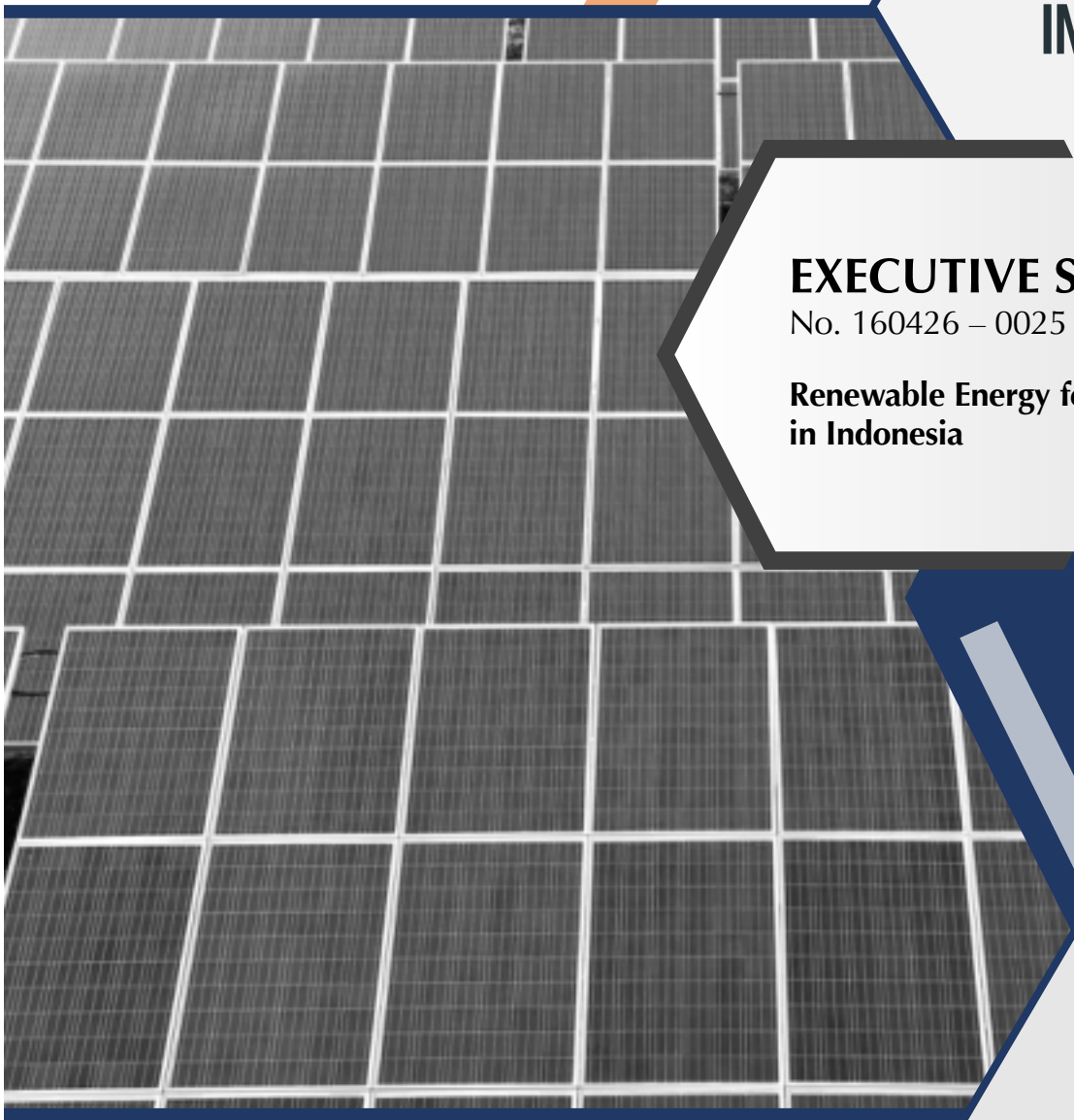
WORKING TOGETHER TO PROVIDE ELECTRICITY FOR ALL

INDONESIATERANG



EXECUTIVE SUMMARY

No. 160426 – 0025 – A00

Renewable Energy for Village Electrification in Indonesia

Developed by:

tusk
Advisory Pte Ltd
Delivering Infrastructure

″Working Together to Provide Electricity for All″

EXECUTIVE SUMMARY

No.160426-0025-A00

“Renewable Energy for Village Electrification in Indonesia”

Contents

Foreword by the Coordinating Minister for Maritime Affairs

The Indonesian Government believes firmly in the principles of equitable economic growth. Indeed, this is why President Joko Widowo's "Nawacita" manifesto places considerable store in the importance of increasing the economic growth of Eastern Indonesia to match that of Western Indonesia. One of the key factors behind this disparity in economic growth is the difficulty in accessing electricity in Eastern Indonesia. While the overall electrification ratio of Indonesia currently stands at 88.3% (PT PLN, 2015), there are 43 regencies in Eastern Indonesia where the electrification ratio is still less than 50%. By 2019, the Government of Indonesia aims to achieve a 97% electrification rate across the country. To reach this goal, the Government plans to implement a new rural electrification program called Program Indonesia Terang (PIT) or the Indonesia Illumination Program which will target Eastern Indonesia.

Program Indonesia Terang is an innovative and well-thought-through program of the Ministry of Energy and Mineral Resources aimed at electrifying villages in far-flung regions and districts while using mainly renewable and clean energy sources.

An additional innovation in the PIT implementation plan is the creation of special funding schemes that are aimed at leveraging not only the government's budget but also the private sector's participation via various partnership schemes. PIT underscores the significant involvement of different stakeholders at multiple levels in ensuring acceleration of the rural electrification program. The scope of the program cuts across multiple sectors, namely renewable energy, rural development and electrification.

On behalf of the Coordinating Ministry for Maritime Affairs, I am very pleased to support the release of this report and I would like to thank all stakeholders involved in developing this timely and important report, particularly the Ministry of Energy and Mineral Resources, the National Development Planning Ministry (BAPPENAS), the Ministry of Villages, Underdeveloped Regions and Transmigration as well as the National Team for the Acceleration of Poverty Reduction (TNP2K) and PT PLN.

General (Ret.) Luhut Binsar Pandjaitan
Coordinating Minister for Maritime Affairs

Foreword by Minister of Energy and Mineral Resources

Experience in other countries, and in Indonesia itself, shows that basic infrastructure is an effective tool for reducing poverty and achieving other goals of sustainable development. Electricity supply is not only a requirement that must be met to satisfy basic needs, such as lighting and pumped water supply, but also a mechanism for boosting local economic growth and improving living standards.

The availability of electricity can strengthen the local economy through job creation via new areas of business, increase productivity, and increase the value of the products produced. In addition, access to electricity can provide other indirect benefits, such as the improvement of health services in the villages, increasing the quality of education, and the strengthening of defense and security.

There are still 12,659 villages in remote areas in Indonesia that currently lack the services of electricity from the national grid.[1] To achieve the target of increasing electrification ratio to 97% by 2019 as mandated in RPJMN, major breakthroughs are clearly needed. The breakthroughs include: (i) a policy breakthrough, (ii) a funding breakthrough, (iii) a technological breakthrough, and (iv) a capacity building breakthrough.

The Program Indonesia Terang (PIT) or Indonesia Illumination Program, developed by my Ministry represents a breakthrough in policy development to provide access to electricity for 2.5 million households by making use of locally available renewable energy sources. I am grateful for all the stakeholders involved in developing this watershed program.

The initial phase of PIT will focus on Eastern Indonesia, particularly in the provinces of Papua, West Papua, Maluku, North Maluku, West Nusa Tenggara and East Nusa Tenggara. The program aims that 10,300 villages will be electrified by 2019, and targets the most remote villages, which have been difficult to reach using the national power grid. By utilizing local resources, such as solar energy, hydro, wind, and biomass, construction of electrical facilities using independent off-grid systems is therefore very possible.

PIT is also a breakthrough in funding. This program does not just rely on financing from the government, but also combines the mechanism of state budget with other funding sources (private, grants, and loans from both inside and outside the country) to reduce the fiscal burden. PIT also offers a wide range of options using an implementation model that allows the involvement of various parties such as business entities (private, public enterprises, BUMDes, and cooperatives), as well as NGOs and governmental organizations.

In total, the PIT has the potential to develop up to 1,500 MW of renewable energy, which in turn contributes to the achievement of the Government's target of 97% electrification by 2019 and to achieve a 23% share of renewable energy of the total national energy mix by 2025.

I take this opportunity to also thank the Japan International Cooperation Agency (JICA) for its support in developing this program.

Ignasius Jonan
Minister of Energy and Mineral Resources

1 The Village Potential BPS 2014 on Electricity.

Acknowledgement

This Report is an abridged version of the final report developed by Tusk Advisory, which was submitted to the Japan International Cooperation Agency and the Ministry of Energy and Mineral Resources. It aims to provide an overview of the Government's new rural electrification initiative, aptly named Program Indonesia Terang (PIT) or Indonesia Illumination Program and identifies a plausible way forward for the implementation of this important initiative under the President's Nawacita program for Indonesia's economic growth.

Tusk Advisory was contracted by Japan International Cooperation Agency (JICA), under contract No. 160426-0025-A00 "Renewable Energy for Village Electrification in Indonesia". The team of consultants from Tusk Advisory (TUSK), includes Ir. Raj Kannan, Dr. Nicholas Morris, Shuhaela Zen, Wilson Kurniawan, Akbar Wicaksana, Nanda Erian, Adela Pranindiati, Audi Prabowo and Shrutika Sainani. TUSK is very grateful for the support from JICA, in particular, Mr. Tetsuya Harada (Senior Representative) and Mr. Juraku Masahiro (Representative), for providing guidance and support.

TUSK wishes to put on record its appreciation to a number of key individuals from Ministry of Energy and Mineral Resources who generously gave their time and expert input for the development of the program and the various reports including this abridged version. In particular, TUSK would like to thank Dr. William Sabandar (former Head of National Task Force for Accelerating New and Renewable Energy Task Force or P2EBT) and Dr. Ir. H. M. Said Didu (former Head of Program Indonesia Terang Implementation Unit or UP-PIT) as well as the UP-PIT team members, which include Margareth E. Horhoruw, Herdiyanto Setiawan, Eva Fitrina, Nina Nuraisyiah, Ferruccio Santetti, Afifah Eleksiani, Darul Syahdanul, Abi Prionggo, Arga R. Oktian and A. Azis Kurniawan.

TUSK also extends its appreciation for the support rendered by the leadership at Ministry of Energy and Mineral Resources, namely Bapak Teguh Pamuji, Secretary General of Ministry of Energy and Mineral Resources, Bapak Ir. Rida Mulyana, Director General of New and Renewable Energy and Energy Conservation, Bapak Dr. Ir. Dadan Kusdiana, Secretary of Directorate General of New and Reneable Energy and Energy Conservation, and Ibu Ir. Maritje Hutapea, Director of New and Renewable Energy. In addition, TUSK is thankful for the collaborative spirit and support from Bapak Agung Prasetyo, Bapak Ezron M D Tapparan, and Bapak Suwondo Arie P.


UP CIRATA

Preamble

Providing electricity to the poorest households, who often live in remote areas, is a very effective way of eradicating poverty and meeting sustainable development goals. Even limited access to electricity can provide lighting (which extends the working day); improve water supply (through availability of pumps); enable education (bringing IT to schools and permitting children to study in the evening); link communities (enabling telecoms); facilitate better healthcare (bringing cleaner water, modern medicine and remote diagnosis); provide basic refrigeration (improving food safety and reducing waste); enable the development of new industries, increasing productivity and jobs (for example through the use of power tools for woodworking and agriculture); and provide an alternative to the use of carbon-based fuels for cooking (with both environmental and health benefits).

These myriad benefits are the reason why most developing countries have prioritised rural electrification, and why many countries in Asia now have near-universal access. Indonesia also has a commitment to near-100% provision, but the implementation of this goal is a challenge in a country consisting of over 17,000 island with 6,000 inhabited islands where rural electricity access is currently below 40%. In many islands, it is simply too difficult to bring transmission lines to remote areas, which means that off-grid solutions are needed. Program Indonesia Terang's mission is to identify those communities where an off-grid supply is needed, and then to work out the most feasible and value-for-money method of providing it.

