geothermal project to improve its chances of success. If the main sponsor of the geothermal development project is unable or unwilling to underwrite the side project's full cost, then project teams may consider a special purpose vehicle for its development, with financing sourced through a combination of grants and philanthropic investments seeking outcomes other than commercial returns. In cases where the pure financial internal rate of return (FIRR) is unattractive to investors, teams should attempt to quantify the economic internal rate of return (EIRR), to the extent possible, to capture broader social benefits.

MONITORING AND EVALUATION

It is recommended that projects include specific M&E indicators in the results framework that measure progress toward closing gaps between men and women. The proposed indicators should be part of the project's results chain and linked to the project development objective (PDO), intermediate outputs, and project outcomes. The results framework can include quantitative indicators based on sex-disaggregated statistical data from surveys or human resource records, such as educational attainment or percent of women employed. Qualitative indicators may capture people's experiences, perceptions, attitudes, or feelings, such as assessment of feedback on the community-level impact of construction or the community's perception of the ancillary infrastructure benefit.

Indicators may be at the process, output, or outcome level, as appropriate, and baseline data should be collected in order to set the targets for the indicator. Where baseline data are not available, the project document should provide an alternative way to track progress. For example, starting from a baseline of "not available" or "zero," the indicator could measure incremental changes/values throughout project implementation to demonstrate progress. As good practice, all person-level indicators, such as training of staff or community members consulted, should be sex-disaggregated so that potential differential outcomes can be tracked (table 3.3).

TABLE 3.3: POSSIBLE ISSUES AND INDICATORS TO TRACK PROGRESS, BY SELECTED ACTION

POSSIBLE GENDER ISSUE	INDICATOR EXAMPLES	MONITORING CONSIDERATIONS
Worker Health and Safety		
Lack of protective gear suitable for female bodies and responsive to local customs for modesty	Sex-appropriate occupational clothing available (Y/N)	Report biannually or annually (by health and safety officers) on availability of sex-appropriate occupational clothing available at site. Investigate use of the available clothing and obtain user feedback.
Perpetuation of harassment and gender-based violence (GBV) at project site by workers	Percentage of staff at project site who have completed training on GBV codes of conduct (baseline percentage and target)	Report biannually or annually on percentage of staff at project site who have undergone training on GBV codes of conduct. Training attendance should be monitored through sign-in sheets and tracking of number of workers attending against the number of workers on site at a given time period.
Procurement Practices		
Lack of awareness among majority women-owned firms about geothermal sector opportunities	Number of information sessions held for women business associations and firms that are majority women-owned or -operated (number baseline and target)	Set a target for the number of information sessions to cover and the content (for example, sector opportunities, risks, and bid application process) for firms that are owned or operated by women. Report on number of information sessions held biannually or monthly, as appropriate, during relevant project cycle stage.
Low expenditure under project on firms or small businesses that are majority women-owned or -operated due to limited consideration given to nonprice factors	Percentage expenditure on firms that are owned or operated by women (baseline percentage and target)	Set a percentage target as part of nonprice factors in the bidding evaluation to increase expenditure on firms that are women-owned or -operated. Embed this target with other factors as part of the overall evaluation process.
Workforce Diversification		
Gaps between men and women in opportunities for training and/or apprenticeships	Number of trainings completed, of which completed by women (baseline percentage and target)	Assess the training needs between men and women and any gaps between the opportunities given to either. Track progress toward improved parity in the allocation of training opportunities between men and women (for example, in an institution or company). Include questions on sex in application process, tap diverse networks to advertise opportunities, and possibly earmark percentage of training opportunities for women.

(continued)

TABLE 3.3: CONTINUED

POSSIBLE GENDER ISSUE	INDICATOR EXAMPLES	MONITORING CONSIDERATIONS
Workforce Diversification		
Gender gap in women's employment in the geothermal sector	Percentage of women employed (percentage baseline and target)	Assess the gap between men and women in employment, ideally by grade, role, and department. Track progress through staff survey or other human resource records to monitor progress toward closing the gap. Consider setting a target and annual reporting against that target. Interventions focused on enhancing women's employment could include looking at such issues as workplace culture, parental leave, and GBV. Ensuring toilets and dormitories have been renovated to accommodate men and women is also important.
Increase ratio of women to men in senior management (in number of years)	Ratio of women to men in senior management (baseline ratio and target)	Assess the gender imbalance of men and women in employment, ideally by grade, role, and department. Track progress toward closing the gender gap in leadership. Interventions focused on enhancing women's leadership could include leadership training, reform of human resources policies, and senior leadership commitment through high-level policy or annual certification.
Ancillary Infrastructure		
Gap between male- and female-headed households' access to water or electricity near the geothermal site	Percentage of female-headed households connected to electricity (percentage baseline and target)	Establish baseline between male- and female-headed households' access to energy and water provision (household connections), if possible. Assess possible income differences between households and likely barriers to uptake of electricity or water connection and other affordability constraints. Set target for male- and female-headed household connections, based on percentage representative of the community near the geothermal site.

TABLE 3.3: CONTINUED

POSSIBLE GENDER ISSUE	INDICATOR EXAMPLES	MONITORING CONSIDERATIONS
Direct- and Productive-Use Applications		
Gap in livelihood opportunities between men and women linked to geothermal direct use	Percentage enhanced livelihood/ productivity for women (percentage target)	Support country baseline assessments of livelihood activities in a site defining the target group and obtaining data. Assess drivers of productivity gaps and possible relevant interventions to enhance women's livelihoods through geothermal direct use. Design and implement comprehensive approaches that enhance productive uses of energy in agricultural, industrial, and service sectors, such as enhancing knowledge and skills of small and micro businesses, households, and farmers in how to use newfound electrical and motive power for a profitable enterprise. Additional enabling interventions might include enhancing technical and financial management capacity of women's enterprises, strengthening access to markets, creating linkages and access to financial products and services, enhancing extension or business development services, and addressing discriminatory land laws. Post intervention, monitor outcome of interventions and increase in livelihoods (decide if monetary or another metric).
Gap in job opportunities between men and women linked to geothermal direct use	Women's employment as share of jobs created from direct and productive use application at project site (percentage target)	Assess opportunities for women's employment associated with direct- and productive-use application. Allocate a possible target for the share of jobs created that could be occupied by women near the project site. Monitor progress toward employment target through monitoring human resource records of various institutions or contract allocation, and report against progress made biannually or annually.

Note: The examples in this table are illustrative and do not guarantee that project teams will obtain the Gender Tag. It is therefore advised that further consultations be held with relevant experts.

