FINNFUND

The Impact of Power Investments in Honduras

Final Report

August 2018

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Contents

EXECUTIVE SUMMARY

In this study a framework is developed to quantify the effect of Finnfund's investments in power infrastructure in Honduras. Finnfund's investments include financing three hydro power plants – La Vegona (39 MW), Los Laureles (5 MW) and Mezapa (10 MW) – and one solar power plant – Valle (50 MW).

Methods

The methodology we used in this study to estimate the economic impact of investments in the power sector in Honduras largely follows the one developed and tested during our previous studies for the in the Philippines and Turkey (IFC), Uganda and Cameroon (CDC), and India and Uruguay (PROPARCO). In these studies we analysed the current power supply and demand situation in the respective country and then constructed a counterfactual situation of what would have happened in the absence of the new generation capacity. In this way we calculated the changes in electricity price and employment relative to a hypothetical case in which DFI-invested projects were not realised.

The composite methodology developed in this research project consists of:

1. Statistical analysis of the existing data sources to quantify how power availability and affordability affect economic output;
2. Construction of an electricity price model based on available supply and demand information in Honduras for 2016 and construction of a situation in which Finnfund-invested projects are added to the power fleet;
3. Estimation of how an increase in power capacity leads to a reduction in power outage time and calculation of the related economic output and employment increase in Honduras using input-output multipliers and employment intensity data from Honduras;
4. Calculation of the value added and employment effects related to the operations (and construction) of the four plants using input-output modelling and employment intensity data from Honduras.

The study is based on desk research and relies on publicly available data as well as data shared privately through personal correspondences with energy sector partners in Honduras.

Key findings

1. Installed capacity in Honduras was approximately 2,450 MW in 2016, of which 40% thermal power, 28% hydro power, and 24% solar and wind. The effective capacity (installed capacity adjusted for utilisation) was approximately 1,100 MW;
2. Finnfund invested in three hydro power plants – La Vegona (39 MW), Mezapa (10 MW), and Los Laureles (5 MW) – and one solar power plant – Valle (50 MW) – that combined added 104 MW of installed capacity and 41.7 MW of effective capacity (3.9% of total effective capacity) to Honduras' energy supply;
3. Average daily peak demand for a typical week in 2016 was 1,137 MW;
4. By substituting expensive thermal power with relatively cheaper hydro and solar, Finnfund-supported plants reduced the weighted average cost of generation in Honduras by an estimated 4.7%, from USD 0.163 to 0.155 per kWh (3.7 – 3.5 LPS per kWh). The decrease could translate to a one-off reduction of ENEE subsidies of USD 45 million, equal to 1% of Honduras' 2016 tax revenues;
5. Firms were affected by outages 5–7% of operations time in 2016. By increasing effective capacity and reducing outages, we estimate that firm operations time increased 0.5%. This translates to

estimated increased economic output of USD 77.1 million, as well as estimated value added and employment of USD 42.4 million and 5,100 jobs supported for firms in energy dependent sectors (manufacturing, retail and trade, transport, professional services). The agricultural sector, which is not typically dependent on electricity, indirectly increased output by an estimated USD 2.9 million and employment by 650 jobs. Given the wide-spread underemployment in the country, many of these do not constitute a full-time employment opportunity but livelihoods;

6. Displacement of fuel-run plants translates into reduction of Honduras' imported fuel by 9% (or about 400,000 barrels per year), and 3% of the country's carbon emissions;
7. Through day-to-day plant operations, the four Finnfund supported plants support an estimated 545 jobs and USD 32.7 million in value added, directly and indirectly throughout Honduras' economy. We estimate that for every one job at the Finnfund supported plants, 2.5 jobs are supported elsewhere in Honduras' economy.

Acknowledgements

This report was commissioned by the Finnish Fund for Industrial Cooperation Ltd. (Finnfund), a Finnish development finance company. The authors would like to express their gratitude to the numerous individuals who supported the project remotely from Honduras by sharing their company data and taking the time to discuss the power situation in the country: Gerardo Salgado (CREE), Luis Suazo Davis (Cohersa-Cohessa CFO, teacher of the Master Program on Renewable Energy in Lauretes Universities in San Pedro Sula, and Vice President of the Renewable Energy Honduran Association), Sofia Sandoval (Cohessa-Cohersa), Rafael Picciotto (Mezapa), Victoria Nunez (Mezapa), Javier Prats (Los Laureles).

Impact of Renewable Energy Investments in Honduras

FINNFUND invested **$35.4** million in **4** renewable power companies in Honduras, which together added **104 MW** of installed capacity or **4%** of effective capacity:

- LA VEGONA 39 MW
- LOS LAURELES 5 MW
- MEZAPA 10 MW
- VALLE SOLAR 50 MW

The additional capacity led to estimated

5% DROP IN GENERATION COSTS, resulting in

9% IMPORTED FUEL DISPLACED valued at **$22.5 MILLION**, equal to **400,000 BARRELS** of Honduras fuel

285 KT CO_2 EMISSIONS AVOIDED, equal to **3%** of Honduras' **EMISSIONS**, valued at **$ 1.8 MILLION**

$80 million INCREASE IN FIRM OUTPUT due to reduced outages across Honduras,

which led to the creation of

5,800 JOBS

$ 42.8 MILLION IN INCOMES

for households (salaries), firms (profits), and the state (taxes)

The annual operations of Cabeolica support **155 DIRECT** and **390 INDIRECT JOBS** and

$29.1 MILLION DIRECT INCOMES and **$3.6 MILLION INDIRECT INCOMES** for households (salaries), firms (profits) and the state (taxes).

THE IMPACT OF POWER INVESTMENTS IN HONDURAS FOR FINNFUND

1 INTRODUCTION

The absence of reliable, adequate and affordable power is recognised as one of the main barriers to broad-based economic growth and social development. Poor and/or expensive electricity supply stifles economic activity by reducing productivity and hampering the development of industry and trade which are important drivers of employment and growth.

Electricity production in Honduras has historically been dominated by government- and privately-owned hydropower plants, as well as private diesel fuel plants. However, a push in recent years to develop renewable energy in Honduras has reshaped the supply mix in the country. New hydro, wind and solar power has reduced generation costs and outages, lowered the country's dependence on imported fuel and the amount of greenhouse gases generated by the energy sector.

Finnfund has supported these developments by making investments in renewable power generation. It provided financing for three hydro power plants and a solar power plant. The hydro power plants include La Vegona (39 MW – commissioned 2010), Mezapa (10 MW – commissioned 2009) and Los Laureles (5 MW – commissioned 2010). The solar power plant is Valle (50 MW – commissioned 2012).

The theory of change and previous research indicate that a stronger physical infrastructure, in particular in the power sector, has an important impact on economic development for shared prosperity and poverty reduction. The objective of this report is to assess the impact of Finnfund's recent power generation investments on employment in Honduras. The study aims to contribute to the understanding of how improvements in power availability and affordability affect development across economic sectors and actors.

The remainder of this report covers the following topics:

- Section 2 provides an overview of the Honduras' economy and its power sector;
- Section 3 describes the impact of improved grid electricity, including the analytical framework on which the analysis is based and the results of the analysis;
- Section 4 provides discussion of the economic impact of the plant's operations (backward linkages);
- Section 5 summarises the main conclusions of the analysis and presents a few recommendations.

2 ECONOMIC AND POWER SECTOR PROFILE

2.1 Macro-economic profile

After a period of growth above 6%, the economy of Honduras contracted sharply in 2009 (Exhibit 1). After a GDP drop of nearly 2.5%, the economic growth picked up again to an average of 3.8% during 2010-12, before sliding to 2.8% in 2013. As the global economy was recovering, the country's GDP recorded growth above 3% in after 2014, reaching 3.8% in 2017. This positive trend is expected to continue, with projected 2018 GDP of 3.7%. Over the last years, Honduras' GDP growth has outstripped the LAC region.[1] Nevertheless, its economic growth is not expected to reach the rates observed before the crisis.[2]

The services sector makes up nearly 58% of GDP. Communications and financial intermediation services together account for over half of yearly GDP growth. The manufacturing sector accounts for nearly 19% of GDP and is largely characterized by *maquiladora* firms. A maquiladora is a foreign-owned manufacturing company which operates in designated economic free zones and ships materials into Honduras for the purpose of producing the intermediary or final goods for export. Economic activity by the maquiladoras contributed to 5.2% of GDP and employed over 130,000 people in 2016. Over 85% of employment by the maquiladoras is in the production of textiles and clothes, as well as the manufacture of harnesses and parts for automobiles.[3] The agricultural sector accounts for 13.5% of GDP and employs 26% of the labor force.[4] Important agricultural products include coffee, palm oil, and bananas.

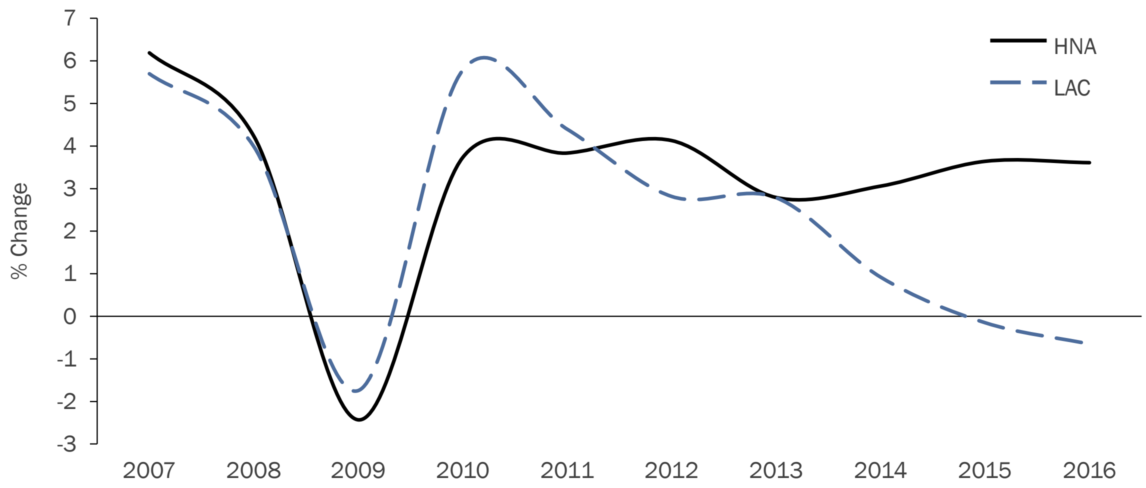

Exhibit 1: Annual percentage change in GDP for Honduras and the Latin America & Caribbean region (source: World Bank)

The Honduran economy is dependent on agricultural exports (including processed foods), which makes it vulnerable to changes in commodity prices. Honduras primarily exports manufactured goods, agricultural materials, and food, in particular coffee, whose exports contribute 5% of total GDP. Both exports and imports have been falling as a proportion of GDP over the past three years. Honduras' exports declined due to lower demand from the United States for textiles and intermediary automobile parts produced by maquiladoras. Imports have been falling relatively faster, driven by lower cost of imported fuel. As a result, the country trade deficit declined from 17% of GDP in 2015 to 15% in 2016 (Exhibit 2).

