Indonesia National Sustainable Energy Strategy Report

on

Enabling Environment and Technology Innovation Ecosystem for Affordable Sustainable Energy Options

Prepared for

Asian and Pacific Centre for Transfer of Technology (APCTT)
of the Economic and Social Commission for Asia and the Pacific (UNESCAP)

Prepared by

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ABBREVIATIONS

5P	:	Pro-poor public-private partnership programme
ADB	:	Asian Development Bank
AICTE	:	All India Council for Technical Education
AMDAL	:	Approval of the environmental impact assessment
APACE	:	Appropriate technology for community and environment
APCTT	:	Asian and Pacific Centre for Transfer of Technology
BAPPENAS	:	The national development planning agency, Indonesia
BOMT	:	Build, operate, maintain and transfer
BOT	:	Build, own and transfer
CNY	:	Chinese Yuan
CPO	:	Construction partner organization
CTF	:	Clean Technology Fund
CTP	:	Craftsman training programme
DANIDA	:	Danish International Development Agency
DEN	:	The National Energy Council, Indonesia
DGET	:	Directorate General of Employment and Training
DGNREEC	:	Directorate General of New Energy, Renewable Energy and Energy Conservation
EE	:	Energy efficiency
EEP	:	Energy and Environment Partnership with Indonesia
EMI	:	Equal monthly instalments
ESCAP	:	Economic and Social Commission for Asia and the Pacific
ESCO	:	Energy service company
ESMAP	:	Energy sector management assistance programme
ESSV	:	Energy self-sufficient village programme
FDI	:	Foreign direct investment
FIT	:	Feed-in tariff
GDP	:	Gross domestic product
GEF	:	Global Environment Facility
GEOCAP	:	Geothermal capacity building programme
GERD	:	Gross expenditure on research and development
GFF	:	Geothermal Fund Facility
GIS	:	Geographic information system
GIZ	:	German Federal Enterprise for International Cooperation
GoI	:	Government of Indonesia
GS	:	Grameen Shakti
GWA	:	Geothermal working area
HPS	:	Husk power system
HRD	:	Human resource development
IDR	:	Indonesian rupiah
IIGF	:	Indonesian Infrastructure Guarantee Fund
IIM	:	Indian Institute of Management
IMIDAP	:	Integrated micro-hydro development and application programme
IPP	:	Independent power producer
ITI	:	Industrial Training Institute
IUPTL	:	Electricity business license
JRF	:	Junior research fellowship
KPLC	:	Kenya Power
M.Sc.	:	Master of Science
M.Tech	:	Master of Technology
MEMR	:	Ministry of Energy and Mineral Resources
MES	:	Modular employment skill development programme
Mha	:	Million hectare
MHPP	:	Micro hydro power programme
MoF	:	Ministry of Finance
MSOE	:	Ministry of State-Owned Enterprise
MSW	:	Municipal solid waste
NDRI	:	Non-departmental research institutes

NGO	:	Non-government organization
NREF	:	National renewable energy fellowship
O&M	:	Operation and maintenance
OSS	:	One-stop service
PDF	:	Project Development Facility
PIP	:	Pusat Investasi Pemerintah (Government Investment Agency)
PLN	:	Perusahan Listrik Negara (State Electricity Company)
PPA	:	Power purchase agreement
PPP	:	Public-private partnership
PRC	:	People's Republic of China
PV	:	Photovoltaic
QBTU	:	Quadrillion British thermal unit
R&D	:	Research and development
RA	:	Research assistantship
RDC	:	Research and development centre
RE	:	Renewable energy
RIKEN	:	General plan of energy conservation
RPO	:	Renewable purchase obligation
Rs.	:	Indian rupee
SBC	:	System benefit charge
SBZ	:	Special biofuel zone
SE4 All	:	Sustainable Energy for All
SET	:	Sustainable energy technology
SHS	:	Solar home system
SLO	:	Certificate of operational worthiness
SME	:	Small and medium enterprise
SNV	:	Foundation of Netherlands Volunteers
SOE	:	State-owned enterprise
SRF	:	Senior research fellowship
SSC	:	South-South cooperation
SWHS	:	Solar water heater system
TOE	:	Tons of oil equivalent
UDBP	:	Indonesia Domestic Biogas Programme
UNDP	:	United Nations Development Programme
UNESCAP	:	United Nations Economic and Social Commission for Asia and the Pacific
USDA	:	United States Department of Agriculture
VAT	:	Value added tax
WISE	:	World Institute of Sustainable Energy

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G. M. Pillai
Founder Director General, WISE

EXECUTIVE SUMMARY

Indonesia is endowed with fossil fuel resources such as coal, oil and gas. The country also has abundant potential for renewable sources of energy such as geothermal, solar, biomass and hydro. However, fossil fuels have dominated the energy portfolio of the country for decades, and the use of renewable energy sources has been limited so far. Fossil fuel subsidies provided by the government over the past four decades kept the price of fossil fuels significantly below the market price, and to some extent are posing problems for increasing the affordability of sustainable energy options in the country. Being an archipelago, the use of decentralized off-grid renewable-based energy applications is important for Indonesia from the point of view of ensuring energy security and energy affordability.

National Enabling Environment for Sustainable Energy Options

In order to increase the share of renewable energy in the energy mix of the country, the government of Indonesia stipulated 17% target share of renewables by 2025 in the country's energy mix.[1] The electrification ratio in the country was about 75.79% in 2012, and is targeted to grow up to 83.4% by 2016.[2] The Directorate General of New, Renewable Energy and Energy Conservation (DGNREEC) administers the development and promotion of renewable energy (RE) under the aegis of the Ministry of Energy and Mineral Resources (MEMR) in Indonesia. The power market is dominated by the state owned company PLN which has 85% share in power generation and is a vertically integrated utility responsible for transmission and distribution of power.[3] The PLN has taken a few initiatives in sustainable energy development in the country, e.g., the '1000 Islands Programme' and establishing geothermal power plants to promote sustainable energy options. In Indonesia, the renewable energy sector is governed by several policies, laws and regulations notified by the government. Programs such as 'Energy Self-Sufficient Village (ESSV) programme', 'Domestic Biogas Development Programme' and 'Solar Home System Programme' promote the use of sustainable energy technologies in Indonesia. The ESSV programme encourages the use of locally available resources and aims to improve infrastructure and economic condition of the villages. Fast-track programmes create a conducive environment for massive investments in the renewable energy sector. Fiscal and financial incentives facilitate investment in sustainable energy. Feed-in tariff and business viability guarantee are provided for attracting more Independent Power Producers in the sector.

Sustainable energy technologies and projects are entitled to income tax reduction, accelerated depreciation benefit, exemptions on import duties and Value Added Tax. Besides, subsidies are available for biofuels. Geothermal fund facility provides financial support to geothermal developers. Farmers get loans at lower interest rates for biofuel plantations. Apart from finance from banks, finance from government and international institutions is also available. The electricity law of 2009 has opened up the market for power supply business to the private entities. However, the RE investor has to obtain large number of permits and approvals from different government departments and ministries for setting up RE projects in Indonesia.

The enabling environment thus creates certain opportunities for development of sustainable energy options in the country. However, there are certain gaps in the sustainable energy framework that poses tough challenges. The lack of coordination among different ministries formulating laws results in delay of project implementation. High level of subsidies provided to fossil fuel resources, lack of working capital, no access to market for products, and insufficient managerial guidance are problems

[1] National Energy Policy, Presidential Regulation No. 5/2006
[2] Dr.Ir. Syahrul Aiman, National Consultant to APCTT
[3] Anang Yahmadi, PLN; Renewable Energy Power Supply for Development

faced by the Energy Self Sufficient Village (ESSV) programme. The biogas programme faces problems such as high initial cost, need to pen animals for effective collection of cow dung, insufficient number of animals, etc. The investors interested in grid-connected RE projects are facing problems such as getting access to finance from the market, inefficient bidding process, low feed-in tariff designed as per the avoided cost methodology, lengthy licensing procedure, and multilevel regulatory and approving authorities. Requirement for high initial finance and lack of after-sales service are problems faced by the off-grid decentralized RE technologies.

Technology Innovation Ecosystem for Sustainable Energy

National Long-Term Development Plan (2005–2025) focuses on energy research as one of the seven distinct fields of research.[4] The 'Master plan: Acceleration and Expansion of Indonesia: Economic Development 2011–2025' puts emphasis on improving innovation in the country.[5] Most of the research and development (R&D) in Indonesia is carried out by R&D centres (RDCs) under the Department of Energy and Mineral Resources, RDCs under non-departmental research institutes (NDRIs), and several public universities. Various universities collaborate with industry and foreign institutes to build up necessary human resource for the sector. The country should ideally follow "Masterplan: Acceleration and Expansion of Indonesia: Economic Development" which proposes that expenditure on R&D be gradually increased from 1% of GDP in 2014 to 3% of GDP in 2025.

Besides, infrastructure and domestic manufacturing needs to be strengthened for better access and acceptability of sustainable energy technologies. Government initiatives such as Indonesian Infrastructure Guarantee Fund (IIGF) provides guarantees for infrastructure projects and the Project Development Facility (PDF) assists in project preparation and selection of appropriate private partners for public-private partnership (PPP) projects. The government has also established special biofuel zones (SBZ), business incubation centres and techno parks for promotion of sustainable energy.

Suitable Sustainable Energy Options in Indonesia

Six sustainable energy technologies suitable for meeting the electricity, heating and cooking requirements of the peoples living in remote area in Indonesia have been identified. These are as follows:

Geothermal

Geothermal energy potential in Indonesia is about 29,000 MW.[6] Geothermal fund facility, second fast-track crash programme and business viability guarantee from the government are key drivers for geothermal technology.

Small and Micro Hydro

The country has a small and micro-hydro power potential of about 770 MW. Key drivers for small and micro-hydro development in Indonesia are distributed water resource across islands, high potential outside Java-Bali island which are relatively larger and populated, modular nature of technology which can be scaled up as per requirement, cost competitiveness over grid connected projects and mandatory power purchase obligation for PLN from small and medium scale power producers, etc.

[4] Australian AID and The World Bank; Indonesia: Research & Development Financing
[5] Australian AID and The World Bank; Indonesia: Research & Development Financing
[6] Directorate of Various New Energy and Renewable Energy

Biomass

Indonesia has biomass-based power potential of about 50,000 MW. Key drivers for biomass based energy technology are abundant availability of agricultural waste, animal waste and municipal solid waste, decentralized power generation technology, feed-in tariff and mandatory power purchase obligation for PLN from small and medium scale power producers.

Biofuels

Indonesia emphasizes use of biodiesel and bioethanol in the transportation sector. Key drivers for bio-fuel production in the country are tropical climate which is conducive for biofuel feedstock production, suggested targets to develop 5.25 mha of biofuel cropland (1.5 mha palm, 1.5 mha jatropha, 1.5 mha cassava, 750, 000 ha sugarcane) on currently uncultivated land, existence of ESSV, creation of SBZ, favourable regulatory environment, availability of subsidized loan to farmers, and government subsidy for biofuel production.

Solar Energy

Indonesia has solar radiation up to 4.8 kWh/m^2/day. Key drivers for promoting solar power technology in the country are demand for electricity in un-electrified areas where grid expansion is relatively expensive, possibilities of replacing diesel-based generation in remote islands, feed-in tariff, and mandatory power purchase obligation for PLN from small and medium scale power producers. The Solar thermal applications are suitable for catering the domestic and industrial heating requirements of moderate temperature range.

Small Wind

The reported average wind speed of 5m/s in the country is suitable for small wind technology. Indonesia has an installed capacity of about 2 MW. Key driver for small wind technology is the lack of access to electricity in remote islands which are suitable for power generation using wind technology. However, scientific wind resource assessment studies are required for ascertaining the potential for onshore and off-shore grid connected wind power projects.

Policies, Programmes and Business Mechanisms for Affordable Sustainable Energy Options in Indonesia

The new policy approaches, and programs delivery mechanism suggested for accelerating sustainable energy / renewable energy development in Indonesia are based on the gap analysis of the current national enabling framework for sustainable energy and technology innovation ecosystem in Indonesia. In order to increase the access to and affordability of sustainable energy options in Indonesia, appropriate strategies, associated policies, programs and business models are required to be implemented.

- Indonesia needs to create an empowered committee consisting of top-level representatives from the ministries of energy, agriculture, finance, and forestry to overcome the problem of lack of coordination among various government ministries and departments.
- There is a need for proper execution of one-stop service and information dissemination about the service to expedite the licence and permit procedures. Besides, training should be given to personnel employed for proper implementation of the licensing procedure.
- In order to create a level-playing field for sustainable energy technologies (i) cost of externalities should be included in price of conventional energy sources, (ii) people should be educated on the adverse effects of fossil fuel subsidies, (iii) subsidies on conventional sources should be tapered

off over the years, and (iv) the poor should be protected from effects of subsidy removal on conventional energy sources through targeted compensation.

- Net metering is a policy option for promoting use of renewable energy in a distributed set-up. This policy should be adopted, especially for urban rooftop solar Photo Voltaic systems which will be connected to the national grid. Owners of the PV renewable energy systems will receive payment from the utility for net energy exported to the grid.
- Public–private partnerships should be encouraged to promote solar home applications in rural areas. In doing so, the government should clearly specify its grid expansion plans, and identify regions that are suitable for off-grid solar applications. Further, the government should prepare phase-wise targets for system deployment, establish a cost sharing mechanism, ensure product quality and provide partial subsidy to reduce upfront cost of solar systems. The public-private partnership may be implemented through Energy Service Company (ESCO) mechanism involving the government, ESCOs empanelled by the local authorities, and banks. Solar power deployment programme should be implemented by introducing solar photovoltaic systems for rural home lighting, solar thermal application for cooking and industrial heating/drying, and solar thermal systems for water heating.
- Community participation should be encouraged in promoting off-grid technologies. The government should build up awareness about community-based projects, facilitate private participation through information dissemination and providing finance through banks, and provide subsidy to reduce upfront costs. Community participation may be promoted through a joint venture between the community cooperative and private entity with clear distribution of labour among the cooperatives, private entities and the local NGO responsible for community capacity building.
- Promotion of the use of biofuels in small-scale electricity production and in transport is important. In order to promote the use of biofuel, the country should (i) prepare a land management plan (ii) increase coordination among departments and institutions responsible for biofuel policy making and R&D (iii) promote role of local administration (iv) provide adequate infrastructure (v) adopt social programmes for rapid scaling up of use of biofuels, and (vi) provide training for administrative capacity building.
- To ensure sustainable use of biomass resources, a zoning policy should be adopted while allocating biomass based power projects to developers. However, regulation to restrict the biomass export is not advisable. Indonesia's domestic manufacturing sector needs thrust to reduce dependence on imported products. Domestic manufacturing in RE should be promoted by introducing certification and testing programs, local content requirements, fiscal and financial incentives, and R&D programs.
- The role of Small and Medium Enterprises (SMEs) is very important in establishing an RE manufacturing base in Indonesia. Therefore, in order to encourage participation of SMEs in RE manufacturing, a special type of incentive structure needs to be devised.
- Scientific RE resource assessment assignment should be initiated by the government. Resources assessment data and GIS based maps compiled at regional or country-level may be shared through a renewable energy portal to help developers in making informed decisions on investment.
- The appropriate government departments should adopt various country-level programmes to promote off-grid energy systems and applications in the country. The DGNREEC should notify regulations stating terms and conditions and parameters for feed-in tariff determination using cost plus methodology.
- Indonesia should choose an appropriate mix of tax incentives to attract investment in sustainable energy technologies by reducing cost of such investments. Different countries offer incentives

such as production tax credits, property tax incentives, personal tax incentives, sales tax incentives and pollution tax exemptions. Quantitative studies should be conducted to determine the right mix of incentives for Indonesia. Besides, the government should create funds to finance renewable energy. Moreover, the government should encourage capacity building of the banking and financial sector. A revolving fund should be created for promotion of for renewable energy technologies by introducing eco-taxation.

- Human resource development can be done through education from school level to doctoral level, through management courses and specialized training courses at various levels. The curricula of educational and training institutions should be revised to include sustainable energy related subjects, and laboratory infrastructure should be strengthened.
- The government should promote business incubators using tax benefits, public-private partnership, low cost loans, encouraging private sector in technology tie-up, or in technology transfer with foreign firms. Besides, the government should (i) formulate and enforce regulations on product standards and requirements for manufacturers and installers, and (ii) support and promote testing and certification of renewable energy equipments.

Indonesia can engage in South-South cooperation with other developing countries whose experience in promoting sustainable energy technologies may become helpful for the country. Indonesia may gain an understanding about government's participation, women's participation in decision-making, and capacity development from Nepal's experience in rural energy development programme. Rice husk based biomass gasification technology used by Husk Power Systems and similar technology developed by Ankur Scietific Pvt. Ltd for power generation from biomass in India may be transferred to Indonesia under south-south cooperation. The Ministry of New and Renewable Energy in India has taken initiatives to develop human resources in the RE sector. The experience of MNRE shall prove important in building human resource in the area of sustainable energy in Indonesia.

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Chapter 1
BACKGROUND AND METHODOLOGY

1.1 Background of the Study

The Economic and Social Commission for Asia and the Pacific (ESCAP) is implementing a project under the UN Development Account titled "Strengthening South-South Cooperation to Increase the Affordability of Sustainable Energy Options in Asia and the Pacific".[7] The project's purpose is to increase affordability of and access to sustainable energy options such as biomass, solar, wind, small hydro and others, as well as energy saving building materials through enhanced South-South cooperation (SSC) in Asia and the Pacific, with the overall goal of achieving sustainable development. This project also aims to contribute to the objectives of the UN Secretary-General's Sustainable Energy for All (SE4 All) Initiative to achieve universal access to modern energy services, doubling the global rate of improvement in energy efficiency and doubling the share of renewable energy in the global energy mix by 2030. The project's intended outcomes are two-fold:

- Strengthen capacity of policy makers and other relevant stakeholders, especially in Least Developed Countries, Landlocked Developing Countries and Small Island Developing States, to develop and/or strengthen national policy frameworks which promote enabling policy and business environments for increased affordability and accessibility of sustainable energy products and services;
- Support implementation and dissemination of good practices and successful business-mechanisms among the countries in the region to provide sustainable energy products and services.

In line with the broader objectives stated under SE4 All initiative, the Asian and Pacific Centre for Transfer of Technology (APCTT) under ESCAP had contracted Mr. G.M. Pillai, Founder Director General, World Institute of Sustainable Energy (WISE), Pune, India as an international consultant to develop national strategy reports in cooperation with national consultants from two pilot countries, Lao People's Democratic Republic and Indonesia. Along with preparation of national strategy reports, Mr. Pillai was also entrusted with the responsibilities of (1) assisting in organizing and actively participating in the national workshops on sustainable energy options and national strategy development at Lao People's Democratic Republic and Indonesia, (2) preparing workshop reports, and (3) assisting APCTT in identifying institutions and businesses in two or three countries, and organizing the study tours for policy makers and decision makers from pilot countries.

1.2 Scope of Work for Designing the National Strategy Report

The International consultant had to prepare national strategy reports presenting:

- an analysis of salient features of opportunities and challenges in the current national enabling environment and innovation eco-system for sustainable energy;
- key elements of technology delivery and business mechanisms for increasing affordability of and access to sustainable energy and energy saving products, paying particular attention to the role of South-South cooperation;
- sustainable energy options relevant to the pilot countries from the context of their enabling environment, identify specific projects/case studies that could be successfully implemented as pilot/demonstration projects making sustainable energy affordable and accessible;

[7] Project TOR

- recommendations on policy approaches, programmes, delivery mechanisms and business mechanisms to implement the national strategy with examples from other developing and least developed countries;

1.3 Methodology

The national strategy report suggesting the policy approaches, programmes, delivery mechanism, business mechanisms in the context of an enabling environment for increasing affordability of and access to sustainable energy options / services is a result of extensive research of literature available on the authentic websites on the internet, academic reports, as well as media materials. However, the assessment framework for affordable sustainable energy remains the axis of the study and this was prepared keeping in mind the parameters required for creating a robust national enabling environment and technology innovation ecosystem. The entire assessment framework is divided into six broad sections, namely, national scenario for sustainable energy, technology enabling environment and ecosystem, business enabling environment and ecosystem, business models for SET delivery, social economic factors and South-South cooperation. A set of questions on different parameters were posed under each category of the assessment framework. Information on these questions and parameters is provided below.