Many remote communities do have access to basic resources – rivers, wind, sun, biomass – which can make the use of renewable technologies a cost- effective method of providing electricity. Even where these are not enough to meet basic needs, or the costs are too high, hybrid solutions involving limited use of diesel generators can also be effective. Micro-grids can improve economies of scale by linking household clusters together. Choosing between technologies requires subtle analysis of available resources, current and expected future technology costs, and how well the local community will adopt and maintain the new facilities.

However, providing electricity in remote places can be expensive, not least because of high logistics costs. Although there are some remote communities where local industry means that some residents can afford to pay for the supply, and therefore a privately-funded system is possible, most poorer communities cannot. In due course, once electricity is supplied, the local economy will develop and affordability will become less of a challenge. But, at least for a transition period, it is necessary to assist the community in paying for the new supply.

Constitutionally, the government is required to allocate budgets for the targeted areas in order to provide basic electricity supply.[2] However, in order to limit the burden on the public budget, involvement of the private sector, charitable organisations or international donors should be encouraged wherever possible. In most cases, rural electrification projects will not be commercially viable as the communities they serve are among the poorest in Indonesia, with very limited ability to pay. But some involvement from the private sector may be possible in the larger clusters, which will have the additional benefit of bringing technological expertise and innovation.

2 This is specified in Law No. 30/2009 on Electricity.

The substantial public funds that are required can be provided through public budgets or special allocation funds such as *Dana Alokasi Khusus* (DAK). In addition, the Energy Resilience Fund or in Bahasa *Dana Ketahanan Energi* (DKE), which the Government of Indonesia is currently exploring, could also be a primary source of public funds. The current provision of government electricity tariff subsidy in Indonesia is regulated under MOF Regulation No. 170/2013, and such a system could also be applied to PIT.

Analysis by the PIT's PMU suggests that the most effective way of getting PIT to work is for it to co-exist with DKE. This would be in line with the successful experience of other countries, who set aside special funds for such programs. With DKE as an organising framework, PIT could be resourced not only via a small levy on fossil fuel companies but also from donor country programs like REDD, MCC[3], JICA etc. The PIT program is explicitly targeting clean energy in order to achieve rapid improvements in rural electrification, thus meeting a number of sustainable development goals. This will make it attractive to donor countries who may then be persuaded to make grants to DKE for the purpose.

Applying effective communication strategies will support achieving the program's target, improving operational effectiveness, and delivering measurable results. Moreover, it will also improve relationships with key stakeholders and the targeted audience, gaining their support and active participation in the program.

As stated elsewhere, this report is an abridged version of the many progress and final reports submitted by TUSK to the Ministry of Energy and Mineral resources and JICA. It is presented in 10 chapters. In Chapter 1, we begin by reiterating the importance of Program Indonesia Terang to the country and concur that PIT is a cost-effective and welfare-optimal way of meeting a wide variety of sustainable development goals. In Chapter 2, we outline the history of the Program, and how it relates to Indonesian government priorities and institutional and regulatory settings. Chapter 3 summarises some key lessons from other countries which have run successful rural electrification programs, for which more detail is provided in the Annex. In Chapter 4, we describe how the communities that need PIT's help have been identified.

Chapter 5 evaluates the benefits and costs of the various technological options and develops scenarios of the most cost-effective (and therefore requiring least subsidy) options. Chapter 6 reports the findings of a 'Strengths, Problems, Opportunities and Directives' (SPOD) analysis of the Program, while Chapter 7 sets out the various decisions that need to be made for its implementation. Chapter 8 discusses funding options, recognising that the vast majority of funds will need to come from government sources, but discussing how to implement Public Private Partnership (PPP) arrangements for the cases where this is a possible solution. A stakeholder communication strategy is set out in Chapter 9, while Chapter 10 provides brief conclusions and required next steps.

3 REDD+ stands for countries' efforts to reduce emissions from deforestation and forest degradation, and foster conservation, sustainable management of forests, and enhancement of forest carbon stocks. The Millennium Challenge Corporation (MCC) is a bilateral United States foreign aid agency established by the U.S. Congress in 2004, applying a new philosophy toward foreign aid.

The benefits and importance of the Program Indonesia Terang

1

There is near-universal agreement in the academic literature on the positive welfare impact of rural electrification.[4] Electricity access both facilitates and creates economic growth, through raising productivity, and hence brings higher-paid employment to poorer communities. Education is enhanced through better lighting and communication tools. Health indicators, particularly reduction of mortality, are improved through better indoor air quality, access to modern equipment and access to information channels. Refrigeration brings food preservation, and pumping systems improve water access and quality. As the case studies in the Annex show, rural electrification has been used as an effective tool to achieve economic growth and reductions in poverty in many countries.

Indonesia has a target to increase its overall electrification ratio from the latest observed (2015) level of 85%[5] to 97.35% by 2019. Using the World Bank's Development Indicators Database, and best-practice estimation techniques,[6] we have estimated that such an increase could raise average Indonesian GDP/capita by US$86, or 1.62% (which of course implies a much higher percentage among the target communities). Overall, GDP could thus be increased by US$22 billion, annually. These calculations suggest that investment in rural electrification can be cost-effective for the economy as a whole, and especially for the poorest regions, over a reasonable time horizon.

The environmental impact of rural electrification is also substantial. Fossil fuel dependency is a major cause of pollution, which a renewables-based program aims to minimize. Analysis of the environmental impact using an *Impact Pathway Approach* (IPA)[7] and a life cycle assessment, covering pollution, global warming and health impacts, demonstrates the benefits.

Four pollutants released in the process of burning fossil fuels are under careful international scrutiny, namely, carbon dioxide, particulate matter, sulphur oxides and nitrogen oxides. Carbon dioxide is now agreed by the scientific community to cause global warming and climatic instability. ExternE, a publicly available dataset, puts the value of CO_2 unit damage at US$ 23.33 per ton of CO_2.[8] According to the Centre for Environmental Research and Technology, a commonly available diesel generator is responsible for emitting between 699.77 and 908.55 kg CO_2 per MWh produced.[9] Using as much as possible of renewable generation technologies, the Terang Program is expected to reduce emissions by between 0.98 and 1.28 Million tons of CO_2 per year, implying avoided environmental damage valued between US$23.03 and 29.86 Million.

4 For a summary, see Independent Evaluation Group (IEG) of the World Bank (2008) as cited in Torero (2014), and CDC (2016). Torero, M. (2014). The impact of rural electrification. The 11th Conference AFD PROPARCO/EUDN: Energy for Development. CDC. (2016). What are the links between power, economic growth and job creation? United Kingdom.

5 See http://www.esdm.go.id/siaran-pers/55-siaran-pers/8189-program-indonesia-terang-segera-direalisasikan.html.

6 Using Grainger Causality and following the methodology employed by Yoo and Kim. Yoo, S. and Kim, Y. (2005). Electricity generation and economic growth in Indonesia. Energy 31 (2006) 2890 – 2899.

7 Developed by the European Commission (ExternE, 2016). External Costs of Energy. Available at: http://www.externe.info/externe_d7/

8 ExternE (2006).

9 Centre for Environmental Research and Technology (2004). Determination of Emission Factor from Back-up Generators. University of California. CA, USA

Recent studies suggest that air pollution is the cause of 6.5 Million deaths each year worldwide, making it the fourth most deadly threat to human health.[10] Rural households without access to modern electricity live in environments with a high concentration of chemicals being released by solid fuels and kerosene lamps used to meet cooking and lighting needs. According to WHO (2002) the high concentration of pollutants in indoor living spaces is the cause of 22% of chronic respiratory diseases and 36% of all infections with a toll of 3.5 million premature deaths per year, mostly in Asia. Recent studies have identified fine particles and ozone as the main responsible factors.

Health problems caused by pollution also lead to lower productivity and increased healthcare costs. It is possible to compute the annual savings from avoided health damage. Preliminary estimates suggest ongoing savings from the completed program of US$12.7 million per annum for particulates, US$55.7 million per annum for nitrogen oxides, and US$17 million for sulphur dioxide. Accumulated savings generated by the Program Indonesia Terang from all sources, including CO_2, over the period to 2039 are estimated to total US$546 million.

The Program Indonesia Terang will also make a significant contribution to Indonesia's achievement of the Sustainable Development Goals (SDGs) which were developed during 2015. These goals include commitments to eradication of poverty, food security, healthy lives, inclusive and equitable education, gender equality, provision of water and sanitation, access to affordable, reliable and sustainable energy, and full and productive employment. Case studies presented in the Annex show how other countries have achieved improvements in the SDGs using rural electrification as a key part of their strategy. For example, electricity access has been shown to boost households' income in China and India by up to 38% and 52% respectively.

Rural electrification programs of the size of Indonesia Terang are necessarily expensive and institutionally complex, but the costs are outweighed by the benefits captured by rural households. Increasing the number of households with access to modern electricity services will help the achievement of all the SDGs and balance the economic growth of the country.

In summary, the Program Indonesia Terang will enable the following improvements in SDGs:

1. Energy and health

- Securing reliable electricity for the establishment of village health centres
- Reducing accidents and infections due to kerosene lamps and poor lighting
- Eliminating morbidity from indoor pollution
- Introducing refrigeration and electric cooking for improved nutrition
- Reducing accidents and health problems from carrying heavy fuel wood and water containers

2. Energy and education

- Improving learning experience through efficient lighting
- Increasing time for education through mechanization of activities and modern lighting
- Introducing night schools for adults thanks to reliable electric lighting
- Improving rural education via modern teaching devices, i.e. computer, Internet, television, etc.

10 For a summary, see IEA. (2016). Southeast Asia Energy Outlook. World Energy Outlook Special Report. Paris, France

3. Energy and gender
- Minimizing women's exposure to the risks connected to energy-related activities, including collection of biomass, cooking and lighting
- Reducing women's exposure to indoor pollution from cooking and kerosene lamps
- Introducing mechanization of heavy domestic duties
- Increasing the female employment rate
- Improving maternal care

4. Energy and water
- Providing reliable and clean sources of water
- Introducing modern irrigation systems
- Increasing hygiene of households and villages
- Reducing risks related to carrying heavy water containers

5. Energy and food security
- Boosting agriculture productivity with the introduction of modern irrigation systems and radio weather forecasts
- Improving nutrition with the introduction of refrigeration and electric cooking
- Increasing purchasing power and food expenditure

6. Energy and environment
- Minimizing all of the discharges of contaminants from energy systems to land, atmosphere and water
- Minimizing the rate of deforestation
- Minimizing GHG emissions from biomass burning and diesel generators

7. Energy and economic empowerment
- Boosting productivity through provision of cheap and reliable access to electricity
- Increasing employment opportunities for both men and women
- Providing access to reliable electricity to support structural changes

Figure 1: The direct benefits of Program Indonesia Terang for the achievement of Indonesia's Sustainable Development Goals

History of the program and linkage to government regulations and priorities

2

The Program Indonesia Terang (PIT) was initiated in 2015 by the Ministry of Energy and Mineral Resources (ESDM) in order to meet the Government's target of increasing the national electrification ratio of 85% to 97% in 2015. The program is targeted on the estimated 12,659 underdeveloped villages which are not connected to the State Electricity Company (PLN) grid. The program seeks to electrify 10,300 villages by the end of 2019, and is explicitly intended to maximize the utilization of local energy, such as solar energy, water, wind, biomass, and ocean currents. A detailed timetable, involving synchronisation of planning, training and development of pilot sites has been defined, and a project management unit was set up by ESDM. In total, ESDM estimates that PIT has the potential to develop 500 MW to 1000 MW of generation facilities.[11]

The current umbrella regulatory framework, *Law No. 30/2009 on Electricity*, and *Government Regulation No. 14/2012 on Electricity Provision Business Activities*, specifies the funding, institutional, land-use, tariff, and technical aspects of electricity business activities in Indonesia. *Law No. 30/2009 on Electricity* specifically requires the government to provide funds for (1) electricity provision for citizens below poverty line; (2) construction of electricity facilities in underdeveloped areas; (3) construction of electricity facilities in underdeveloped areas and border areas; and (4) construction of electricity facilities in villages. Under *Government Regulation No. 14/2012*, the Minister or regional government has the authority to give the right to provide electricity to Regional Government Owned Enterprises (ROEs), private entities, and local cooperatives.