Given the need for thorough reporting against agreed indicators and close monitoring of progress toward associated targets, it is advised that the project set aside an appropriate budget for M&E activities. Governments and project developers may need to be engaged in capacity building and training activities to ensure they understand the M&E commitments made, as well as how to accurately collect data and report on it. The associated indicators should also be included, or even expanded on, in the Project Implementation Manual or Project Operational Manual,[16] which outlines details related to project and program implementation.

USEFUL RESOURCES

Recently developed toolkits, case studies, and other resources can provide project teams, governments, and geothermal developers additional useful guidance on how to prepare projects for more gender-equitable, sustainable outcomes (table 3.4).

TABLE 3.4: USEFUL RESOURCES FOR DEVELOPING PROJECTS WITH A FOCUS ON GENDER GAPS

RESOURCE TYPE	RELEVANCE TO GEOTHERMAL DEVELOPMENT
Guidance and Toolkits	
Getting to Gender Equality in Energy Infrastructure: Lessons from Electricity Generation, Transmission, and Distribution Projects, World Bank http://documents.worldbank.org/curated/en/639571516604624407/pdf/122887-REVISED-GenderEquality-Report-WEB-2-2-18.pdf	Considers the categories of employment, land, risk prevention and positive social impacts, and role of the utilities. Nepal Kali Gandaki "A" hydropower case study (Appendix E) offers a useful template for conducting gender analysis of a power generation project (ESMAP 2018).
Guide to Community Engagement for Power Projects in Kenya, United States Agency for International Development/Power Africa https://www.usaid.gov/sites/default/files/documents/1860/FINAL_Guide_to_Community_Engagement_-_Jan_17_2018_508-compressed.pdf	Takes a stepwise look at how to consult and build fruitful relationships with communities throughout the project development process, including guidance on integrating gender equality. Provides insights for practitioners working in Kenya, including details on current policies and practices (Power Africa 2018).
Good Practice Note on Addressing GBV in Investment Project Financing Involving Major Civil Works, World Bank http://pubdocs.worldbank.org/en/399881538336159607/Good-Practice-Note-Addressing-Gender-Based-Violencev2.pdf	Sets out good practice for task teams on identifying, assessing, and managing the risks of gender-based violence (GBV) in the context of Investment Project Financing (IPF) in any World Bank Global Practice that involves major civil works, defined here as those large enough to be carried out by a contractor; that is, not small-scale projects, such as community-driven development investments, which often involve self-construction by beneficiary communities. Does not focus on preventing GBV through specific design-related infrastructure interventions, such as well-lit public transit spaces or construction of schools with lockable toilets that are physically located in opposite areas for girls and boys (World Bank 2018b).

TABLE 3.4: CONTINUED

RESOURCE TYPE	RELEVANCE TO GEOTHERMAL DEVELOPMENT
Building a Safer World: Toolkit for Integrating GBV Prevention and Response into USAID Energy and Infrastructure Projects, United States Agency for International Development https://pdf.usaid.gov/pdf_docs/PBAAD997.pdf	Outlines approaches for addressing (GBV) (i) in the workplace, (ii) between workers and local communities, and (iii) within communities as a result of new infrastructure. Particularly relevant during drilling and construction phases and as projects try to hire more women to work on-site or when there is an influx of male workers (USAID 2015).
Checklist for Mainstreaming Gender in the Infrastructure Sector, African Development Bank https://www.afdb.org/fileadmin/uploads/afdb/Documents/Policy-Documents/Checklist%20for%20Gender%20Maintstreaming%20in%20the%20Infrastructure%20Sector.pdf	Provides a concise checklist from a project manager's perspective to ensure necessary procedures supporting gender inclusion are taking place (AfDB Group 2009).
Gender Toolkit: Energy, Going Beyond the Meter, Asian Development Bank https://www.adb.org/sites/default/files/institutional-document/33650/files/gender-toolkit-energy.pdf	Includes ideas for adding gender-inclusive components to power generation projects, with examples (ADB 2012).
Gender and Renewable Energy: Wind, Solar, Geothermal, and Hydroelectric Energy, Inter-American Development Bank http://idbdocs.iadb.org/wsdocs/getdocument.aspx?docnum=39647922	Offers concrete recommendations for action on the topics of consultation, employment, land and resettlement, health, safety, and rural energy (IDB 2014).
Integrating Gender Considerations into Energy Operations, World Bank https://openknowledge.worldbank.org/handle/10986/17479?locale-attribute=en	Provides project teams basic tools for integrating gender considerations into energy-sector activities with country examples and a focus on M&E (ESMAP 2013).
Online Resources	
Violence Against Women and Girls Resource Guide http://www.vawgresourceguide.org.	Partnership of the World Bank, International Center for Research on Women, Global Women's Institute, and Inter-American Development Bank. Gives examples on how to prevent and respond to GBV throughout project design and implementation.
Case Studies	
LaGeo, El Salvador https://www.usaid.gov/sites/default/files/documents/1865/IUCN-USAID_LaGeo_Gender-Responsive_Geothermal_Generation_0.pdf	Highlights various ways in which a geothermal energy utility in El Salvador developed strategies throughout its corporate mission and operations to adhere to national laws on gender equality and national development goals, resulting in environmental, social, and women's empowerment outcomes, as well as positive impacts on business outcomes (González et al. 2019).

(continued)

TABLE 3.4: CONTINUED

RESOURCE TYPE	RELEVANCE TO GEOTHERMAL DEVELOPMENT
Reykjavík Energy, Iceland https://blog.branding.energy/closing-the-energy-gender-gap/	Describes how a utility with geothermal assets and operations exploited change accompanying a crisis to achieve gender balance in management and eliminate pay gaps (CHARGE Energy Branding 2017).
Muara Laboh Power Project, Indonesia https://www.adb.org/news/videos/meet-young-woman-engineer-indonesia-geothermal-power-project	Provides profile of a female environmental engineer and role model recruited from a local community (ADB 2018).
Menengai Power Project, Kenya https://www.youtube.com/watch?v=6pKF6NQGFj8&feature=youtube http://theargeo.org/presentations/directuse/Direct%20Use%20of%20Geothermal%20Energy%20-Menengai.pdf https://irena.org/-/media/Files/IRENA/Agency/Events/2018/Apr/IGC2018/GGA-food-2a-GDC.PDF?la=en&hash=3F5BFBFA00BB11DA934CCA69216296B043C3E8F4	Summarizes direct and productive use applications being piloted in Kenya (GDC 2018; Nyambura 2016; Ole Nchoe 2018).
Networks	
Women in Geothermal (WING) https://wing.wildapricot.org/	International professional association that supports increased gender balance in the geothermal sector.
Association for Women Geoscientists (AWG) https://www.awg.org/	Professional organization that promotes the development of its members, provides geoscience outreach to girls, and encourages women to become geoscientists.
Society of Women Engineers (SWE) http://societyofwomenengineers.swe.org/	Professional organization to help women achieve their full potential in careers as engineers and leaders, expand the image of the engineering profession as a positive force in improving the quality of life, and demonstrate the value of diversity. Awards multiple scholarships each year to women in undergraduate and graduate STEM degree programs across the world.