National Scenario for Sustainable Energy

Under this section questions on topology, number of states and provinces in the country, administrative set up, population, electrification ratio, current power sector set up were asked to provide an general idea on Indonesia. Under resources availability and access section questions were asked on share of different sources of energy in country's primary energy mix, resource potential on fossil fuel and renewable energy, installed capacity of grid-connected and off-grid RE technologies, and programmes implemented at various levels of government in the country along with their success and failure factors. Information on sectoral and household level energy and electricity consumption in the past, forecasted demand for energy and electricity, and availability of electricity in urban and rural areas were sought for need and demand for energy section. For analyzing Indonesia's current energy shortage, questions on energy demand-supply and energy efficiency were raised. Market for energy services were captured through questions on identification of customers for decentralized RE application and suitable RE technologies, services for rural and urban areas.

Technology Enabling Environment and Ecosystem

There are three subsections under technology enabling environment and ecosystem. These sections are government initiatives to promote sustainable energy technologies (SETs), institutional and human resource development framework and SET manufacturing capacity. Under government initiatives to promote SET, information was sought for assessing role of government in creating an enabling environment to promote SETs. Questions asked in this section included how favourable are existing laws, regulations and policies for SETs, whether RE targets and renewable purchase obligations (RPO) have been specified, how do government measures facilitate private participation in the energy sector, how much subsidy is dolled out for fossil fuel and renewables. Under institutional and human resource development section information was sought for institutes involved in implementing RE and energy efficiency programmes, services offered by financial institutions for grid connected and off-grid SET development, instances of capacity development of local and national institutes for project implementation, academic curricula in respect of coverage of RE, specialized courses on RE, institutes having expertise in policy making and R&D and ministries involved in promoting SETs. As per as RE manufacturing capacity is concerned, information on RE

and SET manufacturing base in the country, government support in RE manufacturing and effectiveness of local environment in attracting private entrepreneurs, investors, foreign direct investment were asked in the assessment framework.

Business Enabling Environment and Ecosystem

Under this section questions on public financing of SETs, end user financing and participation of private sector in RE were asked. Under public financing section questions were asked on availability of public fund for credit guarantee, risk mitigation and insurance support, import regulations, clean energy fund, considering RE sector for priority sector lending and incentive mechanism such as tax credit, soft loans, generation based incentives, revolving fund etc. Under end user financing, information was sought on examples of government incentives in promoting use of RE, usefulness of micro finance institutions, financial arrangements for micro finance institutions and development finance organizations, examples of income generating activities for RE project implementation so that affordability is increased and involvement of local co-operative society in financing SE, RE products and services. Regarding private sector participation in RE, questions were asked on existing policies, laws, regulations for providing market access to private sector, institutional framework for sanctions of private sector in the country, barriers faced by the private sector and financial and fiscal incentives provided to remove these barriers.

Business Models for SET Delivery

Under this section questions were posed to judge existing business models with respect to certain parameters that epitomize affordability of and accessibility to SETs. Discussion under this section is catered around character of the business models, service provision and distribution mechanism and country-specific risks that could impede project implementation. For assessing character of business models questions were asked on robustness of SET project with respect to economic viability, type of approvals required from concerned authorities and ease of getting such approvals, improvement in standard of living in the community and benefits to disadvantaged segments by setting up the RE project, challenges in terms of logistics and distribution models in remote areas, quality control mechanism for building up consumer confidence, government initiative on entrepreneurial capacity building, monitoring mechanism set for evaluation of efficiency of the project. Under service provision and distribution mechanism information was sought on fiscal and financial benefits available to local community to suit their needs, possibilities on building local energy services distribution chain and problems of reaching rural population for goods and services. For assessing country specific risk to a business model questions were asked on instances of lack of community involvement during the implementation stage, lack of commitment shown by the government, non-participation by financial institutions, availability of alternative solutions other than the one considered by the project proponent.

Socio-Economic Factors

Socio-economic condition influences decision making regarding sustainable energy. Issues in this section centres on two aspects – social factors and affordability. Questions in social factors section are based on issues such as awareness efforts made by the government in promotion of SET, openness to adopt of technology, community participation in energy product development and energy services, suitability of SET product and service based on difference in consumer preference, cultural diversity and rural-urban characteristic of population, involvement of women and disadvantaged groups, NGOs and local community in promotion of SET. Economic factors have been discussed through analysis of affordability and accessibility. Information sought for affordability are various applications used

along with their average unit prices, monthly spending on alternative to RE energy sources, subsidies on fossil fuel, end user financing schemes, end user's ability to afford sustainable energy services, social and cultural preferences.

South-South Cooperation

In this section, possible areas for country level cooperation with countries of global south have been discussed. In this section information has been sought mainly on coordination with private sector, NGOs and organizations for plans and programmes, RE systems deployment, project life cycle, waste disposal, skill and capacity building, and trade.

National consultants provided information on the above mentioned issues or points. The international consultant relied on the information provided by the national consultants on the current national assessment framework on enabling environment, and technology innovation ecosystem for making sustainable energy options accessible and affordable. The consultant also benefited from the outcomes of the two day national workshops on sustainable energy options and national strategy development organized at Jakarta, Indonesia, during 19-20 March 2014 and 12-13 May 2014.

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Chapter 2
INTRODUCTION

Indonesia comprises a number of islands lying at the intersection of the Pacific and the Indian Oceans. The country has population of about 245 million[8] which grew by about 1.5% annually between 2000 and 2010.[9] The economic growth rate of the country was between 5.5% and 6.5% over the last 5 years.[10] With the growing population and expectations of higher economic growth rate in the future, energy demand will surge in the future. According to a report by McKinsey Global Institute, Indonesia's energy demand may triple from 6 quadrillion British thermal unit (QBTU) in 2012 to 17 QBTU in 2030.[11] To meet increasing demand, the country needs to identify available energy resources and use them efficiently.

Despite having abundant supply of renewable energy resources such as geothermal, solar, and hydro, Indonesia is heavily dependent on fossil fuel resources such as coal, oil and gas to meet its energy demand. In fact, fossil fuels dominated the energy portfolio of the country for decades; the use of renewable energy sources has been limited so far. In 2012, about 95% of the energy mix was contributed by fossil fuels of which oil alone contributed almost 47%.[12] One of the main drivers behind this is fossil fuel subsidies provided by the Indonesian government over the past four decades which kept the price of fossil fuels significantly below the market price. When supply was high and demand was low, subsidies stimulated economic growth with low, stable energy prices. However, as demand began to outpace supply, energy subsidy became a burden on the country. In 2012, the subsidy and other fuel products commanded into a budget allocation of US$ 21 billion which was about 21% of the central government's budget and 2.6% of the GDP.[13] In addition to exerting pressure on the budget, sustained fossil fuel subsidies kept investment on renewable energy limited. Besides, large expenditure on fossil fuel subsidies restricted government budget allocations for infrastructure development, which contributed to inadequate infrastructure in the country. As a result, in spite of being endowed with abundant energy resources, many areas remain without power supply, and. Indonesia has transitioned from an oil exporting country to an oil importing country in 2004. Given the high share of oil in its energy portfolio, the country runs the risk of becoming dependent on energy imports in the longer run. Oil import also impacts the country's exchequer as it faces the risk of its foreign exchange reserve being eroded by an unfavourable exchange rate (the devaluation of rupiah against dollar).

The heavy reliance on fossil-fuel-based energy threatens Indonesia's energy security given the exhaustible nature of fossil fuels. According to a project document for wind hybrid power generation prepared by Ministry of Finance (MoF) in Indonesia, Indonesia's total proven and potential reserves of crude oil and natural gas will be depleted in about 10 to 35 years and those of coal will be depleted in about 65 years.[14] Added to this, the country is among the largest green house gas emitters in the world. Sustained use of fossil fuel resources will add to the green house gas emissions. This may

[8] http://data.worldbank.org/indicator/SP.POP.TOTL
[9] Dr.Ir. Syahrul Aiman, national consultant to APCTT
[10] Dr.Ir. Syahrul Aiman, national consultant to APCTT
[11] McKinsey Global Institute; The Archipelago Economy: Unleashing Indonesia's Potential
[12] Directorate of Various New Energy and Renewable Energy
[13] World Bank; Why Is Reducing Energy Subsidies a Prudent, Fair, and Transformative Policy for Indonesia?
[14] Ministry of Finance of the Republic of Indonesia, Directorate General of Debt Management; Project Document, Wind Hybrid Power Generation, Market Development Initiatives

leave Indonesia far behind its commitment of reducing green house gas emissions up to 41% by 2020.[15]

Table 2.1 Energy potential of conventional sources in Indonesia

Energy fuel	Proven	Potential	Total	Production capacity	Life Time, years
Crude oil, Million bbl	4867	4825	9692	500	10
Natural gas, trillion scf	95	75	170	2.9	32
Coal, billion mt	6.5	31.5	38.11	1	65

Source: Project Document, Wind Hybrid Power Generation, MoF, Indonesia

Keeping in mind the exhaustible nature of fossil fuels and the environmental and economic impacts of using them in a sustained manner, the country has been trying to increase the share of renewable energy. An attempt in this direction was to fix a target for new and renewable energy sources in the presidential regulation no. 5/2006, which stipulates a 17% share of new and renewable energy in the country's energy mix. The proposed change in the country's energy mix from the present situation to the future is shown in the figure below.

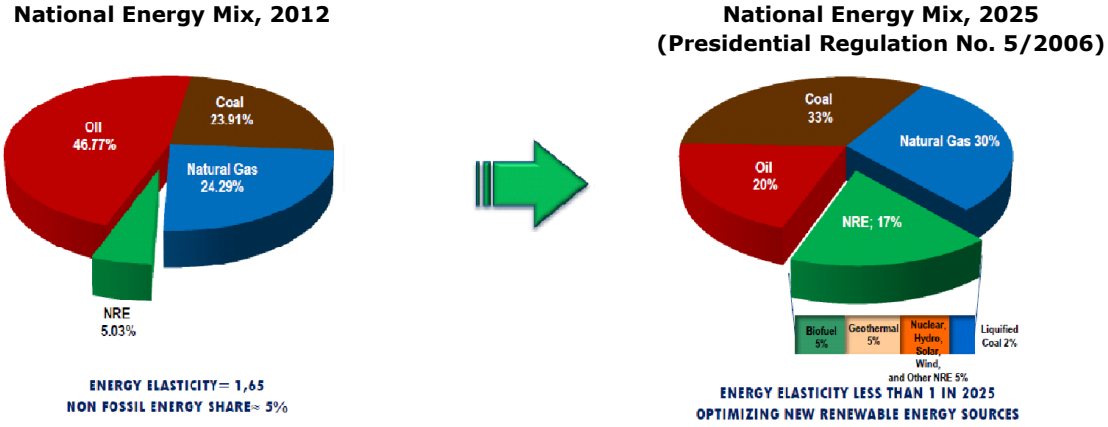

Figure 2.1 National primary energy mix target[16]

The main use of renewable energy is in the electricity and transport sectors in Indonesia. The electrification ratio in the country stood at 75.79% in 2012 and is targeted to grow to 83.4% by 2016. However, in such provinces as Papua, NTB, NTT, and Kalteng, ratio is less than 60% and thousands of islands have no access to electricity.[17] The main source for electricity in these areas is diesel-based decentralized generation systems. The cost of diesel is high due to complex transport system. Besides, the supply of diesel is sometimes irregular, which leads to an unreliable energy generation system. Locally available renewable energy sources may be used for electricity generation in these regions. Moreover, to achieve the target of 93% electrification ratio (a target set by MEMR) by 2025,[18] use of renewable energy needs to be accelerated. The country has enormous potential in biofuels production which can be used as fuel in transport sector.

Indonesia is endowed with abundant geothermal, biomass, and solar energy resources, which can be exploited for providing sustainable energy solutions to the country. Besides, hydro resources and wind resources are also available. The country is already concentrating on biofuels as an alternative form of

[15] Directorate General of New, Renewable Energy and Mineral Resources, Development of New and Renewable Energy and Energy Conservation in Indonesia
[16] Directorate of Various New Energy and Renewable Energy-MENR (2014), Solar PV Tariff in Indonesia: Regulations and Framework Conditions, Berlin, March 4th
[17] Anang Yahmadi, PLN; Renewable Energy Power Supply for Development
[18] Wayan G.Santika, Cess J.H.Midden, A.M.C.Lemmens; Rural Electrification in Indonesia: The Role of Micro HydroPower in Shaping Forest Conservation Behaviour

energy especially in the transport sector. The potential of different forms of renewable energy options is shown in table 2.2.

Table 2.2 Potential and installed capacity of various renewable energy sources in Indonesia[19]

Source of renewable energy	Potential (MW)	Installed capacity (MW)	Ratio (Shares %)
Large Hydro	75,670	6,654.29	8.8
Small Hydro (Microhydro)	769.69	228.983	29.75
Geothermal	29,038	1,226	4.2
Biomass	49,810	1,618.40	3.25
Solar	4.80 kWh/m^2/day	22.45	-
Wind	3-6 m/s	1.87	-

Technical potential alone is not sufficient for the development of renewable energy, which requires a suitable enabling environment in the country. The existing policy and regulatory framework, institutional structure, financial and fiscal arrangements, government initiative in R&D, infrastructure, and diffusion of technology in society play important roles for rapid development of renewable energy technologies. Moreover, society needs to adopt these technologies. The cost of technologies is high initially which acts as a barrier to the adoption of these technologies. Increasing awareness and community involvement help in faster adoption of these technologies.

This report analyzes the existing enabling environment for the development of renewable energy options and technology innovation ecosystem in Indonesia. While analyzing enabling environment, Indonesia's existing institutional framework, market structure, legal, regulatory and policy framework, economic factors, and administrative procedures have been discussed at length. Also the opportunities and gaps in the prevailing enabling environment have been highlighted. Indonesia's technology innovation eco system has been analyzed through the analysis of its endeavours in contributing to R&D, building a robust academic system, providing infrastructure, and promoting manufacturing. This report also analyzes existing prominent business mechanisms in the country. The report suggests suitable renewable energy technology options for the country from the context of enabling environment. These technologies have been chosen based on key drivers creating conducive environment for each technology in the country. In suggesting suitable renewable energy technologies, few case studies from other developing countries have been cited. In the end, the report suggests suitable policy options with business mechanisms and programmes for developing sustainable energy in Indonesia and possibilities of South-South cooperation with other countries.

Focus of this report is to suggest suitable policy options for affordable sustainable energy and possibilities of South-South cooperation for Indonesia.[20] In this context, affordability and South-South cooperation requires special attention. There is lack of a unique definition of affordability and it is different for different social groups within the country. Income is considered to be the most important factor in defining affordability. However, cultural and social preferences are also important aspects of affordability. While income determines the ability to pay, cultural and social preferences influence willingness to pay and decision making for energy services. Take the case of a household, which has no electricity and has the option to buy a solar home system through ESCO. The government partially subsidizes the cost of the solar home system and the remaining amount is obtained as loan from banks. The interest rate along with capital repayment and operation and maintenance cost are so determined that the household is able to repay the amount in installments. Thus the household has the ability to pay for energy services. However, the household prefers spending more on entertainment

[19]Dr. Hasrul, Directorate of Various New Energy and Renewable Energy; New and Renewable Energy Policies
[20]United Nations ESCAP, Expert Group Meeting on the Regional Assessment on Increasing the Affordability of Sustainable Energy Options

such as plays, movies, etc., and is happy with traditional lighting using kerosene. This in turn reduces availability of fund for affordable sustainable energy sources. In this case, the household's preference for traditional lighting outweighs the ability to pay for sustainable energy and this affects the household's affordability for sustainable energy.

There are different approaches to measure affordability. One approach is to consider the percentage of income paid towards procuring energy services. Another approach is to compare cost of production with respect to ability and willingness to pay.

There are certain gaps in the system for promoting affordable sustainable energy options. Most important are the lack of information, inefficient management of existing information and information gap about real costs and benefits of sustainable energy options. Geographic information system (GIS) based maps providing regional and country level information may be considered. In such circumstances, creation of a data repository may be helpful. A renewable energy portal may be launched to showcase information on renewable energy resource and technologies from data repository. Apparently, conventional energy sources may seem to be cheaper than renewable energy sources. However, incorporating costs of externalities and subsidies brings price of conventional energy sources on par with that of sustainable energy sources. The government should create a level playing field for conventional and renewable energy sources in terms of price. The subsidy on conventional energy sources should be tapered off over time. Moreover, studies should be done to find out externalities cost of fossil fuel based power generation and the cost should be incorporated in the price of power from conventional sources. In this way price of sustainable energy technologies can be brought at par with the price of energy from conventional sources. This will create greater acceptance for sustainable energy options. Besides, there is need for better understanding of policies and better strategic intervention to implement such policies for enhancing possibilities of affordable sustainable energy options.

Market development is important. An underdeveloped market hinders access to sustainable energy services as technologies and services do not reach the people. In this regard, the government should declare grid expansion plans and identify regions which will be served by off-grid sustainable energy technologies. This, in turn will eliminate dilemmas from the minds of consumers, and consumers from identified regions will be able to choose sustainable energy options. Thus, market for off-grid sustainable energy technologies will be expanded. Market expansion will create scale economy for producers and price of off-grid sustainable energy technologies will be reduced. Another way in which market expansion for sustainable energy options can be done is to provide feed-in tariff for power producers using renewable resources. This will increase investment in sustainable energy power projects. Consequently, injection of electricity from sustainable energy sources into the grid increases. Initially price of grid connected electricity may be higher. However, over time the price will come down due to economies of scale and technology upgrading.

Moreover, sustainable energy options should be linked with income generation activities so that affordability increases through linkage effect. For example, installation of solar home systems or community based off-grid projects helps to extend working hours. This is particularly helpful for women who can devote evening hours for productive works. Entrepreneurial activities such as electronic goods repairing shops can be created due to availability of electricity. These activities improve the economic health of the locality which in turn increases affordability for electricity.

As per as South-South cooperation is concerned, it should be extended beyond technology transfer among developing countries. South-South cooperation provides opportunities to share experience,

knowledge, information, and build and strengthen existing regional networks and initiatives. Besides, South-South cooperation may help in better understanding of technology and associated aspects (such as management, administration, operation and maintenance, etc.) through capacity building of local people. Local people may be trained by forerunners in related areas for acquiring soft skills pertinent to the project.

There is a need to evaluate existing studies and pilot projects to find out reasons for success and failure of projects. These lessons need to be made available to regional and national policy makers. In this context, regional centres of excellence and APCTT's existing renewable energy technology database may be used as an information sharing platform.

Only exchange workshops and study tours are not sufficient to execute South-South cooperation. The follow up management for peer-to-peer interaction on transfer of technology, knowledge, strategy and networking is crucial. For example, exchange visits should be followed by appropriate plans and government support for extending South-South cooperation in the long term.

This report cites possibilities of South-South cooperation in three different areas. One is knowledge and experience sharing through workshops and study tours to Nepal to understand the country's rural energy development programme. Cooperation with Nepal's policy-makers, local authorities and communities will help in understanding Nepal's experience in rural energy supply through off-grid mode. Another area of South-South Cooperation is through technology transfer. Biomass gasification technology used for electricity production in India may be replicated in Indonesia. Indonesia's huge biomass potential and availability of rice husk makes it ideal for using technologies developed by Ankur Scientific Pvt. Ltd and used by Husk Power Systems for electricity production. The last area of cooperation is human resource development (HRD). Engaging in cooperation with the Ministry of New and Renewable Energy in India which has undertaken initiatives for human resource development will help to develop programmes and curriculum suitable for Indonesia. Moreover, cooperation with institutes through which the initiative is implemented will enhance quality of education and training imparted at different levels. The cooperation for HRD may be extended to student and faculty exchange programmes.

A forum should be created where all stakeholders including the government and the private sector will discuss the needs and strategies for affordable sustainable energy.