However, under the current *Presidential Decree No. 39/2014 on Negative-list for Investment*, no company with any foreign-ownership is allowed to participate in an electricity-generation business with capacity below 1MW (only a 100% locally-owned company is allowed to participate in the sector). This makes it hard to introduce foreign investors, and hence their potential for technological and design innovation, unless some bundling of the very small projects considered under this program can be achieved or some relaxation of this Decree can be achieved.

The Program Indonesia Terang needs to meet specific directives from the Government, including achieving a 97% electrification ratio by 2019, while increasing the portion of renewable energy in the national energy-mix to 23% by 2025. In order to follow the vision of "Nawacita", narrowing the gap between Western and Eastern Indonesia, the initial focus of the program has been on underdeveloped rural areas in eastern Indonesia, in the six priority provinces of Papua, West Papua, Maluku, North Maluku, West Nusa Tenggara and East Nusa Tenggara.

Regional governments are responsible for developing an electricity plan for their constituents, which is manifested in the Regional General Electricity Provision Plan (RUKD). All installations must comply with technical standards set by the Ministry of Energy and Mineral Resources (which may need adapting to off-grid conditions). Required business aspects include the minimum local entity ownership of the company, minimum domestic content rules,[12] a list of required permits to run electricity business in Indonesia and the purchase price of electricity by PT PLN for the electricity produced from renewable energy sources, where applicable. The local government is allowed to set electricity tariffs, with approval from the Local

11 For further detail of PIT and its objectives, see http://www.esdm.go.id/siaran-pers/55-siaran-pers/8189-program-indonesia-terang-segera-direalisasikan.html.

12 For example, for distributed solar power plants the minimum Domestic Consumption Rate (TKDN) must be 30.14% for goods, 100% for services and 53.07% for the combination (*Minister of Industry Decree No. 54/2012*).

Parliament or DPRD. If the local government has not set the tariffs, tariffs in the area will be set through ESDM decree. These tariffs may reflect local cost conditions and affordability, at the discretion of the local government or ESDM.

Under the current regulatory framework, the main institutional stakeholders for the Program Indonesia Terang are:

- **ESDM:** responsible for permits issuance for cross-provinces operation, development of the national electricity plan (RUKN)
- **Regional-government:** responsible for permits issuance for intra-province operation, development of regional electricity plan (RUKD)
- **PLN:** the electricity SOE who is given the priority for electricity provision in any area.

In order to respect the rights of PLN to supply electricity wherever it is able to do so, PIT is focusing on communities that are remote from the PLN's existing and planned transmission network.

Land acquisition for PIT requires close coordination with local leaders to convince the rights owners to release their right. Other complications are the transfer of Village Treasury Lands (*Tanah Kas Desa*), which should be compensated through land substitute mechanism, and customary lands, which usually do not have certification. It is thus important for Regional Governments to take the lead as the champions in implementing the program.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Learning from other countries

3

The international benchmarks, which provide examples of successful rural electrification programs, presented in the Annex and referred below are mostly taken from Asian countries. China provides the standout example of an extremely successful program, while Malaysia has made good progress. India has been included because it provides helpful guidance on problems which may emerge in Indonesia. The Japanese case study provides insights into state of the art technological innovation.

Successful electrification in other countries has resulted from strong leadership by government agencies and state-owned companies, with good coordination. China and Malaysia, the best examples in Asia, have made electrification an integral part of their overall development plans, and allocated substantial funds from the public budget for the purpose. The best international examples include well-defined channels for government funding (there is not a case where the private sector has provided a significant portion of overall funding, although Malaysia does utilize a small levy on IPPs to provide part of the funds and Lao provides an example of a PPP implementation of a hybrid power system with mini-grid).

In many countries, the relevant state-owned enterprise (SOE) has played an important role in the development of rural electrification. The development of resource-specific electrification strategies has been demonstrated in many countries to lead to lower cost solutions. This requires sophisticated choice of appropriate generation and distribution, taking full advantage of local resources and using innovative combinations of technologies (for example hybrid mini-grids).

Some international examples demonstrate the effective use of local institutions such as co-operatives or village committees, which then represent the community in choosing and sometimes operating the technology. This has been particularly effective in Sri Lanka and implemented in Lao PDR. Local participation is particularly important in tailoring the level of supply to that which the local community can make full use of, with good plans for subsequent expansion and provide freedom to private entity on the technology applied based on least-cost analysis. Fostering a strong sense of ownership in the local community, in order to encourage effective operation and maintenance of the systems, is also shown to be important.

Development of micro-finance and other small-scale lending systems to assist the community in affording the up-front costs, both of the system itself (where this is not fully financed by the government) and of the equipment required using it effectively. Sri Lanka's credit program and Small Home System arrangements provide good examples. The government of Thailand established an Energy Conservation Fund as part of the ENCON program. In this case, setting in advance the budget for the following years and establishing clear sources of finance to be used for Renewable Energy (RE) projects allowed the regulatory bodies in charge of the subsidy scheme to plan the development of the market without running the risk of falling short of their obligations with private developers.

Innovative methods of incentivizing small-scale generation, for example Thailand's Very Small Power Producers Program (VSPP), supported by the "adder" system of tariff enhancements. Tax incentives are also provided in some countries, for example Thailand gives exemptions on import duties for equipment related to renewable energy and exemption from corporate income tax for renewable energy manufacturers. However, the Lao Case Study demonstrates "the different challenges facing a private entity looking to pursue a rural electrification project:

high investment costs, low subsidies, obligation to collaborate with the utility, long-term collaboration, and relations with local players."[13] There are examples in Africa (for example Senegal) of the development of concessions covering clusters of rural communities, in which the private sector has been successfully involved.

Case studies of how other countries – China, India, and Tunisia - have addressed the sustainable development goals (SDGs) provide useful lessons for the Program Indonesia Terang. Improved electricity access, for example, has been shown to be able to boost households' income in China and India by up to 38% and 52% respectively. Rural China has achieved an impressive improvement in the quality of life of its citizens due to a rapidly growing electrification ratio from 40% in the 1950s to the 99.8% registered today. Among other benefits, electrification drastically reduces the time employed to gather biomass, increasing time dedicated to income generating activities thus boosting income and the household's purchasing power.

India, in contrast, has been slower to provide access. It is currently aiming to raise its 78.7% electrification ratio with the goal of providing all un-electrified households a minimum lifeline consumption of 1 kilowatt-hour (KWh) per day. The *Rajiv Gandhi Greameen Vidyutikaran Yojana* (RGGVY) electrification program initiated in 2005 had by 2013, brought modern electricity services to over 100,000 un-electrified villages and improved electricity supply in an additional 302,000 clusters (Ministry of Power, 2013).

The Nepalese Rural Energy Development Programme (REDP) aimed to promote the use of renewable energies, namely small hydropower and solar heating (for cooking stoves), in rural communities. The program was initially launched in 1996 as a pilot project in 5 remote areas, and was then expanded in 2001 through the nation's Hydropower Development Policy.

Tunisia's rural electrification program was introduced in the 1970s, a time when the rural electrification ratio remained at a mere 6%. The Tunisian Government decided to make rural electrification a priority on the national agenda and so over 450 Million Tunisian dollars (US$ 319.5 Million) were invested from 1977 to 2000, bringing the electrification ratio up to 95% by 2001.

13 ARE (2011) Hybrid Mini-Grids for Rural Electrification: Lessons Learned. 5: 38. Brussels, Belgium. ARE (2012) Rural Electrification with Renewable Energy: Technologies, Quality Standards, and Business Models. 22. Brussels, Belgium.

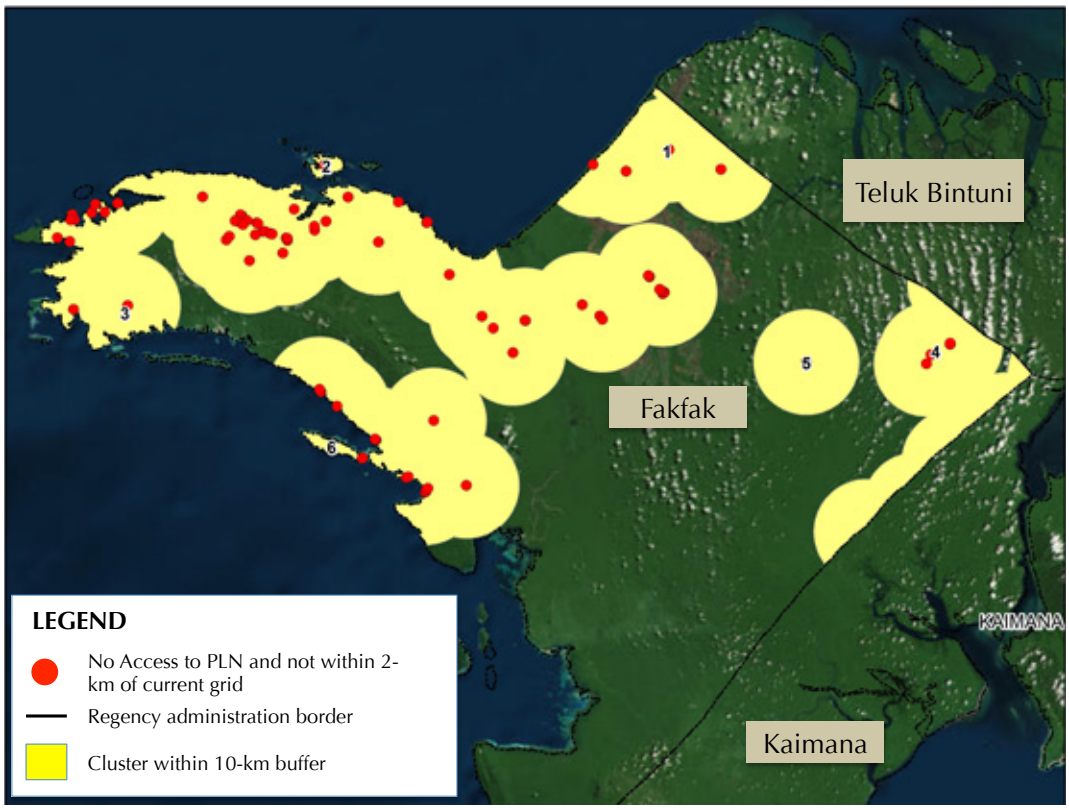
Community locations and requirements

4

The development of PIT relies heavily on understanding of the geospatial and socio-economic information about the villages within the Program target area. Geospatial data analysed includes village position, settlements positions within the village, village boundary data, regency boundary data, road network data, electricity transmission line data and other data that can be translated into a coordinate system. Socio-economic data covers population, age and gender profiles, and local GDP. A detailed database has now been created which permits clusters of settlements to be identified and analysed. Data has also been collected on local resources, including energy sources for renewable technologies such as rivers, wind, sun and biomass.

Using this extensive database, clustering techniques have been used to group isolated communities into clusters for the purposes of providing them with electricity. Settlements without on-grid electricity supply were grouped into those which are sufficiently close to PLN transmission lines to be potentially supplied by PLN,[14] and those for whom an off-grid solution is necessary. The latter settlements – those to be supplied by PIT - were then grouped into those within a 10-km radius of the settlement centroid (providing they are not separated by sea). An example of this clustering, for Fakfak Regency, West Papua, is shown in Figure 2 below. In this case, six clusters were identified, one with 78 settlements, and one with 4 settlements. The other clusters contained only one or two settlements.

Figure 2: Cluster Fakfak Regency, West Papua



Focusing on the six provinces which have been given initial priority, Table 2 below summarises the challenge facing PIT. In total, 8,901 settlements have been

14 In initial work, a cut-off of 2km from the nearest transmission line has been used.

identified, containing 713,445 households. At very basic levels of consumption,[15] these households need 592.3 MWh per day, requiring generation capacity of nearly 170 MW. Of the 429 clusters identified, only 2 require greater than 10 MW, 31 require between 1 and 10 MW, and 396 require less than 1 MW.