NOTES

1 These aspects are in line with the Gender Tag, adopted in FY17.

2 The entry points suggested in this section should be viewed as starting points for gender-equitable activities that persist throughout the project cycle.

3 The insights provided draw from, and are often applicable to, infrastructure projects generally, given the limited knowledge base focused on the geothermal sector.

4 In 2013, EEPCo was split up into two companies: Ethiopian Electric Utility and Ethiopian Electric Power.

5 For efforts that primarily concern regulatory support and institutional strengthening (that is, without tangible assets deployed to geothermal resource sites), many of the same activities could be relevant at the level of the line ministry, regulator, or publicly-owned utility.

6 One should note that World Bank procurement guidelines restrict preferential bidding. To apply the Sustainable Procurement strategy provided in its regulations, the project borrower must obtain prior approval, with justifications of purpose, target groups, and intended outcomes.

7 More work is needed to collect and track data on response, success, and performance rates for geothermal tenders by size, type, and composition of firm by majority male versus female ownership. There is also a need to document inclusive, cost-effective procurement techniques in the geothermal sector.

8 See note 6.

9 Ibid.

10 Ibid.

11 The post-2016 World Bank procurement framework recognizes this issue and provides flexibility for making procurement processes “fit for purpose” and thus more finely tailored to the size and risk of the project (http://www.worldbank.org/en/projects-operations/products-and-services/brief/procurement-new-framework).

12 See note 6.

13 Also helpful are mixed-gender hiring committees and job postings that specifically encourage women to apply.

14 Detailed information is available at http://siteresources.worldbank.org/INTGENDER/Resources/336003-1250632365376/6396629-1265214711102/nistha_sinha.pdf

15 Some evidence suggests that the arrival of television has been accompanied by decreased fertility and diffusion of gender norms more prevalent in urban areas (Westoff and Koffman 2011).

16 These documents usually include details of the project components and roles and responsibilities of the implementing agencies, including implementation arrangements for coordination between sector agencies and local governments and procedures for financial management and procurement. They also provide details of reporting processes and details regarding implementation and monitoring of project- and activity-level plans, including those detailed in the ESF.

REFERENCES

ADB (Asian Development Bank). 2012. *Gender Toolkit: Energy, Going Beyond the Meter*. Mandaluyong City, Philippines: ADB. https://ppp.worldbank.org/public-private-partnership/sites/ppp.worldbank.org/files/documents/gender-toolkit-energy.pdf

———. 2014. "ADB Facility Agreement Relating to the Sarulla Geothermal Power Project." https://www.lawinsider.com/contracts/RowCdGJVuDuY2mU159zQX/ormat-technologies-inc/1296445/2014-05-09

———. 2018. "Meet a Young Woman Engineer in an Indonesia Geothermal Power Project" (video). March 8. https://www.adb.org/news/videos/meet-young-woman-engineer-indonesia-geothermal-power-project

AfDB Group (African Development Bank Group). 2009. *Checklist for Mainstreaming Gender in the Infrastructure Sector*. Abidjan: AfDB. https://www.afdb.org/fileadmin/uploads/afdb/Documents/Policy-Documents/Checklist%20for%20Gender%20Maintstreaming%20in%20the%20Infrastructure%20Sector.pdf

Blair, A. 2016. "Māori Participation in New Zealand Geothermal Energy Development." Presentation at GNS-JOGMEC Workshop, June 2. http://geothermal.jogmec.go.jp/report/file/session_160602_12.pdf

Bungane, B. 2017. "Unearthing a Woman of Substance in the Geothermal Sector." *ESI Africa* 1 (1): 64–66.

CHARGE Energy Branding. 2017. "Closing the Energy Gender Gap" (blog). April 3. https://blog.branding.energy/closing-the-energy-gender-gap/

Eberhard, A., J. Kolker, and J. Leigland. 2014. "South Africa's Renewable Energy IPP: Procurement Program—Success Factors and Lessons." Washington, DC: World Bank Group.

ESMAP (Energy Sector Management Assistance Program). 2013. *Integrating Gender Considerations into Energy Operations*. ESMAP Knowledge Series, 014/13. Washington, DC: World Bank. https://openknowledge.worldbank.org/bitstream/handle/10986/17479/765710ESM0P1230to0Energy0Operations.pdf?sequence=1&isAllowed=y

———. 2018. *Getting to Gender Equality in Energy Infrastructure: Lessons from Electricity Generation, Transmission, and Distribution Projects*. Washington, DC: World Bank. http://documents.worldbank.org/curated/en/639571516604624407/pdf/122887-REVISED-GenderEquality-Report-WEB-2-2-18.pdf

GDC (Geothermal Development Company). 2018. "Beyond Electricity" (video). April 1. https://www.youtube.com/watch?v=6pKF6NQGFj8&feature=youtube. Accessed September 18.

González, A., J. Siles, A. Rojas, J. Wen, and M. Prebble. 2019. *Advancing Gender in the Environment: Gender-Responsive Geothermal Generation—Powering Energy and Social Benefits in El Salvador*. Washington, DC: IUCN Global Gender Office and USAID.

IDB (Inter-American Development Bank). 2014. *Gender and Renewable Energy: Wind, Solar, Geothermal, and Hydroelectric Energy*. Washington, DC: IDB. http://idbdocs.iadb.org/wsdocs/getdocument.aspx?docnum=39647922

IFC (International Finance Corporation). 2007. *Stakeholder Engagement: A Good Practice Handbook for Companies Doing Business in Emerging Markets*. Washington, DC: IFC.

ILO (International Labour Organization). 2013. *10 Keys for Gender Sensitive OSH Practice—Guidelines for Gender Mainstreaming in Occupational Safety and Health*. Working Paper. Geneva: ILO. https://www.ilo.org/wcmsp5/groups/public/---ed_protect/---protrav/---safework/documents/publication/wcms_324653.pdf

KenGen (Kenya Electricity Generating Company). 2016. “KenGen Procurement Guidelines for Youth, Women and People with Disability.” http://www.kengen.co.ke/sites/default/files/KENGEN%20PROCUREMENT%20GUIDELINE%20FOR%20SPECIAL%20GROUPS.PDF

Koissaba, B. 2017. “Geothermal Energy and Indigenous Communities: The Olkaria Projects in Kenya.” https://eu.boell.org/sites/default/files/geothermal-energy-and-indigenous-communities-olkariaproject-kenya.pdf

Mwangi-Gachau, E. 2011. “Social Aspects of Geothermal Development: A Case of Olkaria Geothermal Project in Kenya.” Paper presented at Short Course VI on Exploration of Geothermal Resources, organized by UNU-GTP, GDC, and KenGen, Lake Bogoria and Lake Naivasha, Kenya, October 27–November 18. https://orkustofnun.is/gogn/unu-gtp-sc/UNU-GTP-SC-13-0806.pdf

NIRAS Indevelop. 2017. *Evaluation of the UNU Programmes in Iceland: Final Report*. Stockholm: NIRAS Indevelop.