However, there are limitations to South-South cooperation. For example, different countries have diverse economic, political, social and cultural systems which should be taken into consideration. South-South cooperation is more suitable between two countries having more or less similar milieu for dissemination of technology and associated aspects. Moreover, there is a tendency to project only the positive factors of a project. But negative factors should also be considered to address the gaps in the system.

Keeping in mind the importance of affordability and South-South cooperation in promoting affordable sustainable energy options, we analyze the main features of national enabling environment for sustainable energy technologies in Indonesia in the next chapter. We also envisage the opportunities and gaps in the system so that appropriate strategy and policies can be suggested for development of sustainable energy.

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Chapter 3
NATIONAL ENABLING ENVIRONMENT FOR SUSTAINABLE ENERGY OPTIONS

A national enabling environment for sustainable energy is a set of interrelated conditions that influences promotion, adoption and dissemination of sustainable energy options. These conditions may be identified through the existing institutional framework, market structure, legal, regulatory and policy framework, economic factors, and administrative procedures. This chapter discusses the existing enabling environment for sustainable energy options in Indonesia through the prism of various measures taken and activities performed by the government, financial institutions, international organizations and other organizations. The features of these measures and activities are discussed first, and the opportunities and challenges they create along with the gaps in the existing environment for development of sustainable energy options in Indonesia are discussed next.

3.1 Institutional Framework for Sustainable Energy[21]

Indonesia has complex institutional and stakeholder arrangements in the energy sector. Several government agencies are involved in formulating or implementing renewable energy policy at the national level, with local governments influencing the policies and their implementation.

The Ministry of Energy and Mineral Resources (MEMR)

The Ministry of Energy and Mineral Resources is the main institution responsible for day-to-day supervisory activity related to the energy sector. In particular, the ministry oversees state-owned companies and is also in charge of providing data and analyses related to energy sector development and conducting survey and research into energy and mineral resources. In 2010, the ministry established a Directorate General in order to administer the development and promotion of renewable energy. The formation of this sub-ministerial agency has strengthened regulatory supervision over renewable energy.

The National Energy Council (DEN)

The National Energy council was set up in 2009 as a measure to implement the Energy Law of 2007. The council is expected to formulate a comprehensive national energy policy and general plan, as well as set out a strategy for energy consumption, to be implemented and executed by the MEMR. The council is chaired by the President, with seven ministries as members. To counter balance government officials, the council also has eight non-government members, including academics, environmentalists, consumer advocates and industry and technology representatives.

The National Development Planning Agency (Bappenas)

The National Development Planning Agency is influential in determining the direction of energy policy, as in aligning it with broader economic plans and regulations. Bappenas sets out the plan for energy development to be carried out by MEMR. Its recent road map for the acceleration of development identifies the promotion of renewable energy as a key issue in the provision of infrastructure.

[21] Y R Damuri, Raymond Atje; Investment Incentives for Renewable Energy: Case Study of Indonesia

Ministry of Finance (MoF)

The Ministry of Finance has authority over approving government expenditure such as subsidies for renewable energy, including investment incentives. The ministry sets out these decisions while formulating the annual government budget.

Local and Regional Governments

Local and regional governments play an important role in the implementation of energy policy by developing relevant regulations and issuing permits, and may also introduce their own, sub-national promotional strategies. Some local governments also provide schemes to simplify administrative procedures related to project development.

Other Government Agencies

A few other government agencies are related to energy policy formulation and implementation. Two of them are mentioned below.

Ministry of State-owned Enterprises (MSOEs)

This ministry of State Owned Enterprises controls the operation of state owned enterprises (SOEs) in the energy sector. With SOEs as dominant players in the energy sector, the ministry also plays an important role in determining the direction and implementation of energy policy.

Ministry of Forestry

Policies from the Ministry of Forestry also affect the development of renewable energy projects such as geothermal. Many geothermal sources are located in forest areas. In order to develop geothermal-based power plant the investor has to secure related permit from the Ministry of Forestry. The requirement to get the permit is similar to permit required for mining in general. The environment implications make it difficult to obtain such permits. The policy of obtaining the permit for geothermal power plant in the forestry area is not being reviewed as it is realized that its environmental effect is not the same with that of mining activities.

3.2 Power Industry and Market Structure[22]

The power sector in Indonesia is categorized into three related activities: generation of power, transmission of power, and distribution and sale. Today, electricity is either generated by the state-owned power company, the National Electric Company (Perusahaan Listrik Negara, or PLN), or by private power producers. Power generation has been partially liberalized since the early 1990s, when the government first invited private independent power producers (IPPs) to participate in the power sector. PLN is virtually the sole transmitter and distributor of power services to final consumers, with the exception of a few small, privately-owned, closed electric networks, which normally operate in industrial areas. However, those IPPs that operate large-scale power plants are allowed to sell their services only to PLN based on specific power purchase agreements (PPAs), which specify the amounts and agreed-upon selling prices of the services.

PLN has taken certain initiatives for development of renewable resource based power generation in Indonesia. These initiatives are spread over different sustainable energy technologies which are highlighted below.[23]

[22] Y R Damuri, Raymond Atje; Investment Incentives for Renewable Energy: Case Study of Indonesia
[23] Anang Yahmadi, PLN; Renewable Energy Power Supply for Development

- The PLN, along with different IPPs, is supposed to build up geothermal power plants up to 6,060 MW capacity by 2022. Expected commissioning year for these geothermal power plants is mostly after 2016.
- The PLN has developed 216.52 MW of mini hydro power plants of which 140.68 MW of mini-hydro power plants is operational, 5.5 MW is under construction, 37.7 MW is under procurement and 32.6 MW is under study.
- By 2012, 2,860 kWp of solar PV plants have been developed by the PLN out of which 2,650 kWp is operational and remaining 200 kWp is under construction. Apart from this, PLN has plans to develop hybrid systems of solar photovoltaic along with diesel, biomass or other RE potential in smaller islands through the 1000 islands programme. The planned capacity under the 1000 islands programme is 850 MW up to 2021.
- Pilot scale biomass projects (between 500 kW and 1 MW) of PLN are under progress. Examples of biomass projects are Nias Island and Sumba Island projects both of which are of 1MW capacities. These projects use woodchips as fuel for power generation.
- PLN also has wind power development programme which aims at producing 200 MW power by 2020.

3.3 Policies/Laws/Regulations for Sustainable Energy[24&25]

Indonesia has enacted energy policies, laws, and regulations aimed at promoting sustainable energy in the country. Some features of a few of these are described below.

National Mid-term Development Plan[26]

The National Mid-Term Development Plan for 2010-2014 prioritizes "energy security and independence" and seeks diversification of energy sources to ensure sustainability of energy supply to the whole nation and to increase the use of renewable energy. The plan also aims at increasing energy efficiency and conservation in household, industry, and transport sectors.

Law No. 27 year 2003 on Geothermal

The law on geothermal sources regulates the management and development of geothermal energy sources for direct (heat) and/or indirect utilization (electricity).

Presidential Regulation No. 5/2006[27]

The regulation has set a target share for renewable energy (RE) at 17% in the country's energy mix by 2025. This regulation also proposes that the government may provide facilities and incentives for energy conservation and development of specified alternative energy sources by the MEMR.

Presidential Instruction No. 1/2006

The Presidential Instruction No. 1/2006 provides a framework for coordination among ministries for the development, supply, and use of biofuels and designates the ministries responsible for formulating and implementing policies related to the following aspects: incentives; tariffs and trading systems; standards and procedures for cultivation, processing, quality testing, supply and distribution of biofuels; the provision of land; and the development of research and technology. The instruction also states that provincial governors, district heads, and mayors should support and promote the establishment of a domestic biofuel industry.

[24] Budi Prawara, National Consultant to APCTT
[25] Indonesia's Country Report, Encouraging Clean Energy Initiative
[26] Regulation 5 2010, National Medium Term Development Plan
[27] National Energy Policy, Presidential Regulation No. 5/2006

Law No. 30, 2007 on Energy[28]

Law No. 30 of the year 2007 pays special attention to the development of new and renewable energy and energy conservation, and stipulates that the provision and use of new and renewable energy should be increased by the central government and local governments. within their authorities. Incentives should be offered for provision and use of new and renewable energy. The central government and local governments should offer these incentives for a certain period until RE reaches a stage of certain economical development. This law also stipulates that energy conservation is the responsibility of the people and that the central and local governments will provide suitable incentives to energy consumers and producers for using energy-efficient equipment.

MEMR Regulation No. 32/2008 on Production, Trade and Use of Biofuels

MEMR regulation no. 32/2008 on production, trade and use of biofuels regulation specifies targets for a phased introduction of biofuels up to 2025, for transport, industry, and power generation sectors (Table 3.1 and Table 3.2). The regulation also provides fiscal and non-fiscal incentives for the use of biofuels. For example, value added tax levied on the transfer of biofuels will be absorbed by the government in line with the regulation (Ministry of Finance Decree No. 156/PMK.011/2009).

Table 3.1 Bioethanol targets for different sectors up to 2025[29]

Sector	2015	2020	2025
Transportation Public Service Obligation (PSO)	5%	10%	15%
Transportation Non PSO	10%	12%	15%
Industry	10%	12%	15%

Table 3.2 Biodiesel targets for different sectors up to 2025[30]

Sector	2015	2020	2025
Transportation Public Service Obligation (PSO)	5%	10%	20%
Transportation Non PSO	7%	10%	20%
Industry	10%	15%	20%
Electricity	10%	15%	20%

Law No. 30, 2009, on Electricity[31]

In supporting renewable energy, the law no. 30 prioritizes the use of locally available renewable energy resources for electricity generation. The law also opens up the market for power supply business to private entities, cooperatives, and self-reliant communities.

Ministerial Regulation No. 31, year 2009, on Purchasing Price by PT PLN (Persero) of Electricity Generated from Small and Medium Scale Renewable Energy Power Plants

The aim of the ministerial regulation No. 31 (2009) is to increase the quantum of electricity generated by small and medium renewable energy power plants or excess power to be purchased by state owned company, regional owned company, cooperative and the society. This regulation provides different prices for renewable energy generated from small and medium enterprises in different regions.

[28] Law of the Republic of Indonesia Number 30 Year 2007 on Energy
[29] Indonesia Biofuels Annual 2013, USDA Foreign Agricultural Services
[30] Indonesia Biofuels Annual 2013, USDA Foreign Agricultural Services
[31] Law of the Republic of Indonesia Number 30, 2009 Concerning Electricity

Government Regulation No. 70, 2009, on Energy Conservation

The government regulation no. 70, 2009, on Energy Conservation regulates the responsibility and the role of the central government, local governments, the private sector and the communities in ensuring energy efficiency, standardization and labelling, and implementation of energy efficiency. This regulation also mandates the development of the General Plan of Energy Conservation (RIKEN) as a guideline for the stakeholders on implementing energy efficiency and energy conservation in Indonesia.

The regulation makes it obligatory for large energy consumers those who consume at least 6000 TOE a year to implement energy management through such measures as appointing energy managers, conducting regular energy audits, and implementing the recommendations from energy audit. This regulation also stipulates the obligation for producers or importers of energy appliances to implement energy-efficiency labelling.

Presidential Regulation No. 4, 2010

Presidential Regulation No. 4 (2010) allows the utility (PLN) to build power plants using renewable energy in cooperation with the private sector. The technology of the power plants is environment-friendly and partly produced within Indonesia. During the engineering, procurement, and construction of the power plant and its transmission lines, the Government will guarantee the viability of the business of PLN according to the existing regulations. Facilities such as tax free import of the equipment will be offered under the jurisdiction of Ministry of Finance.

Ministry of Finance Regulation No. 21/PMK.011/2010 on Tax and Customs Facilities for the Utilization of Renewable Energy[32]

The Ministerial Regulation No. 21 (2010) aims to support the deployment of renewable energy and to secure energy supply, to attract investors and to promote the renewable energy sector by lowering the tax and customs duties for the entrepreneurs who are in renewable energy business. These facilities include accelerated depreciation benefit, lower tax on the dividend, exemption from the tax on the import of machineries and equipments excluding spare parts and from value added tax.

Ministerial Regulation of MEMR No. 2/2011 on Geothermal Price Structure

Regulation No.2 (2011) considers that electricity price is the result of a geothermal working area (GWA) tender which is represented as purchase price by PT PLN in the power purchase agreement, but the price has a ceiling of US cents 9.7/kWh. Else, negotiations between parties are needed if the price exceeds that limit.

MEMR Regulation No. 4, 2012, on Power Purchase from Small Scale and Medium Scale Renewable Energy Power Plant or Excess Power by PLN

Regulation No. 4, (2012) requires PLN to purchase power from small and medium power plants up to 10 MW using renewable energy or the excess power from state-owned enterprises, regionally owned enterprises, private enterprises, cooperatives, and NGOs to strengthen the local electricity supply.

[32] Regulation Of The Minister of Finance number 130 / Pmk.011 / 2011 concerning Provision of Corporate Income Tax Relief or Reduction Facility

Figure 3.1 Different laws and regulations on renewable energy

MEMR Regulation No. 10, 2012, about Implementing Physical Activity Energy Utilization of New and Renewable Energy

Regulation No. 10 (2012) makes it mandatory to implement the relevant measures to support sustainable national development to enhance national energy security. The measures to facilitate the use of new and renewable energy include installation of infrastructure for supply of electricity and biofuels, and/or development of productive tools to support business activities resulting from the use of new energy and renewable energy.

MEMR Regulation No. 17, 2013, on Solar Photovoltaic Power Price[33]

Regulation No. 17 (2013) stipulates (a) new procedures for purchase of power from solar photovoltaic power projects in Indonesia, which require developers to bid for such projects in capacity quota tenders; and (b) feed-in-tariff for solar photovoltaic power at the ceiling price of USUS$ 0.25/kWh, or USUS$ 0.30/kWh if the photovoltaic module contains 40% or more local components.

A timeline of these laws and regulations is shown in figure 3.1.

[33] DGNREEC; Solar PV Feed in-Tariff in Indonesia: Regulation and Framework Conditions

3.4 Programme on Sustainable Energy

Programme on sustainable energy in Indonesia has become a priority in Indonesia where the government play a very important role. Table 3.2.a. describes Indonesia's plan for development of small scale renewable and new energy power plant in Indonesia from 2013 to 2022.

Table 3.2.a Development plan of small scale renewable and new energy power plants (in MW)[34]

No	Pembangkit - EBT	Kapasitas	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	Jumlah
1	PLTMH	MW	33	42	96	149	237	192	186	156	190	200	**1.481**
2	PLT Surya	MWp	6	104	75	54	36	60	75	75	75	75	**634**
3	PLT Bayu	MW	-	-	50	20	20	20	30	40	50	50	**280**
4	PLT Biomass	MW	48	10	15	20	30	40	50	50	50	50	**363**
5	PLT Kelautan	MW	-	-	1	-	1	3	3	5	5	10	**28**
6	PLT Bio-Fuel	Ribu Kilo Liter	15	400	400	500	500	600	600	600	600	600	**4.815**
Jumlah		**MW**	**87**	**156**	**237**	**243**	**324**	**315**	**344**	**326**	**370**	**385**	**2.786**

Note: PLT= power plant; MH= Micro hydro; Surya= Solar; Bayu= Wind; Kelautan= Ocean; Jumlah= Total.

To implement this plan, the government launches various policies and programme including providing some incentives to encourage various stakeholders to participate in this programme as will be elaborated later.

Some other features of Indonesia's programme on sustainable energy[35] are discussed below.

The Energy Self-Sufficient Village Programme

The Energy Self-Sufficient Village (ESSV) Programme was launched in 2007. The objective of the programme was to improve village-level energy security by reducing dependency of the rural community on fossil fuels, specifically kerosene, and accelerate the development of infertile regions in the country.

The programme aims to utilize locally available resources that have the potential to achieve self-sufficiency in energy. Locally available resources are divided into two broad categories. One is bio-energy, such as bio fuels and biogas, and the other is non bio-energy such as renewable energy sources like micro-hydro, solar energy. The government claims to have established more than 600 ESSVs and by 2014, plans to have 3,000 ESSVs in place.[36]

Fast Track Crash Programme

To stimulate the expansion of electricity generating capacity in the near term the Indonesian Government set up two-phase crash programmes. The first programme (2006 to 2013), focused on coal and natural-gas-based power plant development, and the second (2009 to 2014) proposed to increase generation of renewable-based projects, especially, geothermal and hydropower projects. The total capacity planned to be installed in the second programme has been increased from 10,047 MW to 17,918 MW out of which 12,169 MW has been earmarked for IPPs.[37]

[34] Documen RUPTL—Rencana Usaha Penyediaan Tenaga Listrik PT. PLN (Persero) 2013-2022/Business Plan Provision of Electricity PT. PLN (Persero) 2013-2022

[35] More comprehensive plan on Indonesia policy and programme on (sustainable energy) is elaborated in RUPTL 2013-2022 and RUKN (General Plan on National Electricity) 208-2012 and Draft RUKN 2012-20231

[36] United States Agency for International Development; Economic Modelling to Improve Energy Strategy in Selected Indonesian Villages

[37] Mr. Budi Prawara; National Consultant to APCTT

Domestic Biogas Development Programme

A national domestic biogas development programme supported by a grant from Netherlands (through the Dutch Embassy) known as "Programme Biru (BIogas RUmah tangga)" was implemented in Indonesia between 2009 and 2013. The Dutch NGO Hivos aims at developing up to 8,000 biogas units from cow dung in cooperation with the Dutch Development Institution.[38] The project is worth IDR 142,264.11 million (US$14.80 million)[39] and is funded by the Dutch embassy.

Micro Hydro Power Programme (MHPP)

A collaborative programme between the Government of Germany, managed by GTZ and GoI, has been prepared be experts in the field of micro-hydro power plants (MHPP) from the design to fabrication by conducting several workshops. The programme also prepares the institutions which will be managing the micro-hydro power plants.

Solar Home System and Solar Programme

The Indonesian government runs a programme to distribute solar home systems (SHS) among the rural households in the country. The government procures SHS from local companies and provides them to a limited number of households for free. The Laboratorium Sumber Daya Energi (LSDE), a government body, accredits the products procured through tenders or bids. The suppliers are responsible for installation and for training local technicians to ensure after-sales services. The costs of providing these services are included in the cost quoted in the government tenders.

The most common product distributed is a 50 Wp SHS with a 6W fluorescent lamp and a 70 Ah lead acid battery. About 260 000 SHS had been installed till 2011 under the government scheme, constituting a market penetration of around 1.3%.[40] Indonesia in 2013 has launched a programme to install solar power and photo voltaic in 1,000 islands in Indonesia equivalent to 75 MW in 2015.[41]

The use of Solar Water Heater System (SWHS) has spread widely in Indonesia especially in urban area at various housing compounds. It is estimated that there had been more than 20 000 households already installed SWHS. This is purely driven by the awareness of the community on the benefits of SWHS. Likewise, tens of thousands of solar cell panel had been installed mainly in big cities as electric lighting on the roads and also for source of lighting at households in remote areas. This shows the increased awareness of community on the benefit of solar energy and also how business sector had captured the commercial attractiveness of this renewable-based product.

3.5 Incentives for Renewable Energy

The main barrier to the adoption of affordable sustainable energy options is their high initial cost. Quite often government incentives for sustainable energy options play a crucial role in reducing the cost and thus in creating suitable environment for the deployment of affordable sustainable energy options. Incentives provided for renewable energy in Indonesia can be classified into three broad groups, namely fiscal incentives such as tax exemptions and subsidies, financial incentives such as loans and loan guarantees and market price support and regulation.

[38] SNV, Hivos; Indonesia Domestic Biogas Programme
[39] Average daily exchange rate of IDR 9612.44/US$ for the period January 2009 to December 2013 has been considered.
[40] International Finance Corporation; Lighting Asia: Solar Off-Grid Lighting
[41] Documen RUPTL—Rencana Usaha Penyediaan Tenaga Listrik PT. PLN (Persero) 2013-2022/Business Plan Provision of Electricity PT. PLN (Persero) 2013-2022

Fiscal Incentives[42&43]

Indonesia provides fiscal incentives for energy through tax exemptions and subsidies. A few of these have been introduced for renewable energy but only to a limited extent. Fiscal incentives related to renewable energy include the following incentives:

Income Tax Facilities

- **Income tax reduction:** a renewable energy investor is eligible for net income reduction by 5 % of the investment value each year, over a six-year period.
- **Accelerated depreciation:** this incentive allows investments to be depreciated within 10 years, depending on the type of asset, and thus reduces the income tax paid by the investors and encourages expansion of investment.
- **An income tax reduction for foreign investors:** this incentive allows foreign investors to pay a rate of only 10 % on dividends they receive.