Table 1: Summary of the six priority provinces

	West Nusa Tenggara	East Nusa Tenggara	Maluku	North Maluku	Papua	West Papua	All 6 Provinces
Number of Settlements	49	1,569	673	537	4,665	1,408	8,901
Number of Households	8,183	103,210	65,173	60,302	409,030	67,547	713,445
Est. Consumption	6.8 MWh/ day	85.7 MWh/ day	54.1 MWh/ day	50.1 MWh/ day	339.5 MWh/ day	56.1 MWh/ day	592.3 MWH/ day
Est. Capacity	2.1 MW	26.0 MW	6.5 MW	15.2 MW	102.9 MW	17.0 MW	169.7 MW
Number of Clusters	9	36	100	79	135	70	429
Cluster < 1 MW	9	28	100	77	117	65	396
Cluster 1-10 MW	0	8	0	2	16	5	31
Cluster >10 MW	0	0	0	0	2	0	2

The PIT PMU has begun the process of pilot testing, based on clusters with an estimated potential demand of more than 1 MW. Six initial pilots have been identified, using further criteria of population density, economic level, accessibility, and the presence of useful local NGOs. All of these criteria have been selected in order to give the initial pilots a reasonable chance of immediate success.

Table 2: Summary of the selected pilot clusters' characteristics

Cluster Name	Province	Estimated Capacity (kWp)	Population Density (HH/ km^2)	Village Average income per year (IDR)*	Accessibility**
Arfak Mountains	West Papua	4,519	5.2	15 million	49 km from nearest port (Manokwari Port), 5 km from nearest airport (Tiom Airport)
Yahukimo	Papua	14,173	3.9	44 million	Mountain area, no major infrastructure nearby
Lanny Jaya	Papua	10,585	11.4	5 million	Mountain area, no major infrastructure nearby
Taliabu Island	North Maluku	2,049	3.4	34 million	37 km from nearest port
South West Sumba	East Nusa Tenggara	2,248	20,9	104 million	25 km from nearest port
East Manggarai	East Nusa Tenggara	5,538	16,4	34 million	30 km from nearest port

*Excluding grant
**Distance from cluster's centroid to the nearest major infrastructure, especially port, within 100km from the centroid

15 Indonesian households currently without electricity can be grouped into three categories, with a monthly energy demand ranging between 25 to 100 kWh. Profile A users are assumed to account for 50% of total households with profile B and C accounting for the remaining 30 and 20%, respectively.

Choosing the right mix of technologies

5

It is an over-riding objective of PIT to use renewable energy technologies wherever possible. In many remote locations, this makes technical, commercial and environmental sense, as local resources such as rivers, wind, sun, biomass and possibly strong tidal currents are available in abundance. Renewable energy technologies which tap these resources include solar PV, pico- and micro-hydro power plants, biomass installations, wind farms and localized use of wind turbines.

Solar power plants are an obvious choice in most locations, as daily insolation across the country ranges from 4.50 to 5.10 kWh/m2.[16] Several pilot projects have been conducted over the past decade providing evidence that solar PV micro-grids represent the least-cost electrification strategy in numerous rural areas.[17] Solar PV technology has a useful life exceeding 20 years, with micro-grid components such as battery, inverter and solar controller requiring constant maintenance and available spare parts to avoid them falling short of their expected life. Overall, paying for solar systems on average requires an electricity tariff of 0.95 US$/kWh inclusive of O&M and replacement costs.[18]

Installed hydropower generation in Indonesia is currently 6.84 GW, less than 10% of the country's potential.[19] The Program is expected to leverage on the large availability of these resources, especially in Sumatra, Sulawesi, Papua and East Kalimantan which have small but fast flowing rivers, well suited to provide electricity to isolated villages through the installation of pico- and micro-hydro power plants. According to the historic data from Directorate General of New and Renewable Energy and Energy Conservation (NREEEC), ESDM, this technology has been able to provide electricity reliably with a useful life of 25 years with a performance ratio of 60% inclusive of systems and distribution losses. Overall, such systems can provide electricity at an average economic tariff of 0.12 US$/kWh.

Recent assessments have suggested a potential for up to 9 GW of wind power capacity to be deployed across the archipelago. Interestingly, locations that showed the highest wind speed correspond to areas with low level of electrification, suggesting the potential for a strong penetration of wind in Program Indonesia Terang energy mix. However, despite the largely untouched wind potential, the market is still in embryonic phase with only 1.40 MW installed, the majority of which have been financed under bilateral grants from multilateral agencies. The limited market development means that this technology is still expensive in Indonesia at 5.35 US$/Wp, well above international benchmarks. A capacity factor of 25%, after system and transmission losses, implies an electricity tariff of up to 0.65 US$/kWh.

Indonesia is among the world's largest producer of biomass including palm oil, rice husk and other derivatives from forestry and agriculture. According to ESDM (2014) estimates, the country has the potential to develop up to 49.81 GW of biomass electricity generation capacity; despite this, as of today the installed biomass power generation reaches barely 1.64 GW. Given the availability of resources in rural areas and the maturity of the technology, biomass power production represents a

16 NASA (2016), Surface meteorology and solar energy. A renewable energy resource website 6.0. Available at: https://eosweb.larc.nasa.gov/sse/RETScreen/

17 NREL (2016), Sustainable energy in remote Indonesian grids: Accelerating projects development. National Laboratory of the U.S. Department of Energy. However, technical problems prevented these pilot projects from being scaled up in most cases.

18 This estimate does not allow for the cost of transport of equipment and spares to remote locations, or for the provision of required expertise in those locations, which will of course add to the costs, in some cases substantially.

19 ESDM (2014), Renewable Energy Development in Indonesia: Potential and Policy Framework. Energy and Mineral Resources for People's Welfare

strategy of choice for the Program. With a capacity factor of 60% after losses due to transmission and distribution, electricity is expected to be priced at 0.14 US$/kWh.

Initial directives for PIT from ESDM mandated that the Program energy mix should be dominated by solar PV installations, providing 60% of the electricity required, with remaining demand to be met by micro-hydro, biomass and wind power generation, accounting for 20%, 15% and 5%, respectively.

However, at local Indonesian prices, solar PV panels are expensive and as a result the gap in required subsidy between solar PV (0.91 US$/kWh) and, for example, hydropower (0.08 US$/kWh) is large. Sourcing solar panels and other components more cost-effectively could reduce this gap, but nevertheless the issue remains. On current cost settings, with 60% solar, the required solar electricity tariff subsidy would account for over 90% of the annual government subsidy.

So, the PIT PMU has undertaken analysis in order to explore how to reduce the cost of undertaking the program to manageable levels. Large reductions in this required subsidy could be achieved by increasing the proportion provided by other technologies. The first stage in this analysis was to compute the required annual subsidy which would be required if electricity needs (a total of 592.3 MWh/day as specified in Table 1 above) were to be met using the initial MEMR mandate of 60% solar, and required tariffs for the remote regions matched those in other parts of Indonesia. In total, an annual subsidy of US$849 million (IDR 11.2 trillion) would then be required, an amount which is in excess of that which could realistically be funded from a mixture of government and private sector sources.

Scenario analysis has therefore been undertaken which explores how the required subsidy would vary under different assumptions on costs and energy mix, with the objective of reducing this subsidy requirement.

The uncertain business environment and significant country risk contribute to increase the investment cost of RE project development in Indonesia. Past projects deployed by both DG of NREEC and private developers show investment costs being considerably higher than international benchmarks. This is due to a multitude of factors including but not limited to local content requirements, limited RE market development, lack of technical capability and logistics barriers. Scenario 1 applies international benchmark costs, and calculates that the required subsidy could fall by US$105.8 million (IDR 1.39 trillion) if such costs became available in Indonesia.

The review of successful rural electrification strategies reported in the Annex ranging from the Chinese *National Rural Electrification Program* to the Indian *Village Energy Security Program* share a common decision making process of tailoring the program's strategy around the natural resources available in the area. This translates into a bottom-up energy mix allowing the development of least-cost strategies to be deployed quickly and inexpensively in the region. Scenario 2 therefore explores the effect of changing the energy mix to favour lower cost technologies such as hydro and biomass. Under this scenario, depending on the extent to which these alternative technologies can be implemented in each local situation, savings of between US$410 million (IDR 5.4 trillion – 48%) and US$461 million (6.1 trillion - 55%) might be achievable.

Access to climate finance within Indonesia is still limited in volume as traditional providers of finance lack the technical capability and experience to include green financing into their operations. As a consequence, project developers looking for debt financing are forced to cope with unattractive interest rates and guarantee

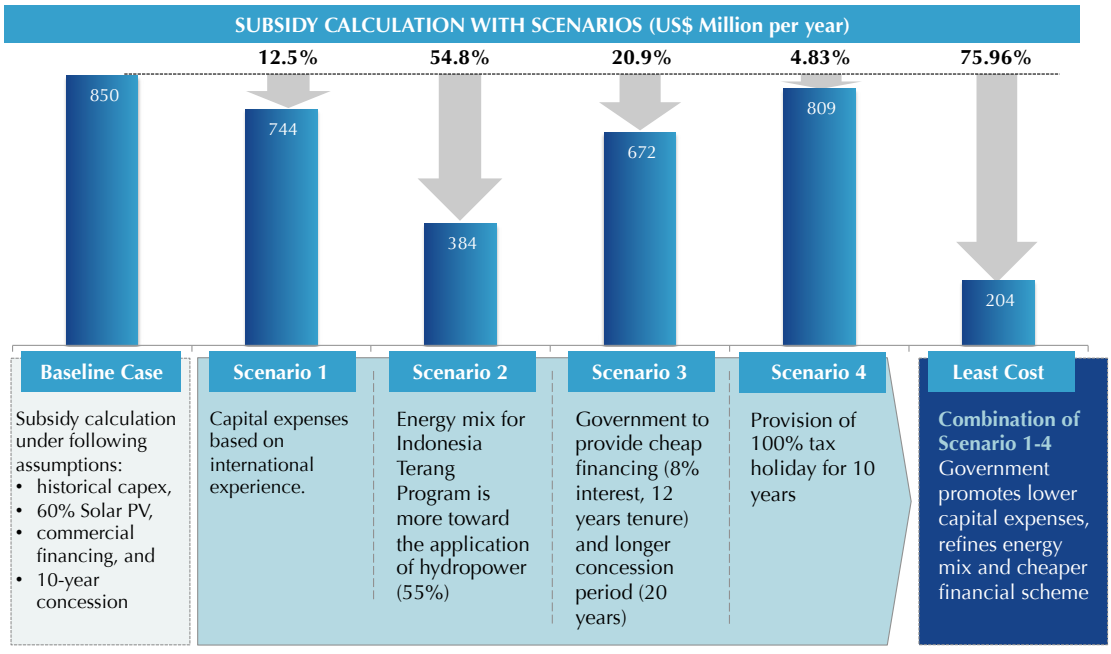
requirements set by finance providers. Despite this, international funds and development agencies offer several opportunities to access capital on easier terms thus reducing the cost and riskiness of projects. Scenario 3 explores the extent to which cheaper finance - through 'green financing' and better PPA terms might contribute to lower required subsidies. On moderate assumptions, this is estimated to provide a potential US$178 million (IDR 2.3 trillion - 21%) in subsidy savings.

Scenario 4 explores the impact on the required susbidy if Government provides 100% tax holiday to project developer for 10 years. In this scenario, profit generated by the developer from providing rural electrification service is free from tax. This incentive is estimated to provide a potential saving of US$ 41.1 million (IDR 0.54 trillion - 4.83%) only.

Combining the four scenarios simultaneously - in Scenario 5 - indicates the possibility of substantial savings in required subsidy. If all four of i) reduced technology costs, ii) energy mix, iii) better financing and concession terms were achieved, and iv) the implementation of tax holiday, the scenario calculations suggest that the required subsidy might be reduced from US$849 million (IDR 11.2 trillion) to US$204 million (IDR 2.7 trillion), a 76% reduction.

The various scenarios, and their costs in US$ million, are summarised in Figure 3.