Nyambura, E. 2016. “Direct Use of Geothermal Energy: Menengai Direct Use Pilot Projects in Kenya.” Presentation by Geothermal Development Company, Addis Ababa, November 3.

Ole Nchoe, J. 2018. “Direct Use of Geothermal Energy for Food Security: Towards Achieving Kenya’s BIG4 Agenda.” Presentation, Geothermal Direct Utilization and Food Security, Reykjavík, April 24. https://irena.org/-/media/Files/IRENA/Agency/Events/2018/Apr/IGC2018/GGA-food-2a-GDC.PDF?la=en&hash=3F5BFBFA00BB11DA934CCA69216296B043C3E8F4

Power Africa. 2018. *Guide to Community Engagement for Power Projects in Kenya*. Washington, DC: United States Agency for International Development. http://www.usaid.gov/powerafrica/kenya. https://www.usaid.gov/sites/default/files/documents/1860/FINAL_Guide_to_Community_Engagement_-_Jan_17_2018_508-compressed.pdf

Stergiou-Kita, M., E. Mansfield, R. Bezo, A. Colantonio, E. Garritano, M. Lafrance, J. Lewko, S. Mantis, J. Moody, N. Power, N. Theberge, E. Westwood, and K. Travers. 2015. “Danger Zone: Men, Masculinity and Occupational Health and Safety in High Risk Occupations.” *Safety Science* 80 (December): 213–20. https://doi.org/10.1016/j.ssci.2015.07.029

USAID (United States Agency for International Development). 2015. *Building a Safer World: Toolkit for Integrating GBV Prevention and Response into USAID Energy and Infrastructure Projects*. Washington, DC: USAID. https://www.usaid.gov/documents/1865/building-safer-world-toolkit-integrating-gbv-prevention-and-response

Westoff, C., and D. Koffman. 2011. “The Association of Television and Radio with Reproductive Behavior.” *Population and Development Review* 37 (4): 749–59.

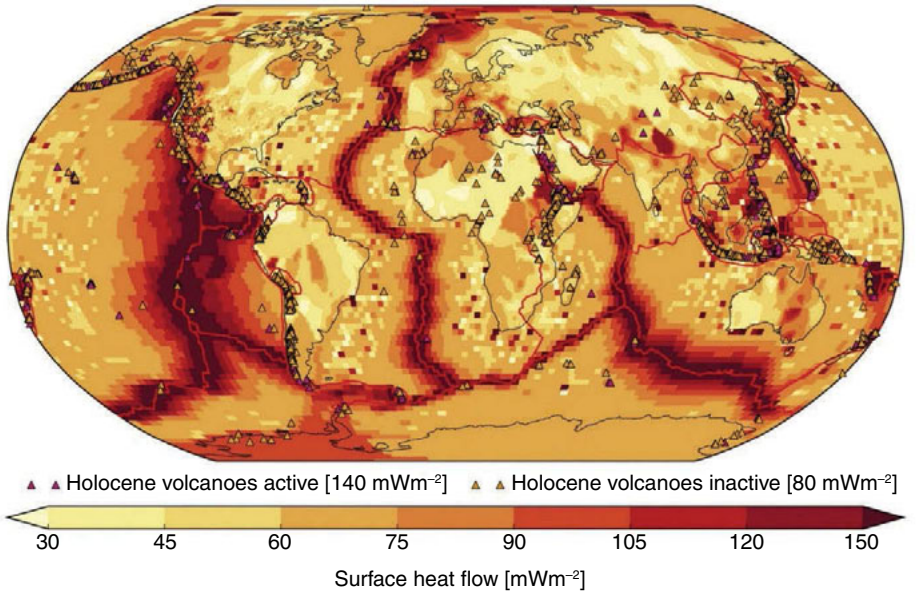
World Bank. 2018a. “First Progress Report on the Implementation of Management’s Action Plan in Response to the Inspection Panel Investigation Report (Report# INSP/97705-KE) on the Kenya Electricity Expansion Project (P103037).” World Bank, Washington, DC.

World Bank. 2018b. “Good Practice Note: Addressing Gender Based Violence in Investment Project Financing Involving Major Civil Works.” September 28. World Bank, Washington, DC. http://pubdocs.worldbank.org/en/399881538336159607/Good-Practice-Note-Addressing-Gender-Based-Violencev2.pdf

APPENDIX A. GEOTHERMAL RESOURCE UTILIZATION

Geothermal energy is heat from the Earth's core—where temperatures reach approximately 6,000°C—that flows outward to the surface. Due to variations in the thickness and composition of the Earth's crust, geothermal energy is more accessible in some areas than others. To date, most geothermal power production has taken place near tectonic plate boundaries, where pockets of magma rise higher (e.g., near volcanoes) and where rocks have been fractured and are porous, allowing subsurface fluids to circulate and transfer the heat upward more effectively (figure A.1).

FIGURE A.1: DISTRIBUTION OF GLOBAL SURFACE HEAT FLOW, WITH PLATE BOUNDARIES AND VOLCANOES

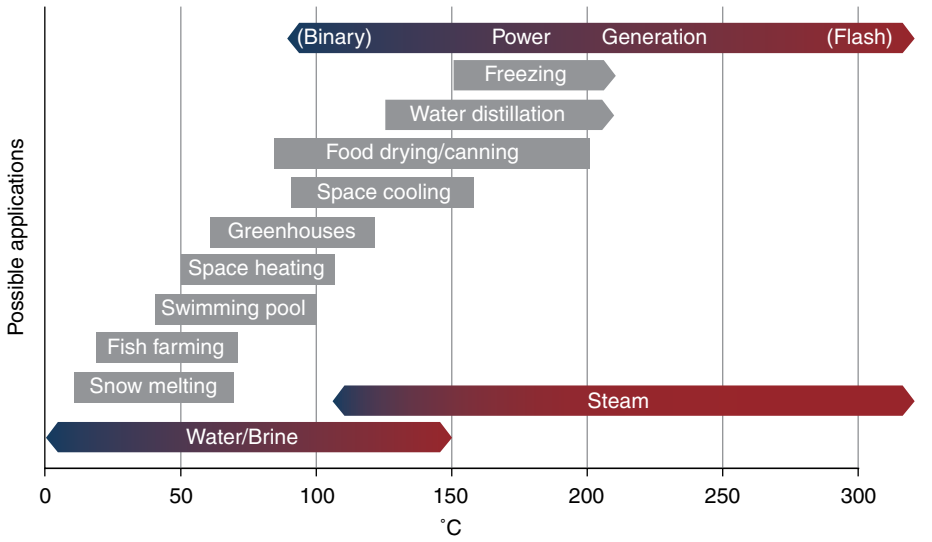


Source: Limberger et al. 2018.
Note: The zones of high heat flow (dark red) and volcanic activity (triangles) are the areas where high-temperature geothermal systems occur.