Import Duty and VAT Facilities

- Exemptions on import duty: Indonesia provides exemptions from import duty for capital goods and machinery, provided that the goods are not available in Indonesia or their Indonesian equivalents have unsuitable specifications or are available in insufficient quantity.
- VAT exemption: Indonesia also offered a tax incentive for investors in renewable energy projects that would allow the government to pay for the investors' value added tax for the current year. In fiscal year 2010, the government set aside IDR 900 billion (US$ 90 million)[44] in the state budget to pay for these based on requests from investors'.

Subsidy for Biofuels

Indonesian government declared subsidies of IDR 3,500 (35 cents per litre) per litre for the years 2012 and 2013.[45]

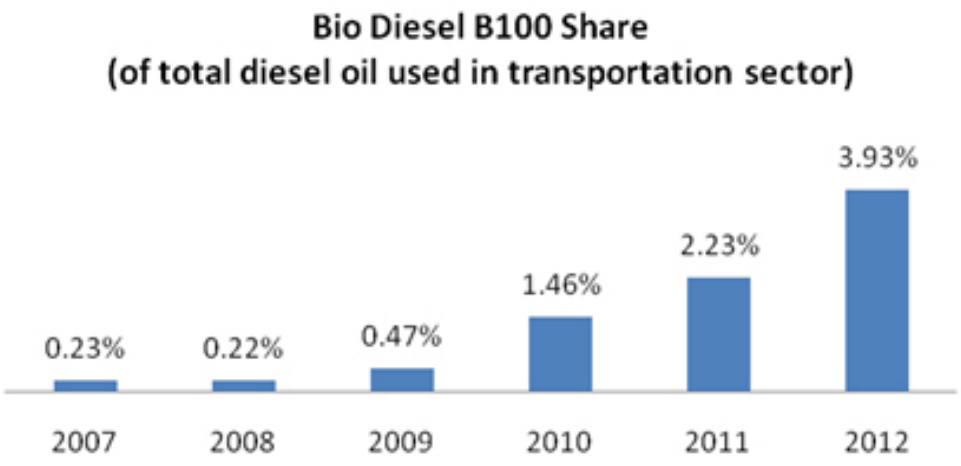

Figure 3.2 Year-wise share of biodiesel in transport sector

Introduction of subsidies for biofuel has increased use of biodiesel in the transportation sector. Biodiesel contribution to total diesel oil use in transportation sector increased significantly from 0.23% in 2006 to 3.93% in 2012.[46]

[42] Y R Damuri, Raymond Atje; Investment Incentives for Renewable Energy: Case Study of Indonesia
[43] Dr.Ir. Syahrul Aiman, national consultant to APCTT
[44] Average annual exchange rate of USUS$ 0.0001/IDR has been considered for 2010
[45] Indonesia Biofuels Annual 2013, USDA Foreign Agricultural Services

Financial Incentives[47]

Financial incentives focus on the provision and cost of project finance. This can be a major issue for large renewable energy projects such as geothermal power and hydropower plants, which require large amounts of capital and can therefore involve substantial risks.

The Geothermal Fund Facility (GFF)

The geothermal fund facility is currently managed by the Government Investment Agency (Pusat Investasi Pemerintah, or PIP). In 2011, the government allocated a revolving fund of IDR 1,236.5 billion (approx. 136.3 million)[48] for geothermal development. One of the two services performed by the GFF, as stipulated in MoF Regulation No. 3/2012, is that it will provide financial support for collection of data and high-quality information about new potential geothermal sites. The cost of the research is only to be paid back if a site proves to be productive. The service is intended to mitigate exploration risks during the early stages of geothermal power development. Similarly, the PIP also offers loans to geothermal developers to finance geothermal exploration activities. The geothermal developers are eligible to borrow up to IDR 350,187 million (US$ 30.5 million)[49], available at the central bank (Bank Indonesia) interest rate.

The Indonesia Infrastructure Guarantee Fund

The infrastructure guarantee fund (IIGF) guarantees to cover any contractual risks in relation to government actions in order to facilitate the implementation of large infrastructure projects. This is part of a public–private partnership scheme as described in the Presidential Regulation 78/2010 and MoF Regulation 260/2010.

Loans at Lower Interest Rate

Loans are available for farmers at lower interest rates than that charged by national banks, particularly for biofuel plantations. In late 2006, the MoF issued Decree No. 117/PMK.06/2006 to provide subsidized loans to farmers to help them develop biofuel plantations. The decree provides credit to farmers at an interest rate lower than that offered by commercial banks, particularly for planting oil palm. This was followed up by MoF regulation no. 79/2007, which enables small and medium-sized enterprises to obtain subsidized finance from national banks for food and energy crops. The banks do not charge credit commission or administrative fees for these loans which can be given to farmer groups or cooperatives for particular commodities for five years.

Market Price Support and Regulation[50]

Market price supports play a crucial role in attracting investments and support the projects at their operational stages. Few of such incentives are outlined below.

Business Viability Guarantee for PLN

In Indonesia the retail price of electricity is below PLN's power purchase cost from IPPs which raised questions about PLN's solvency in the long run. As a consequence, IPPs found it difficult to get loans from banks. To eliminate this difficulty, Presidential regulation no. 139/2011 introduced procedures for providing business viability guarantees to generate power using renewable energy in cooperation with private electricity developers. With this guarantee scheme, the government ensures that PLN would have sufficient financial capacity to fulfil its payment obligations to IPPs under the specified

[46] Indonesia Biofuels Annual 2013, USDA Foreign Agricultural Services
[47] Y R Damuri, Raymond Atje; Investment Incentives for Renewable Energy: Case Study of Indonesia
[48] Assuming an average exchange rate of IDR 9069/US$ for 2011
[49] Assuming an average exchange rate of IDR 11 500/US$ for the period January 2014 to April 2014
[50] Y R Damuri, Raymond Atje; Investment Incentives for Renewable Energy: Case Study of Indonesia

power purchase agreements (PPA). The guarantee is addressed to the project company (not lenders), but the project company is entitled to assign the guarantee as security to the lenders. However, now the viability guarantee is available only for renewable energy projects under the Fast Track II programme.

Feed-in Tariff Policy

A feed-in tariff (FIT) sets a guaranteed purchasing price by PLN for renewable electricity generated by IPPs. This price certainty reduces the risk associated with recovering investment and operational costs. A guarantee of this kind is particularly important in Indonesia, where the PLN's domination of transmission and distribution makes the electricity market a monopsony. As of 2013, the government of Indonesia has introduced a FIT for the purchase of electric power generated from various renewable sources, summarized in Table 3.3.[51] To encourage smaller-scale power plants using renewable sources, the government has also introduced FITs for mini- and micro-hydro power, biomass, and waste power plants.

Table 3.3 Feed in-tariff for renewable energy in Indonesia

Energy source		Feed in-tariff (IDR/kWh)
Mini- and micro-hydro		656–1,506
Biomass		975–1,722.5
City waste	Zero waste	1450-1885
	Sanitary landfill	1250-1625

Note: Feed in-Tariffs depend on location and whether it is connected to a low- or medium-voltage network.

3.6 Provision of Finance

Financing for renewable energy projects and programme comes from different sources. These sources are conventional and Islamic banks, government, international governments and institutions, and other agencies or companies.

Conventional and Islamic Banks

Indonesia's conventional banks including rural banks and Islamic banks provide green financing which covers the following categories.[52]

- Renewable energy such as micro-hydro, mini hydro, biomass, biogas, geothermal, solar, wind.
- Sustainable agriculture such as organic agriculture, machine replacement for energy efficiency, and waste recycling.
- Green industry such as machine replacement for energy efficiency, waste recycling, eco-label products, and green buildings.
- Eco tourism.

Based on a survey of the green financing portfolio 29 conventional banks and Islamic banks, is summarized in the table 3.4.

Table 3.4 Green financing for renewable energy sources in Indonesia[53] (trillion IDR)

Type of bank	2011			2012			2013 (Incomplete Year)		
	Total financing	Green financing	% of green financi	Total financing	Green financing	% of green financi	Total financing	Green financing	% of green financi

[51] Budi Prawara; National Consultant to APCTT
[52] Mulya E.Siregar; Enhancing the Role of Indonesian Banks in Green Projects Finance
[53] Mulya E.Siregar; Enhancing the Role of Indonesian Banks in Green Projects Finance

Type of bank	2011			2012			2013 (Incomplete Year)		
			ng			ng			ng
Conventional Banks (24)	500.4	5.48	1.10%	664.17	7.7	1.16%	681.47	8.62	1.27%
Islamic Banks (5)	37.9	1.02	2.68%	56.18	1.6	2.85%	63.57	1.61	2.53%
Total	538.3	6.4	1.19%	720.35	9.3	1.29%	745.04	10.2	1.37%

Note: By the end of 2013, green financing portfolio was supposed to be increased up to IDR15.5trillion (US$1.4 billion).

Source Bank Indonesia, 2013

More than 50% of green financing portfolio is meant for the mini hydro sector (26.08%) and geothermal sector (25.72%).

Government

The Indonesian government provides financing to support different financial and fiscal incentives and sustainable energy programme it has adopted for the development of renewable energy technologies. It also provides support in the form of subsidy to the PLN for buying electricity from IPPs at a price which is much higher than the retail price. Apart from these, the GoI also provides financing for R&D in the sustainable energy sector.

The government provides financial support for the development of infrastructure in Indonesia which includes infrastructure for renewable energy on a large scale.

International Institutions

International institutions support many renewable energy projects in Indonesia. In the past the Asian Development Bank (ADB) and the World Bank have supported different programme on sustainable energy in Indonesia.

ADB provided grants to Indonesia to produce gas from waste in 2005 and ADB also supported the building of four micro-hydro electricity generation projects in the country.

The United Nations Development Programme collaborated with MEMR to support IMIDAP funded by GEF of World Bank which facilitated mini and micro-hydro power development across the country.[54]

In 2008, the GEF also supported a project to enhance the development of geothermal energy utilization in the country.

At present, the government of Indonesia, in collaboration with the government of Finland seeks to promote renewable energy, energy efficiency and investment in clean energy technology through the Energy and Environment Partnership with the Finland government.[55] The programme started in April 2011 with a budget of IDR 63.27 billion (4 million Euro)[56] until 2014 and provides funding for renewable energy, especially bioenergy related projects, studies, capacity development and information sharing in the provinces of Central Kalimantan and Riau. In addition, EEP Indonesia contributes to the development of renewable energy-friendly policies both in the programme target provinces and at the central level in Indonesia. As part of this project, public–private partnerships, project implementation in cooperation with local communities, and enhancement of technology transfer in collaboration with Finnish organizations are encouraged.

[54] UNDP; Project Facts, Rural Development with Renewable Energy
[55] http://www.eepindonesia.org
[56] Exchange rate of IDR 15 816.9/Euro for the period of January 2011 to April 2014 has been considered

Indonesia will receive IDR 46191.2 billion (US$ 400 million)[57] as part of the Clean Technology Fund (CTF) mainly to scale up large-scale geothermal power development and acceleration of initiatives to promote RE and EE (in particular biomass) in Indonesia.[58] The planned contribution of different multilateral agencies in the CTF is shown in the table 3.

Table 3.5 Financing plan under Clean Technology Fund[59]

Institution	CTF (million US$)
IBRD (geothermal)	125
ADB (geothermal)	125
IFC/ADB (geothermal – investment and transaction advisory)	50
IFC (EE/RE)	50
ADB (EE/RE)	50

ADB has signed a US$350 million financing package supporting the construction of the 320 megawatt Sarulla Geothermal Power Development Project in North Sumatra, Indonesia.[60] Under the loan package, ADB will provide US$250 million from its ordinary capital resources, US$80 million from the ADB CTF, and US$20 million from the Canadian Climate Fund for Private Sector in Asia (funded by the Government of Canada) under the Clean Energy Financing Partnership Facility. The project represents the first deployment by ADB of the Canadian Climate Fund and the first disbursal of CTF funds by ADB in Indonesia.

Indonesian power projects also get finance from international lenders with strong support from export credit agencies such as JBIC and the Korea Export Import Bank (KEXIM).

Other Agencies or Companies[61]

PT. Astra Mita Ventura finances small and medium enterprises (SMEs) to develop their business to become independent, modern, and resilient. The company participates through direct equity participation, convertible bonds and profit sharing.

Various state owned enterprises (SOEs) provide funding for the development of green-based economy including renewable energy programme and businesses through partnership funds.

3.7 Permits and Clearances[62]

An Indonesian power project requires a large number of permits from a variety of government departments and ministries.

The main permits that a power project developer is required to obtain are listed below:

- Registration with the Investment Coordinating Board to establish the project company and to obtain investment principle license.
- Business license.
- Approval of the environmental impact assessment or Analisis Mengenai Dampak Lingkungan (AMDAL).

[57] Exchange rate of IDR 11 547.8/US$ for January 2014 to May 2014 has been considered for conversion
[58] Clean Technology Fund Investment Plan for Indonesia
[59] Clean Technology Fund Investment Plan for Indonesia
[60] http://www.adb.org/news/adb-supports-renewable-energy-investing-indonesian-geothermal-plant
[61] Budi Prawara; National Consultant to APCTT
[62] Norton Rose; Indonesian Power Projects, Ten Things to Know

- Location permit (Izin Lokasi), which allows the company to procure the land required for the project from a third party or from the state.
- Electricity business license (izin Usaha Penyediaan Tenaga Listrik or IUPTL).
- Certificate of operational worthiness (Sertifikat Laik Operasi or SLO)

If a project company seeks finance from the international lending community, it is likely to have to comply with established environmental standards such as the Equator Principles or the IFC environmental standards. These raise requirements beyond the permit of the AMDAL.

3.8 Negative Investment List[63]

The negative list on investment regulates FDI in the power sector in Indonesia. According to the presidential regulation no.36 (2010), up to 95% foreign investment is allowed in power plants of greater than 10 MW capacity. For power plants of less than 10 MW capacity, the foreign investor requires to form a partnership with a domestic entity. Moreover, domestic investments in power plants of less than 1 MW capacity have been reserved for micro, small and medium enterprises and cooperatives.

3.9 Opportunities and Challenges in Enabling Environment

The enabling environment creates certain opportunities for development of sustainable energy options in the country. These opportunities are discussed below.

Opportunities in Enabling Environment

- The most important opportunity to promote SETs is the targets set for RE in the country's energy portfolio. The targets guide in preparing a set of laws and regulations for encouraging generation from RE sources.
- Law no. 30 (2007) stipulates that the central government and local governments should increase the use of RE and they may subsidize the utilization of RE. This provision makes it more likely that sustainable energy will be accessible and will be used.
- The emphasis on biofuel promotion is supported by the presidential instruction no 1 (2006) which provides a framework for coordination among ministries for development, supply and use of biofuels. This reduces the lack of coordination among various departments on biofuels development. Further regulation no. 32 (2008) encourages the use of bio-fuels.
- More important, opportunities for accelerated private-sector investment in RE are created by Presidential Regulation No. 4 (2010) which gives an opportunity to the state-owned utility (PLN) to build power plants using RE jointly with the private sector.
- In another regulation of 2012, PLN is mandated by the government to buy the power generated by small-scale and medium-scale (up to 10 MW) RE based power plants. This enhances the chance of participation of small and medium scale generators in the electricity market.
- Through various regulations, the government has also influenced the price for various RETs, which reduces the risk in investing in the RE sector.
- Power supply business has also been opened up to the private sector through the law no. 30 (2009) which is likely to make the distribution business more efficient. However, PLN has the right of first priority.
- Government-run programme such as ESSV encourage the use of locally available resources, especially biomass for sustainable energy development. This in turn makes sustainable energy

[63] Presidential Regulation of the Republic of Indonesia Number 36 of 2010 on List of Business Fields Closed to Investment and Business Fields Open, with Conditions to Investment

options more accessible in rural areas. Besides, through these programme infrastructure and economic conditions of the villages are improved.

- The fast-track programmes create an environment conducive for massive investments in the sustainable energy sector at a faster pace. Moreover, international funding and cooperation may be tapped for sustainable energy projects.
- Income tax exemptions and reductions provided by the government encourage investment in RE sector. Examples from many countries including India and the United States show that such benefits as accelerated depreciation and investment tax credit facilitate investment at early stages of development.
- Subsidized loans and direct subsidies can accelerate biofuel development. Subsidized loans for small-scale investors, especially, for off-grid solutions, should be encouraged.
- Introduction and implementation of feed-in tariff and a business-viability guarantee for PLN are good instruments in attracting more IPPs to the power generation sector in Indonesia. However this is currently provided for projects under second fast track crash programme. The business-viability guarantee may be extended to all types of projects.
- Green financing benefits sustainable energy projects. Such financing is expected to make it easier to release funds. Apart from market-based financing, the government's budgeted expenditure and grants and credits from international organizations also offer opportunities to launch more projects.

In spite of several measures and actions by the government and international agencies, the growth of RE in Indonesia has been limited. There are several gaps in the system which pose tough challenges.

Gaps or Challenges in Enabling Environment

- One significant gap is the lack of coordination among different ministries in formulating laws. This, in turn, results in a set of conflicting laws and regulations that delay or sometimes cancel many projects. For example, geothermal development faces barriers from regulations of the forestry department. More than 30% of Indonesia's geothermal resources are in forest conservation areas, but forest regulations restrict the exploration of these sites.
- The requirement of minimum 5% domestic shareholding for power plants with more than 10 MW capacity sometimes delays projects.[64]
- The ESSV programme also observes a few gaps. Many of the ESSVs have been idle, especially those meant for productive uses, owing to lack of working capital, access to market for products, and insufficient managerial guidance to beneficiaries of the facilities.[65]
- Although the technical viability of biogas technology has been internationally acclaimed, its dissemination in Indonesia has been limited. The major gaps were the need to pen animals for effective collection of cow dung, owning sufficient number of cattle for continuous flow of raw material to the biogas plants and high initial costs.[66]
- There are gaps in terms of getting access to finance from the market for sustainable energy industry. Banks are reluctant to lend to new projects such as wind and solar which do not have a proven track record.
- In Indonesia bidding is used for choosing an investor for a new project at concessional rates. But execution of bidding process in Indonesia has seen certain gaps. Many times, the bidding process

[64] Supandri Prabono, Indonesia Chamber of commerce; Business Enabling Environment to Promote Sustainable Energy in Indonesia
[65] United States Agency for International Development; Economic Modelling to Improve Energy Strategy in Selected Indonesian Villages
[66] SNV, Hivos; Indonesia Domestic Biogas Programme

fails to take into account the technical and financial capabilities of local enterprises while awarding the project. Consequently, projects are delayed.[67]

- Licensing procedure for projects in Indonesia is lengthy and requires a number of permits. There are gaps in the licensing procedure too. Many times licenses are given to incompetent developers because of inadequate knowledge and education on part of the local authorities on license-granting techniques.
- External multilateral investment agencies are confronted by an opaque mix of political and multilevel regulatory authorities in Indonesia that generates uncertainty and entails higher transaction costs for investors. One source of these transaction costs is the division of power between the central government and local governments. With the current decentralized system, local governments have been given the right and the responsibility to issue concessions and operating licenses to renewable energy developers. However, most local governments have very limited capacity and understanding of the implications of various energy scenarios.[68]
- In the case of off-grid technologies, lack of finance for initial investment acts as a deterrent to sustainable energy development. Lack of after-sales service is another problem. For example, the government programme on solar home system for rural areas face problems mainly in the form of lack of after-sales service and maintenance, and inadequate monitoring and evaluation by the implementing agencies.[69] Moreover, the dependence on subsidies and grants is high. Running these programme successfully even after donor grants and subsidies are withdrawn are challenging as large-scale market-based financing is not available for sustainable energy programme.