Figure 3: Various subsidy scenarios



[1] US$ 850 Million equal IDR 11 Trillion; [2] US$ 226 Million equal IDR 2.9 Trillion; US$ 1 = IDR 13,000

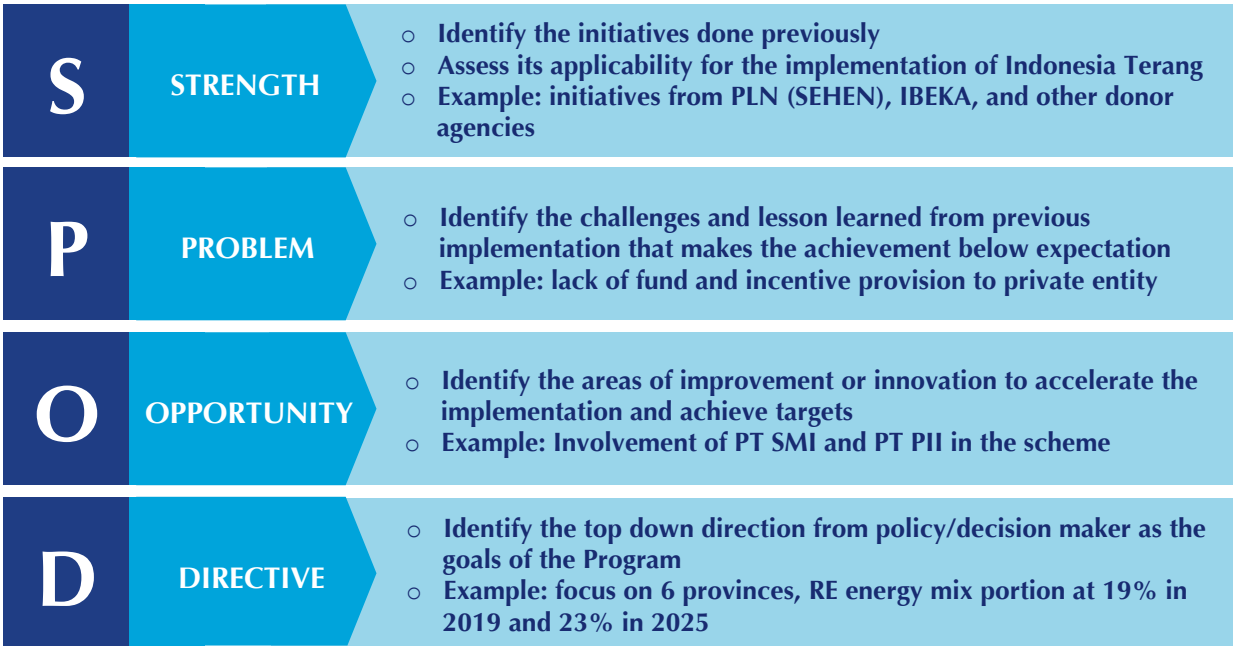
This reduction is clearly worth seeking, even if it cannot be fully realized given the constraints that Indonesia faces. Starting the process would include providing long-term government support, developing a resource-tailored strategy, implementing cost-reflective tariffs and achieving effective rural community participation. We turn to achievement of these objectives in the later chapters of this report.

SPOD Analysis of the Program

6

SPOD (Strength, Problem, Opportunity, and Directive) analysis permits the identification of additional enablers required to avoid/solve current hurdles and/or to accelerate the implementation of the Program. The process is illustrated in Figure 4 below.

Figure 4: SPOD Analysis Framework



Strengths

The Program Indonesia Terang concept was derived from the "Nawacita", to narrow the gap between developed and underdeveloped regions in Indonesia. Politically, the Program Indonesia Terang received a direct blessing from the President himself – which suggests strong political support and high-level coordination. At the policy level, various supporting policy and regulatory frameworks, including for the acceleration of renewable energy utilization, have also been set up in paving the way for potential incentive packages to support the Program.

At the implementation level, the Team identified several success-stories concerning rural electrification initiatives, which might be leveraged for the implementation of the Program. The social business model traditionally implemented by the People Centered Economic and Business Institute (IBEKA) provides a good example of how bottom-up community engagement and community building can result in sustainable models for both rural electrification and empowerment.

Problems

Program Indonesia Terang is expected to face various challenges in building the electricity facilities for the target areas – the challenges will span from planning (e.g. data collection and consolidation, coordinated planning between local and central government, etc.) to construction (funding availability, land acquisition, etc.).

Compared to conventional PLN on-grid projects, providing electricity to a massive number of villages located in various scattered areas within a relatively short period will present additional challenges, both in funding and technical aspects.

These additional challenges of deploying off-grid installations are not only caused by the need for additional components (e.g. batteries), but also logistics issues that may occur due to lack of supporting infrastructure and difficult geographical conditions in target areas. In addition, rural electrification facilities provided in previous initiatives are currently not working due to a lack of maintenance efforts and expertise from the project provider, and vandalism.

Opportunities

Similarly, to other infrastructure development programs conducted in Indonesia, private participation is currently allowed and is being used for program acceleration, via the PPP framework. Implementation via PPP can help to reduce lifecycle cost of the facilities, and ultimately provide more value-for-money to the community and government. Moreover, Indonesia has laid down a solid foundation for PPP, including clear regulatory frameworks and the establishment of various supporting institutions such as the IIGF & SMI. Mechanisms such as availability payments can enhance the process.

The Indonesia Terang PMU (PMU) has also identified some 'quick-win' opportunities, such as through revitalization of existing assets – the revitalization path is expected to eliminate major cost components, such as land acquisition and the need to provide full capital cost. Institutionally, the initial revitalization phase and the operation & maintenance phases could be implemented via PPP schemes (via tenders open to private players).

Another 'quick-win' opportunity that has been identified by the PMU is through technical empowerment of local governments who wish to achieve independent electrification. One of the steps towards this aim is to provide an "implementation guideline" for local government, which includes knowledge regarding technical aspects, and general best practice on small-scale electrification.

Opportunities may exist to improve electrification through established PPP arrangements, and the extent to which mechanisms such as availability payments and fee-for-service arrangements can assist is being investigated. However, making PPP arrangements work for these small scale and diverse situations is challenging. The PIT PMU has also identified possible 'quick wins' through revitalization of existing assets and empowerment of local governments.

Directives

The Program Indonesia Terang has been established with the goal of pushing the country's electrification ratio from 85% to approximately 97% by 2019 while increasing the portion of renewable energy in the national energy-mix to 23% by 2025. In order to follow the vision of "Nawacita", to narrow the electrification gap between western and eastern Indonesia, the focus of the Program will be on underdeveloped rural areas in eastern Indonesia, namely, Papua, West Papua, Maluku, North Maluku, West Nusa Tenggara and East Nusa Tenggara.

Nevertheless, the inclusivity principle of Indonesia Terang means that the program is open to new proposals/initiatives, especially bottom-up initiatives, such as in the case of Nias, which has been recently added to Indonesia Terang's priority list, due to a special request to the President from Nias local government.

The implementation of Program Indonesia Terang has to comply with a set of five criteria used as the underlying strategies for the program, as follows:

1. Legally legitimate;
2. Bureaucratically workable;
3. Financially viable;
4. Politically acceptable; and
5. Publically beneficial.

These five Directives set the scene for the implementation strategies discussed in the next chapter of this report.

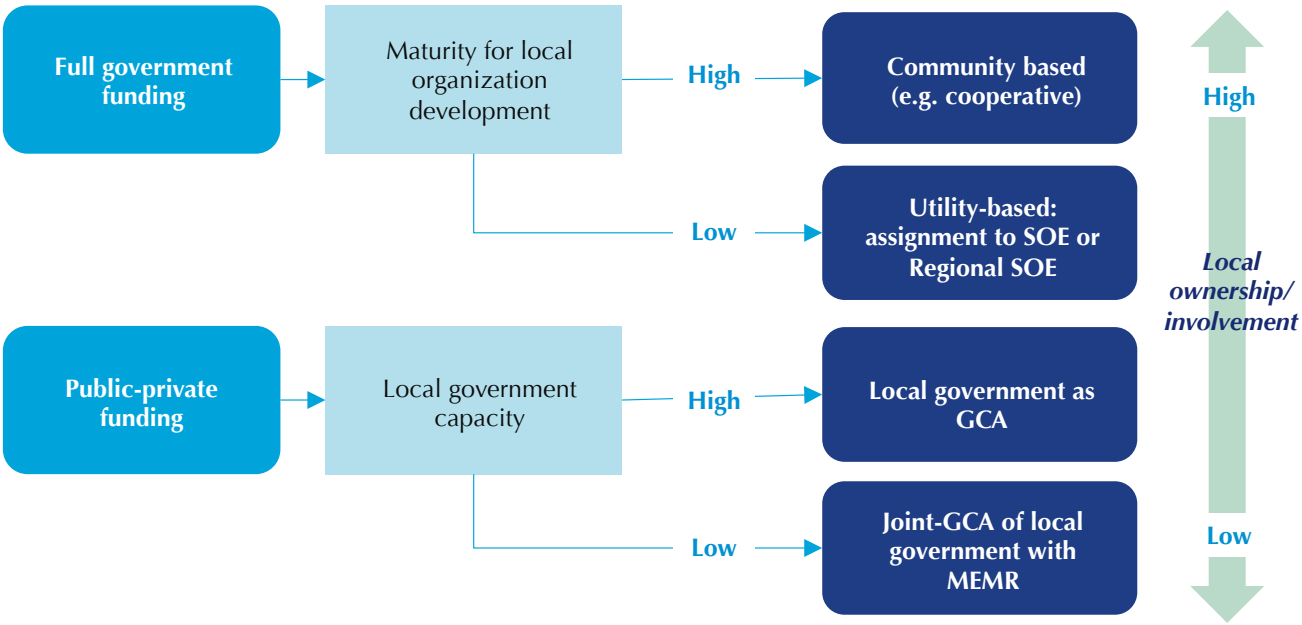
Implementing the Program

7

It is important to achieve the best possible institutional and regulatory arrangements, as well as the appropriate balance of funding and management between the public and private sectors in different situations. This needs to recognise suitable institutional arrangements for project implementation, including village characteristics and local-government capacities. As a result, As a result, decision trees have been developed to assist in the implementation process.

PIT could be implemented via varying degrees of local ownership and involvement – this should be determined by local capacity to implement projects (e.g. conduct procurement, technical capacity in maintaining assets etc.). Figure 5 explores the choice of appropriate institutional set-up in the cases of full government funding, and with public-private funding.

Figure 5: Decision Tree for Institutional Set Up



To implement a project funded by full government funding, the options for the institutional arrangement are via a community-based (e.g. via cooperative) or a utility-based one, via (direct) assignment to utility company such as SOE or regional SOEs (BUMN, BUMD, BUMDES). For public-private funded projects, institutional arrangements on the public side could include local government as GCA or a joint-GCA structure, between local and central government. In general, the lower the available local capacity – financial, technical or management – the more the arrangements need to be delegated to third parties.

The PIT PMU has explored a number of options for the optimal institutional arrangements for delivering the overall Program Indonesia Terang. Among the options which were considered are:

1. Ministry of Energy and Mineral Resources (ESDM),
2. Current State Utility Company (PLN),
3. A New State Utility Company (PLN for New and Renewable Energy or PLN-EBT), and
4. A new Public Service Agency.

Establishment of a Public Service Agency, which is in Bahasa called, Badan Layanan Umum (BLU), is currently the prioritized option to implement the Program Indonesia Terang in each location. This BLU, according to *Government Regulation 23/2005,* would be required to provide services to the community in the form of supply of goods and/or services which are sold without looking for profit and with focus on efficiency and productivity, and would operate as a working unit of the state ministries/agencies/local authorities. The source of funds for a BLU could come from national budgets or local budgets, revenue from services provided to the community, restricted grants, unrestricted grants, earnings from BLU cooperation with third parties and other business income. The benefits of having a National dedicated agency are that economies of scale and scope can be achieved if the numerous individual projects are well co-ordinated and successes in one part of Indonesia can be replicated in other parts. The BLU can also act as the GCA if ESDM/ Local government delegated their GCAs authority.

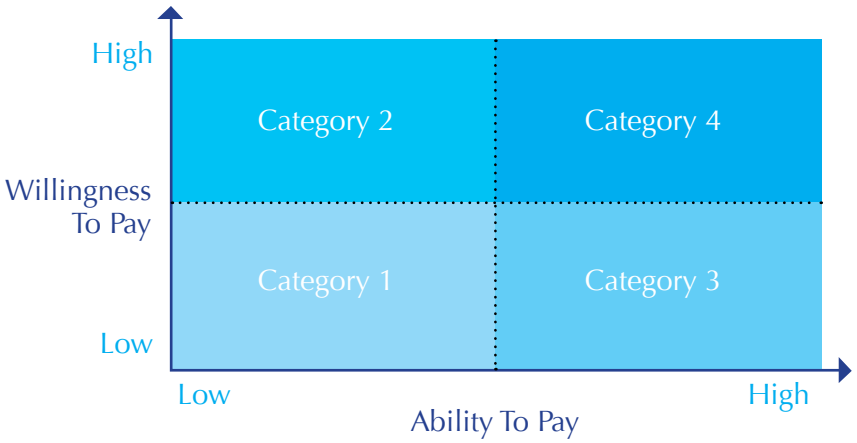
Three implementing regulations that must be issued to support the Presidential Regulation are: (1) ESDM Regulation on Program Indonesia Terang implementation, (2) ESDM Regulation on the Implementation of Availability Payment for Program Indonesia Terang, and (3) ESDM Regulation on Electricity Tariff applied for Program Indonesia Terang.