[1] All data reported in this chapter – unless explicitly stated otherwise – is from World Development Indicators, World Bank, Washington, D.C.

[2] World Bank (2015). Honduras Economic DNA. http://documents.worldbank.org/curated/en/150731468189533027/pdf/97361-WP-PUBLIC-Box391473B-Honduras-Economic-DNA-First-Edition-11Jun2015-FINAL-PUBLIC.pdf

[3] Industry of Goods for Transformation and Related Activities. 2017. Central Bank of Honduras.

[4] Permanent Survey of Multiple Purpose Households. June 2016. Instituto Nacional de Estadistica.

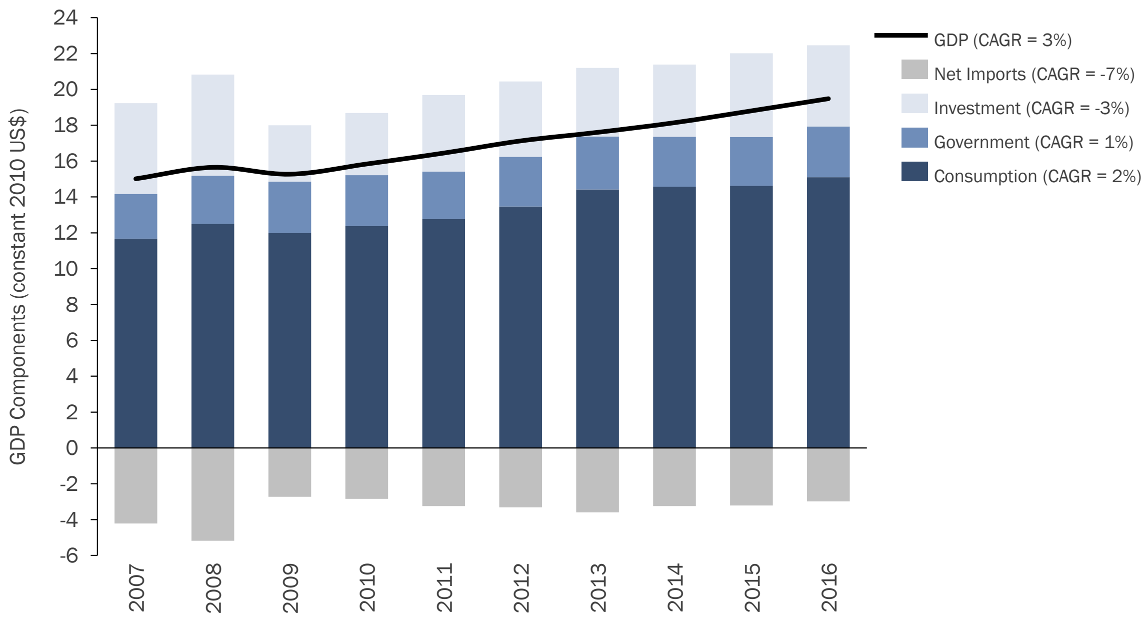

Exhibit 2: GDP components over time (constant 2010 US$) (source: World Bank)

Although Honduras' economy has been growing in recent years, the country remains a difficult place to conduct business. It is ranked 115 out of 190 countries in the World Bank's Ease of Doing Business rankings. The low score is due to the high frequency of tax payments (48 times per year) and the cost to start a new business, which is 41% of income per capita. The difficultly of operating in Honduras is substantiated in the World Bank's Enterprise Survey for Honduras. In the 2016 survey[5], firms reported that their biggest obstacles were access to finance, the informal sector, tax rates, business licensing, and poorly educated workers. The poor business environment in Honduras may explain the recent decrease in gross fixed capital formation to 21.8% of GDP in 2016, a year-on-year drop of -7.3% illustrated in Exhibit 3.

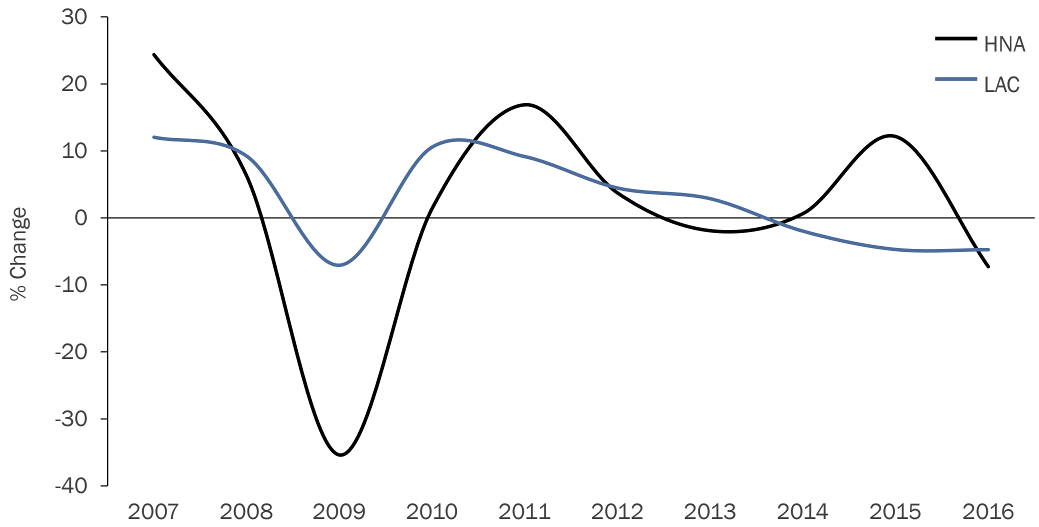

Exhibit 3: Gross fixed capital formation of Honduras and the LAC region (source: World Bank)

[5] Survey consisted of 332 firms across 15 industries.

Un- and underemployment, inequality, poverty, and crime remain serious challenges. In 2017, the overall unemployment was 5.7%. The rates were higher for women and youth, 8.4% and 11% respectively. Underemployment is prevalent, affecting about a third of the labor force.[6] Despite economic growth, in 2016 an estimated 60% of the population were living beneath the national poverty line. This percentage has been declining since 2012, when it stood at 67%. Nevertheless, in rural areas approximately one out of five Hondurans still lives in extreme poverty. In terms of safety, the country records 64 crimes per 100,000 people, far higher than the LAC average of 22.

2.2 Power sector overview

Until recently, the Honduran power sector was characterized by a single vertically-integrated, state-owned power company, *Empresa Nacional de Energia Electrica* (ENEE), and the Government of Honduras' efforts to introduce competition and privatization. Until 2016 ENEE was responsible for purchasing generated electricity, and controlling the transmission and distribution systems in the country. In the autumn of 2016 Energy Company Honduras (EEH) was assigned as the operation and maintanance of the distribution network.

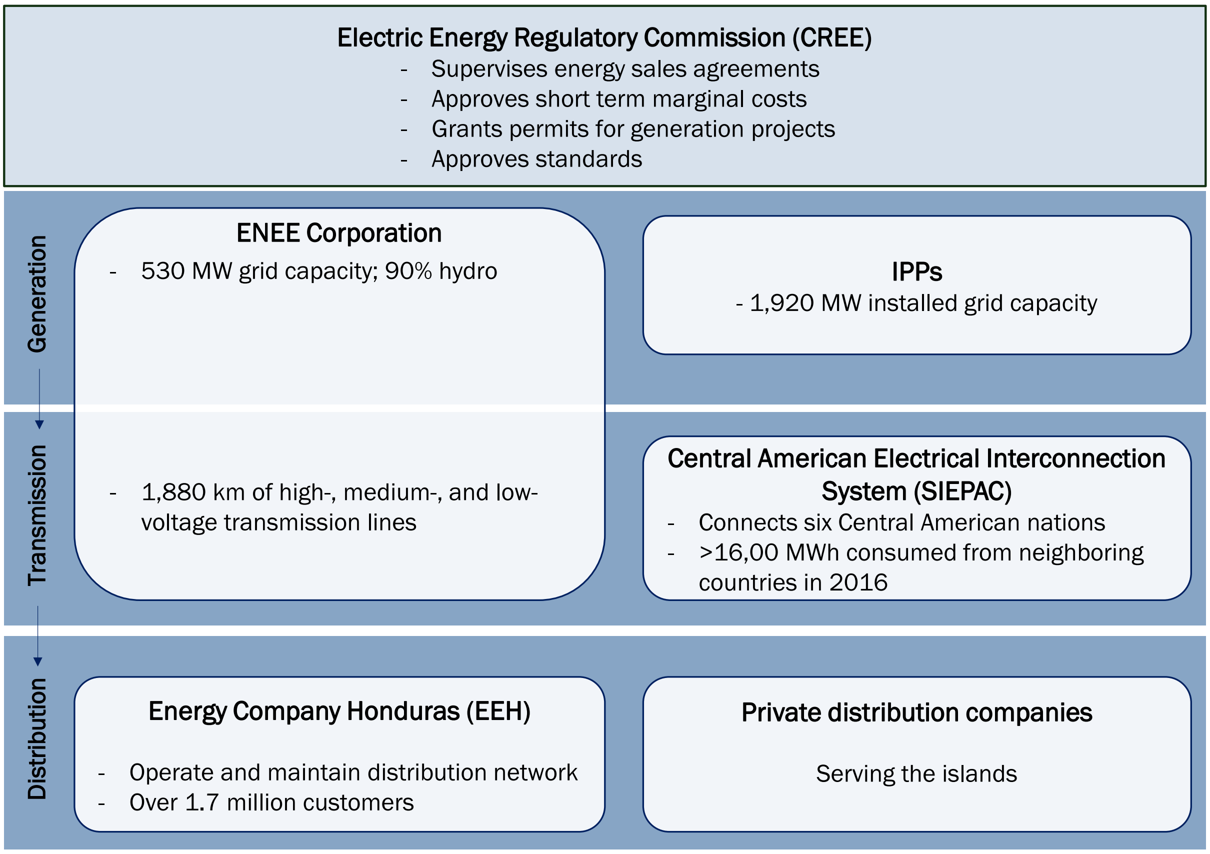

Exhibit 4: Overview of the Honduran power sector

Back in 1994, the government passed an electricity law intended to divide ENEE into separate entities for generation, transmission and distribution, while separating the roles of policy making and producing energy. The measure was enacted in response to an energy crisis in 1993 caused by a combination of the poor financial management of ENEE and a severe draught that lowered reserve generation capacity. However, ENEE was not unbundled as intended and was left as the sole purchaser of electricity through power purchasing agreements (PPAs). The law increased private investment in power generation and incentivized the development of renewable energy sources. Since 1994, substantial advances were made

[6] CIA Factbook https://www.cia.gov/library/publications/the-world-factbook/geos/ho.html

in private sector participation with the development of new generation sources.[7] In 2016, independent power producers (IPPs) generated nearly 80% of the electricity in Honduras.