This chapter highlights national enabling environment for sustainable energy options in Indonesia. In doing so, several laws, policies, programmes, incentives and financial arrangements have been discussed elaborately. Indonesia has a well structured institutional framework for overseeing and implementing sustainable energy projects. The country has already put in place policies, laws and regulations for promotion of sustainable energy options. Besides, there are fiscal and financial incentives such as tax exemptions, subsidies, and feed-in tariff for promoting sustainable energy technologies. Finances are arranged from national and international sources. Whereas, Green financing mechanism helps in disbursing funds from conventional and Islamic banks, international funding sources provide grants and credit line for sustainable energy. Despite several opportunities for promotion of affordable sustainable energy in the national environment, there are certain gaps that create hindrances in rapid promotion of sustainable energy in the country. This chapter ends with discussions on these opportunities and gaps. While analysis of enabling environment is necessary, its effectiveness in promoting sustainable energy technologies should also be judged. This has been done in the next chapter by discussions on sustainable energy business mechanisms in the country. The discussion caters around two existing business mechanisms, their strengths and weaknesses.

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[67] Y R Damuri, Raymond Atje; Investment Incentives for Renewable Energy: Case Study of Indonesia
[68] Fitrian Ardiansyah, Neil Gunningham, and Peter Drahos; An Environmental Perspective on Energy Development in Indonesia
[69] International Finance Corporation; Lighting Asia: Solar Off-Grid Lighting

Chapter 4
ANALYSIS OF EXISTING SUSTAINABLE ENERGY BUSINESS MECHANISMS

A suitable business mechanism is crucial for dissemination of affordable sustainable energy options in a country. Business mechanisms are of different types in different countries. However, from the perspective of delivering rural energy services using local resources, community-based mechanisms have proved successful in Indonesia. Also there are business mechanisms based on public–private partnerships. Both types of mechanisms are discussed in this chapter. These two business mechanisms are applied for two different projects, namely Cinta Mekar micro-hydro project (a community–based mechanism) and the Indonesia Domestic Biogas Programme (IDBP) (a public–private partnership mechanism).

4.1 Cinta Mekar Micro Hydro Project[70]

The Cinta Mekar project is a 120 kW run-of-the-river micro-hydro power plant (MHPP) in Cinta Mekar village, Subang, West Java. This plant has been operational since 2004 and supplies electricity to the grid. The project is an example of increasing access to affordable sustainable energy options using locally available technology through a community-based, small-scale project. The business mechanism of this project may be replicated in other regions with appropriate modifications.

Stakeholders of the Business Mechanism

The business mechanism for Cinta Mekar micro-hydro project involves four stakeholders, who work together from the project preparation stage to the implementation stage.

- Yayasan Ibeka
- Mekar Sari Cooperation
- PT HIBS
- UNESCAP

Yayasan Ibeka is a local NGO, which focuses on rural community empowerment through application of environment-friendly technologies. This NGO initiated the project, coordinated it, and also conducted capacity-building programmes for the community so that the community members can actively participate in the project.

Mekar Sari Cooperative represents the community, was assigned the responsibility of developing and operating the power plant together with PT HIBS, a private company.

PT HIBS provides technical assistance and served as the contractor to build the facilities for the MHPP. The company also operates the plant together with the village community.

UN ESCAP elected the project as part of its 5P (Pro-Poor Public-Private Partnership Programme) programme and awarded a grant of US$75 000 to the project.

The project was endorsed by the governments of the Netherlands and Indonesia through the Ministry of Small Enterprises and Cooperatives and the Ministry of Energy and Mineral Resources respectively.

[70] Henriette, Imelda Rambitan and Fabby Tumiwa; Institute for Essential Services Reform, Cinta Maker Micro Hydro Power Plant, Giving Power to the People

Business Mechanism for the Cinta Mekar Project

Ownership pattern The Cinta Mekar plant is owned by a joint venture between the Mekar Sari Cooperative and the private company PT HIBS. The Mekar Sari Cooperative comprises local villagers. The two owners have an equal ownership of the joint venture.

Financing The project is considered to be a public–private partnership because it is funded and managed by the public and the private institutions. According to Ibeka, the total project cost of US$225 000 was borne equally by three parties: UNESCAP and PT HIBS contributed US$75 000 each to cover the investment cost of the power plant and Ibeka contributed US$75 000 for technology dissemination, social preparation, and the training facility for the village community.

Profit sharing The joint venture sells the electricity generated by the plant to PLN at a tariff fixed under a power purchase agreement (PPA) for low-voltage and medium-voltage connections. The net monthly profit is equally shared between Mekar Sari cooperative and HIBS after deducting the depreciation and maintenance costs.

Strengths and Weaknesses of the Business Mechanism

The business mechanism encourages community participation, which contributes to the success of the business mechanism. Also, the equally shared ownership between the community and the private company gives equal decision making power to both parties. However, the willingness of communities to participate in the project and availability of foreign funding were critical for this mechanism to be successful. The strengths and the weaknesses of the mechanism are listed in Table 4.1.

Table 4.1 Strengths and weaknesses of the business mechanism for Cinta Mekar hydro project

Strengths	Weaknesses
Ownership of the community in the business mechanism motivates the community to operate and maintain the plant as well as the surrounding environment and ecosystem.	Success depends on external sources of finance.
Equal ownership of the venture allows both the community and the private owner equal voice in decision- making.	Such funding made it possible for the community to have an equal share in the project. Otherwise, participation of the community in the project would not have been possible or the community's share would have been low.
Supply of electricity to the grid generates a continuous stream of revenue from the utility part, which is used for community development.	The utility must agree to purchase power at a fair and reasonable price that benefits both the utility and the community.

4.2 Indonesia Domestic Biogas Programme[71]

IDBP, also known as the BIRU programme, is implemented by Hivos in collaboration with the Indonesian Ministry of Energy and Mineral Resources and SNV Netherlands Development Organisation. The programme aims to distribute biogas digesters as a local affordable sustainable energy source by developing a commercial, market-oriented sector.

Hivos develops the biogas sector in Indonesia by establishing and developing construction partners. Hivos also provides investment incentives to farmers not exceeding 40% of the price of a digester. The level of this incentive is based on the expected return on investment for the farmer. A digester can serve its owner for 15 to 20 years with minimum maintenance costs.

[71] Robert de Groot; Innovative Development Financing through Public-Private Partnership

In 2008, a feasibility study of the IDBP identified the dairy sector in East Java province as a highly potential target area. The dairy farmers are organized in cooperatives with a high level of organization and the farmers have a steady stream of income from milk. This income allows them to undertake small investments using loans, which are repaid through monthly instalments.

Partnership Process

Hivos Indonesia works together with Nestlé Indonesia in disseminating biogas and biogas plants among dairy cooperatives. The partnership process includes three stakeholders: Hivos, Nestlé Indonesia, and Construction Partner Organizations (CPOs).

Hivos provides the expertise and management capacity to ensure large quantities and high-quality digesters for the cooperatives.

Nestlé Indonesia ensures access to credit, encourages its cooperatives of cattle farmers to invest in biogas digesters, facilitates access to its network of dairy cooperatives, and provides loans to individual farmers.

CPOs enter into an agreement with Hivos and plays a role in guaranteeing a loan for their farmers and arranging the repayments through the regular milk deliveries over 2 to 3 years. CPOs also offer biogas digester construction services at affordable and subsidized prices. At present, some 40 CPOs are active.

Funding Strategy

The financing of IDBP has two components: a flat mixed subsidy (investment incentives) from the government and Hivos and an interest free loan from Nestlé. Since January 2013, IDR 3,000,000 (US$300) has been given as a subsidy and IDR 4,500,000 (US$450) as loan to meet the market price of IDR 7,500,000 (US$750) of a biogas digester.[72] Thus, the subsidy amount is a flat 40% of the digester price and rest of the finance comes from the loan.

In order to raise the finance for providing loans, Nestlé initially provided one million dollars for a revolving fund, which has been increased to 3.1 million dollars.

The Dutch government funding to Hivos was phased out by the end of 2013; however, the ENDEV (Energizing Development) programme of GIZ enables Hivos and its partners to continue developing the biogas sector.

Strengths and Weaknesses of the Business Mechanism

The strengths and weaknesses of the public–private partnership are listed in Table 4.2

Table 4.2 Strengths and weaknesses of the public-private partnership business mechanism

Strengths	Weaknesses
The business mechanism takes the form of a market-based mechanism for biogas digesters, which increases the financial sustainability of the mechanism.	The high price of the biogas digesters excludes marginal farmers from getting access to biogas energy.
Involvement of Nestlé Indonesia which uses its network of dairy farmers for dissemination of digesters is a valuable asset.	The government and Hivos subsidy is still too low to ensure rapid dissemination of the technology.
Loan recovery is less risky as the farmers supply milk regularly to the Nestlé and the loan can be recovered from these sales.	The project is confined only to the dairy sector, which slows the speed with which technology is adopted.

[72] Annual average exchange rate of USD 0.0001/IDR has been used for the year 2013

This chapter analyzes two business mechanisms that are adopted for two projects in Indonesia. The Cinta Mekar project uses a community-based business mechanism where community members participate from project planning to implementation stage. The IDBP, on the other hand, is a public–private partnership project which uses customer base of the Nestle Indonesia for distributing biogas digesters. The Indonesia government endorses the Cinta Mekar project and provides subsidies for the IDBP. Thus government played an important role in supporting these two business mechanisms. However, these two mechanisms have been implemented only for two technologies. The country needs to diversify to other technologies, especially domestically developed technologies. For this, Indonesia needs to put emphasis on technology innovation. The next chapter identifies existing institutional mechanism for technology innovation and analyzes prevailing innovation ecosystem in the country.

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Chapter 5
TECHNOLOGY INNOVATION ECOSYSTEM FOR SUSTAINABLE ENERGY OPTIONS

The technology innovation ecosystem in Indonesia includes R&D institutions, manufacturing and industry sectors, and academia and universities who are contributing to sustainable energy development. Besides, infrastructure facilitates the innovation ecosystem in the country. Moreover, government policies play a crucial role in galvanizing efforts of these sectors for technology innovation.

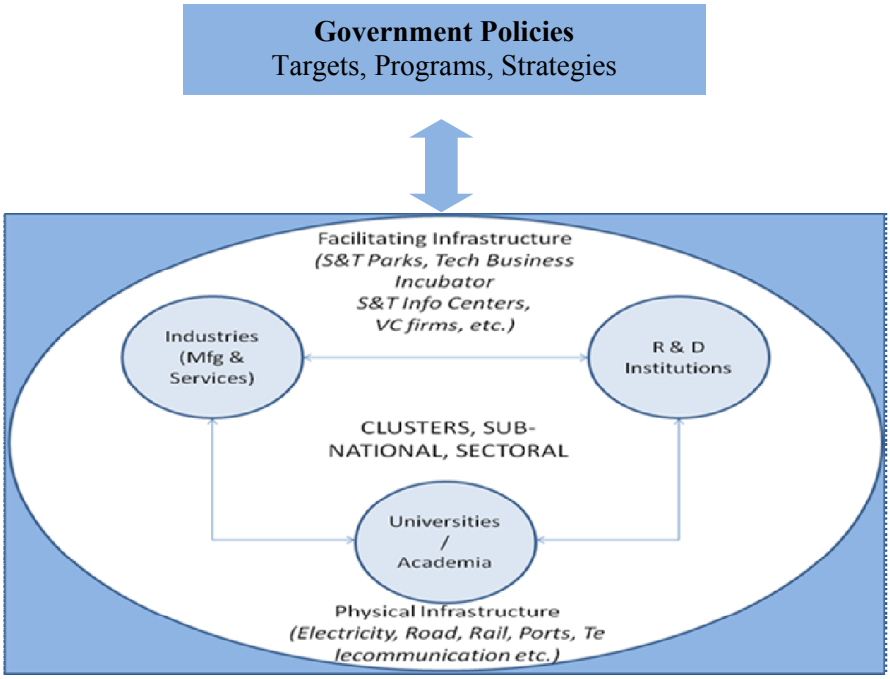

Figure 5.1 Technology innovation ecosystem

Technology innovation ecosystem is a system of interrelated physical entities that contributes to invention of new technologies through diffusion of the invented technologies. National enabling environment is created by a set of interrelated conditions which influence promotion, dissemination and diffusion of technologies. Technology innovation ecosystem works hand in hand with enabling environment for affordable sustainable energy technologies. For example, whereas technology innovation ecosystem helps in diffusion of sustainable energy technologies, the national enabling environment makes it mandatory for distribution companies to supply electricity which contains share of sustainable energy. Another example may be that industries enjoy fiscal and financial incentives from the government and bring products with new technologies in the market for demonstration and diffusion. This symbolizes existence of a favourable enabling environment and technology innovation ecosystem for sustainable energy options.

Technology innovation ecosystem increases affordability of sustainable energy options in a country. For example, R&D institutions invent new products which in turn increase options of sustainable energy for the customers. This creates competition among differentiated products and drives down cost. Reduced cost indirectly enhances affordability of consumers and influences decision of customer for energy technologies. Universities and academia creates pool of knowledgeable and skilled manpower. This manpower is engaged at different stages from R&D through diffusion of sustainable

energy technologies. Especially, manpower involved at the level of operation and maintenance of systems and equipment creates competitive labour force which reduces cost of service, thereby enhancing affordability of sustainable energy services.

Thus, technology innovation ecosystem is related to national enabling environment and affordability. This chapter discusses contribution of facilitating institutions and sectors of innovation ecosystem in Indonesia for sustainable energy. While discussing contribution of these institutions and sectors, we have discussed the role of government through adoption of policies and initiatives in supporting technology innovation.

5.1 Research and Development

The first and important step of technology innovation is R&D. The Government of Indonesia has drawn up the National Long-Term Development Plan (2005–2025), which focuses on seven areas of R&D including energy. In the energy sector, R&D aims at developing ways of extracting energy from renewable sources such as wind and ocean currents and also at mapping new energy sources, developing new technologies to meet the demand, disseminating information on the industry to relevant parties, and improving the efficiency of energy use.

A comprehensive document, namely "Masterplan: Acceleration and Expansion of Indonesia: Economic Development 2011–2025", lists seven steps improving the innovation system: (i) Introduction of an incentive and regulation system that emphasizes innovation and the use of products made in Indonesia (ii) Improvement in the quality of human resources as well as their flexibility (iii) Development of innovation centres to support small- and medium-sized industries (iv) Development of regional innovation clusters (v) Improvement in the remuneration system for researchers (vi) Improvement in the infrastructure of the R&D system (vii) Development of a funding and funding management system that furthers innovation.

The master plan proposes to establish an R&D fund equal to about 1% of the GDP until 2014, with a gradual increase in funds to 3% of the GDP by 2025.

Research and Development Institutions[73]

Most of the R&D related to energy sector in Indonesia is carried out by R&D centres (RDCs) under the Department of Energy and Mineral Resources, RDCs under non-departmental research institutes (NDRIs), and several public universities. The NDRIs are coordinated by the Ministry of Research and Technology. Major activities of some important national R&D institutes are described below.

Department of Energy and Mineral Resources (DEMR)

Renewable energy research conducted by DEMR focuses on geothermal and biomass energy. The department also carries out research in the field of wind electric generation, solar energy utilization, biogas production, and biodiesel derived from palm oil and micro algae.

Indonesian Institute of Sciences (LIPI)

LIPI carries out its research activities in the renewable energy sector through various centres within LIPI. Its research areas span wind energy technologies, solar cells and modules, concentrated solar power, micro-hydro and pico-hydro generation, and green transport by means of electric and hybrid cars. LIPI also provides training and technical assistance for capacity development in this area.

[73] APCTT-UNESCAP; Indonesia Renewable Energy Country Report

Assessment and Implementation Technology Agency (Badan Pengkajian dan Penerapatan Teknologi, BPPT)

BPPT has several research centres, which conduct research on energy. Their main activities in renewable energy relate to wind power and biofuels including bio-ethanol. BPPT also carries research on geothermal development.

National Institute of Aeronautics and Space (Lembaga Penerbangan dan Antariksa Nasional, LAPAN)

Activities of LAPAN are centred on utilization of wind power (especially using low-speed wind turbines), solar power and also on wind-solar hybrid systems. LAPAN has identified more than 130 potential sites for wind power generation in the country.

Institute Technology of Bandung (ITB)

ITB conducts research on utilization of municipal solid waste for electricity generation, utilization of wind power, biomass for biofuels and also on ocean wave power for generating electricity.

Universities

A few universities in the country conduct research on RE technologies. These universities include Gadjah Mada University (UGM), Surabaya Institute of Technology (ITS), Airlangga University (Unair), Indonesia University (UI), Sebelas Maret University (UNS), North Sumatra University (USU), Bogor Institute of Agriculture (IPB), and Diponegoro University. Research by these universities covers wind energy technologies, solar energy technologies, and biomass technologies and includes feasibility studies, engineering developments, and system control and its applications.

Expenditure on Research and Development[74]

Gross expenditure on R&D (GERD) in Indonesia is about 1% of the GDP. Only a small fraction of this is used for the energy sector. In 2009 (the latest year for which data are available), Indonesia spent just over 0.08% of its GDP on R&D, only a little more from 0.07% in 2000. However, some state bodies involved in R&D financing, such as the Directorate for Higher Education, have increased their spending by large amounts in recent years. Indonesia's GERD level is low, compared even to its regional peers, or several developing nations, and to its developed neighbours.

Although many institutions participate in R&D related to sustainable energy options, limited budget has kept Indonesia dependent on foreign technologies. Government research grants are awarded competitively to increase the effectiveness and quality of research, but the system of annual budget allocation for research distracts researchers as they cannot plan long-term research projects.

5.2 Academia

Various universities and industries collaborate to develop capabilities. Leading universities and selected R&D organizations conduct various programmes and use information technology for capacity building among stakeholders in sustainable energy sector.

For example, the ITB has developed software packages for technical and economic studies and evaluation activities in the area of geothermal energy. Leading universities such as ITB, UGM, and UI collaborated with two state owned companies, namely. PT PERTAMINA and PT Rekayasa Industri, to conduct non-academic training programmes for those involved in geothermal area.[75]

[74] Australian AID and The World Bank; Indonesia: Research and Development Financing
[75] APCTT-UNESCAP; Indonesia Renewable Energy Country Report

An example of collaboration with international institution is Geothermal Capacity Building Programme (GEOCAP) between Indonesia and Netherlands.[76] University of Indonesia, Technical University Bandung, and University of Gadja Mada have collaborated with University of Twente of Neherlands as part of the programme. The objective of GEOCAP is to increase the capacity of Indonesia's ministries, local government agencies, public and private companies, and knowledge institutions to develop, explore, and utilize geothermal energy sources. GEOCAP also assesses and monitors its impact on the economy and the environment.

5.3 Manufacturing

The manufacturing industry for sustainable energy equipment is not large in Indonesia. However, there are incentives for using local components in power plants using RE technologies such as solar. However, for large-scale projects, the components are mostly imported. For example, manufacturing of photovoltaic systems and components in Indonesia is limited to solar home systems; components for centralized systems or grid-tied systems are imported. The manufacturing of photovoltaic modules is limited to framing and laminating. The GoI has, however, shown a desire to attract foreign solar cell manufacturers to Indonesia. This would not only help create jobs for local Indonesians, but also drive an interest in solar power.

Since the Asian financial crisis, a number of macroeconomic challenges have led to a decline in the growth of Indonesia's manufacturing sector. The major factors behind these were the real appreciation of the rupiah, rising unit labour costs, a shift to commodities sectors, strong international competition (especially from China), and a tightening of profit margins. Indonesia is also lagging relative to its competitors. Major challenges for Indonesian firms are lack of adequate infrastructure leading to high transportation and logistics costs, difficulties in getting loans from banks, and lack of transparency and certainty in regulations. These factors discourage new entrants to set up shop and prevent existing manufacturers from expanding and enjoying the economies of scale.

The challenges in the manufacturing sector have created a large proportion of unproductive small manufacturing firms which due to problems in the business environment has prevented the manufacturing sector from making greater contributions to Indonesia's economic growth and employment opportunities.

5.4 Infrastructure

Indonesia is characterized by inadequate infrastructure and ranks low among countries in the quality of its infrastructure. Government and private spending on infrastructure has remained very low over the years. In this report we have considered two broad categories of infrastructure. One is physical infrastructure and the other is facilitating infrastructure.