DIRECT AND CASCADED USES

The two most common direct uses of geothermal energy are space heating and spas/bathing pools. Hot geothermal fluids can be used directly, as in spas, or their energy can be transferred via heat exchangers to another medium, such as air, freshwater, soil, or an alternate fluid. Geothermal energy also has a range of possible cascaded uses: geothermal resources used in succession for different purposes, such as power generation followed by greenhouse heating. A Lindal diagram depicts the application temperatures of current and possible direct uses of geothermal fluids (figure A.2).

FIGURE A.2: MODIFIED LINDAL DIAGRAM SHOWING APPLICATIONS FOR GEOTHERMAL FLUIDS



Source: ESMAP 2012.

ELECTRICITY PRODUCTION

Most geothermal power plants use condensing technology. Geothermal steam is used to drive turbines and generators that power plants ranging in size from a few up to hundreds of megawatts. Binary technology, whereby heat from geothermal steam and liquid is used to boil a secondary working fluid, is also widely used and is generally suitable at lower resource temperatures (Fukuda, Ishiguro, and Saito 2008).

Twentieth-century technology made it possible to harness geothermal energy for electricity production. The first geothermal power plant was built over 100 years ago; the second followed 50 years later, and shortly thereafter the technology matured. Most of the growth of the geothermal power generation sector has, in the last decade, been limited to countries with an established geothermal industry, including Turkey, Indonesia, the United States, Kenya, and New Zealand (ThinkGeoEnergy 2019). As of July 2018, only 28 nations possessed geothermal power plants, far fewer than the 82 countries that utilize geothermal for direct-use applications (Bertani 2015; IGA Geothermal Power Database; Lund and Boyd 2015).

Geothermal energy projects are competitive and attractive to the private sector once early-stage risk is mitigated. The per-megawatt investment cost of a typical 50 MW greenfield geothermal project with a drilling depth of 2 km is in a range of US$2.8–5.5 million (ESMAP 2012). The resulting levelized cost of electricity is estimated at US$0.04–0.08 per kWh, which is the range observed for World Bank–funded projects. Private-sector participation, often in conjunction with governments and multilateral investment banks, is quite common. By 2012, the percentage of privately-owned installed capacity had reached about 63 percent, and it continues to increase (ESMAP 2012). The past 20 years has seen a compound annual growth rate of 3.12 percent for geothermal-generated electricity worldwide.[1]

NOTE

1 This calculation is based on data from Bertani (2015).

REFERENCES

Bertani, R. 2015. “Geothermal Power Generation in the World 2010–2014 Update Report.” In *World Geothermal Congress, 16–24 April 2015, Australia-New Zealand: Proceedings*. Bonn, Germany: International Geothermal Association.

ESMAP (Energy Sector Management Assistance Program). 2012. “Geothermal Handbook: Planning and Financing Power Generation.” Technical Report 002/12. Washington, DC: World Bank. https://www.esmap.org/sites/esmap.org/files/DocumentLibrary/FINAL_Geothermal%20Handbook_TR002-12_Reduced.pdf

Fukuda, H., J. Ishiguro, and S. Saito. 2008. “How Geothermal Power Plants Help to Reduce CO2 Emission.” *Mitsubishi Heavy Industries, Ltd. Technical Review* 45 (1): 63–65.

IGA (International Geothermal Association) Geothermal Power Database. https://www.geothermal-energy.org/explore/our-databases/geothermal-power-database/#electricity-generation-by-country

Limberger, J., T. Boxem, M. Pluymaekers, D. Bruhn, A. Manzella, P. Calcagno, F. Beekman, S. Cloetingh, and J.-D. van Wees. 2018. “Geothermal Energy in Deep Aquifers: A Global Assessment of the Resource Base for Direct Heat Utilization.” *Renewable and Sustainable Energy Reviews* 82 (1): 961–75.

Lund, J., and T. Boyd. 2015. “Direct Utilization of Geothermal Energy 2015 Worldwide Review.” In *Proceedings of World Geothermal Congress 2015*. Melbourne, Australia, April 19–25.

ThinkGeoEnergy. 2019. “Global Geothermal Power Generation Capacity Reaches 14,600 MW at Year End 2018.” Reykjavík: ThinkGeoEnergy. http://www.thinkgeoenergy.com/global-geothermal-power-generation-capacity-reaches-14600-mw-at-year-end-2018/

APPENDIX B. WORLD BANK EXPERIENCE IN INTEGRATING GENDER EQUALITY INTO GEOTHERMAL PROJECTS

CURRENT FRAMEWORK FOR WORLD BANK–FINANCED PROJECTS

The World Bank is committed to addressing gender equality and social inclusion in energy infrastructure development as part of its Gender Strategy and through the Gender Tag. Four pillars of the World Bank Group's broader 2016–23 Gender Strategy are relevant to the energy practice: (i) improve human endowments, such as education, health, and social protection; (ii) remove constraints for more and better jobs; (iii) remove barriers to ownership and control of productive assets; and (iv) enhance women's voice and agency and engaging men and boys.[1] Use of the Gender Tag prompts discussion aligned with these four pillars at the project design stage.[2] It identifies operations that are critical to closing key gaps between men and women and helps corporate reporting capture the good work that project teams are doing to address gender inequalities and achieve tangible outcomes.