In addition, options for implementation in each individual cluster/location include:

1. Implementation by DKE Management Agency (*Badan Pengelola* DKE or BP-DKE),
2. Implementation by Central Government Agency,
3. Implementation by Regional Government,
4. Implementation by Private Entity without fiscal support,
5. Implementation by Private Entity with fiscal support, and
6. Implementation by Corporation through their CSR Program.

Choice of which is the best mechanism will clearly need to be on a case-by-case basis. However, whether it is likely that an individual village case can be implemented by entities further down the list will depend on local willingness and ability to pay, as illustrated in Figure 6 below. Category 4 cases are the most likely to attract private sector or corporate support.

Figure 6: Village Categories by Willingness-to-Pay and Ability-to-Pay



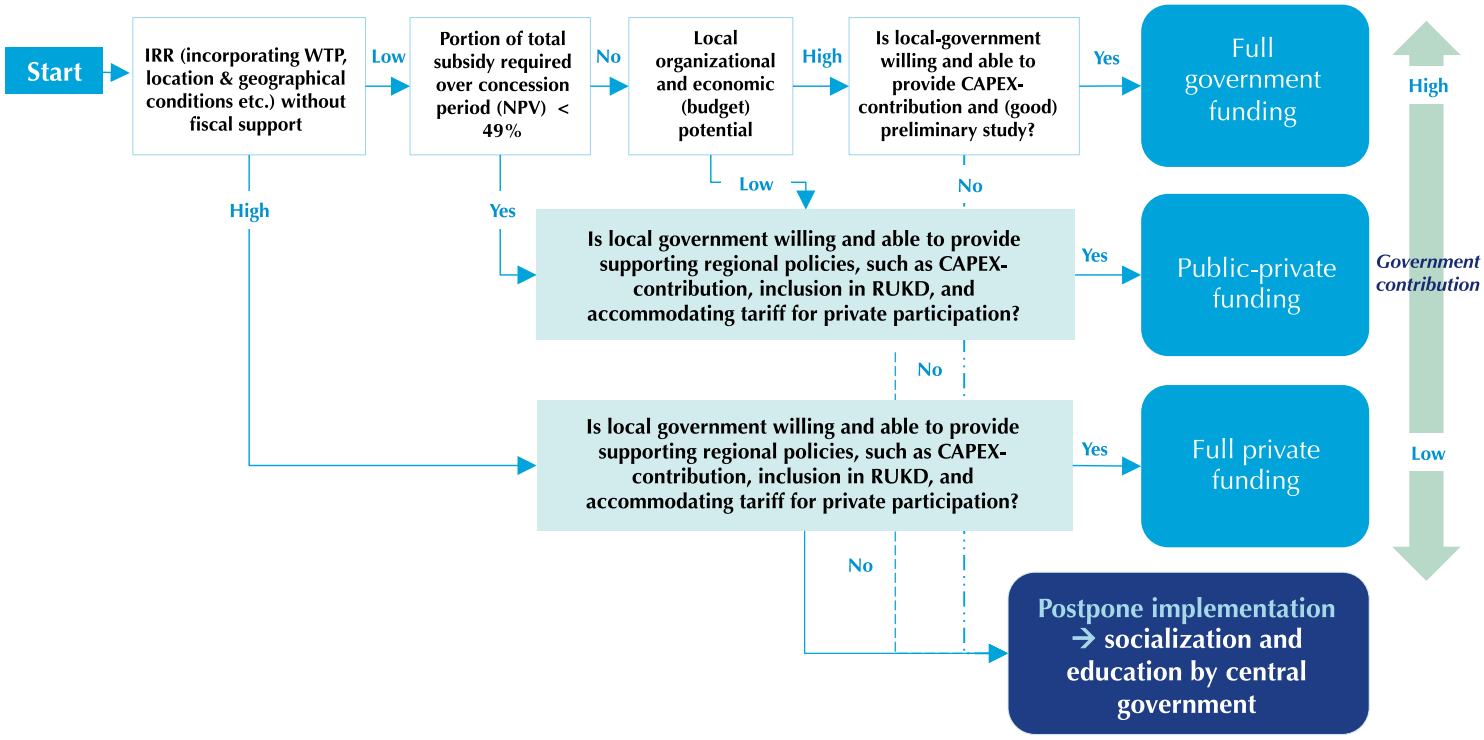
The Program will work best if Provincial Government, Regency/Municipality Government or Village Government take a strong leadership role. This is because:

1. The majority of projects are small-scale and unattractive to private investors since they do not provide attractive economies of scale for their investment,
2. Regional Budget (APBD) can afford the small-scale projects,
3. Implementation by Regional Government may generate better local ownership which is crucial for project sustainability,
4. Implementation by Regional Governments triggers transfer of knowledge and transfer of expertise related to the implementation of renewable energy and local organizational experience. This will promote local expertise in planning, preparing, developing and managing the operation of the project, and
5. Regional Government can establish Regional-Owned Enterprise (ROE) or Village-Owned Enterprise (VOE) as the vehicle to develop, own and maintain the facility.

The choice of implementation method will also need to take account of the existing activities of the communities concerned. Each village has its own economic activities; villages on coastlines have economic activities predominantly related to fishery; villages in pastures or meadows have economic activities mostly related to stockbreeding; villages which border with forests have economic activities commonly related to logging or forest products gathering; and villages with paddy fields have economic activities generally related to agriculture. Introducing electricity to these villages will support their economic activities because they can use electronic equipment or appliances to improve their work efficiency like: cold storages for fishermen, milkmen and breeders to keep the freshness of their products; rice mills for farmers to add selling value; electric saws for woodcutters; and even sewing machines to promote micro or small industry in the villages.

The output of the funding decision tree presented in Figure 7 provides recommendations for the portion of public and/or private funds. It relates the likely IRR for the project to required subsidies, local capacity and policy interest. In general, the more commercially viable the project is likely to be the less the required government contribution.

Figure 7: Decision Tree on Public vs. Private Funding



Regulatory arrangements include the Presidential Regulation on the Energy Resilience Fund (DKE) which will be crucial in providing the relevant funding. This includes GCA delegation to the PIT BLU, a direct procurement process with certain criteria to accelerate the electricity provision, inclusion of Availability Payment, VGF, PDF and in-kind grant as the possible various fiscal supports, etc.

As most of the Program Indonesia Terang projects will be intra-province operations, the authority for permit issuance will ultimately be held by the local-government at the regency level. Thus, in the case that a project will be implemented via PPP by utilizing Central Government/ESDM fund allocation (e.g. availability payment to private via ESDM's BLU), the GCA should ideally be a joint-GCA between ESDM (via BLU) with the relevant regional government.

Funding the Program

8

Constitutionally, the government is required to allocate budgets for the development of the areas that are also targeted under the Program Indonesia Terang.[20] However, in order to limit the burden on the public budget, involvement of the private sector, charitable organisations or international donors should be encouraged wherever possible. In most cases, rural electrification projects will not be commercially viable as the communities they serve are among the poorest in Indonesia, with very limited ability to pay. But some involvement from the private sector may be possible in the larger clusters, which will have the additional benefit of bringing technological expertise and innovation.

The substantial public funds that are required can be provided through public budgets or special allocation funds such as DAK. The first option would involve implementation by Central Government Agency through traditional goods/services procurement. In this option, the Central Government Agency procures all the goods and services required to develop power generator facility. All the activities related to the facility development (planning, preparation, and development) are fully funded through State Budget (APBN), which is sourced from state income, loans or grants. After the facility is procured, the Central Government Agency can decide to transfer the facility ownership to the relevant Regional Government.

Under ESDM Regulation No. 10/2015 (on technical guidance for the usage of DAK for rural energy), each regency receives an amount stipulated in the relevant Presidential Regulation issued one year before. Based on this allocation, the regencies then plan the usage of the fund. The assets created from DAK for rural energy will be operated by a management agency established by local community. ESDM will monitor and evaluate the utilization of DAK for rural energy based on the report provided by the Regent. In the case of Program Indonesia Terang, the DAK can be utilized as one of the sources of funds.

The Energy Resilience Fund (DKE), which the Government of Indonesia is currently developing, could also be a primary source of public funds. In order to collect, administer, manage, keep and distribute the DKE, the Government of Indonesia will establish a dedicated Public Service Agency or *Badan Layanan Umum* (BLU). DKE is a pool of funds, which will be utilized to ensure state energy resilience. There are multiple possible sources of funds for DKE including State Budget, a premium from fossil fuel exploitation, collections from the sales of coal, fuel, LPG and domestic gas, revenue from services provided by BLU, returns from BLU investment activities, Loans, and Grants. DKE may fund PIT with a variety of fiscal instruments such as grants, subsidy, loans, Availability Payments (AP), Viability Gap Funding (VGF) and project development funding (PDF). Other types of support available from DKE could include:

1. **In-kind grant:**
    a. provision of experts and/or consultants for the development of feasibility study
    b. capacity building on project preparation and project O&M
2. **Grant:**
    a. Hybrid Financing: partial financing for the development of the project, and
    b. O&M support: partial financing for the O&M of the project.

20 As specified in Law No. 30/2009 on Electricity.

The current provision of government electricity tariff subsidy in Indonesia is regulated under MOF Regulation No. 170/2013, and such a system could be applied to PIT. The current subsidy is provided to PT PLN through the annual State Budget or Revised Sate Budget and is administered by the Ministry of Finance. The amount of subsidy is calculated based on the value of electricity tariff, cost of goods sold, agreed margin and sales volume. The formula for tariff subsidy is as follows:

$$S=(TTL-BPP\times(1+m))\times V$$

Note:

S = Subsidy
TTL = average of electricity tariff (IDR/Kwh) from each tariff group
BBP = cost of goods sold (IDR/Kwh) from each tariff group
m = margin (%)
V = sales volume

If such a system were to be applied to PIT, the formula would need to be extended to cover the higher capital expenditures involved in remote area provision.

In order to implement a PPP scheme, three kinds of PPP government support can be applied for PPP project, namely: Viability Gap Fund (VGF) model, Availability Payment (AP) model, or hybrid financing. Application of the implementation model will need to be tailored to the characteristics of each village (e.g. distribution and ATP/WTP of the community of interest). As per Presidential Decree No. 38/2015, PPPs can be partially funded by the government. In addition, private sector involvement can be encouraged via tax subsidy. According to Government Regulation No. 18/2015 and MOF Regulation No. 89/2015, income tax incentives can be provided for taxpayers who run their business in new and renewable energy sectors, and these arrangements could be adapted to PIT.

A VGF scheme involves direct government support to increase financial feasibility for special infrastructure projects. The VGF was stipulated by the Ministry of Finance (MoF) to attract investors towards less financially attractive projects, and is already regulated under MoF Regulation No. 223/PMK.011/ 2012and MoF Regulation No. 143/PMK.011/2013.

An AP scheme allows for periodic payments made by the authority-in-charge (GoI or Regional Governments) to the Business Entity during the operational period of the project for providing predetermined infrastructure services (depending on the quality or performance). Availability payments enable private participation when the infrastructure is not commercially viable and the demand risk is high. The payment takes into account the capital costs, operational costs, and/or profit of the implementing Business Entity. To be eligible for an AP, the project must involve end-users with low-income level, as well as social infrastructure or infrastructure of public interest: clearly these criteria are satisfied in the case of PIT communities.

The role of the private sector in a PPP-based arrangement can be of many different kinds. First, the IPP can act as a mini utility company in the designated cluster. Here the IPP develops the power generation facility (i.e. off-grid mini-grid), transmits the electricity to each household, operates and maintains the facility. The payment

collection (tariff/kWh consumed) from the village community is expected to be performed by the BLU. Second, the Private Entity provides electricity by leasing the equipment for independent power generator (Solar Home System) to each household in the cluster or by selling the equipment to local community, which is paid for in instalments. Third, the IPP could develop an off-grid mini-grid power generation facility (a 'Community Centre Scheme') and provide electricity to the local community through community centre facilities like battery charging centres, cold storage for fishermen and rice mills for farmers to support local community activities. The end-users would then pay for the services they get from the community centre in form of monthly subscription fee or payment per length of facility usage.