Physical Infrastructure[77]

Indonesia's physical infrastructure consists of road, rail, air and sea. Indonesia's road network totals 437 759 km, of which 258 744 km (46%) consists of paved or sealed roads. Road network is excellent in the most developed islands such as Java, Sumatra, and Bali and main population centres of these islands. The railway system covers 5042 km, all of which is narrow gauge. But only 565 km (11.2%) is electrified. The public railway, which comprises most of Indonesia's rail network, is operated by the state-owned PT Kereta Api (Persero), while some freight railways are privately owned and operated. As of February 2011, Indonesia had 684 airports operated by Angkasa Pura I, Angkasa Pura

[76]http://www.utwente.nl/en/newsevents/2014/1/225693/itc-coordinating-partner-of-the-geothermal-capacity-building-programme
[77] KPMG; Investing in Indonesia, 2013

II and the Directorate General for Aviation. Sixteen scheduled commercial airlines, thirty charter airlines, and seven cargo (freight) airlines operate in Indonesia. Navigable waterways in the larger islands such as Sumatra, Java, Kalimantan, Sulawesi and Papua run to 21 579 km. Tanjung Priok in Jakarta, Tanjung Perak in Surabaya Esat Java, Belawan in Medan North Sumatera, Makassar South Sulawesi and supported by Cilacap, Cirebon, Kupang, Makassar, Semarang, Bitung, Lembar in Lombok, Balikpapan, Papua, etc. However, Indonesia is known to lack deep water ports.

Facilitating Infrastructure

The role of facilitating infrastructure such as science and Technology Park, special economic zone for sustainable energy technology manufacturing, science and technology information centres is equally important in facilitating the technology innovation. For example, the Indonesian government has created special biofuel zones (SBZs) in certain areas throughout the archipelago, which are sized at least 10 000 ha in Java or 100 000 ha outside Java.[78] Another example of facilitating infrastructure is Solo Techno Park (STP) which aims to develop human resource for technology innovation at international standards.[79] There are few business incubation centres at university level.[80]

Status of Infrastructure

Basic infrastructure in Indonesia is poor. Connectivity in rural areas is mostly inadequate. Lack of adequate infrastructure makes expansion of the transmission and distribution network uneconomical. Besides, energy products and services become costly due to inadequate infrastructure which in turn makes access to energy unaffordable in many parts of the country. Consequently, technology dissemination is hindered.

Government Initiatives to Promote Infrastructure[81]

The government has initiated a few measures to improve infrastructure. Establishment of the Indonesian Infrastructure Guarantee Fund (IIGF) is a move in that direction. The IIGF is responsible for providing guarantees for infrastructure projects, or, more specifically, to public-private-partnership (PPP) projects.

A Project Development Facility (PDF) has been established and is being administered by BAPPENAS with funding from ADB. The objectives of PDF are to assist in project preparation, selection of appropriate private partners in infrastructure services, and monitoring of project preparation.

5.5 Suggestions on Technology Innovation Ecosystem

The main issue in technology innovation remains increased coordination between different contributing institutions and sectors to the innovation of sustainable energy options in the country. Although R&D at the institutional level is the starting point of technology innovation, domestic manufacturing, commercialization, and dissemination of technologies are also important. There is need to increase budget share in sustainable energy research following the “Masterplan: Acceleration and Expansion of Indonesia: Economic Development 2011–2025”. More precisely, allocation and disbursement of fund should be made targeting sustainable energy technologies.

Apart from R&D sector, issues related to other sectors such as manufacturing and infrastructure are also required to be addressed. At present the sustainable energy manufacturing sector is weak in Indonesia which increases reliance on imports. This leads to higher cost of equipments leading to higher cost of energy. Conversely, there are possibilities that cheaper components inundate the market

[78]Statement Notable of Energy Development Republic of Indonesia, Since EWG 35
[79]http://sinas-indonesia.org/tech-intermediaries/science-and-technology-park/
[80]http://sinas-indonesia.org/company-type/incubator/
[81]KPMG; Investing in Indonesia, 2013

at the cost of quality. This happens especially in case of off-grid systems. These low quality components may reduce duration of products and thereby reduce consumer confidence on sustainable energy options. Thus, in order to ensure better acceptance of sustainable energy options domestic manufacturing needs to be encouraged. The domestic manufacturing sector, on the other side, is full of unproductive small-scale producers. To spur the domestic manufacturing, these small producers should be rejuvenated. This may be done by means of fiscal and financial incentives to these firms, motivating them to produce high quality products at a reasonable cost through tax breaks on purchase of raw materials, production subsidies etc. There are requirement of training and education for creating personnel for various levels to provide the small producers with the continuous supply of requisite manpower. Weak infrastructure acts as impediment to rapid adoption and dissemination of sustainable energy technologies. One way to develop infrastructure is to encourage foreign direct investment (FDI) in infrastructure development projects. This may help in faster flow of financial resources in infrastructure projects and in turn hasten up the infrastructure development. Administrative procedures related to IIGF and PDF may be expedited. Besides, the facilitating infrastructure needs to be strengthened by means of various financial instruments with special focus on sustainable energy technologies. Although, Indonesia has built up facilitating infrastructure such as SBZ, business incubators, techno-parks, there is a need to spread this facilitating infrastructure. For example, business incubators may be created beyond university level and they should be specialized to sustainable energy technologies. There may be development of techno parks dedicated to sustainable energy technologies. Thus there is need for encouraging the manufacturing sector for domestic production of components and building quality infrastructure for improving technology innovation.

Besides, a concerted policy approach is required to ensure that new technologies are commercialized properly and adopted by society. This may be done by educating people and other stakeholders of a project about the benefits of sustainable energy technologies. Role of community and community involvement in a sustainable energy project is also important. One way of increasing role of community is to develop community-based sustainable energy projects. The government may subsidize the project cost partially only if local community is involved by the project developer in project activities. This, in turn, encourages active participation of the society and motivates the community to participate at various stages of the project. Consequently, community's responsibility in looking after the project and in turn, the sustainability of the project increases. Non governmental organizations has to play crucial role in encourage communities to actively participate in sustainable energy projects through campaigning and knowledge dissemination activities.

Based on national enabling environment and existing technology innovation ecosystem, Indonesia should choose appropriate sustainable energy options for the country. In the next chapter, six sustainable energy options, namely, geothermal, small and micro-hydro, biomass, biofuel, solar, and small wind have been identified to be suitable for Indonesia.

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Chapter 6
SUITABLE SUSTAINABLE ENERGY OPTIONS IN INDONESIA

Indonesia is blessed with various sustainable energy resources, but their use has been limited so far. Technically there are potential sources such as geothermal, hydro, solar, biomass, wind, ocean, and tidal current; however, mere technical potential is not sufficient to adopt RE technologies. The environment of the country should be conducive for the development of sustainable energy options. In this chapter, technologies are suggested from view point of enabling environment and along with their possible applications for Indonesia. Technologies have been selected based on the enablers discussed under each technology. These enablers vary technology wise and cover government policies, laws and regulations, fiscal and financial incentives, finances, geographical and economic conditions. Possible applications under each technology were followed by case studies from the developing and the least developed countries which can be replicated in Indonesia.

6.1 Geothermal Technology[82,83&84]

Indonesia has about 29 000 MW of geothermal potential energy, which accounts for about 40% of the world's potential geothermal resources. However, so far only about 1,200 MW has been installed. The country's geothermal plants have been developed in North Sulawesi, North Sumatra, and Java geothermal areas, and the country has plans to develop nine other geothermal areas.

Key Drivers for Geothermal Technology

- Geothermal fund facility, which is a revolving fund set aside by the government for developing geothermal resources.
- Second Fast Track Crash Programme focusing on geothermal development.
- Business viability guarantee by the government to IPPs for generation of power using RE sources under the Second Fast Track Crash Programme.

Possible Applications

Use of geothermal resources for generation of heat and electricity.

Case Study: Olkaria Geothermal Power Plant in Kenya

Location: The 48 MW Olkaria III geothermal power plant was developed in the Great Rift Valley of Kenya by a private company. This is the first privately funded geothermal project in Africa.

Project Mode: Tenders for the project were invited in the mid-1990s under World Bank supervision. A US subsidiary of Ormat Technologies won the tender and set up a Kenyan company, OrPower4. The project was awarded in build, own, and operate mode. In June 2005, DEG and KfW Entwicklung bank were mandated as lead arrangers for project financing.

Technology: The 48 MW plant has been fully operational since 2009. The plant uses organic Rankine cycle technology for power generation. Besides, the plant is able to tap thermal energy in a liquid medium. The electricity generated is bought and distributed by Kenya Power (KPLC).

[82] Private Infrastructure Development Group; Olkaria Geothermal Power Plant, Kenya
[83] WWF; Igniting the Ring of Fire, A vision for Developing Indonesia's Geothermal Power
[84] UNFCCC; Geothermal Power Stations in Olkaria

Financing: The total project investment cost for the 48 MW plant was US$179.4 million of which US$ 59.7 million of long-term commercial equity was provided by the project owner (Ormat) and the balance US$119.7 million was raised through long-term loans from various development finance institutions.

Development Impact*:* The project helped in implementing Kenya's vision 2030 by contributing energy security. Improved quality and reliability of power are enhancing the life of people living in Hells Gate National Park region. The project owner also supports local education activities and provides books to all students and teaching personnel for girls' education.

6.2 Small and Micro-Hydro Technology[85]

Indonesia is endowed with both large hydro and small hydro resources. While large hydro technologies are commercially viable, their construction involves social, political, and environmental complexities. Compared to that, small hydro development involves fewer complexities. The country has small and micro-hydro power potential of about 770 MW, of which only 229 MW has been tapped. Small and micro-hydro are a good source of distributed energy generation on Indonesia's many islands.

Key Drivers for Small and Micro-Hydro Technology

- The small and micro-hydro power with smaller generation capacity is easier and faster to be implemented as it needs less investment and less complicated planning as compared to large hydro power.
- Small and micro-hydro potential is distributed across the islands and can be developed as local energy resources especially in remote areas for independent power supply in villages.
- The power generation cost by PLN for remote islands is higher as compared to other regions. This creates the need for decentralized power generation and distribution.
- Many islands are dependent on diesel-based power which is environmentally harmful and an unsustainable source of energy. Moreover, transport of diesel to the power plants in these islands is difficult and expensive.
- The high potential of small and micro-hydro outside the Java-Bali system provides opportunities for rapid electrification in the regions outside the Java and Bali.
- Private entities have the opportunity to participate in electricity generation business which opens up the opportunity for rapid adoption of the technology.
- Law no. 30 of 2009 allows participation of private entities, cooperatives and self reliant communities in electricity supply business. This creates incentives for private entities, cooperatives and self reliant communities in developing small and micro-hydro power projects.
- Regulation no. 4 of 2012 mandates PLN to buy electricity from small and medium power plants up to 10 MW capacity using renewable energy or excess power produced by state owned enterprises, regional-owned enterprises, private enterprises, cooperatives and NGOs.
- Feed in-tariff for small and micro-hydro power generation incentivizes private investors for investing in small and micro-hydro power projects.

Possible Applications

Small hydro power projects can be connected to the PLN grid or can serve as community-based small and micro-hydro power projects off-grid sources or can form part of micro-grid power projects.

[85] AusAID, Government of Australia; An economic Assessment of Renewable Energy Options for Rural Electrification in Pacific Island Countries

Case Study: Bulelavata Micro-Hydro Electricity Project, Solomon Islands

Location: Bulelavata is a remote community of about 300 people, located in the Western Province of Solomon Islands. It is only accessible by sea, which increases the cost of fuel and makes fuel supply less reliable.

Business Model and Financing: The Bulelavata plant was constructed in 1999 with assistance from an Australia based NGO, namely Appropriate Technology for Community and Environment (APACE), and funding from AusAid, Australian Agency for International Development. The capacity of the project is 29 kW. The project was implemented using the 'Village First' model, the main feature of which was to contribute to the project's success and sustainability by promoting community ownership of the micro-hydro schemes. Under this model, communities were required to contribute financially to the cost of carrying out feasibility studies and to donate local materials and labour for the construction of micro-hydro systems. Once the construction was completed, the community retained the ownership of the scheme. The community was also responsible for operation and maintenance of the system and collection of user fees from the beneficiaries. The fees were so designed that revenues received through fee collection were sufficient to cover all project costs. The user fees are set at a monthly flat rate, and are determined by the community hydro committee. Fees are collected by the women's club and the collection s held in the community bank account. Future expenses such as repairs to the micro-hydro system and parts replacement are covered by the fees. The village also sells electricity to Beulah Provincial Secondary School.

Benefits from the Project: Some of the benefits which have been realised as a result of the project include the following.

- **Improved quality of life:** Prior to the implementation of the Bulelavata micro-hydro scheme in 1998, households relied on kerosene lamps, dry cell batteries, and fuel wood as sources of energy. As a result of the village micro-hydro system, households have benefited from improved lighting in houses, especially kitchen. Also, many households have acquired water heaters and radios; and a few have purchased video cassette player machines, refrigerators, and electric drills. In addition, the project supplies electricity to village clinic, for street lights, and community deep freezers. The project also benefited students by allowing them to read in the evening hours and women to engage in income-generating activities such as weaving for longer hours. Besides, a local school, which previously relied on kerosene, fuelwood, and diesel generators for electricity for approximately 4 hours a day gets electricity from the project.
- **Employment and income-generating activities:** The project trained village people in operation and maintenance. In some cases, income generating activities have been facilitated by allowing fish to be stored in community deep-freezers.
- **Reduction in cost of energy:** Prior to the implementation of the project, Bulela Provincial Secondary School generators were consuming about 600 litres of diesel a month, which was replaced by hydro-based electricity. Also, household expenditure on energy has declined since the monthly user fees are lower than monthly spending on kerosene and dry cell batteries for lamps and radios.

6.3 Bioenergy[86]

In this report biomass resource based technologies, municipality solid waste to energy technologies and biofuel technologies have been discussed under bioenergy.

Biomass and Municipality Solid Waste Based Technology

Indonesia has biomass-based power potential of about 50,000 MW of which only 1,600 MW has been tapped so far. Biomass combustion or gasification is an option for energy generation. Use of municipal solid waste for electricity generation is considered another good option for Indonesia. Biogas digesters also have a potential in rural areas as dung from buffaloes, pigs, and cows is available in all provinces of Indonesia.

Key Drivers for Biomass and Municipality Solid Waste to Energy Development

- Aabundant availability of agricultural waste in Indonesia having technical energy potential of 470 GJ/year
- Availability of animal waste in almost all provinces of Indonesia which can be used for energy production from biogas digesters
- Increasing availability of municipal solid waste in urban areas creating opportunities for promotion of municipal solid waste to energy production in the country
- Biomass can be used to produce decentralized power using locally available resources
- The private sector is permitted to participate in power generation and power supply business
- Regulation no. 4 of 2012 giving mandate to PLN to buy electricity from small and medium power plants up to 10 MW using renewable energy or excess power produced by state owned enterprises, regional-owned enterprises, private enterprises, cooperatives, and NGOs
- MEMR regulation no. 4 of 2012 and 19 of 2013 specifying feed-in tariff for biomass and MSW-based power plants
- Reduced income tax through such incentives as accelerated depreciation, import duty exemption for import of machinery and equipment, and no value added tax.

Possible Applications

Electricity from biomass-based and MSW-based power plants, biomass-based cooking stoves and biogas digesters.

Case Study: MSW to Energy Power Plant in Wenzhou China under PPP Model

The refuse incinerator power generation plant in Wenzhou in Zhejiang province in China is an example of public private partnership (PPP) in the MSW sector. Although the proportion of MSW incinerated in China is still relatively low, such MSW-to-energy plants are a growing segment. In Zhejiang province alone, more than 30 such plants exist in cities such as Wenzhou, Jiaxing, Shaoxing, Hangzhou, Ningbo, Jinhua, and Taizhou.

Business Model: In 2002, the local government decided to form a partnership with a local private contractor, Wei Ming Environmental Protection Engineering, to build, own and operate a new MSW-to-energy incinerator plant under a build, own and transfer (BOT) scheme. The company invested a total of CNY90 million (US$10.863 million at an exchange rate of 0.1207 US$/CNY for 2002) in phases to build the plant and would operate, manage, and maintain it for a period of 25 years (excluding a 2-year construction period) under the BOT agreement. At the end of the period, the plant

[86] Asian Development Bank ; Municipal Solid Waste Treatment: Case Study of Public Private Partnerships (PPPs) in Wenzhou

will revert to government ownership without any additional compensation to the company. The plant has been operational since 2003.

The incinerator plant has a design capacity of 320 tonnes of MSW per day and electricity generation of up to 25 million kilowatt-hours annually. The plant receives a service fee from the Wenzhou city government for the disposal of MSW at a rate of CNY 73.8 per tonne (US$ 10.13 per ton at an average exchange rate of 0.1372 US$/CNY for the period 2003 to 2013). The BOT project is expected to break even after 12 years.

Incentive Structure: The implementation of the MSW-to-energy plant in Wenzhou is closely aligned with the objectives of the PRC's Renewable Energy Law passed in 2005 and is supported by a host of incentives and preferential policies which include the requirement that electricity network operators purchase electricity generated by qualified energy producers using renewable energy sources. Waste to-energy incineration facilities are also exempted from corporate income tax for the first 5 years of operation and are eligible for immediate refund of value-added tax.

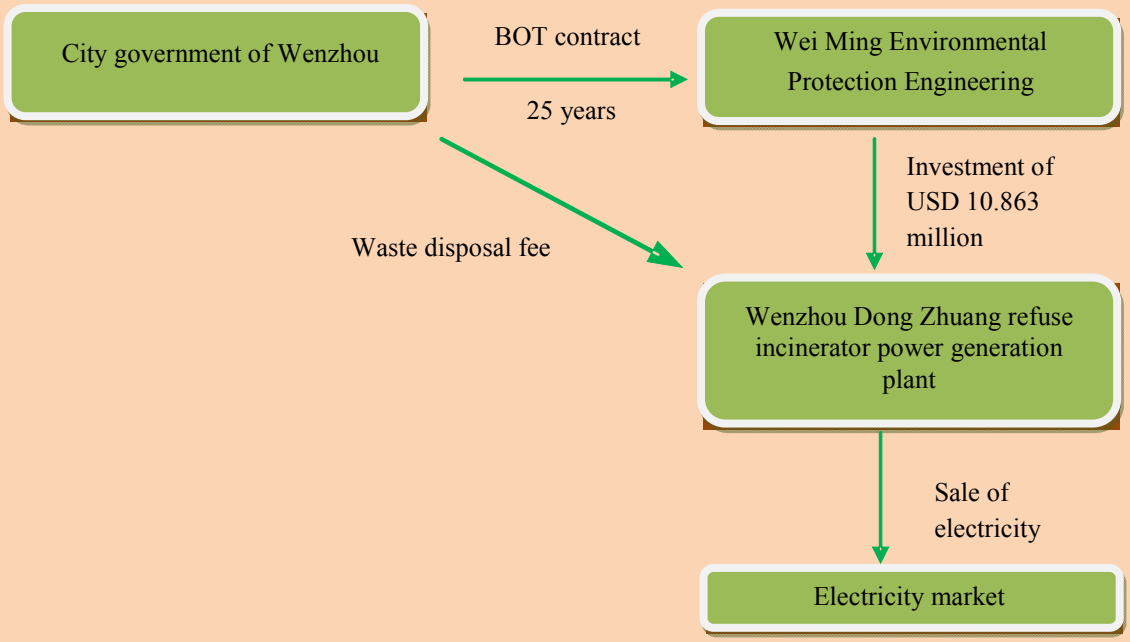

Figure 6.1 The BOT structure of the Wenzhou MSW to Energy Power Plant

Biofuel Production

Indonesia emphasizes the use of biofuels in industry, transport and electricity sector. The country produces biodiesel mostly from palm oil. The country is among the largest producers of palm oil in the world. Up to now the country has succeeded to blend 5% bioethanol into gasoline. The government has a commitment to increase the proportion of use of bioethanol in the by blending it into gasoline (part of national energy mix policy). R&D programme in Indonesia is also exploring sources of biofuel beyond palm oil such as from sweet sorghum.