While private generation increased, the fiscal health of ENEE continued to deteriorate. ENEE was unable to recover its costs because of poorly targeted tariff subsidies, large losses and theft in the transmission and distribution systems, and inadequate billing and collection of payments. Since ENEE's losses are born by the government, its poor financial situation impacted the country's fiscal position and impeded economic growth. In 2013, ENEEs deficit was 1.8% of GDP.[8] As a result, the GoH introduced the 2014 Electricity Law to reform ENEE. The law introduced multiple reforms for the energy sector. It raised the electricity tariff, laid the foundation for the creation of separate subsidiaries for generation, transmission, and distribution, and established the *Comision Reguladora de Energia Electrica* (CREE). The latter is responsible for the transparent management of the energy sector and defining methodologies for establishing tariffs. As a result of these reforms, ENEE's deficit declined to 0.3% of GDP by the end of 2015.

2.3 Power generation, transmission and distribution overview

2.3.1 Generation

Capacity and generation have been increasing rapidly in order to keep up with growing demand for electricity. In 2016, the total installed energy capacity in the country was 2,450 MW, of which about 45% was utilized on average, translating to approximately 1,100 MW in effective capacity.

Installed capacity rose more than 50% between 2009 and 2016 (with 6% in average growth). The increase was driven by the rise of renewable solar and wind power (Exhibit 5). However, World Bank research estimates that supply might be 100 MW lower than demand due to high levels of theft and fraud in the system and distorted price signals produced by subsidies.[9]

Historically, state-owned hydropower has been the most important source of electricity in Honduras. Between 1964 and 1985 multiple hydro power plants were constructed by the GoH, with the help of international financial institutions, in order to provide clean energy. The largest of these plants, El Cajón, has an installed capacity of 300 MW and it is the largest provider of renewable energy in Honduras. The La Vegona hydro power plant is located 8 km downstream from El Cajón and generates power in synchronisation with it. However, severe droughts between 2001 and 2004 forced El Cajón to draw down its reservoir levels in order to maintain steady amounts of energy generation. As a consequence El Cajón had a lower effective capacity and there was a shortfall in available electricity in the system.[10] The lack of electricity was met by numerous emergency thermal energy plants leased by ENEE.

Despite the large presence of renewable hydro power the generation mix in Honduras still depends on thermal energy, mostly diesel and fuel oil which comprised 50% of the effective supply in 2016. Honduras imported 1,925,000 tonnes of diesel and fuel oil in 2015, of which some 1,080,000 tonnes were used by for electricity generation.[11] Other thermal energy sources such as coal and gas provide less than 4% of the effective capacity.

[7] Energy Sector Management Assistance Program, 2010. Honduras: Power Sector Issues and Options. ESMAP Formal Report; No. 333/10. World Bank, Washington, D.C.
https://openknowledge.worldbank.org/handle/10986/27724

[8] Hernandez Ore, Marco Antonio, Lilian D. Soursa, and J. Humberto Lopez. 2016. "Honduras: Unlocking Economic Potential for Greater Opportunities." Systemic Country Diagnostic. World Bank, Washington, D.C.
http://documents.worldbank.org/curated/en/539771467987912356/Honduras-Unlocking-economic-potential-for-greater-opportunities-systematic-country-diagnostic

[9] Country Partnership Framework for the Republic of Honduras for the Period FY-16-FY20. World Bank, Washington, D.C.

[10] ESMAP, 2010. World Bank, Washington, D.C.

[11] International Energy Agency. OECD. Accessed March, 2018.
https://www.iea.org/statistics/statisticssearch/report/?year=2015&country=Honduras&product=Oil

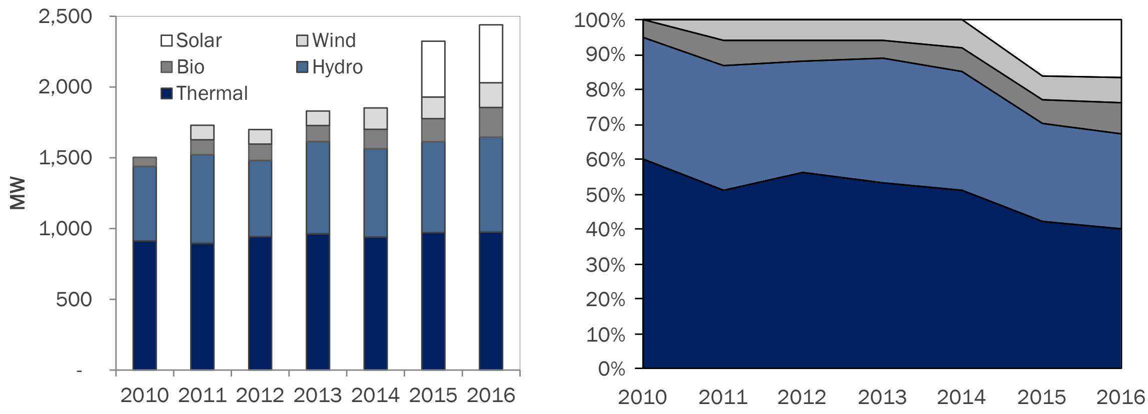

Exhibit 5: Evolution of the Installed Capacity Energy Mix (Source: ENEE)

Solar and wind power comprised 17% and 7% of the total generated electricity in 2016 respectively. The GoH incentivizes the production of renewable energy sources in order to provide clean energy with stable generation costs. The Renewable Energy Promotion Law, introduced in 2007, provides financial incentives to renewable energy companies such as compulsory dispatch of electricity produced by renewable generation facilities, preferential prices, and tax exemptions on income, sales, and import tariffs.[12] Particularly solar power producers receive high feed-in tariffs designed to incentivize and increase their supply. A 2013 amendment to the Renewable Energy Promotion Law, added an additional $0.03/kWh to the price of electricity produced by solar power generators for the first 300 MW installed before July 31, 2015.[13]

Overall the country is considered to have high renewable resources, with potential for 5,000 MW of hydro capacity, 1,200 MW wind capacity, and 100-990 MW of unrealised geothermal.[14]

The new law was part of the GoH larger commitment towards combating climate change. Honduras' geographical location in Central America makes it vulnerable to extreme weather events related to climate change; in 2016 Honduras was ranked the most climate change-affected country of the last 20 years.[15] Given all of this, the GoH committed to a 15% nationwide emissions reduction compared to the business as usual scenario by 2030. In its Paris Agreement Intended Nationally Determined Contribution (INDC), adaptation measures for hydroelectric power infrastructure were specifically identified as a priority.

2.3.2 Transmission and distribution

ENEE is the sole owner and operator of the transmission system. EEH, an international consortium, is responsible for operation and maintenance of the distribution network, its commercialization and

[12] SREP, 2017. Climate Investment Funds.

[13] Country Partnership Framework for the Republic of Honduras for the Period FY16-FY20. November, 2015. International Finance Corporation, Washington, D.C.
http://documents.worldbank.org/curated/en/431191468179338816/Honduras-Country-partnership-framework-for-the-period-FY16-FY20

[14] Sustainable Energy for All Rapid Assessment Gap Analysis – Honduras (2012).
https://www.seforall.org/sites/default/files/Honduras_RAGA_EN_Released.pdf
Dolazal, Majano, Ochs, Palencia , 2013. The Way Forward for Renewable Energy in Central America.
http://www.worldwatch.org/system/files/The%20Way%20Forward%20for%20Renewable%20Energy%20in%20Central%20America_low-res2.pdf
Norton Rose Fulbright, 2017. Renewable Energy in Latin America
http://www.nortonrosefulbright.com/files/renewable-energy-in-latin-america-134675.pdf

[15] David Eckstein, Vera Kunzel, and Laura Schafer. November, 2017. "Global Climate Risk Index 2018: Who Suffers Most From Extreme Weather Events? Weather-Related Loss Events in 2016 and 1997 to 2016." Germanwatch e.V. Bonn, Germany.
http://germanwatch.org/en/14638

optimization, reduction and control of technical and non-technical losses, and for the collection of payments.

Lack of investment in the infrastructure supporting transmission network has stunted the growth of the national electricity grid, the *Sistema Interconectado Nacional* (SIN). Poor transmission infrastructure negatively affects the quality of service, access to electricity, and the frequency of power interruptions and blackouts. A backlog of planned investments in the transmission network accumulated due to ENEE's financial constraints. In its 2016-2020 Strategic Plan, ENEE reports that the transmission network requires more than USD 424m, or about 2.3% of GDP, to improve the system. As of end-2017, ENEE was still in the process of searching for a subcontractor to be the technical operator of the transmission network as part of its ongoing reform.[16]

The electricity distribution network was subcontracted to a technical operator in December 2015. The contract was awarded to the Honduras Energy Consortium to operate ENEE's distribution system for seven years. The Honduras Energy Consortium comprises two Colombian companies and a Honduran financing firm. According to the conditions in the contract, the consortium is required to invest approximately USD 358m and to reduce electrical losses by 17% over the seven year period.[17]

ENEE continues to lose money and in January 2017, the Honduran government issued USD $700 million in sovereign bonds to cover payment arrears and refinance more expensive existing debt. According to the U.S. Department of State's Investment Climate Statements, lowering the cost of power generation, increasing tariffs, investing in transmission upgrades, reducing losses, and implementing operational reforms will be required for ENEE to achieve financial solvency.[16]

2.4 Energy consumption

2.4.1 Consumption per group

Energy consumption was 5,921 GWh in 2016, increasing at 2.2% on average per year since 2009. The residential sector consumes the largest amount of generated electricity (40%), followed by the commercial and industrial sectors, which both consume a roughly equal amount of electricity (26%) The remaining electricity is consumed by the public sector (8%) and a small amount is exported (<1%).

Electricity consumption varies by region. The North-Western region, which includes the city of San Pedro Sula, where many maquiladoras are located, consumed 3,028 GWh (51%) in 2016, while the South-Central region, which includes the capital city Tegucigalpa, consumed 2,332 GWh (40%). The Coastal-Eastern region has significantly less access to electricity than the rest of the country. This is reflected in the low electricity consumption of 544 GWh (9%) in the region.

Access to electricity was still unavailable to more than 10% of the population in 2015. The gap grew in 2016, when more than 12% of the population lacked access.[18] In comparison, the average electrification rate in Latin America is 98%. Furthermore, in Honduras there is a large gap between access to electricity in the urban and rural areas. While 100% of population in the metropolitan areas is electrified, only 72% of the rural population have access (compared to average of 94% in Latin America).

ENEE, in its 2016-2020 Strategic Plan, expects that electricity demand will grow 4% per year until 2030. Electricity demand is driven by favourable subsidies to residential consumers, large amounts of theft and losses throughout the system, and economic growth. Notably, electricity consumption is growing slower than GDP resulting in declining electricity intensity. Although Honduras has been growing faster than its

[16] State Department's Office of Investment Affairs' Investment Climate Statement. *Honduras - 7-State-Owned Enterprises* https://www.export.gov/article?id=Honduras-State-Owned-Enterprises

[17] La Prensa. ENEEs distribution awarded to Honduras Energy Consortium. December, 2015. http://www.laprensa.hn/honduras/911217-410/adjudican-a-consorcio-energ%C3%ADa-honduras-distribuci%C3%B3n-de-la-enee

[18] Population growth in Honduras in the same period was 1.7%, meaning that the drop in electrification rate was higher than the increase in population.

neighbours and the LAC region in general, the electricity intensity is quite high and has been slightly declining. The level of energy intensity indicates that the Honduran economy is not translating electricity generation into economic output as efficiently as other countries in the region. However, the downward trend in Honduras' electricity intensity signals that as the country continues to grow, the economy is more effectively utilizing the available electricity.