Finally, it is possible that some of the funding for the program can come from charitable bodies or from companies as part of the Corporate Social Responsibility (CSR) commitments. Under a CSR scheme, a private company could develop a rural electrification facility for a cluster and then handover the facility to a local enterprise or locally based organization, which would then be responsible for operating and maintaining the assets. The local enterprise could then provide electricity directly to end-users or through a community centre facility.

Stakeholder Communication and Engagement

9

Stakeholders involved in the Program can be classified into seven general groups, namely line ministries, national agencies, local government, legislation boards, non-government organizations, media and of course the local communities involved. Their possible roles in the Program include project planning, approvals, funding, implementing, monitoring and evaluation, capacity building and supervision, as well as publication and dissemination. Applying effective communication strategies will support achieving the program's target, improving operational effectiveness, and delivering measurable results. Moreover, it will also improve relationships with key stakeholders and the targetted audience, gaining their support and active participation in the program.

Action plans will be needed involving all these stakeholders, including:

1. Policy Making

- **Ministry of Energy Mineral Resources** (ESDM)
  a. Organize the role and structure of DKE Management Agency
  b. Develop legal basis for the institutional set up of BLU in the form of a Presidential Regulation,
  c. Develop the clear policy guideline required to attract private sector participation
  d. Formulate and design applicable fiscal incentive schemes in line with PIT implementation model
- **Ministry of Finance (MoF)**
  a. Issue Minister of Finance Decree on establishment of BLU
  b. Issue Minister of Finance Regulatios on fiscal and non-fiscal supports that can be applied by BLU for the implementation at project-level
- **CMMA and/or CMEA**
  Lead the cross-ministry coordination for the issuance of the regulation
- **Other Line Ministries**
  Develop their internal policy related to rural electrification program

2. Program Planning

- **Geospatial Information Agency**
  a. Organize the role and structure of BLU
  b. Develop legal basis for the institutional set up of BLU (available options include BLU-DKE or BLU PIT)
- **Statistics Centre Bureau**
  a. Provide the latest Village Potential Data once available
  b. Communicate with Indonesia Terang PMU to enlist all the data to be collected in the next village data survey.
- **State Utility Company (PT PLN)**
  a. Provide the rural areas where PT PLN will not enter into in the next 3 years

b. Communicate with PLN regional offices to provide the current 20kV line to Indonesia Terang PMU for every regencies which are targeted by the Program.

c. Communicate with PLN regional offices to provide the data annual update.

- **Other line ministries, Regional Governments and Non-Government Agencies**

  a. Develop their rural electrification program under the coordination of Indonesia Terang PMU.

- **Indonesian Institute of Science (LIPI)**

  Provide their inputs on the technology specification applicable in Indonesia as part of the goods/services procurement standard.

3. Funding allocation for the program

- **Ministry of Energy Mineral Resources** (ESDM)

  Propose budget allocation and funding from the state budget to implement Program operational activities

- **Ministry of Finance (MoF)**

  a. Set the proposed State Budget allocation for the program

  b. Approve fiscal incentive schemes for the program by considering the fiscal capacity of the State Budget, DKE, and/or other sources of fund

- **Other Line Ministries (e.g: MMFA, MVD, MCSME)**

  Provide their budget allocation for rural electrification-related projects to be coordinated by PIT

- **National Parliament**

  Approve the budget allocation in State Budget

- **Regional Governments**

  Provide Regional Budget allocation to fund their rural electrification project under PIT

4. Program Monitoring and Evaluation

- **Program Indonesia Terang PMU**

  a. Request and compile reports from line ministries and other implementers

  b. Analyze reports and develop action plans if necessary

  c. Provide reports to ESDM

- **Other line ministries and project implementers**

  a. Collect information on the status of the rural electrification initiatives under their jurisdiction

  b. Reports to Indonesia Terang PMU

- **Ministry of Finance (MoF)**

  Evaluate the effectiveness of the implementation of the fiscal supports provided

5. Program Socialisation

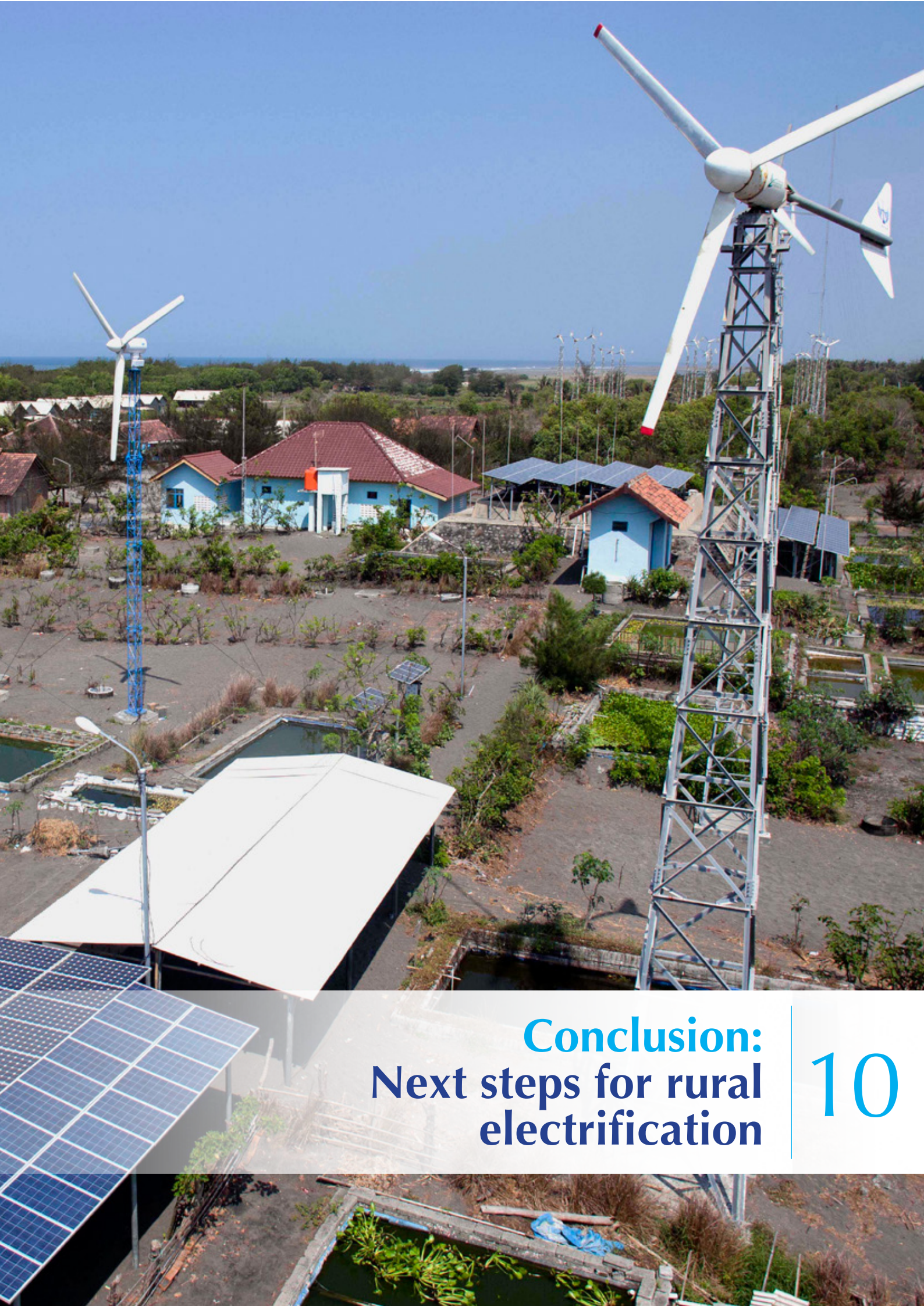
- **Program Indonesia Terang PMU**
  a. Develop Program socialisation strategy and work plan
  b. Engage Communication Division of ESDM to support the socialisation efforts using their platform
  c. Engage Ministry of Communication and Information to support the efforts using their platform
  d. Engage national and local media to communicate the Program
- **Civil Society Orgranizaton**

  Provide manpower supports to communicate the Program at grassroot level

6. Implementation at project-level

- **Ministry of Energy and Mineral Resources** (ESDM)
  a. Develop relevant and applicable regulatory framework on Program Indonesia Terang (which is issued as Presidential Regulation or Minister Regulation or else).
  b. Develop SOP of BLU in which BLU is allowed to accelerate the implementation of rural electrification initiatives (eg: initiate direct appointment for development of rural electrification in certain areas with specific criteria where acceleration efforts need to be carried out, also to facilitate the process of issuance related to rural electricity business)
- **State Utility Company (PT PLN)**
  a. Clearly define and release the operation right over Program Indonesia Terang working area
  b. Simplify and fast-track the issuance of permits related to the development of rural electrification projects to be facilitated by BLU

Effective strategies for program socialisation are also required to ensure that the key messages of the program are conveyed to targeted audience/participants. Through these strategic communication approaches, the Program Implementation Unit would disseminate information and increase awareness amongst communities, private sectors, policy makers, researchers, CSO activists, and academia as well as energy and rural electrification practitioners. The use of online and social media should be given special attention.



Conclusion: Next steps for rural electrification

10

The preceding chapters have provided evidence that rural electrification is not only a government priority and a constitutional requirement, but also a cost-effective and implementable strategy for achieving a variety of important sustainable development goals. PIT is a well-conceived program which provides a blueprint for how Indonesia can catch up with other countries and bring its electrification ratio to above 97% within a few years. This will reduce poverty, improve education and health, and assist with economic development.

However, Indonesia does face considerable challenges in doing this, not least because it consists of thousand of inhabited islands, and many of the communities which PIT seeks to assist are extremely remote. Although Indonesia does have many of the institutional and regulatory building blocks that are needed to implement an effective program, there is still a need to adjust these to make them applicable to the very small scale and disaggregated projects that will comprise the PIT initiative.

Institutional and technical capacity at regional and local levels needs to be considerably enhanced for the program to run effectively. In particular, for a multitude of reasons we have discussed above, good local leadership will make the program work best. Community engagement, developed through stakeholder involvement, is an essential pre-requisite for the program to be cost-effective and sustainable.

Government at all levels needs to recognise that the majority of the costs of the program will inevitably need to be financed from the public budget. The communities involved are among the poorest in Indonesia, and simply do not currently have the financial capacity to provide the sort of returns required by private sector investors. In addition, most of the population clusters are simply too small for an effective PPP project to be developed. Although it is clearly desirable for private investors, and companies through their CSR schemes, to be involved, this will provide the minority of the funding. As a result, effective mechanisms such as the DKE or allocations from DAK, must be developed to channel public funds to where they are needed. DKE as envisaged by the Government provides the best opportunity for funding PIT efficiently using a combination of public, private and donor funds. When fully implemented, DKE presents one of the best opportunities for creating bankable project structures that can harness the private sector's technical and management capabilities while enabling payments from DKE to the private sector.

A program like PIT needs to demonstrate success at an early stage, which is why pilot projects need to be selected and developed as a matter of urgency. The successes from these early projects can then be adapted and applied more widely.

ANNEX:
Case Studies of Successful Programs in Other Countries

A. Japan

Japan has provided electricity to all its citizens for many decades, in tandem with the modernisation of the country and the development of its industry. However, a strong interest in decentralisation of power generation systems still exists. With climate change effects already evident throughout the world and a sharp increase in the occurrence of natural disasters such as floods and heavy rain, the Japanese government is committed to the safeguarding of its most affected citizens. This is being achieved by deploying independent micro-grids to guarantee a stable supply of electricity and access to essential services even in the most extreme circumstances, such as transmission grid failure.