Likewise Indonesia also has produced bioethanol from cassava for industrial application due to its higher prices compared if it is used as energy sources.

Key Drivers for Biofuel Production

- Entirely tropical climate suitable for feedstock production for biofuel

- Targets to develop 5.25 mha of biofuel cropland (1.5 mha palm, 1.5 mha jatropha, 1.5 mha cassava, 750 000 ha sugarcane) on currently uncultivated land suggested by the National Biofuel Development Team
- Existence of Energy Self Sufficient Villages (ESSVs) focusing on biofuels
- Creation of special biofuel zones in some areas of the country
- MEMR regulation no. 32 (2008) concerning provision, utilization and procedures for commercialization of biofuels
- Road map for mandatory biofuel utilization in transportation, industry and electricity generation sectors
- Presidential instruction no. 1 (2006) concerning provision and utilization of biofuel as other fuel
- MoF decree no. 117/PMK.06/2006 allowing farmers to avail themselves of subsidized credit for biofuel plantations
- MoF regulation no. 79/2007 enabling small and medium enterprises to obtain subsidized finance from national banks
- Government subsidy for biofuels encourages production of biofuels
- Better price indexing including the cost of transport from producers to blending plants

Possible Applications

Biofuel can be used in transport sector, electricity sector and industry sector.

6.4 Solar Photovoltaic Technology[87]

Indonesia has the equator crossing through it and has solar radiation up to 4.8 kWh/ m^2/ day. Although the country has an installed solar capacity of 22.45 MW, the development of solar energy in the country has been very limited so far. With its geographical location, radiation, and enabling conditions the country has a great potential for developing solar photovoltaic-based energy generation.

Key Drivers for Solar Photovoltaic Technology

- Many regions having electrification ratio of less than 60% which are suitable solar PV technology.
- Many remote areas which are still without electricity with high potential for solar power generation. Besides, grid expansion in these places is relatively costly.
- Many islands are dependent on diesel-based power generation which is environmentally harmful and an unsustainable source of energy. Moreover, transport of diesel to the power plants in these regions is difficult and expensive.
- The power generation cost by PLN is high in remote islands.
- Solar-PV-based power generation is suitable for both grid-connected mode and off-grid mode.
- Law no. 30 (2009) allows private sector participation in electricity supply business.
- Regulation no. 4 (2012) mandates PLN to buy electricity from small and medium power plants up to 10 MW capacity using renewable energy or excess power produced by state owned enterprises, regional-owned enterprises, private enterprises, cooperatives, and NGOs.
- Feed-in tariff is applicable for solar PV power generation through MEMR regulation no.17 (2013).

[87] Grameen Shakti, A Case Study by the Grameen Creative Lab

Possible Applications

Solar PV power may be deployed in urban and rural areas for both grid-connected and off-grid modes. The IPPs may produce electricity based on solar PV to sell it to PLN. Also, solar PV may be used in off-grid mode to supply electricity. Few applications of solar PV technology which can be implemented in rural and urban areas is shown in the table 6.1.

Table 6.1 Different applications of solar PV technology

Area	Applications	Grid-connected	Off-grid
Rural	Solar home systems for households in scattered locations		√
	Off-grid PV system for relatively dense areas		√
	Solar lanterns for households		√
Urban	Roof-top PV in households for electricity	√	√
	Roof-top PV in offices and commercial buildings for electricity	√	√
	Hot water systems in hotels, hospitals, and hostels for water heating.		√

Case Study: Dissemination of SHS by Grameen Shakti in Rural Bangladesh

Background: Being a young technology, renewable energy in the form of home systems is an expensive proposition. The initial capital investment is especially prohibitive for the poor. Thus, one of the initial challenges is to find a way to reduce this high upfront cost. Grameen Shakti (GS), a non-profit organization in Bangladesh, facilitates the adoption of SHS in rural areas through an instalment based finance scheme, which reduces the monthly cost of a solar home system to that of kerosene. This allowed GS to expand its market, which led to economies of scale, making it possible to reduce unit costs even further. As a result, the company became a profitable and sustainable social business. The financing scheme promotes ownership (as opposed to a rental model), because this leads to better care and longevity of the systems. At the beginning of 2011, over 140 000 customers had become owners of their own energy source this way.

Payment Scheme: Huge subsidy on fossil fuels and high upfront costs of the technology are major obstacles to motivating people to move away from fossil fuels. One option is to reduce cost of upfront investment in sustainable energy options to make it affordable. GS model makes it possible for lower-income households to purchase products by developing a number of payment schemes, which allow for clients to pay in instalments. Clients who cannot pay the whole sum upfront can select one of the alternatives shown table 6.2.

Table 6.2 Different payment schemes for Grameen Shakti Microfinance

Mode of repayment	Down payment	No. of monthly instalments	Service charge (flat rate)
Option 1	35%	12	5%
Option 2	25%	24	6%
Option 3	15%	36	8%
Option 4	100%	-	4% discount
Option 5	10%	36	5% (exclusively for micro-utility clients)
Option 6	25%	12	Nil (Specially for religious institutions)

Creation of a strong grassroots network to provide after-sales service right at the doorsteps of the rural customers: Rural people are unlikely to invest in a technology that is not durable and one that they do not fully understand. To assure its customers that the systems would be looked after well, GS introduced after-sales service. It focused on creating a vast network of rural engineers, who developed one-to-one rapport with their customers. They visited each client's home monthly to offer

free after-sales service for nearly 3 years. GS offered a long-term warranty (20 years for panels, five years for batteries, and three years for charge controllers) plus buyback options under which a client can return his /her system, if the area becomes grid connected.

Another important aspect was the creation of a rural network of women technicians. These technicians were responsible for assembly and repair of solar accessories to ensure a low cost, quick, and effective repair, maintenance services. The availability of spare parts right at the doorstep of the users made the scheme readily acceptable. By January 2011, over a thousand women had been trained as technicians. Customers were also trained on how to take care of their systems and provided with user manuals. This meant well-kept systems and therefore minimum repair and maintenance cost for both the clients and Grameen Shakti.

Capitalizing on Community Forces: Important to the company's success was also the active involvement of the rural community. The rural population was initially unaware of renewable energy technology and its benefits. Grameen Shakti educated them about solar energy and biogas generation to win their confidence. The focus was especially on creating both social and economic local stakeholders. GS gave local communities control over solar installations in their areas. To this end, GS worked with teachers, community leaders, and elected officials, who in turn explained the benefits of the solar home systems to the people they represent.

GS offered special packages for rural schools in order to ensure their goodwill**.** It introduced scholarship for the schoolchildren of solar home system users and designed special programme for rural school children to spread awareness of renewable energy in the next generation. GS recruited local youth who helped to install and maintain the systems and who understood the local market and refined the distribution effort. The company set up village-based technology centres to assemble all solar accessories, creating jobs for local women in the process. This decentralized grass-roots approach helped to keep operating costs low and to gain acceptance by the local communities. GS was unique in that it not only provided clean energy solutions, but also created powerful social and economical incentives for their adoption. Creating jobs in the villages led to increased adoption of SHS as more families were able to afford the instalments.

Key Success Factors:

- No direct subsidies, thus eliminating dependency
- Innovative use of micro-credit to reduce upfront costs and reach economy of scale
- Development of a vast rural network with branch offices
- Training to personnel who are also known as social engineers
- Training local technicians
- Linking technology with income generation
- Local manufacturing of SHS accessories

6.5 Small Wind Technology[88]

Indonesia has a countrywide average wind speed of 5 m/s. So far the installed capacity of wind energy in the country is about 2 MW, most of which consists of small-capacity and off-grid turbines. We propose small wind technology for the country.

[88] Laia Ferrer Marti, Anna Garwood, Jose Chiroque, Rafael Escobar, Javier Coello and Miguel Castro; A Community Small-Scale Wind Generation Project in Peru

Key Drivers for Small Wind Technology

- Remote islands in Indonesia that lack access to electricity and suitable for generation of power using wind resources.
- Islands with high wind speed that lack a transmission network capable of sustaining large wind farms.
- MEMR regulation no.31 (2009) ensures power purchase by PLN from small-scale producers of electricity.

Possible Applications

Small wind systems are used for producing power primarily on-site for a single user. Small wind turbines may be used for single family houses, businesses, farms, institutions, schools, government buildings, communication systems.

Case Study: Community Small-Scale Wind Generation Project, El Alumbre, Peru

Location: The inhabitants of Alumbre in Northern Peru are mainly engaged in subsistence agriculture and livestock rearing. The electrification project is designed to cover basic household needs and community services (school and health centres).

Project Size: In the first phase, 21 wind turbines of 100 W were installed in 21 homes and a wind turbine of 500 W was installed in the local school. In the second phase, 14 more family systems and a 500 W wind turbine were installed to electrify homes and the health centres respectively.

Case Study: Community Small-Scale Wind Generation Project, El Alumbre, Peru (Contd.)

Community Selection: The community was selected after evaluating the wind resource at different sites in the region. The region is characterized by low to moderate winds and the wind turbines installed are specifically designed to operate at low wind speeds.

Management Model: A local micro enterprise was formed to operate, maintain and administer all systems. The formation of the local enterprise promotes rural entrepreneurial culture. The micro-enterprise-based management model promoted active participation of beneficiaries, representatives from the enterprise, and community leaders. First, the community itself selected candidates to run the micro enterprise. Then, all the candidates participated in a comprehensive training programme which covered both administrative and technical skills. The project team and community leaders selected the top candidate based on evaluations during the training programme as well as past community involvement.

The micro enterprise is legally registered as a sole proprietorship and has a monthly tariff structure. The micro enterprise is in charge of collecting the monthly tariff paid by the users and the tariff serves to cover the costs of maintenance and replacement of the equipment throughout the lifespan of the project. The tariff also serves to provide a stipend to the operator-administrator. The Alumbre micro enterprise for rural electrical services has been successfully operating for over a year.

Results and Conclusions

- The wind turbine installed in each home covers the domestic use of electricity for 5 hours/day. The households use the turbines for lighting, weaving or knitting in the evenings, studying in the evening, listening to the radio and charging cellphones.
- Energy in the school powers four computers and a DVD player for educational videos, used by students from Alumbre and the neighbouring communities.

- The health centre, which attends to people in four communities, now has electricity for lighting and for a vaccine refrigerator.
- Community training sessions for authorities and local technicians strengthen operation and maintenance.
- Use of wind turbines has reduced the expenditures on other energy sources such as kerosene and candles.
- Families have been using energy directly or indirectly in the implementation of small business such as a radio station, the production of sweaters, and the making of cheese.

This chapter discusses key drivers for and possible applications of suitable sustainable energy options in Indonesia. Besides, relevant case studies for different technologies have been discussed. However, for proper adoption of these technologies and smooth transition from fossil fuel-based energy dependent economy to sustainable resources-based energy dependent economy, suitable strategies are required. In the next chapter, we have outlined various strategies and discussed necessary policy actions required for promotion of selected sustainable energy options.

Chapter 7

SUGGESTED STRATEGIES AND POLICIES FOR AFFORDABLE SUSTAINABLE ENERGY OPTIONS IN INDONESIA

Indonesia has an integrated energy policy that sets a target for renewable energy consumption in the total energy mix by 2025 and a green energy policy for promotion of renewable energy in the country. The country provides various fiscal and financial incentives for promotion of sustainable energy. However, the share of renewable energy in the country's energy mix remains only about 5% as of now. The small share may be attributed to various problems associated with implementation and lack of suitable policies and incentives. To overcome these problems, various strategies and associated policies are required.

This chapter is built on the analysis of the national enabling environment and technology innovation ecosystem of Indonesia done in the earlier chapters. The gaps or challenges that are identified in the first chapter have been instrumental in creating the strategies in this chapter. For example, strategies and corresponding policy actions have been suggested for lack of coordination among various government institutions and departments that create procedural delays in project execution. Many times inefficient manpower allotted for licensing and permit procedure delays projects. Keeping that in mind, policy actions for expediting the license and permit procedures and increasing education and capacity of personnel related to license and permit procedure have been described. Indonesia spends large amount for subsidies on fossil fuel. Moreover, cost of externalities is not included in price of fossil fuel based energy. These factors keep the price of fossil fuel based energy far below that of renewable energy based energy. To cure this 'ailment', policies have been suggested so that renewable energy sources are given a level playing field with conventional energy sources. Another example of strategy is to make financial arrangements in making private entities responsible for good after sales service of off-grid systems which has been poor so far. Policy actions on community based energy projects have been developed to ensure community involvement in renewable energy projects. The government of Indonesia is putting emphasis on promoting use of biofuels in transport and electricity sectors. In order to increase sustainable use of biofuels for transport and electricity sectors, a set of policy actions have been suggested. Although Indonesia has started resource assessment for small hydro technologies with the ESMAP and thinking for wind resource assessment with the DANIDA, resources assessment should be carried out for other technologies also. Domestic biogas programme and ESSV programme suffer from lack of initial capital for which government needs to provide financial resources in the form of subsidy or grants. Policy actions have been suggested to arrange for financial resource for these subsidies or grants. On the other hand new investments can be attracted by providing tax incentives which have been discussed under general policy section.

Manufacturing forms a part of technology innovation eco system. Necessary policy actions have been suggested for development of domestic manufacturing. Policy actions have been suggested for human resource development through all levels of education. Another important part of technology innovation ecosystem is promotion of facilitating infrastructure. Policies for promoting formal regional business incubators dedicated to sustainable energy technologies have been discussed. However, government of Indonesia has already taken certain strategy and policy actions to improve R&D and infrastructure. Therefore, no policies on these sections have been suggested

In discussing policy options for affordable sustainable energy in Indonesia, two approaches are adopted. Initially, we suggest some strategies and then suggest the necessary policy actions to implement those strategies. Later, we suggest some general policies adopted worldwide for sustainable energy promotion. The suggested general policies fit the current enabling environment of Indonesia. Along with the policies, a few business mechanisms have been proposed to suit the Indonesia's enabling environment. In the end, possibilities of South–South cooperation are discussed with examples from developing countries.

7.1 Strategy I

Improve coordination among various government ministries and departments, such as coordination between the Ministry of Energy and Mineral Resources, Ministry of Finance, and the Ministry of Forestry to remove barriers in project implementation.

Necessary Policy Actions

Empowered Committee on Renewable Energy

Forming an empowered committee under the aegis of National Energy Council would go a long way in removing inter-ministerial conflicts on approving renewable energy projects. The empowered committee would consist of top level representatives from various ministries responsible for legislations related to renewable energy development. These ministries will be

- The Ministry of Energy and Mineral Resources
- The Ministry of Forestry
- The Ministry of Agriculture
- The Ministry of Finance

The committee will be coordinated and chaired by the National Energy Council. The empowered committee will be responsible for:

- Examination of laws of various ministries.
- Identification of conflicting clauses in various laws of different ministries.
- Taking decisions to remove these conflicting clauses.
- Expediting the arrangement of finance.

Sequential Sign Off

Sequential sign off on regulatory areas will allow negotiating the hold-ups one at a time. This will reduce the drudgery of running around simultaneously to various departments for approval.

7.2 Strategy II

- Expedite the license and permit procedures in order to make investments easy and less time consuming.
- Increase the education and capacity of related personnel to manage the license and permit procedure efficiently.

Necessary Policy Actions

One-Stop Service

The Indonesia Investment Coordinating board has already opened up a one-stop service (OSS) for investors.[89] However, investors need to be informed about the service, and also be allowed to clearly

[89]http://www2.bkpm.go.id/contents/general/117156/about-one-stop-services#.U5AApXKSxUk

communicate problems they face with the one-stop service, so that necessary amendments can be made.

Increased private sector participation is required to provide constructive feedback to the concerned authorities to identify the gaps in the system. In South Africa for example, the private sector in some cases has provided free legal counsel to municipalities, which catalysed project approval and improved the long-term capability of the regulator.

Training of Personnel Employed for Licensing

The government should arrange for training of personnel through workshops and training programmes to enhance the capacity of personnel. The private sector should be encouraged to involve in the training process. One way to do this is to encourage the private sector to pay for training and other measures to improve regulatory expertise. This may be treated a profitable investment as this leads to increase in project approval rates.

7.3 Strategy III

Creating a level playing field for renewable energy resources: This may be done in two ways. First, by incorporating the cost of externalities in the cost of conventional energy sources, and second by gradually reducing subsidies on fossil fuels. Till date, no study has been undertaken to incorporate cost of externalities in the cost of conventional power.

The Indonesian government announced its intention to remove subsidies on fossil fuels by 2014 in the Medium Term Development Plan. But the country still spends a whopping amount on subsidies. In 2012, US$21 billion was spent for subsidies on fossil fuel. This was about 21% of central government's budget and 2.6% of GDP. Such sustained fossil fuel subsidies make renewable energy apparently uneconomical and the development of renewable energy is hindered. The government should therefore enforce subsidy reforms for creating a level playing field for sustainable energy options.

Necessary Policy Actions

Incorporating the Cost of Externalities of Fossil Fuel based Energy

Conventional power continues to enjoy various hidden subsidies. The cost of environmental, social, and health externalities is not factored into the price of conventional power. Thus, studies should be done to find out the externalities cost of fossil fuel based power generation considering social, economic and environmental externalities, and these costs should be included in the price of conventional power.

Educating People on Adverse Effects of Fossil Fuel Subsidies

The government should use print and electronic media to educate people about the adverse effects of fossil fuel based subsidies. This will help in increasing consumer awareness, and help the government to implement its strategy on subsidy reform.

Set a Price Determination Rule

The government needs to set a new domestic price with reference to international price through a pre-agreed rule. This price may be set on a periodic basis (monthly, quarterly, yearly). To adopt this price setting rule, Indonesia will have to determine the intended gap between world and domestic prices over the coming years. For example, the rule may be set that domestic prices would be 70% of average world prices for 2014 (from about 50% in 2013), 80% in 2015, 90% in 2016, and 100% in 2017.

Targeted Compensation for the Poor

The weaker sections of the society become vulnerable to energy subsidy reduction. Targeted compensatory measures should be adopted to protect low income households from the immediate rise in energy prices. This can be done by direct cash transfer to the affected people.

7.4 Strategy IV

Encouraging use of solar energy by the urban population through grid-interactive mode.[90] This increases the adoption of sustainable energy options and helps in reducing carbon di-oxide emissions.

Necessary Policy Action

Net Metering[91]

Net metering is a policy option used for promoting use of renewable energy in a distributed set-up. It should be applied for encouraging electricity consumers to install their own system, generate electricity for their own consumption and supply excess (generation over consumption) electricity generated to the grid of the distribution utility.

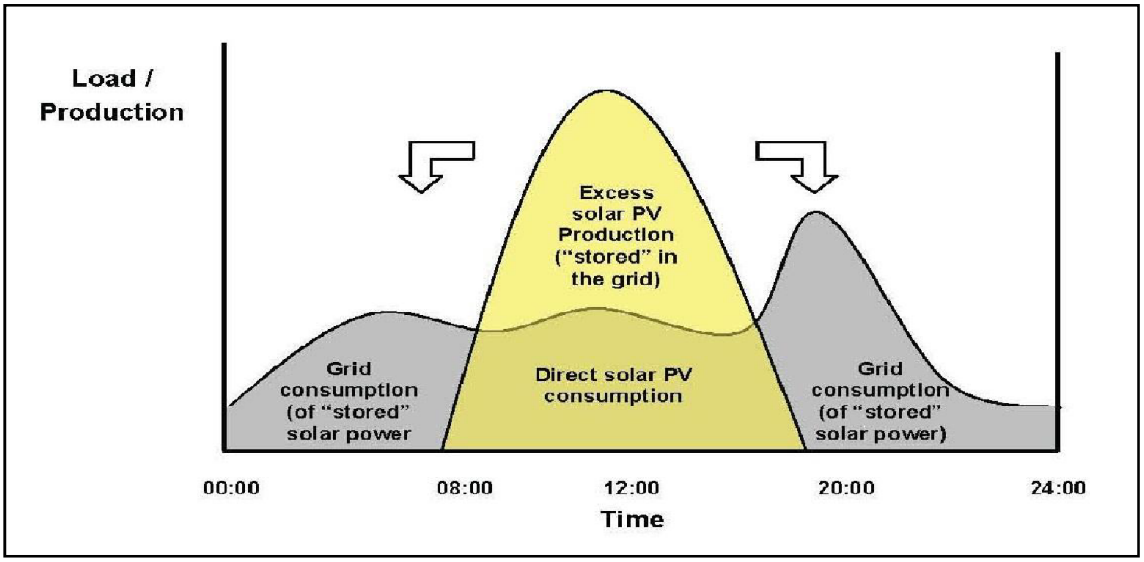

Figure 7.1 Excess electricity production

Net metering will allow small scale solar PV owners to "bank" or "store" their excess electricity generation in the utility grid (e.g. for solar energy during peak production in the day), and to consume this banked or stored electricity from grid during other times (e.g. for "stored" solar energy during night, morning and evening hours). The amount of supply of electricity to the grid over the amount of consumption of electricity from the grid is known as net export. This is illustrated in Figure 7.1 for a typical domestic solar photovoltaic (PV) installation.