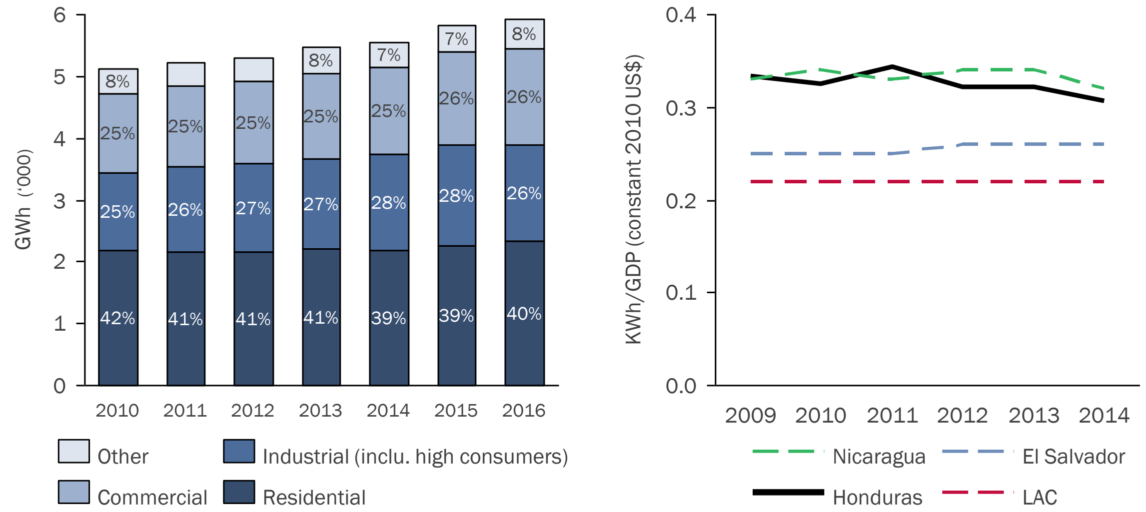

Exhibit 6: Electricity Consumption by Group (left, source: ENEE) and electricity intensity (right, based on World Bank data)

2.4.2 Energy tariffs

Electricity users in Honduras pay between $0.112 (LPS 2.46) and $0.175 (LPS 3.84) per kWh depending on their consumer category (with residential consumers paying the lowest, and commercial and industrial the highest price).

Prior to the 2014 Electricity Law, Honduras' electricity tariff system was designed with the intent that distributors would purchase electricity at a price reflective of the generation and transmission costs. Small residential consumers (those using less than 300 kWh per month) would receive an explicit cross subsidy from commercial and industrial sectors and an additional direct subsidy from the GoH. The tariffs would be calculated every year by the generators and any adjustments would be approved by energy sector regulators by taking into account variations in fuel prices and exchange rates.[19] However, ENEE did not apply the official tariff-calculation and adjustment methods, causing prices to diverge from the economic costs of providing electricity.

In June 2016, the regulatory commission established a new tariff scheme based on cost recovery.[20] It is unclear if and when the tariff scheme was implemented, however it is worth noting that average tariffs increased by some 7% between 2016 and 2017, after a period of decrease in 2015-16 (Exhibit 7).

[19] ESMAP, 2010. World Bank, Washington, D.C.
[20] IMF Country Report No.16/362, November 2016 http://www.imf.org/external/pubs/ft/scr/2016/cr16362.pdf

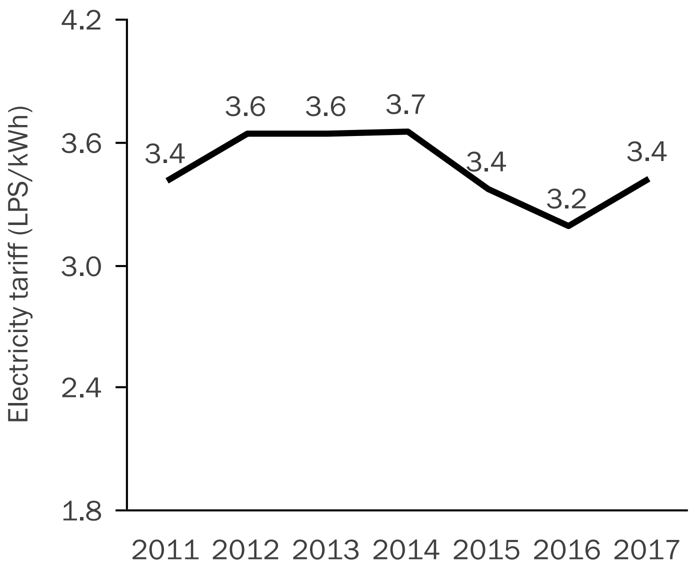

Exhibit 7: Tariffs in Honduras (Source: ENEE)

2.4.3 Outages and losses in the system

The Honduran power sector suffers from large losses and periodic outages. Electricity losses are among the highest in Central America. Caused by inefficiencies in the transmission and distribution systems, theft and fraud, electricity losses increased from 21% to 30% between 2007 and 2017. Losses peaked in 2016 at a high of 34%.[21] ENEE has been combatting losses by installing automated meters, new transformers, and by cutting service to delinquent and fraudulent customers.

In 2017, there were on average 31 hours of outages per month, meaning that outages took up about 12% of firms' operation time.[22] According to data from CREE, the total electricity which was not delivered was 130.1 GWh, or 1.5% of the total electricity sold in 2016. Of the total electricity lost due to outages, more than 2/3 was due to generation faults.[23] However, these seem to be planned outages, and not electricity rationed due to insufficient supply (load shedding). Unfortunately, this data was only made available for 2017, making it difficult to make any conclusions on the development of outages, and load shedding in particular, over the past years. The World Bank Enterprise Survey for Honduras from 2016 has company-reported data on outage time and duration, indicating that in total firms experienced between 12 and 18 hours of outages per month. Even though it is difficult to compare self-reported data with official statistics, it is possible that outages have increased in the last two years, most likely as a result of distribution faults given the growth of the network demand.

[21] Data received through communication with Luis Suazo Davis. February, 2018.

[22] Operations time is based on self-reported data by businesses in the World Bank Enterprise Study for Honduras for 2016.

[23] Data received through communication with CREE. March, 2018.

3 ECONOMIC IMPACT OF IMPROVED GRID POWER SUPPLY

3.1 Analysis framework

The analysis framework for the economic impact of increasing power supply is presented in Exhibit 8. We previously applied this framework to estimate the economic impact of power sector investments in studies for IFC (in the Philippines and Turkey), CDC (in Uganda), PROPARCO (India and Uruguay), the Private Infrastructure Development Group (PIDG, in Senegal), and the Nigerian Infrastructure Advisory Facility.

Going from left to right in Exhibit 8, an increase in power generation capacity decreases the price of power and/or reduces the number of outages. Lower prices and fewer power outages increase the production level at which companies maximise their profits which will henceforth increase electricity use to produce more output[24]. This in return increases their intermediate demand from other firms (both users and non-users, e.g. agriculture) and value added. The resulting increase of value added increases GDP and employment. Finally the higher GDP increases the demand for electricity, which increases the electricity price and thus offsets some of the before-mentioned effects. The framework does not include the effect of lower electricity price on capital investment (either directly or indirectly), a feedback that may be relevant in the longer run. The potential pathway of additional supply allowing more household consumers to connect to the grid is not included in the framework either. This is because we expect residential consumption to not significantly increase overall electricity use in the short term. Residents often depend on (rural) state electrification programs to be connected to the grid, while the majority of firms already have electricity connections and can benefit from more and cheaper power as soon as it is available.

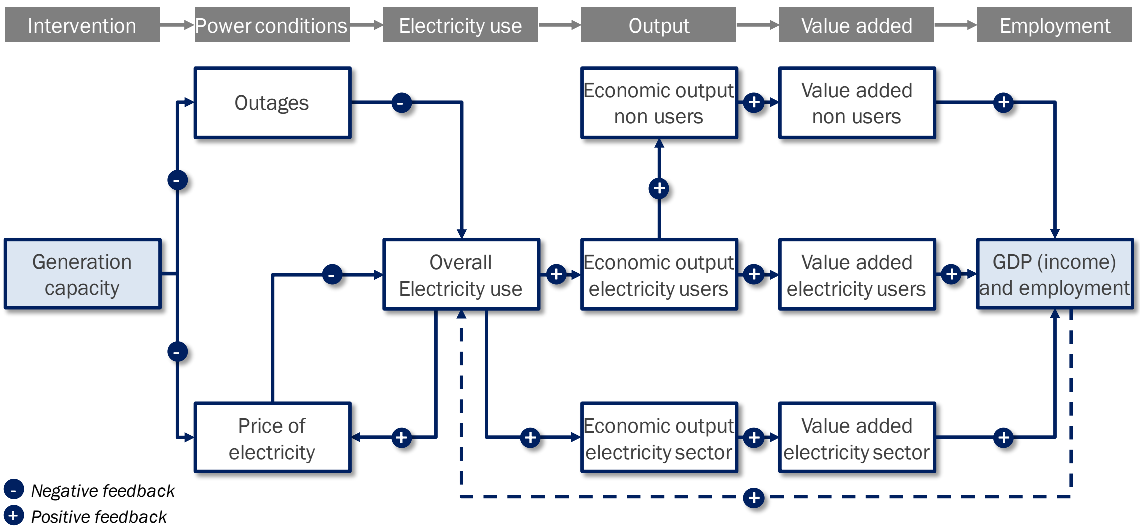

Exhibit 8: Analysis framework for the impact of increase in power sent into the grid on GDP (value added) and employment

It is important to note that in different countries, one of the pathways is typically dominant. For example, the outage pathway will be key in countries with very low reserve margins where insufficient capacity causes blackouts. In a country where the power sector is subsidised and prices are not cost-reflective, addition of capacity would not necessarily lead to change of electricity price. The price pathway is especially relevant for countries where new capacity replaces existing expensive thermal generation. The lower price for electricity due to more (and cheaper) generating capacity can come about in two different pathways, depending on the specific power conditions. In countries where the grid electricity is normally sufficient in quality and quantity, an increase of generation capacity lowers the price of electricity, depending on the short and long-run cost level of additional capacity relative to the average wholesale

24 The exhibit depicts relationship between two variables. The negative relationship between e.g. electricity price and consumption means that a lower price is associated with more consumption (and vice versa).

electricity price. In countries where the grid is not able to deliver sufficient power (e.g. Nigeria) increased capacity will reduce the dependency of companies on expensive self-generation, thereby lowering their effective electricity cost[25].

3.2 Impact via the price pathway

3.2.1 Methodology

To estimate the impact of Finnfund-supported plants on employment in Honduras, we analyse how the additional capacity affects electricity prices.

We start by calculating the effect of the new plants on electricity generation costs and consequently on the end-user tariff based on a power supply-demand model and the structure of the tariffs. Reduction in the generation cost will lead to decrease in the end-user tariff only when the latter is cost-reflective, which as previously discussed is not the case in Honduras. Therefore, we do not expect changes in the generation cost to have an impact on electricity end-user prices. This in turn means that businesses (and households) would not feel any changes for their production activities, and their operations would not be affected. Therefore, no job creation effect is expected.