The Gender Tag allows for tracking a focus on gaps across analysis, actions, and monitoring and evaluation (M&E) in projects and programs. If a project is tagged, it first identifies relevant gaps between men and women and boys and girls in the analysis, particularly as they relate to the World Bank's broader country engagement frameworks and analytical work, including the Systematic Country Diagnostic, Country Partnership Framework, Country Gender Assessment, Poverty and Social Impact Analysis (PSIA), and Country Gender Action Plan (GAP). Second, it addresses these gaps through specific, project-supported actions. Third, it links these actions to indicators in the results framework.[3]

Safeguards instruments are becoming more common as a way to promote a focus on consultations that engage both men and women and social assessments as a way to capture initial issues around gender equality. The World Bank operationalized the new Environmental and Social Sustainability Framework (ESF) in October 2018. The ESF establishes 10 Environmental and Social Standards (ESS) that the borrower and project will meet throughout the project life cycle to manage risks and improve development outcomes.[4]

GENDER ASSESSMENT OF GEOTHERMAL PORTFOLIO

The World Bank's geothermal portfolio was reviewed to assess efforts and experience in integrating gender into geothermal projects (table B.1). More than a dozen possible avenues for gender inclusion were identified, and project documents were searched and tallied for references (box B.1). A limited number of interviews with project teams were also conducted to update and complement the

TABLE B.1: WORLD BANK GEOTHERMAL PROJECT AND TECHNICAL ASSISTANCE PORTFOLIO, JULY 2017

COUNTRY	PROJECT NAME	AMOUNT (US$, MILLIONS)	PROJECT STAGE	KEY ACTIVITIES
Armenia	Geothermal Exploratory Drilling Project	10.7	Implementation	Exploratory drilling
Chile	Technical Assistance for Geothermal Development in Chile	3.5	Implementation	Policy, legal, and regulatory framework
Djibouti	Geothermal Power Generation Project	25.2	Implementation	Exploratory drilling
Dominica	Geothermal Risk Mitigation Project	45.5	Preparation	Power plant construction
Ethiopia	Geothermal Sector Development Project	219	Implementation	Exploratory and capacity drilling
Fiji	Development of Geothermal Power in Fiji	0.40[a]	Implementation	Review of exploration data; geophysical surface exploration
Indonesia	Geothermal Clean Energy Investment Project	575	Implementation	Capacity drilling and power plant construction
Indonesia	Geothermal Energy Upstream Development Project	104.25	Implementation	Exploratory drilling
Latin America and the Caribbean	Scaling Up Geothermal Power in Latin America and the Caribbean	0.51[a]	Implementation	Screening of geothermal fields across the region
Malawi	Energy Sector Support Project	84.7	Implementation	Small geothermal component in a larger project; country-wide reconnaissance and surface exploration at selected sites
Nicaragua	Geothermal Resource Risk Mitigation Project	47	Preparation[b]	Exploratory drilling
St. Lucia	Renewable Energy Sector Development Project	24.5	Preparation	Exploratory drilling
Tanzania	Capacity Building for the Tanzania Geothermal Development Company	0.30[a]	Implementation	Capacity building
Turkey	Geothermal Development Project	352	Implementation	Risk sharing for exploratory drilling; loan facility for capacity drilling and power plant construction
Uganda	Energy for Rural Transformation III	168	Implementation	Small geothermal component in a larger project; focus on capacity building
World	Gender and Geothermal Report and Pilot	0.20[a]	Implementation	Study on the linkages, risks, and opportunities between gender and geothermal

a. Advisory Services and Analytics (ASA) or own-managed Trust Funds (TFs).
b. This project has been dropped.

BOX B.1: QUESTIONS DEVELOPED FOR THE WORLD BANK'S GENDER AND GEOTHERMAL PORTFOLIO REVIEW

The geothermal portfolio review developed a set of 15 questions to review each of the documents created for World Bank–financed geothermal projects to determine the degree to which gender equality considerations had been accounted for.

1	Is there a reference to World Bank or other multilateral bank gender policy?
2	Is gender, as a cross-cutting topic, acknowledged, and is it important in setting the tone?
3	Does the document specifically mention gender statistics or include the statistics?
4	Is there a separate acknowledgment of women as stakeholders?
5	Is there acknowledgment of women's point of view and opinions from consultations?
6	Are there separate consultations for men and women?
7	Is there preferential employment and job training and separate on-site facilities (e.g., toilets)?
8	Are there women-specific health and safety provisions, including personal protective equipment (PPE)?
9	Is there support for women's business development?
10	Is there awareness of potential community health and safety problems?
11	Are there provisions to avoid harm to women specifically?
12	Is there a plan for monitoring and mitigating consequences of harm?
13	Is there documented awareness that the project will possibly affect women most?
14	Is there consultation with women's groups?
15	Is there professional development for women?

information found in these documents. Using both methods, it was possible to identify whether emphasis was placed on closing gaps between men and women in the project.

Considerations for gender equality were scant overall, suggesting the need for much on-the-ground work to strengthen the Bank's focus on these issues. Even when projects referenced gender issues, it was at a cursory level (often a single instance) and typically in the context of women consulted in the Environmental and Social Impact Analysis (ESIA) and Resettlement Action Plan (RAP) documents. Out of 13 projects in 12 countries, 7 made reference to women as a proxy for gender considerations. Some projects missed opportunities to capture outcomes at the project level by limiting the focus of indicators to such quantitative measures as 50 percent female beneficiaries, which do not capture reductions in gaps between men and women.

In some cases, women were not identified as project stakeholders since data on the sex of stakeholders was not collected by the client. If women were indicated as being part of community consultations, the possible need for separate consultations by gender was not mentioned.[5] **In cases where project documents made reference to project employment of men and women, how this was to be achieved was seldom addressed.** It is well understood that the geothermal-sector talent pool for women with the required technical and operational skills is still quite limited.

Although various environmental and social safeguards and regulations are in place to avoid, mitigate, or minimize adverse impacts of energy infrastructure projects, consultations and social assessments that have specifically addressed gender equality issues have rarely occurred.[6] To date, these considerations have typically been an afterthought or relegated to a "check box" during the project design phase, with little or no formal follow-up required. This means that it has not always been apparent how women's views were taken into account or influenced project design and implementation.

NOTES

1 Prior to implementing the gender strategy, projects were monitored as "gender-informed" if they carried out gender assessments and integrated gender actions and M&E within the Project Appraisal Document (PAD).

2 World Bank staff can access Gender Tag guidance, using the following link: https://worldbankgroup.sharepoint.com/sites/Gender/Sitepages/Detail.aspx/Documents/mode=view?_Id=350&SiteURL=/sites/gender

3 More information on the World Bank Group's Gender Strategy, Regional Gender Action Plans (GAPs), and Global Practice Follow-Up Notes is publicly available at http://www.worldbank.org/en/topic/gender and http://openknowledge.worldbank.org/handle/10986/23425. World Bank staff may also access further information at https://worldbankgroup.sharepoint.com/sites/Gender/Pages/Home.aspx

4 Details are available at http://pubdocs.worldbank.org/en/837721522762050108/Environmental-and-Social-Framework.pdf

5 Separate consultations by gender are especially important in countries where cultural norms limit women's ability to express their opinions in the presence of men.