A.1 Rural Electrification Solutions for Climate Change Adaptation and Resilience

The coastal city of Higashimatsushima experienced a catastrophic tsunami-caused flood in 2011, resulting in a death toll of about 1,100 and 10,000 residents losing their homes. To create a sustainable way of living for the remaining population and improve evacuation and emergency plans, the city set a goal of zero net-energy by 2022 to be achieved by supplying the entire city with energy produced locally. In order to do so the local government converted a former city park damaged by flooding into a 2 MW solar PV plant and commissioned the construction of three PV carport systems with a total installed capacity of 270 kWp in strategic locations sheltered from possible natural disasters. Additional solar PV installations and a 500kWh battery system have been deployed to provide reliable sources of electricity to sensitive areas throughout the city. During an extended power outage, the city can now meet the energy demand of its hospitals and assembly hall. Higashimatsushima's grid infrastructure was both developed and owned by the city itself. Through a Community Energy Management System (CEMS), the city is able to monitor consumption and generation trends with smart meters, manage energy storage systems, and bill customers. The city has also been able to decrease electricity costs by negotiating contracts on behalf of the community.

A.1 Results and Relevance to SDGs

Overall, the Higashimatsushima Disaster-Prepared Smart Eco-Town not only opened the way for more renewable energy adaptation measures capable of improving the resilience of cities, but it also allowed a vulnerable community to reach energy independence, reduce emissions and bring down electricity expenses. In brief, the above case shows the successful achievements of two climate-change relevant SDGs:

SDG 11 Make cities and human settlements inclusive, safe, resilient and sustainable

- Emergency facilities can be powered independently in case of natural disasters
- Disaster-prepared hospitals and city halls can function independently from the central grid

- Achieved energy independence with ability to meet three days worth of energy demand via RE sources
- Provide economic stimulus for a devastated town with the benefit of sheltering inhabitants from future events

SDG 13 Take urgent action to combat climate change and its impacts

- GHGs emissions cut by 8%
- CO2 reduced by 256 tons a year
- Cut energy usage by 10% by 2020
- Feasibility analysis to deploy 44MW of RE by 2022 in order meet 100% of the city's energy demand

B. China

China has used rural electrification as a key strategic tool in order to reduce the poverty level in rural villages and provide electricity, health and education services to remote households. Strong political support allowed the country to achieve a 99.94% electrification rate by 2009. Today, the emphasis is on modernization, service and quality improvements, further poverty alleviation and introduction of new technologies and innovative solutions for the few remaining non-electrified remote areas in the vast western regions of China.

B.1 China's Rural Electrification Strategy

The "Brightness Program" was established in 1996 by the State Development Planning Commission (SDPC) with the ambitious goal of supplying electricity to approximately 23 million people by 2010 by deploying decentralized RE systems such as hydropower, solar and wind power plants (NDRC, 2008; EU-China, 2009). Between 1999 and 2002 the government made it possible for 50,000 individuals to benefit from modern electricity services via hybrid PV, solar home systems and PV/battery. The "Township Electrification Program" (2002-2005) was further established under the existing Brightness Program to reach an additional 1.3 million individuals and was financed with central and local government funds. In addition to this, the Ministry of Water Resources established the "County Hydropower Construction of National Rural Electrification" to ensure electricity access to 99% of China. The program aimed at electrifying approximately 900,000 individuals without access to modern electricity by deploying a total of 400 hydropower power plants in rural areas (Chen Lei, 2009).

B.2 Achievements

The electrification of off-grid areas drastically boosted villagers' livelihood by introducing modern machineries, extending working hours and increasing literacy rates. Overall, electricity access in rural China played a major role in the achievement of several SDGs, including:

SDG 1 End poverty in all its forms everywhere

- Average household income increased by 36-52%

SDG2 End hunger, achieve food security and improved nutrition

- Number of households owning refrigerators increased from 12.3% in 2000 to 30.2% today

- Higher households purchasing power allowed for improved and healthier nutrition

SDG 4 Ensure inclusive and equitable quality education and promote lifelong learning opportunities

- Children enjoy longer and more efficient learning hours with the introduction of modern means of lighting
- Introduction of evening schools for adults

SDG 5 Achieve gender equality and empower all women and girls

- Modern appliances reduce the time employed by women to conduct heavy domestic activities
- Reduced rate of miscarriage due to transporting heavy fuel wood

SDG 6 Ensure availability and sustainable management of water and sanitation for all

- Introduction of water pumps increased water security and hygiene

SDG 7 Ensure access to affordable, reliable, sustainable and modern energy for all

- Service reliability increased to over 99%
- Cheaper electricity tariffs from cost competitive renewable energy sources

SDG 8 Promote inclusive and sustainable economic growth, full and productive employment

- Longer working hours as electricity made possible moving some activities to the evening
- Electric lighting freed 6.5 hours per week previously employed in gathering fuel wood
- Enhanced agricultural productivity from modern irrigation

C. India

India is currently aiming to raise its current electrification ratio of 78.7% by providing un-electrified households a minimum lifeline consumption of 1 kilowatt-hour (KWh) per day. Several major policies launched over the last decade have shown this task to be arduous to achieve requiring significant government subsidies given the country's massive rural population. Despite this, the recently launched "11th Five-Year Plan" is expected to accelerate the pace of electrification with large government funds dedicated to speed up the extension of grid lines and the deployment of small-scale renewable energy systems.

C.1 India's Rural Electrification Strategy

In 2005, several electrification schemes were merged under the umbrella of the *Rajiv Gandhi Greameen Vidyutikaran Yojana* (RGGVY) electrification program. The direction of the program was placed in the hands of the Rural Electrification Corporation (REC), which was put in charge of financing and promoting rural electrification via grid extension and off-grid solutions. RGGVY covers 90% of the project cost with REC supplying the remaining 10% in the form of a loan. Based on guidelines released by the Ministry of Power, grid extension represents the

preferable electrification strategy; however, if this is not economically justifiable, the RGGV provides substantial capital and operating subsidies for off-grid solutions leveraging on the natural resources available to isolated communities such as solar PV and biomass plants. As of 2013, the program has managed to successfully bring modern electricity access to over 100,000 non-electrified villages and improved electricity supply in an additional 302,000 clusters (Ministry of Power, 2013).

C.2 Achievements

The impact of rural electrification on the welfare of isolated households in India has been subject to both quantitative and qualitative studies. The results are consistent with the enabling role of access to clean and affordable energy as a gateway towards increased food and personal security while also improving access to education, health care and jobs. The following SDGs have been successfully achieved:

SDG 1 End poverty in all its forms everywhere

- Poverty rate reduced by 13.3%
- Household income increased by 38.6%

SDG2 End hunger, achieve food security and improved nutrition

- Food expenditure recorded a 14% increase
- Improvement in nutrition from refrigeration and modern cooking devices

SDG 3 Ensure healthy lives and promote well-being for all at all ages

- Food expenditure increased by 14%
- Access to modern health care

SDG 4 Ensure inclusive and equitable quality education / lifelong learning opportunities

- School enrolment rates improved by 6% for boys and 7.4% for girls
- Average completed schooling year up by 0.5
- Increased usage of desktop PC, television and radio

SDG 5 Achieve gender equality and empower all women and girls

- Female employment rate raised by 13.5%
- Reduced time employed by women and children to collect biomass
- Reduced schooling and employment disparities

SDG 8 Promote inclusive and sustainable economic growth, full and productive employment

- Employment hours went up by 17% for women and by 1.5% for men
- Created village cooperatives involved in the planning and implementation processes

SDG 13 Take urgent action to combat climate change and its impacts

- Reduced emission of NOX, CO2, PM and SO2 from kerosene lamps, biomass and diesel generators

D. Tunisia

After independence, the Government of Tunisia initiated a general policy to nationalize key economic activities, including power generation. In the following decades, energy demand increased at a pace of 11.5%. However, it was not until the 1970s that the government established a national rural electrification strategy to increase the very low electrification ratio of 6%.

D.1 Tunisia's Rural Electrification Strategy

The Tunisian Government decided to make rural electrification a top priority on the national agenda and over 450 Million Tunisian dollars (US$ 319.5 Million) were invested between 1977 and 2000. The proposed plan was part of the IV Five-year Plan (1972-1976) aimed at providing electricity to isolated settlements with the ultimate goal of improving basic education and health services for the population (Meisen & Irem, 2008). Between 1972 and 2001 the government-led electrification program reached 609,000 households. The least-cost electrification plan consisted of grid extensions and solar PV solutions, depending on the project's economic viability. Overall, post-implementation, the rural electrification ratio rose to 88%, and overall electrification to a staggering 95% over the span of 23 years. As of today, the National Agency for Renewable Energy (ANER) is responsible for the deployment of SHSs and PV minigrids in remote settlements.

D.1 Results and Relevance to SDGs

Similarly to the Chinese and Indian cases, rural electrification in Tunisia shows a strong correlation with socioeconomic indicators. Some of the SDGs achieved via rural electrification include:

SDG 1 End poverty in all its forms everywhere

- Reduced rate of poverty from 40% in 1956 to 7% in 1995
- Improvement in regional disparities and income distribution

SDG 3 Ensure healthy lives and promotes well-being for all at all ages

- Increase in life expectancy from 50 to 74 years
- Refrigeration of foods and medicines
- Increased television usage (increased exposure to contraceptives, hygiene, and diseases)

SDG 4 Ensure inclusive and equitable quality education and promote lifelong learning opportunities

- Near-100% primary-school enrolment
- Increase in primary school graduation from 60% to 70%
- Improved lighting in schools, leading to more effective & efficient learning

SDG 5 Achieve gender equality and empower all women and girls

- Improved gender equality and an increase of women in the Tunisian labour force
- Improved role of women in their communities/families

SDG 7 Ensure access to affordable, reliable, sustainable and modern energy for all

- 88% to 95% electrification ratio in 23 years

SDG 10 Reduce income inequalities within and among countries

- Improvement in regional disparities and income distribution

SDG 11 Make cities and human settlements inclusive, safe, resilient and sustainable

- Decrease in the rate of urban growth from 4.3% in 1975 to 1.2% in 1999, while the population doubled

E. Malaysia

Rural electrification has been a key focus of the government of Malaysia since the First Malaya Development plan highlighted its enabling role for accelerating the sustainable development of the country. An integrated grid extension program was adopted by Malaysia with focus on providing 24-hour electricity to target areas and achieving a 100% electrification rate throughout the country. Today, the government is continuing its efforts to connect small villages and islands, mainly in Sabah and Sarawak via SHSs and PV/diesel hybrids.

E.1 Malaysia's Rural Electrification Strategy

In order to provide electricity supply to rural un-electrified households and to enhance the quality of life and living standards of rural communities, the government established the "Bekalan Elektrik Luar Bandar" (BELB) program. The geographical focus of the program was on Sabah, Sarawak and the 'orang asli' in Peninsular Malaysia. Modern electricity access has been provided by means of central grid extension, provision of generator sets and use of alternative energy such as SHSs and solar-hybrid systems. In order to close the gap between the

electrification coverage of Sabah-Sarawak and Peninsular Malaysia, the BELB program offers financial support based on two methods: 1) connecting un-electrified households to the existing grid, with priority given to villages with a large number of houses, including schools, clinics and other facilities, and 2) deploying alternative resources, such as solar photovoltaic, gen-set and solar hybrid for villages with a distance of at least 10 km from the 11 kV grid line.

E.1 Results and Relevance to SDGs

Over the last decades the Malaysian government has committed significant resources to numerous policies to improve the livelihood of its citizens and assume a leading role among South East Asian countries. The combination of these policies, including rural electrification, played a key role in achieving the following:

SDG 1 End poverty in all its forms everywhere

- Eradicated absolute poverty
- Poverty rate at 0.6%
- Child poverty rate at 1.3%

SDG2 End hunger, achieve food security and improved nutrition

- Number of underweight children reduced by 90% between 1990 and 2014

SDG 3 Ensure healthy lives and promotes well-being for all at all ages

- Malaria and HIV cases fell to an all-time low thanks to improved access to information and health services

SDG 4 Ensure inclusive and equitable quality education and promote lifelong learning opportunities

- Literacy rate over 98%
- Moved closer to universal education: 97.9% of students completed primary education in 2015

SDG 5 Achieve gender equality and empower all women and girls

- Closed the gap between boys and girls enrolled in primary and secondary education
- Female participation in the workforce reached 52.4% in 2015
- Men's to women's wage ratio at 1.06
- Domestic violence fell from 12.7 to 9.6 per 100,000 population between 2010 and 2014

SDG 8 Promote inclusive and sustainable economic growth, full and productive employment

- Achieved full employment with unemployment rates as low as 2.7% among men and 3.2% for women

SDG 13 Take urgent action to combat climate change and its impacts

- Saved 4,000 ton of oil equivalent in 2015 alone

INDONESIATERANG