Nevertheless, the reduction in generation prices will have had an impact on ENEE and the government, since lower generation costs bring the end-user tariff closer to cost reflective levels. There will be a reduction in the need to provide subsidies to keep the costs at lower levels.

This approach, summarised in Exhibit 9, is explained in more details in the sections below. Results reflect changes brought about by the four plants and do not take Finnfund attribution into account.

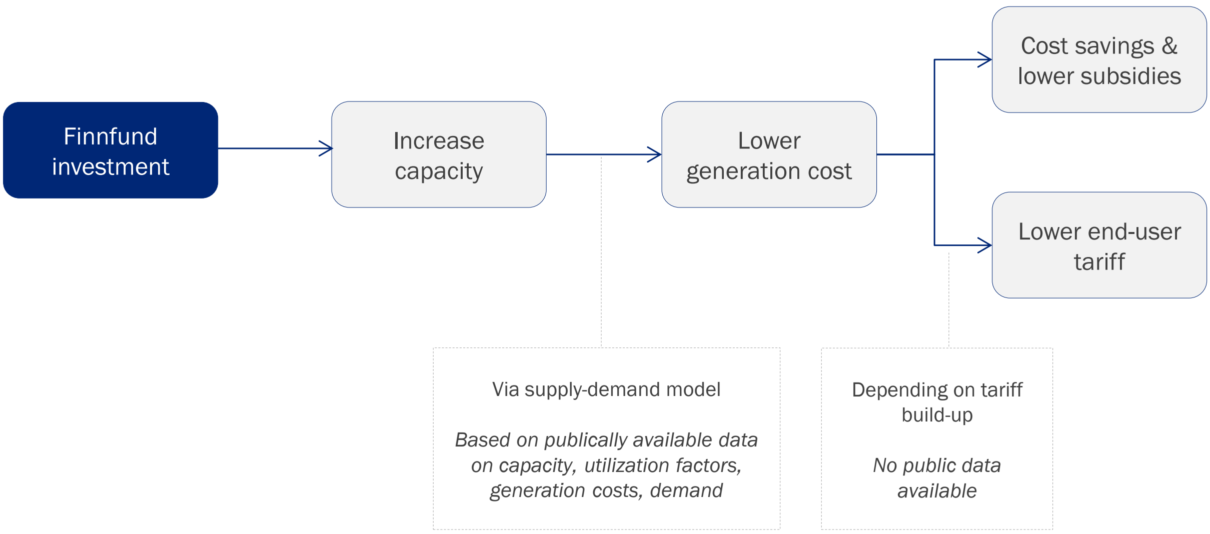

Exhibit 9: Price pathway approach

3.2.2 Results

The effect of new capacity on Honduras' economy is derived by constructing a power price model based on the specification of a power supply and demand curve. A power supply curve ranks all power plants side by side based on dispatch order commensurate with their capacity (in MW). For each plant, it gives the cost of

[25] Although the quality of grid electricity may not be sufficient for some firms to switch from self-generation to grid power, at the level of an entire sector or economy this is not of great importance; electricity not used by one firm is available for another one.

supplying electricity.[26] We construct the power supply curve by using the information on the effective power generation fleet of Honduras, i.e. installed capacity adjusted for utilisation.

By combining the supply curve with the observed power demand of a country (in MW), one can determine the demand-weighted average generation cost. The impact of the addition of generation capacity is determined by deriving two power supply curves: one with and the other without the Finnfund-backed plants. Determining the weighted average generation cost for both situations allows one to calculate the effect of adding generation capacity to the power fleet.

This model has been shown to adequately reproduce observed price behaviour in the Philippines[27], Turkey[28] and Uganda[29].

Supply curve

To construct the country's supply curve, we assigned generation cost values (USD per MWh) for each of the power plants in Honduras, based on plant-specific data. The curve represents the capacity, adjusted for utilization rates. The non-dispatchable plants, which must supply power when available (wind, solar), are placed at the left hand side of the curve.

Exhibit 10 presents a hypothetical curve without the plants financed by Finnfund, while Exhibit 11 shows a curve in which the Finnfund-financed plants are added to Honduras' power fleet. The four power plants add 41.7 MW (or 3.9%) of effective solar (14.7 MW) and hydro (27 MW) power capacity (adjusted for utilization) to Honduras' power fleet and shifts the supply curve to the right.

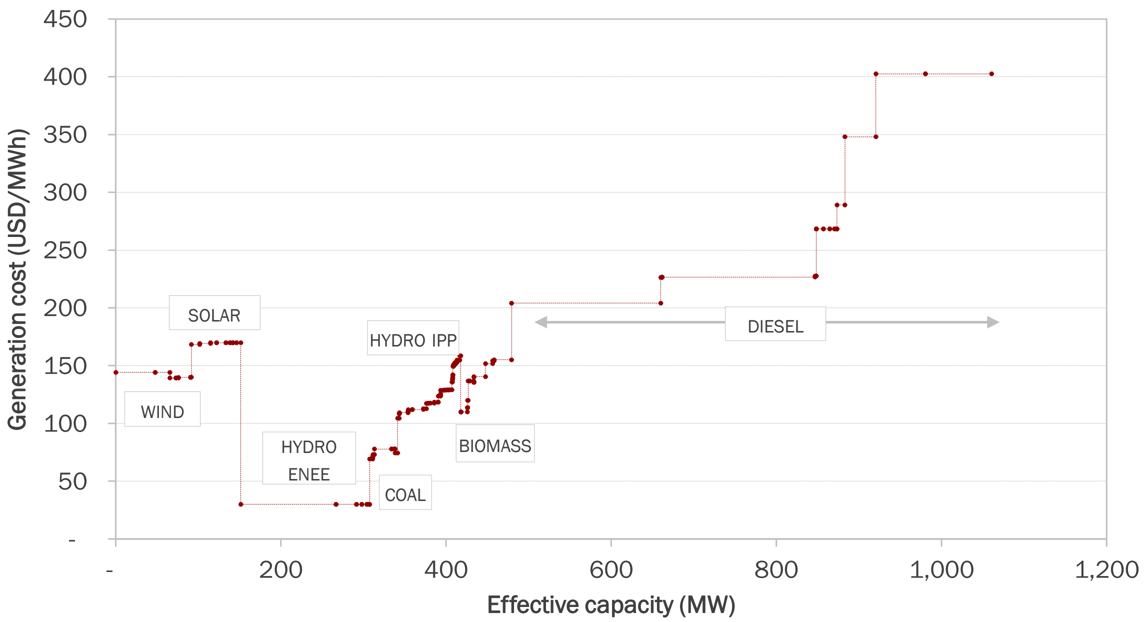

Exhibit 10: Supply curve before Finnfund portfolio plants came online

[26] Data on costs for all plants (except thermal) is received through communication with Luis Suazo Davis. February, 2018. For the thermal plants we only received the fixed cost (excluding fuel). We used 2017 fuel prices and information from ENEE on average fuel use in order to calculate the total generation cost for these plants.

[27] Let's Work study on the impact of power investments in the Philippines, Steward Redqueen 2015.

[28] IFC, How Power Contributes to Jobs and Economic Growth in Turkey, 2016.

[29] CDC, What is the Link between Power and Jobs in Uganda 2016.

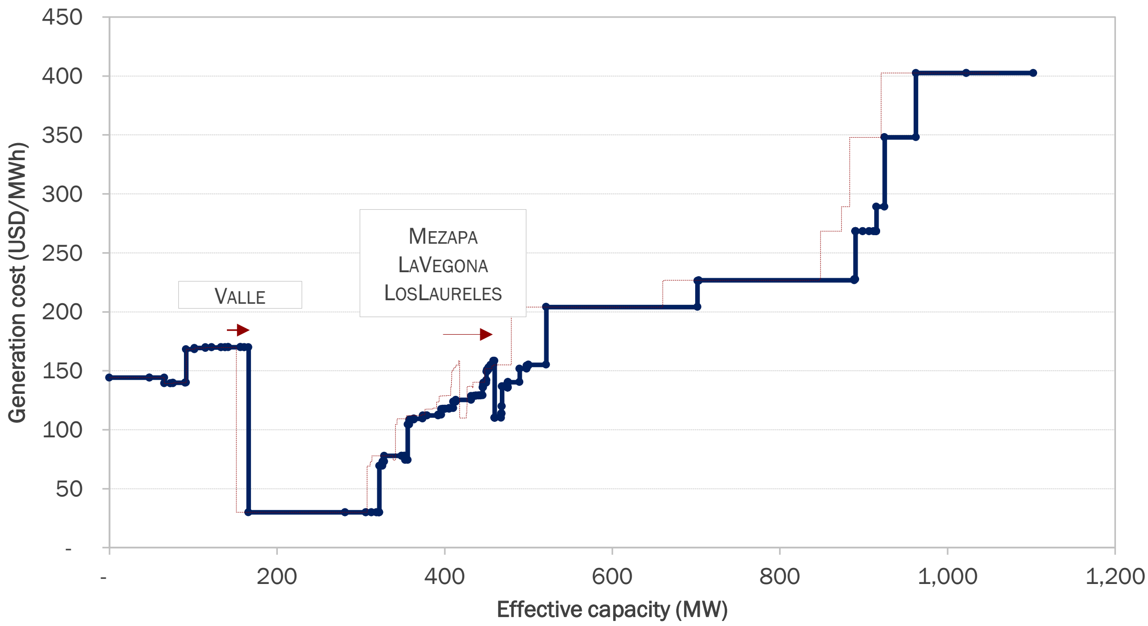

Exhibit 11: Hypothetical supply curve after the addition of the Finnfund plants

Demand curve

In order to determine electricity prices one needs to know the power load curve (in MW) which essentially amalgamates the total power consumption in the system. The curve in Exhibit 12 shows the level of power load in the course of a typical day. It is based on the average hourly power load data for each day of 2017. The peak demand at 1,140 MW occurs between 18:00 and 19:00 is 1.3 times the average load (870 MW). A smaller peak of 1,050 MW occurs around noon.

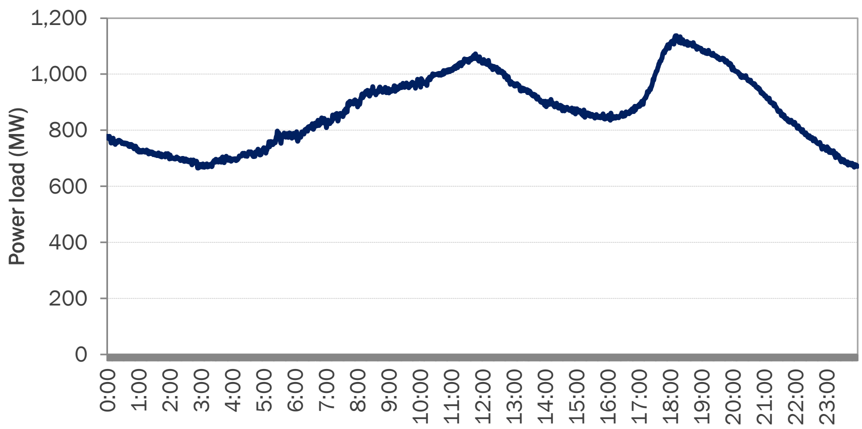

Exhibit 12: Demand curve

Price model

The effect of the four plants financed by Finnfund on the average generation cost is determined by combining the two supply curves with the demand curve. The results are shown in Exhibit 13. The blue line illustrates the demand, while the coloured sections show which capacity is used to cover the demand.