6 The World Bank's overarching safeguards policy in effect at the time of the geothermal portfolio review, (Operational Policy 4.01) [superseded by the Environmental and Social Sustainability Framework (ESF) in October 2018], required environmental and social assessments, but did not explicitly require project-level gender assessments. At the time of the review, Indigenous Peoples (Operational Policy 4.10), subsequently integrated into the new ESF, was the only operational policy that referred to gender considerations as part of identifying social and economic benefits with measures to avoid, minimize, or mitigate adverse impacts on indigenous peoples (https://policies.worldbank.org/sites/ppf3/PPFDocuments/090224b0822f7384.pdf).

APPENDIX C. EARLY INSIGHTS FROM SELECTED CASE STUDIES

TURKEY

The World Bank–supported **Turkey Geothermal Development Project** uses a risk-sharing mechanism for exploration drilling and credit lines with two state-owned financial intermediaries for production drilling and power plant construction. Prior to the World Bank's involvement, the financial intermediaries had already secured cofinancing and completed Environmental and Social Impact Assessments (ESIAs) for the first three proposed projects, which reduced the Bank's scope for advancing gender equality considerations. However, the Resettlement Policy Framework (RPF) cited women as a vulnerable group and required sex-disaggregated tracking of the Grievance Redress Mechanism (GRM). Through the RPF, a retroactive ex-post social review was requested, providing an opportunity for ongoing dialogue with the two financial intermediaries and three project sponsors (box C.1).

BOX C.1: KEY LESSONS FROM THE TURKEY GEOTHERMAL DEVELOPMENT PROJECT

- Early intervention, preferably with a single project sponsor, provides greater opportunity for analysis of gender equality considerations that can then be planned and budgeted for during the project's design phase.
- High-quality firms with international experience that are familiar with project challenges and prevailing best practices are generally receptive to integrating considerations with regard to gaps between men and women.
- Including references to actions focused on gender equality in early project documentation—especially in cases where sites and sponsors are not identified beforehand—can "hold the door open" for later action.

The World Bank team found the project sponsors generally receptive to considering how corporate social responsibility (CSR) activities could benefit men and women equitably in the affected communities for positive project and development outcomes (box C.1). For example, the land acquired by the project sponsors was on a willing buyer/seller basis, at a 30–40 percent premium above market price.[1] At least one project sponsor set aside a 50,000 m^2 parcel of land for mutual ownership with the community. Steam from the geothermal power plant will be diverted for greenhouses, and the World Bank team is working with the sponsor to ensure that related jobs and economic opportunities benefit both women and men.

In addition to voluntary CSR activities, both male and female community liaison officers were hired to ensure women's participation in consultative processes. In terms of employment, women in the project-affected community were hired to provide cleaning and catering services. Women from outside the

community were hired for jobs requiring more education; however, the exact numbers are unknown since sex-disaggregated reporting of hiring was not a requirement.

INDONESIA

The **Geothermal Clean Energy Investment Project** (2011–18) is a US$575 million effort funded by the International Bank for Reconstruction and Development (IBRD); the Clean Technology Fund (CTF); and Pertamina Geothermal Energy (PGE), the borrower. Its objective is to support steam field development, along with construction of the Steamfield Above-Ground System (SAGS) and 110 MW and 40 MW power plants at the Ulubelu and Lahendong (Tompaso) geothermal fields. The project has effectively addressed gender equality aspects in several main ways. First, the project's RPF referenced gender gaps to ensure that women were equitably compensated for loss of land, assets, and incomes in compliance with national laws and local contexts. Second, an analysis was conducted as part of the ESIA. Issues related to the project impacts on women in the affected communities, including land acquisition, were broadly and transparently discussed with stakeholder groups, and adequate measures were implemented to address them. Third, the project promoted women-inclusive land acquisition committees (LACs), which gave female community members the opportunity to raise issues and problems most pertinent to them.

The **Geothermal Energy Upstream Development Project** (2018–22) is a US$55.25 million investment, complemented by a US$49 million contribution from the Government of Indonesia, for a total investment of US$104.25 million. Of the US$55.25 million, US$49 million is a CTF contingent recovery grant to finance exploration drilling and supporting infrastructure; the other US$6.25 million is a Global Environment Facility (GEF) grant for capacity building and technical assistance, designed to establish an efficient and effective geothermal energy exploration and tendering program and implementation of safeguards measures. Where specific drilling locations for this project were not identified during preparation, an Environmental and Social Management Framework (ESMF) was prepared to identify and address, among other issues, the impacts of drilling activities and land acquisition on women. An ESIA aligned with the ESMF is being prepared, and an LAC will soon be established for each subproject.

The **Indonesia Geothermal Resource Risk Mitigation Project,** currently under preparation, will support the government of Indonesia in establishing a risk mitigation facility. The total cost of Phase 1 of the project is US$465 million, with contributions from the IBRD, Climate Funds, the Government of Indonesia, and private-sector developers. Blended concessional subfinancing is being provided for exploration and delineation drilling, with technical assistance provided to PT Sarana Multi Infrastruktur (Pesero) ("PT SMI") as the implementing agency to manage and govern the facility. In its Concept Note, the project highlighted several ways in which its design is focused on concerns of and opportunities for men and women (box C.2). As a financial intermediary (FI) operation, the project does not directly finance infrastructure development. Rather, it finances sub-borrowers to undertake exploration drilling. It will support PT SMI, as implementing agency, in its supervision of sub-borrowers' activities; these are designed to improve corporate human resource standards (through updating and collaboration with suppliers) for a diverse and qualified labor force and women's employment. Potentially, this effort will be complemented by others to work with local universities to provide women students more and better employment opportunities in the geothermal sector, ranging from engineers to finance officers and safeguards specialists.

BOX C.2: CONCEPTS FOR DEVELOPING A RISK MITIGATION PROJECT WITH A FOCUS ON MEN AND WOMEN

Preliminary ideas for integrating concerns of and opportunities for both women and men into the project design include the following:

- Consider undertaking an analysis to inform project-related surveys and documentation, such as the ESIA or assessment of the implementer's capabilities. Early analysis will allow for integrating the collection of relevant sex-disaggregated data or qualitative findings that can be used to identify an appropriate results framework, along with the budgeting and planning procedures for those activities.
- Provide the implementing agency and sub-borrowers relevant technical assistance and capacity building to raise the standards and improve the process of increasing women's participation and employment in the geothermal sector. This can be achieved by first promoting good practices of sub-borrowers or developers that have already hired women, with a view toward gradually raising the industry's standard practices.
- Develop partnerships with local universities to improve and promote mentoring and apprenticeship programs that broaden women students' greater access to employment opportunities in the geothermal sector upon graduation.