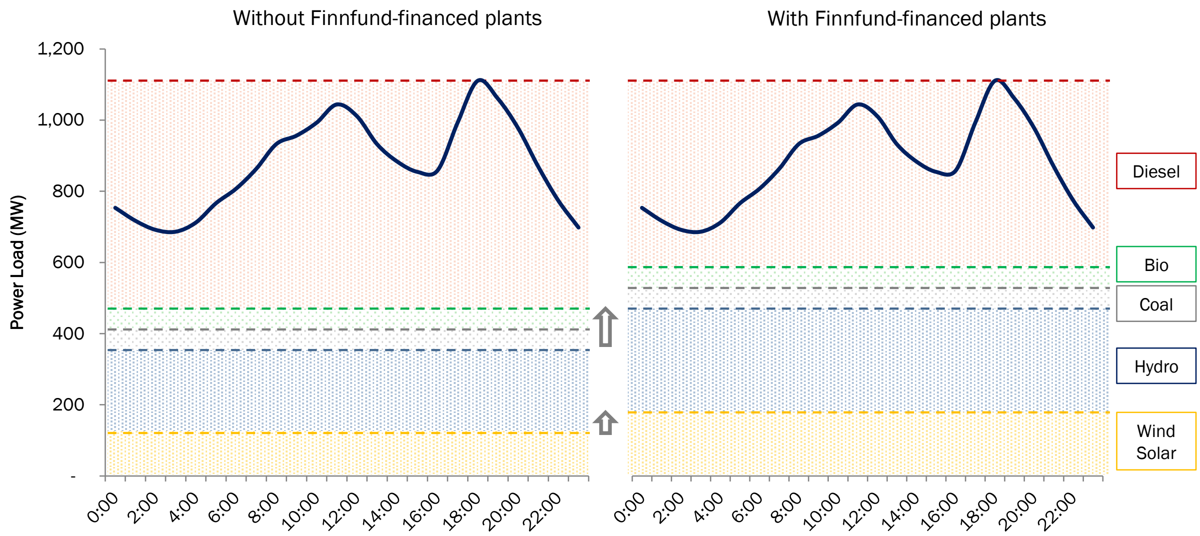

Exhibit 13: Demand curve with and without Finnfund-financed plants

Looking at Exhibit 13, without the four plants, the maximum renewable capacity (wind, solar, hydro) is used to supply demand up to 393 MW demand. Thereafter, coal, biomass, and diesel are turned on to cover the rest of the demand. The expensive diesel plants are used to cover load at above 660 MW. By contrast, with the Finnfund-financed plants, 434 MW of demand is covered by renewables. The diesel plants kick in at 702 MW.

Effect on price and savings

The supply and demand curves were combined in a price model, which matches the hourly demand to the available capacity and yields the (load-weighted) average generation cost per MWh. As indicated earlier, the four plants financed by Finnfund offer additional capacity which means the diesel plants are used to cover less demand. The power generated by the renewable plants is cheaper compared to the diesel plants. We estimate that the additional capacity will decrease the estimated weighted average kWh cost by 4.7% (from estimated $0.163 to $0.155 per kWh; HNL 3.7 to HNL 3.5).

Reduction in the generation cost will lead to decrease in the end-user tariff only if the latter is cost-reflective, which is not the case for Honduras, as explained in Section 2.4.2. Given the critical financial situation of ENEE during the period, it is hard to conclude to what extent decreasing electricity tariffs were driven by the reduction of generation cost.

Nevertheless, the lower generation costs mean final tariffs have come closer to cost-reflective levels. The decrease of price of $ 0.008 per kWh could mean improvement of the financial situation of ENEE, since for each kWh sold $0.008 less in subsidies is needed. Based on the total electricity sales in 2016 (5.9 million MWh), the decrease in generation cost translates to a one time cost savings of a USD 45.1 million, equal to 1.0% of Honduras' tax revenues.[30]

Furthermore the switch from diesel to renewable production means that the country requires less fuel imports. The renewable plants produce energy which would have otherwise been produced by thermal generation. That means that they displace fuel purchases. Given that diesel plants use about 1.1 barrels of fuel per MWh[31], the 365,300 MWh produced by the Finnfund-financed plants in 2016 displaced nearly

[30] Total 2016 tax revenues of Honduras reported by OECD at NHL 104,976 million.

[31] Calculation is based on total imports of diesel and fuel oil in Honduras in 2016 of 22,000 barrels per day, translating into total of 8 million barrels a year (source EIA Imports database). IEA reports that in 2015, from the total imports of diesel and fuel oil of 1,925k tonnes (IEA figure for 2015), 1,080k tonnes (56%) were used by the electricity sector. This means about 4.5 million barrels were used for electricity. The total production from diesel and fuel plants in 2016 was 4,116 GWh.

400,000 barrels of fuel, or approximately 8.9% of the total fuel and diesel imported for the electricity sector in Honduras. The estimated cost of this fuel is about USD 22.5 million.

Lower fuel use also translates to lower overall CO_2 emissions. The four plants are estimated to have contributed to the avoidance of 285 kt of CO_2 emissions, or approximately 3.0% of Honduras' total emissions.[32] The avoided emissions are valued at USD 1.8 million based on a carbon price of USD 6.3 per ton of emissions.[33] Based on the price needed to keep global warming below 2C – USD 47 per ton – the amount would be USD 13.2 million.[34]

3.3 Impact via the outage pathway

3.3.1 Methodology

Outages can have a substantial impact on firm output and productivity. They can affect economic output in different ways: (i) loss of production, (ii) restart costs, (iii) equipment damage, and (iv) spoilage of raw or finished materials. There are a number of factors which can completely or partly mitigate these negative impacts. In addition to self-generation, firms can continue operations without electricity or reschedule production; adopt technologies that allow faster production during hours when power is available; or procure energy intensive semi-finished goods and thereby eliminate power-intensive production steps.

A complicating factor here is that outages occur for many different reasons: insufficient power generation capacity (often leading to planned load shedding); (unplanned) tripping of power plants; (planned) maintenance of the transmission and distributions networks; or (unplanned) faults in the network. Research shows that when reserve margins are low, additional capacity does prevent blackouts or power rationing. In order to determine the effect of additional capacity on power outages one therefore has to:

1. Determine which fraction of the total outage time is caused by insufficient power supply, something which is likely to vary greatly from country to country;
2. Determine how an increase of power supply reduces the outage time caused by insufficient generation capacity (as determined under point 1);
3. Convert the outage time reduction into a relative increase of production time (in %) and economic production.

Unfortunately, as stated in Section 2.4.3, there is no publically available dataset on Honduras from which we can infer the trends in outages since the commencement of any of the four plants. Because of the lack of such data, for this analysis we have relied on insights from our previous research in the power sector, as shown in Exhibit 14, and outside research. In an extensive study we did in Uganda, using detailed data on outages from the national utility company, we found that 1% capacity increase increases operation time of firms by 0.14%.[35] This value is very similar to the 0.11% derived from research in Malaysia.[36] This is not entirely coincidental because power systems in many countries exhibit a fairly similar range of reserve margins as mentioned before. In this report we take the simple average of the two estimates and assume that a 1% increase of generation capacity increases available production time by 0.125%. Although based

[32] Based on 0.778kg/kWh emission avoidance (source: On-Grid Solar PV versus Diesel Electricity Generation in Sub-Saharan Africa: Economics and GHG Emissions) and total emissions of Honduras of 9,472 kilo tonnes (source: Trading Economics https://tradingeconomics.com/honduras/co2-emissions-kt-wb-data.html)

[33] Trends and projections in the EU ETS in 2017: The EU Emissions Trading System in numbers. (2016) Environmental Energy Agency. No. 18/2016. https://www.eea.europa.eu/publications/trends-and-projections-EU-ETS-2017

[34] Financial Times, 2016. *BlackRock calls for higher carbon price to tackle climate change.* https://www.ft.com/content/bde6859a-9ac2-11e6-8f9b-70e3cabccfae

[35] Steward Redqueen (2016). *What is the Link between Power and Jobs in Uganda?* http://www.stewardredqueen.com/uploads/cases/what_is_the_link_between_power_and_jobs.pdf

[36] Zafir, S.R.M., Razali, N.M.M. and Hashim, T.J.T., *Relationship between the loss of load expectation and reserve margin for optimal generation and planning.* Jurnal Teknologi, 2016

on only two empirical studies, this heuristic assumption is directionally correct and its simplicity does not require the specification of additional parameters.[37]

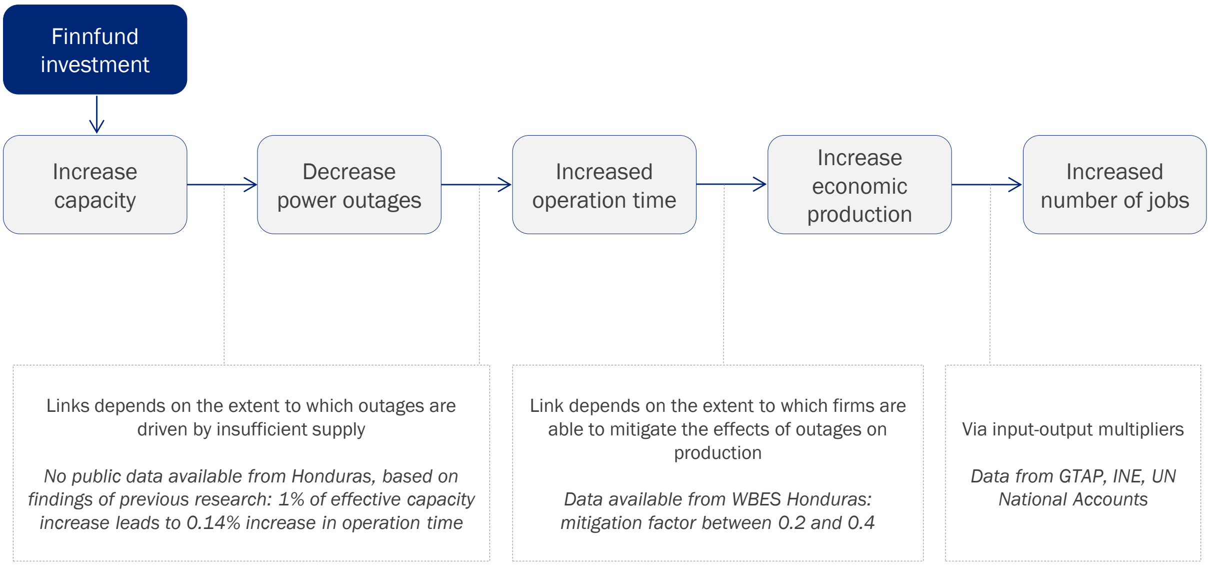

Exhibit 14: Outage pathway approach

As in the previous section, results presented here reflect changes brought about by the four plants and do not take Finnfund attribution into account.

3.3.2 Results

Contribution to effective generation capacity

The 104 MW installed capacity of the four plants financed by Finnfund constitute 4.5% of Honduras' total installed generation capacity. In terms of effective capacity contribution, based on utilization factors of the plants, the four power producers contribute 3.9% to the country's effective capacity.

Increase of operation time for companies

An increase of generation capacity reduces the power outage time which in turn increases the time that companies can be operational. Although the relationship between increased generation capacity and outage time is by no means straightforward, from previous research we argue that 1% increase of generation capacity translates into a 0.125% increase of production time. That means that the increase of operation time related to the four Finnfund financed plants is 0.5%. Although this number seems small, one has to keep in mind that at the regional or local level, the impact of the plants can be much larger. But in this research we look at the impact of the plants on the Honduran economy in its totality.

Increase of economic output

The increased time that companies can operate due to the reduced outage time must be converted into an increase of actual economic output. This means accounting for how outages affect companies with different sizes and different economic sectors. The reasons for this are the previously mentioned

[37] In a recent research we carried out on the power sector in Cape Verde, we found that 1% increase in capacity leads to 0.05% reduction of outages. The lower reduction in the latter can be explained by the different power sector circumstances. Uganda suffered from significant shortage of power, leading to frequent load shedding. In Honduras, insufficient supply exacerbated by droughts was also the cause of power shortages In Cape Verde, while outages occurred because of tight demand-supply balance, the country did not experience shortage of electricity of the magnitude in Uganda and Honduras. Due to the fat that the situation in Honduras resembled more the one in Uganda rather than in Cape Verde, we use the multiplier from the power study in the former country.

differences in how companies respond to outages. In the WBES, companies report on the time of outage and the resulting loss in their sales. Table 1 shows the average operations time lost by companies because of outages and the resulting sales losses.

Table 1: Reported firms' outages, losses, and estimated mitigation factor

Company type	Outage (% of operation time)		Losses (% of sales)		Factor
	Average	Median	Average	Median	Mid-point
Small	8%	5%	5%	1%	0.4
Medium	8%	5%	5%	3%	0.6
Large	5%	2%	3%	1%	0.5
Manufacturing	9%	4%	4%	1%	0.4
Wholesale, retail	7%	5%	5%	1%	0.4
Services	5%	4%	4%	1%	0.6
TOTAL	**7%**	**5%**	**5%**	**1%**	**0.4**

The mitigation factor is calculated by dividing the loss share to the outage share, and shows the extent to which firm sales (output) is affected by loss of operation time due to outages. The fact that the factors for all company types are less than one implies that for each hour of outages, companies lose less than one hour of possible production. As previously mentioned, this could be because they are able to generate electricity themselves (e.g. from a diesel generator), reschedule lost working time when electricity is back, or because during blackouts they continue utilizing manual labour. It also means that for each hour gained as outages are phased out, companies will gain less than one hour of output.

Although the factors per company type are similar, it is interesting to note that small companies have the lowest factor, meaning that they are least affected by outages. This could be because they have a more flexible production schedule or can continue to work without electricity. Service companies have the highest factor among the three reported sectors, meaning that they lose relatively the most output during outages. This is surprising as one would expect that manufacturing and trade companies' operation would be more affected by the lack of electricity. The differences between sectors are small however.

Multiplication of the relative operation time increase by the mitigation factor and subsequently by the total sector economic output results in the change of economic output per individual sector. The results are presented in Exhibit 15.

Output effect is estimated for two groups of economic agents:

- Companies/sectors which directly benefit from the reduction of outages – firms operating in manufacturing, trade, and services all depend on electricity for their operations (to various extents) and will thus directly benefit from the lower outage duration;
- Companies/sectors which do not directly benefit from the reduction of outages – firms operating in the agriculture sector do not rely on electricity for their operations. Therefore, lower outage duration does not have a direct effect on agricultural production. However, agro-businesses will benefit indirectly due to increased procurement from other sectors affected by the change in price (most notably food & beverage manufacturing). We quantify this effect using Honduras' Input-Output table[38]. We calculate how USD 1,000,000 increase in the sectors affected from the lower electricity price translates into higher output for the agriculture sector. Based on these multipliers, we estimate the total increase in agricultural output related to the higher production of the electricity-dependent sectors.

[38] The most recent IOT for Honduras comes from the Global Trade Analysis Program (GTAP).

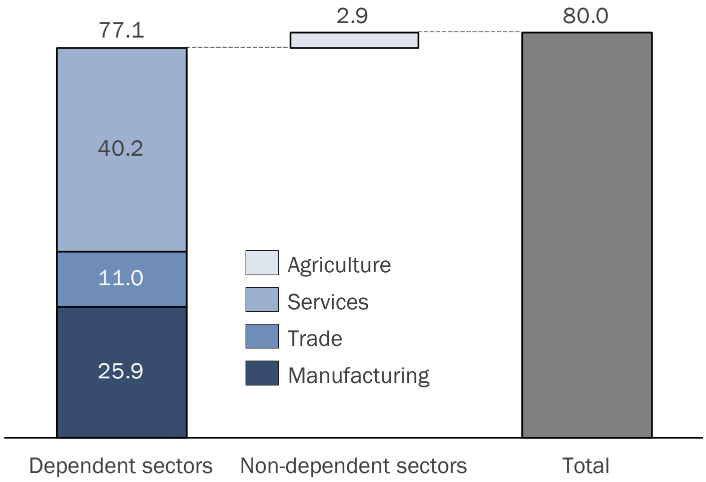

Exhibit 15: Change in output and share of sector (USD m)

Based on the outage multiplier, the mitigation factors, and the output of sectors, we estimate that the production output related to the decrease of outages is USD 77.1 million among firms which are dependent on electricity use (as presented in Exhibit 15). Companies in the manufacturing sector up-scaled production by USD 25.9 million (0.2%), while the trade sector increased output by USD 11 million (0.2%). The increase of output in the services is the largest at USD 40.2 million (0.3%). Businesses in agriculture did not directly benefit from less outage time given their negligible use of electricity. However, due to the increased production –and thus procurement– from the 'dependents', the agro-sector also expanded its output in order to meet the growing demand for its products. This procurement effect increased total economic output value by USD 2.9 million (0.1%).

The total output increase in Honduras was thus USD 80 million, equal to 0.2% of total economy output.

Effect on incomes and employment

In order to translate the sectoral changes in economic output into employment effects we determined the employment intensity of the economic sectors in Honduras. For this, we use data on the National Accounts of Honduras, published by UN.[39] The latest available output and employment data is from 2016. Using the output produced in the corresponding sector and year, for 10 economic sectors (ISIC Rev. 3) we calculate the number of jobs needed in a sector to produce one unit of output (in USD), i.e. the employment intensity of the sector.

Approximately 5,100 jobs can be attributed to the additional capacity of the four Finnfund-financed plants, which is equivalent to 0.2% of the total employment (Exhibit 16, left). Most jobs are added in the service sectors (2,850, or 0.3%) which experiences the highest output growth. The labour intensive trade sector added some 1,450 jobs (0.2%), while the manufacturing sector added 840 employees (0.2%). Approximately 650 additional people were involved in agricultural production (0.1%).

As discussed in Section 2.1, the level of underemployment in Honduras is high at about 30%. Many employment opportunities are not permanent and could entail a few hours of work. Therefore these employment results should not be interpreted as jobs in full-time equivalents (FTE), but as people/livelihoods affected.

[39] National Accounts Statistics: Main Aggregates and Detailed Tables https://read.un-ilibrary.org/economic-and-social-development/national-accounts-statistics-main-aggregates-and-detailed-tables-2016-five-volume-set_d3642f52-en#page9

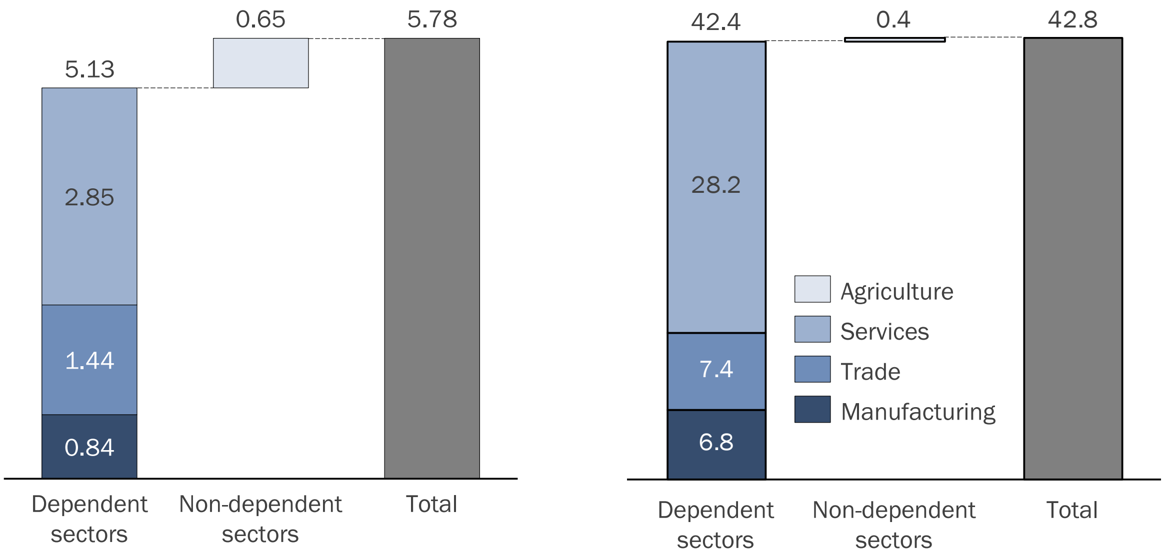

Exhibit 16: Employment (left, total headcount, thousands) and value added supported (right, USD m)

Nearly USD 42.8 million in value added can be attributed to the additional capacity of the four Finnfund-financed plants, equivalent to 0.2% of 2016 GDP (Exhibit 16, right). Like the additional jobs, most value added is supported in the service sectors (USD 28.2 million or 0.1%) due to high output growth in those sectors. The trade and manufacturing sectors added USD 7.4 million (0.04%) and USD 6.8 million (0.03%) respectively. The non-energy dependent agriculture sector added approximately USD 0.4 million.

3.4 Overview of key results and multipliers

The results derived in Sections 3.2 and 3.3 presented the total effect of this new capacity to the economy. In Table 2 we express the price and employment results as key ratios – per 1% and per 1 MW increase in capacity.

The generation cost effect in Honduras is in line with the one estimated by Steward Redqueen in Uruguay (0.93%). The slightly lower effect in the latter is due to the flatter power supply curve in Uruguay than in Honduras.

The job multipliers for Honduras are lower than the ones for Uganda, where we estimated that each additional 1 MW of capacity led to approximately 800 jobs. This is mostly due to the differences in the level of labour productivities in the two countries. The economy of Uganda is more labour intensive than the one of Honduras. This is particularly true for the manufacturing, services, and trade sectors. This is also reflected in the fact that % capacity has similar effect expressed as percentage of the total labour force – 0.04% in Honduras versus 0.03% in Uganda.