THE CARIBBEAN

The **Saint Lucia Renewable Energy Sector Development Project** is a five-year, US$23 million investment, with IDA and other financing, for exploratory drilling near the Pitons Management Area. This area is located along the fringes of the Pitons UNESCO World Heritage Site, which has significant cultural, ecological, and touristic value. The project is working with local communities to identify feasible sites with the fewest possible social and environmental impacts. The ESIA did not identify specific impacts for the affected communities; however, it is unclear to what extent women were encouraged to participate in consultations or had their responses tracked separately. The project aims to close gender gaps related to women's labor-force participation (box C.3), as well as increase awareness of gender-based violence (GBV). Opportunities for young men and women in renewable energy will be provided in the form of scholarships, internships, and apprenticeships.

The **Dominica Geothermal Risk Mitigation Project** is a five-year, US$45 million investment, with IDA and other financing, to construct a 5–7 MW plant in the Wotten Waven-Laudat field, with contingent financing for follow-on plants. The World Bank is aiding the government to complete a small proof-of-concept plant in hopes of demonstrating the reservoir's viability to attract private developers for potentially 30–50 MW of future capacity additions; these are intended for export to neighboring Martinique and Guadeloupe. Although progress stalled on the heels of devastation wrought by Hurricane Maria, the

BOX C.3: WORKING TOWARD A BALANCED GEOTHERMAL WORKFORCE IN THE CARIBBEAN

Task teams for the Saint Lucia and Dominica geothermal projects anticipate little need for displacement of communities or individuals. Thus, the focus is on tackling the underrepresentation of women in the geothermal workforce and ancillary job opportunities. A regional workshop, which took place in Guadeloupe in March 2019,[a] provided a platform for discussing the entry points to address gender gaps in the geothermal workforce. Priorities for the region include the following:

- Ensure women are encouraged to apply for better-paying, on-site jobs, including drilling and construction, by conducting outreach, ensuring the safety of job sites, and providing adequate training.
- Make efforts to include civil society organizations (CSOs) or specific ministry staff, such as gender focal points or human resource department heads, in development planning as they may have more detailed, practical ideas for increasing women's participation in the project workforce and oversight committees.
- Since all drilling sites are located near protected areas with potentially steep grades and fragile soils, investigate hiring women to help reforest/afforest and preserve adjacent areas, as was done in El Salvador (box 2.10).
- Explore whether local agricultural activities, such as cotton cooperatives with female members, are located in close enough proximity to drilling sites to benefit from cascaded uses of geothermal resources (e.g., condensates for drip irrigation, mechanical power, or process heat).

a. Workshop details are available at http://www.esmap.org/gender_and_geothermal_workshop.

government vows to build back stronger and adopt clean power, a significant portion of which is geothermal. The project has conducted a geothermal energy workshop to increase sectoral knowledge about the benefits of closing gender gaps (box C.3). Also, it will promote a Community Development Fund to address community needs in the affected areas.

ETHIOPIA

The World Bank's Ethiopia energy portfolio includes the **Ethiopia Geothermal Sector Development Project,** a US$218.50 million investment for development at two sites—Aluto and Alalobad—including the drilling and testing of some 26 wells and construction of steam-gathering systems connecting producing and injection wells. IDA financing will be used for production drilling and testing activities to establish the economic viability of the geothermal resources and finalize a feasibility study for the Alalobad site. The project will also finance two full-sized, diesel-electric drilling rigs with all associated equipment, accessories for directional and over-pressure/under-pressure drilling, and a complete inventory of spare parts. In addition, the project will develop a legal, institutional, and regulatory framework.

The project team takes a proactive approach to integrating a focus on gender gaps across the entire energy portfolio, from planning and procurement through exploration and operations. For the World Bank and its clients, this programmatic and transformational approach to achieving gender equality in the energy sector is unprecedented. The model embraces the idea that centralizing gender-related issues in the development agenda is smart economics, particularly for large-scale infrastructure projects (box C.4).[2]

BOX C.4: CLOSING GAPS BETWEEN MEN AND WOMEN ACROSS ETHIOPIA'S ENERGY SECTOR

The World Bank's energy team in Ethiopia undertook a systematic portfolio- and sector-wide approach to analyzing fundamental gender gaps, providing high-level policy advice, and mobilizing development partners and significant financial resources (roughly IDA's US$2 billion energy program). Actions with clear outputs and targets are being implemented across sector agencies including Ethiopian Electric Utility (EEU) and the Development Bank of Ethiopia (DBE), as follows:

- Addressing occupational sex segregation across sector utility with more than 15,000 employees.[a]
- Providing childcare facilities in utility offices across all 11 of the country's regions, thus overcoming a key impediment to women's participation in the workforce.[a]
- Supporting girls' education in science, technology, engineering, and mathematics (STEM); career development of female candidates; and women's ongoing management and leadership training.[a]
- Preventing and responding to gender-based violence (GBV) in the workplace and at project sites.[a]
- Promoting women's entrepreneurship in the off-grid market through targeted technical assistance and removal of productivity constraints, including the lack of access to finance.[b]

a. Implemented at EEU.
b. Driven through World Bank and DBE collaboration.

BOX C.5: EARLY LESSONS FROM PORTFOLIO-WIDE ENGAGEMENT AND LINKS TO THE ETHIOPIA GEOTHERMAL SECTOR DEVELOPMENT PROJECT

- Taking a sector-wide approach to identifying gaps and opportunities at the project and institutional levels is likely to lead to scalable approaches across projects and sector engagement; for example, a focus on electricity access has cascaded into the geothermal and off-grid sectors.
- Champions at a high level, including World Bank task team leaders and government counterparts, combined with technical support from gender experts and engagement across the team, including social safeguards and procurement specialists, are essential for charting out clear and realistic entry points for addressing gender gaps in a portfolio.

As an initial step, the team held consultations with Ethiopian Electric Power (EEP), the primary implementing agency, to better understand key institutional priorities (box C.5). Based on a recently conducted audit, EEP has developed specific actions for advancing gender equality to be implemented over the next several years. At the level of the company, it will ensure that gender equality is embedded in its values and policies. For example, EEP has set a target of reaching 30 percent women's employment. In the project-affected communities, it will ensure women's enhanced participation in consultations and fair compensation for lost assets during resettlement.

These institutional priorities will be further explored as drilling gets under way in 2019. A labor influx management plan has already been developed, and procurement bidding documents for the Aluto site include requirements for contractors to adhere to principles of nondiscrimination at work and GBV prevention and response.

NOTES

1 The ex-post social reviews will reveal what role gender considerations played during the compensation proceedings.

2 See Ethiopia's "First-of-its-Kind" Gender and Energy Program Wins Award. https://www.esmap.org/node/165809.

ESMAP MISSION

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