Table 2: Key multipliers

	Per 1 % capacity increase	Per 1 MW capacity increase
Δ Generation cost (%)	-1.19%	-0.11%
Δ Employment (# jobs)	1,465	138
Δ Employment (% labour force)	0.04%	

4 ECONOMIC IMPACT OF PLANT'S OPERATIONAL EXPENSES

In addition to the forward economic impact brought about the four plants (stemming from the productive use of the electric power they generates), Finnfund's clients affect the economy through the spending related to operation of power plants and from their backward economic (i.e. supply) linkages. These include the direct (related to value added and employment generated at the power plant both for construction and operations), and indirect (at the level of the suppliers and the suppliers' suppliers) effects.[40]

4.1 Methodology

Money flows relating to the construction and operation power plants are being traced using the Input-Output methodology, which is commonly used by academics and practitioners in impact assessments. This allows for the quantification of GDP and employment impact. The key-ingredient in this process is a so-called Social Accounting Matrix (SAM) shown in Exhibit 17. The SAM describes the financial flows of all economic transactions that take place within an economy; it is a statistical and static representation of the economic structure of a country. In the SAM the number of columns and rows are equal because all sectors or economic actors (industry sectors, households, government, and the foreign sector) are both buyers and sellers. Columns represent buyers (expenditures) and rows represent sellers (receipts). As shown in the exhibit, consumption induces production which leads to financial transfers between the various sectors which subsequently generate incomes for households (salaries), governments (taxes) and companies (profits and savings). The latter three represent the GDP (value added) effect related to the financial transaction.

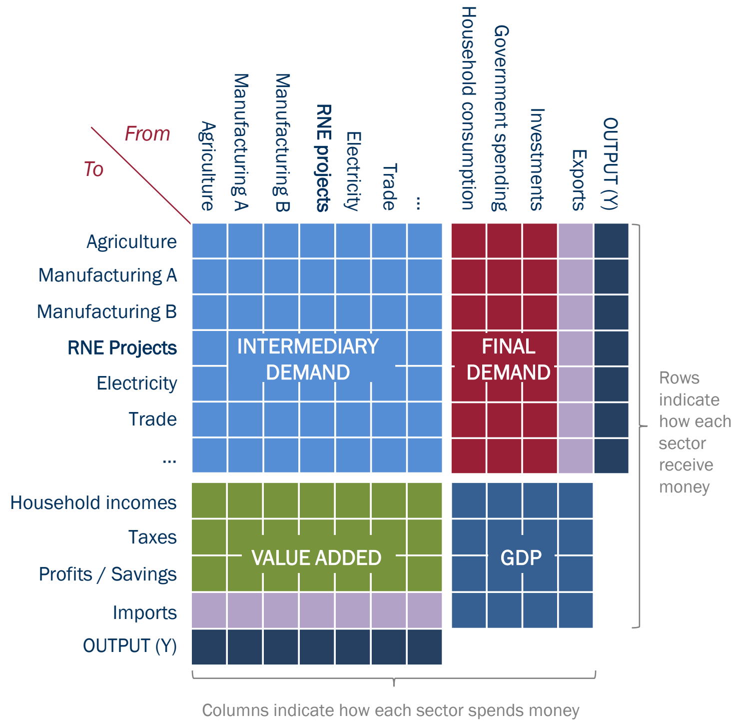

Exhibit 17: Social Accounting Matrix

Sales revenues generated by the four plants in 2017 were spent by the entities on procurement from local and foreign suppliers, on employee salaries and tax payments. To calculate the related impact, we follow

[40] Induced effects are calculated only for the employment results and not for the value added results in order to avoid double-counting of the (effects of) household incomes.

the plants' expenditures through the Honduras SAM. This is done by adding their expenditures pattern as a separate column in the SAM. In this way we can determine how spending of the four plants induce production down their local value chains (i.e. for their suppliers, and the suppliers of the suppliers), and how this subsequently leads to salaries, taxes, and profits.

To calculate the job effects of the related production, we make use of sector-specific employment intensities showing the number of employees needed in a certain economy/sector to produce one unit of output. These intensities are based on the latest available output and employment statistics (2016) from the national statistics institution and the UN National Accounts database.

4.2 Results

The value added and employment results are presented in Exhibit 18.

In terms of employment, some 545 jobs are supported by the plants' operations, both directly and indirectly (Exhibit 18). The power companies employ 155 people directly, 210 people at the level of their suppliers, and additional 180 people at suppliers of suppliers. That means the total value chain of these companies consists of 155 direct and 390 indirect jobs.

Most of the total indirect jobs are in wholesale/retail trade (95 jobs), and financial and other professional services (215). Only about 20 jobs are supported in the local manufacturing sector which is not surprising, as most of the equipment purchased for the plants is imported. While most equipment is purchased one-off, repair and maintenance needs to be done regularly and such services are available locally. Comparing the direct jobs at the four companies to the indirect jobs in their broader value chains, we can conclude that each job at the power companies supports another 2.5 jobs elsewhere in the economy of Honduras.

Of the estimated total USD 32.7 million of value added, about USD 29.1 million is directly generated by the four plants, while the remainder is supported at the level of its suppliers and their suppliers. In terms of beneficiaries, the majority of the total incomes are in the form of profits and savings for the four companies and their direct and indirect suppliers (USD 28.4 million), while a smaller portion is in the form of salaries and taxes paid along the value chain (USD 3.3 million and USD 1.0 million respectively).

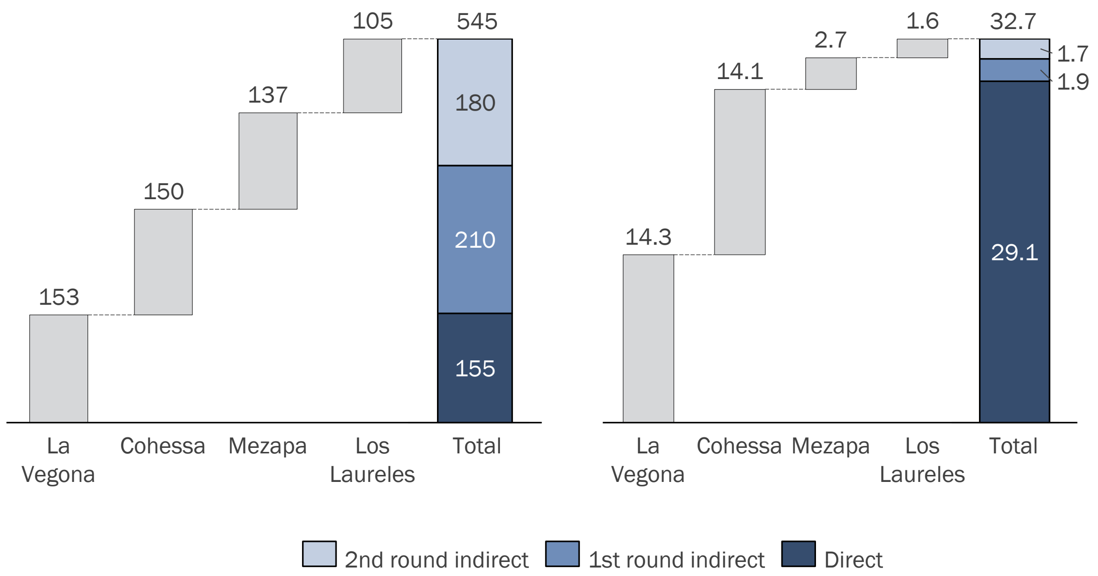

Exhibit 18: Employment (left, headcount) and value added (right, USD m) related to the operations of the four plants

5 CONCLUSION AND RECOMMENDATIONS

The addition of La Vegona, Mezapa, Los Laureles, and Valle to Honduras' power fleet improved the availability and affordability of electricity in the country. In more concrete terms, the plants had the following impact in Honduras:

1. By supplying renewable energy cheaper than thermal, they have lowered the average generation cost of electricity in the country. Using an economic model based on supply and demand data, we estimate this decrease in generation costs to be nearly 5%. This reduction in costs translates to a cost saving for the state of a total USD 45.1 million, equal to 1.0% of Honduras' tax revenues;
2. By displacing imported fossil fuels needed for thermal generation, the plants contributed to reduction of imported fuel estimated at nearly 400,000 barrels, or approximately 9% of the total fuel and diesel imported for the electricity sector in Honduras. The associated reduction in carbon emissions is nearly 285 k MT, or 3% of the country's total emissions;
3. By providing needed power supply, the four plants contributed to the reduction of outages in the country. This has enabled firms to increase production time and output. The resulting employment creation effect is quantified at 5,800 jobs. Given the wide-spread underemployment in the country, many of these do not constitute a full-time employment opportunity but livelihoods;
4. By operating in Honduras, the plants also create employment opportunities and sustain local value chains. The related direct and indirect incomes and employment opportunities related to these operations are estimated at USD 33.4 million and 630 jobs. While definitely present, these 'backward' effects are of smaller magnitude than the 'forward' impacts related to outages.

Considering the developments in Honduras' power sector and the findings of this report, we make the following recommendations:

1. This study, along with others we have conducted in the power sector, shows that the impacts from investments in power vary depending on certain characteristics of the local energy sectors. When considering investing in (renewable) power, organizations need to take the following in consideration with respect to the economic impact of their investments:
   a. Low reserve margins imply that the power sector is more prone to blackouts and therefore additional energy supply leads to reduced outages, higher production and more jobs;
   b. A high dependence on fossil fuels for generating energy leads to displacement of expensive thermal generation and avoidance of carbon emissions;
   c. The effect of displacing thermal on the overall generation cost will depend on the difference between the cost of fuel and renewables. When fuel price are high, investing in cheaper renewable capacity will have a high impact on the generation cost. However, some thermal could still be cheaper than renewable from feed-in-tariffs.
   d. The effect of lower generation costs is different depending on whether or not tariffs are cost reflective. If tariffs are not cost reflective, as is the case in Honduras, a lower generation cost moves the energy situation closer to a cost reflective price, reducing the need for government support, driving the sector closer to a market-based model. Whereas, if tariffs are cost reflective, a lower generation cost leads to lower end user tariffs, higher electricity consumption, more production and more jobs.
2. The study has demonstrated that inclusion of renewable power capacity to Honduras' grid can decrease generation costs by displacing fuel plants. Non-hydro renewables account for 24% of the country's installed capacity. Given the intermittent nature of solar and wind, investments in other technologies might be considered for the future. Honduras, as well as other countries in the region, has a large unexploited geothermal potential. Geothermal power has the advantage of providing baseload power at relatively low costs and with low greenhouse emissions. Provided that extraction

procedures are undertaken in responsible manners, it could provide a good opportunity to diversify Honduras' power fleet away from diesel.

3. Given the relatively low electrification rate of Honduras (compared to other countries in the region), as well as the gap between urban and rural electrification, more investments seem necessary to ensure universal access to electricity. Decentralized renewable mini-grid projects could be a potential financing opportunity to support development of rural areas of the country.