[90] A roof top solar PV system that is connected to centralized grid and can draw power from the grid in time of excess demand and supply electricity to the grid in time of excess generation by the roof top system.

[91] World Watch Institute; Sustainable Energy Roadmaps, Guiding the Global Shift to Domestic Renewables

It is important to note that the "excess solar PV production" referred to in Figure 7.1 is not the same as the net exports over a billing period. Net export is the total supply of electricity to, less total consumption of electricity from, the distribution grid for the particular billing period. For a whole day, as in Figure 7.1, the "net exports" would be the area under the solar production curve above the

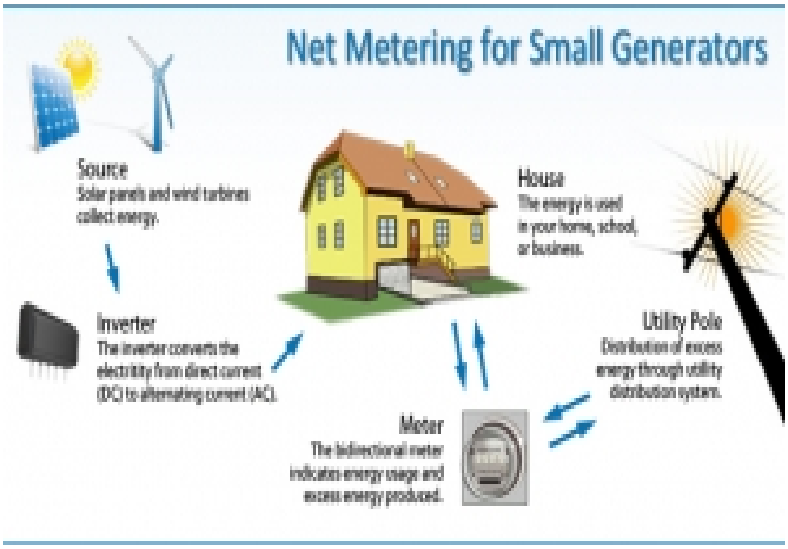

Figure 7.2 Net metering mechanism for small producers

consumption curve, less sum of the areas under the consumption curve and outside of the production curve (in Figure 7.1, the vertical axis denotes power in kW and the areas under the curves denote energy in kWh).

Net metering is supplemented by meters that roll forwards when the customer consumes power from the grid, and rolls backwards when the customer exports power to the grid. The billing period may be monthly, quarterly or annual. If the consumer consumes more energy over the course of a billing period than they have generated, they pay only for the net energy that they have imported from the system, plus any fixed monthly charges provided by the rate schedule.

There are a number of key policy aspects that need to be considered for successful implementation of net metering. These aspects are pointed out and the associated actions are described in the table below.

Table 7.1 Policy aspects and actions for implementing net metering

Aspect	Associated Action
Aggregate generation capacity	There should be aggregate generation capacity limits in order to protect the utility from revenue loss and address concerns around grid stability as voltage levels vary across the electrical network. An increased number of distributed generators on a network could also cause fluctuation in voltage, and thus destabilise the system.
Interconnection principles	Standardized interconnection procedure with a clear process of approval should be adopted.
Classification of customers	Electricity consumers should be classified into three classes; residential, commercial and industrial. Different prices may be adopted for different categories of customers.
Distributed generation feed-in tariff	Set a DG feed-in tariff (buy back price) to ensure that the producer of power from solar PV is capable of selling excess power to PLN at a fixed price over a period of time.
Ownership of carbon credits	The ownership of any potential carbon credits generated from the installation of renewable energy technologies for distributed generation should be considered in the design of net metering rules.
Third party ownership	Third-party ownership of on-site renewable energy generation should be approved. Under this type of arrangement, a resident or business hosts a renewable system that is owned by a separate investor. Third-party ownership arrangements are particularly beneficial for entities that cannot claim tax credits (such as governments, schools and

Aspect	Associated Action
	non-profit organisations), and for entities that either lack initial investment capital to purchase a system or the desire to own and maintain a distributed generation (DG) system.
Equipment standards	Set specifications for electrical equipments and allow consumers to connect to the grid only if these specifications are followed.
Installation and maintenance	Appoint qualified and competent entities who should be in charge of installation, inspection and approval of grid connected systems through standardized, transparent and efficient procedures.
Monitoring and controlling	The utility should be mandated to submit net metering data regularly to the MEMR.

7.5 Strategy V

Encouraging private participation in promotion of solar home applications in rural areas: These applications may be in the form of solar home systems or solar lanterns. This is suitable for regions with sparse population, where grid expansion is uneconomical and no other source of energy is available, in regions having low electrification ratio, and in regions that depend heavily on diesel and kerosene for access to energy.

Although the government of Indonesia has adopted a solar home system programme for rural areas, the programme faces challenges, such as below par after-sales service, and complete dependence on government financing. The inclusion of private sector will eliminate these problems.

There are two ways in which the private sector may participate in promotion of solar home applications. One is entirely private mode, and the other is public-private partnership mode. The difficulty with entirely private mode is higher costs to consumer as government subsidy is absent. The consumers may lack the capacity to pay in the longer run. As a result, the entirely private mode may become financially vulnerable. On the other hand, public-private partnership mechanism relies either on government subsidy or support to make the cost calculation effective, but is implemented through private agents.

Necessary Policy Actions

Grid Expansion Plan and Identification of Regions

- The government will clearly declare its plans on grid expansion and identify regions suitable for solar-based home applications. The decision for identifying regions should be based on the following criteria.
- Average distance from the existing grid.
- Total number of potential connections (customers) in the target community.
- Expected power demand of the community (including the potential for productive use of electricity).
- Affordability/ability of the end-users to pay.
- The government will be transparent in sharing information on regions identified for solar-based home applications.
- The priorities of deployment of solar home applications and expected results will be clearly mentioned. This will help in participation of the private sector in promoting solar home applications and managing expectations.

Prepare a Phase-wise Target for System Deployment

- The government will set phase-wise targets for deploying solar home applications in the identified regions. This would help in programme evaluation and monitoring.

Establish a Mechanism for Cost Sharing

- The government will clearly define principles for cost sharing. This will help in mobilizing resources from various sources to finance solar applications.

Provision of Subsidy

- The government will provide subsidy to reduce upfront cost of solar systems. However, there will be contribution from the consumer in terms of initial down payment and loan from financial institutions. This will increase accountability of consumers.

Product Quality Standards

- The government will examine the existing regulations on product standards and identify the gaps. If required, the government will issue new regulations on product quality.
- The government will ensure strict enforcement of product quality requirement standards.

For Indonesia, the public private partnership mechanism is proposed. One such mechanism is energy service company (ESCO) based mechanism for solar home system deployment, but a portion of the capital cost of solar system will be financed by government subsidy.

A suitable business mechanism involving ESCOs for solar home systems to the rural households is described below.[92]

There are four stakeholders in the mechanism, i.e. the government, banks, ESCO and the households. The government provides capital subsidy for the product, but only partially. ESCOs are responsible for project implementation, and operation and maintenance. Banks provide loans for the systems, and households use the system against payment of EMI to the banks. The ownership of the product is initially with the ESCO, and after the loan tenure is over, ownership is transferred to the customer.

The schematic representation of interaction between different stakeholders is presented below.

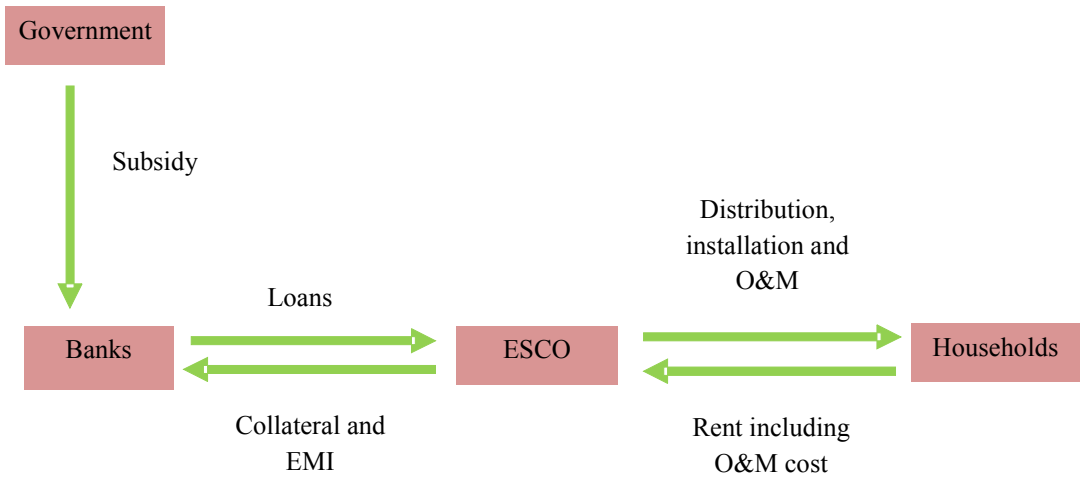

Figure 7.3 Schematic representation of ESCO mechanism

The business mechanism for the scheme is presented in the table below.

[92]Green Peace, India; Creation of a Legal Policy and Regulatory Framework for Accelerated Renewable Energy Development in Bihar

Table 7.2 Business mechanism in the ESCO mechanism

Financial Institution	ESCO	Households
ESCO will apply for loans to the bank.	The ESCOs will be empanelled with the local authorities responsible for RE project sanctions and implementation.	Will pay regular rent (which is the EMI including the operation and maintenance cost of the ESCO) to the ESCO.
Bank will receive subsidy from the government.	ESCOs will act as implementing agency.	Will take custody of the solar home lighting system.
Bank will grant loan to the ESCO after deducting the amount of subsidy from the total cost of the system.	Will rope in the interested buyers.	Will take over the solar PV system on completion of the agreed rent period of 3 to 5 years.
Bank will receive loan instalments from ESCO.	Will submit application with collateral security to bank for the loan.	
On successful repayment of loan by the ESCO, bank will release the collateral guarantee of ESCO.	Will get loan and subsidy amount from bank and contribution from beneficiary.	
	Will buy and distribute the SPV home lighting systems to buyers.	
	Will provide O&M for the tenure equivalent to the loan repayment period.	
	Will collect rent from the beneficiaries so as to take care of EMI and O&M service.	
	In case the beneficiary defaults six instalments, ESCO shall repossess the solar PV system.	

7.6 Strategy VI

Encourage community participation in promoting off-grid technologies: This may be done by increased participation of community representatives in decision-making, project implementation, operation and maintenance, and financial matters. In Indonesia, community level small hydro projects are operational with help from multilateral agencies. One of the problems with this type of projects is dependence on donor funds. Donor funds may be helpful in promoting sustainable energy options at the pilot scale, but for large-scale implementation, private sector participation is necessary. This strategy is suitable for small wind turbines, small and micro-hydro, and centralized solar PV systems.

Necessary Policy Actions

Awareness Building about Community-based Projects

- This may be done by educating stakeholders about the benefits of such projects and their sustainability. To run the whole system successfully, awareness building of private and community stakeholders is a crucial factor.

Facilitating Private Participation

- The government will facilitate private sector participation in community based projects. This will be done by informing them about the regions suitable for these types of projects, and the possible impacts of these projects.
- Green financing option should be exploited for providing finance for these projects.

Provision of Subsidy

- The government will provide subsidy to reduce the capital cost of the project. Initially, the amount of subsidy will be higher and it will be tapered off over time.

Management Mechanism for the Project

- The project will consist of three different stakeholders: private entity, an NGO and community cooperative.
- The cooperative will be a legally registered entity.
- The private entity will enter into a joint venture with the cooperative.
- The joint venture will receive loan from banks, and subsidy from the government.
- The loan repayment will be the responsibility of the joint venture.
- The private entity will be responsible for installation, operation and maintenance of the project.
- The cooperative will be responsible for collection of monthly fees from the users. The monthly fees will include loan repayment cost, maintenance cost and a replacement cost. The fee will also include return for cooperative and the private entity.
- There will be a core committee comprising of equal number of members from the cooperative and private entities who will be responsible for managing accounts for the project.
- The NGO will be responsible for knowledge dissemination among users, and facilitating capacity building of the cooperative members in managerial works.

7.7 Strategy VII

Promote use of biofuels[93] especially in small scale isolated electricity production and in transport:[94&95] Indonesia is already focusing on biofuels for use in transportation, and electricity sectors. The country has set targets for biofuel use in industry, electricity and transport sector up to 2025. The country possesses different biofuel feedstocks, such as palm oil, sugarcane, cassava and jatropha.

Indonesia is a net oil importer, but a food exporter.[96] Thus, the country's main need is to reduce use of gasoline and replace some of its use by biofuels. This can be done by using biofuels for generating electricity in small isolated systems, and reducing use of petroleum in transportation. Indonesia already has put in place targeted mandatory use of biofuels in electricity and transportation. The country also provides fiscal and financial incentives for biofuels production. However, few more policy actions will add to the use of biofuels in the electricity and transport sectors. These actions are described below.

Necessary Policy Actions

Prepare a Land Management Plan

- Although Indonesia is currently a food exporter, the demand for food will grow in future with the growth of population, which is growing at about 1.5% per annum. In order to ensure sufficient land for food production in future and maintain food security, the government should have a land management plan. An effective plan will reduce GHG emissions and biodiversity risk. Public and private organizations with large land concessions should be involved to plan the land use.
- Create an independent and accessible store of web-based information on land use pattern, land availability, land rights, and biodiversity for universal access.

[93] Biofuel refers to biodiesel and bioethanol

[94] Hector Pistonesi, Gustavo Nadal, Victor Bravo, Daniel Bouille; ECLAC, The contribution of biofuels to the sustainability of development in Latin America and the Caribbean: elements for formulating public policy

[95] Winrock International working paper; Implications of biofuel sustainability standards for Indonesia

[96] Ronnie S. Natawidjaja, Iran A. Rum; Food Security Situation and Policy in Indonesia

Increase Coordination among Departments and Institutions

- Coordination among different government departments should be increased to formulate policy. A greater coordination will help to address conflicting purposes of various departments and build up a harmonized policy for biofuel development and use.
- Coordination among various biofuel research organizations should be increased to prepare a consolidated biofuel research agenda. This research agenda should be addressed to assist in delivering a comprehensive national strategy for biofuels from research through implementation.

Promoting Role of Local Administration

- Provide support for local administrative bodies and assign them to act as information providers and promoter of technologies. They will help in identifying and establishing locally appropriate feedstocks. A strong information system using information technology should be developed.

Provide Adequate Infrastructure

- The areas of potential supply of biofuel feedstock does not have suitable infrastructure. Thus, it is necessary to build up adequate infrastructure and improve the existing infrastructure of potential areas to increase economic viability of producing fuel crops.

Programmes to Meet Demand for Energy

- The government shall promote social programmes for large scale dissemination of biofuels for the electricity and transport sector. These may be encouraged by allocating grants, providing subsidies, and campaigning for these programmes.

Training for Capacity Building of Government Institutions

- Provide training for capacity building of government institutions involved in developing and applying biofuel policy. Training will include topics such as remote sensing techniques and GIS, collation of existing methodologies and toolkits on policy making, techniques of developing a data repository for key country databases, and providing long-term secure storage of these data.

7.8 Strategy VIII

Indonesia's biomass[97] potential is huge. However, to ensure sustainable use of biomass resources, certain actions are required.

Necessary Policy Actions

Zoning of Biomass Projects

- For ensuring sustainable supply over the long term, permission for setting up biomass power projects may be given, considering the availability of local resources and existence of nearby power projects. A specific radius should be defined around each biomass project where no permission will be given for new projects.

Laws to Restrict Export of Biomass

- The government should bring in strict laws and enforcement mechanism to regulate export of biomass from the country.

7.9 Strategy IX

Development of domestic manufacturing sector for sustainable energy equipments: Development of domestic manufacturing sector for sustainable energy equipments is necessary for deploying

[97] Biomass excludes biofuel

affordable sustainable energy options. Indonesia has been producing solar photovoltaic modules and components. However, grid tied technology systems are still imported.

Necessary Policy Actions

In Indonesia, the smaller manufacturers need to be encouraged by opening up access to resources. This would make it easier for smaller firms to grow and participate in renewable equipment manufacturing. As a result, local manufacturing can be promoted. Besides, the firms should be helped to move up the value chain by increasing their profit and reducing costs. This can be done through greater investment in education, worker skills and technology, and greater cooperation between firms and educational institutions. Overall, market efficiency should also be improved by encouraging competition and maintaining economic openness. All these can be achieved by various instruments which are discussed below.

Financial Incentives

- Financial incentives mainly include subsidy on cost of manufacturing, and low cost loans at subsidized interest rates.

Local Content Requirement

- Indonesia has been promoting local content requirement for solar PV technologies through its feed in-tariff regulation. However, this should be expanded to other industries.

Tax Incentives

- Tax incentives may be provided by means of reduced corporate income tax, import tax exemption for raw materials, manufacturing tax credit (This incentive provides tax credit to new, expanded or re-equipped advanced energy manufacturing projects), and exemption on VAT. The government, however, already provides reduced income tax and VAT exemption.

Import Quota or Restriction

- Through import quota, restriction is imposed on imported commodities up to a certain quantity. As a result, domestic manufacturers are not affected by the onslaught of foreign products.

Certification and Testing Programme

- Certification and testing programmes helps manufacturers to produce according to the needs of the industry. This increases acceptability of domestically manufactured products in the industry.

Research, Development and Demonstration Programme

- Higher investment on research and development for manufacturing improves product quality and helps innovation. Demonstration of new products through industry parks creates markets for newly invented products.

7.10 General Policy Actions for Sustainable Energy

Apart from issue-based strategies, Indonesia needs certain general policy actions for accelerating development of sustainable energy in the country. These policy actions are widely accepted and have been implemented worldwide for development of renewable energy options. Some of these policies may have been adopted by the government. But these policies need modifications to cover a wider range of technologies and a well thought out plan for implementation. Few such policies relevant to the country are discussed below.

Need for a Scientific Resource Assessment

- There is an urgent need to assess the physical renewable energy resource potential in Indonesia including solar, wind, hydropower, biomass, and geothermal. Resource assessment data and GIS based maps compiled at the regional or country level can provide broad technology options, and help the developer in making informed decisions about investment in renewable energy projects. Higher resolution data that covers narrower geographic zones is necessary for making precise decisions on energy generation and planning.
- Currently, the country is thinking of exploring the wind power potential by conducting wind resource assessment studies in collaboration with Danish International Development Agency (DANIDA). Also, the country has taken initiatives for resource assessment with Energy Sector Management Assistance Programme (ESMAP),[98] the initial phase will focus only on small hydro. This process of scientific resource assessment should be extended to all technologies later on.
- There are possibilities that the resources assessment is carried out; but the data may not be integrated into publicly available framework. The resource maps and data should be made available publicly through renewable energy portals, particularly for foreign developers with less geographical knowledge. Public availability of regional resource mapping data will have impact on local market development.

Promotion of Off-grid Energy Systems

The government of Indonesia had issued Ministerial Decree No. 1122/K/30/MEM/2002 on Small Distributed Power Generation using Renewable Energy. The objective of this decree is to promote small-scale RE power plants by allowing enterprises to sell the power produced or surplus power to the local utility's power grid (if already accessible). Since the introduction of this decree, there has been development of small scale power plants in Indonesia, but only to a limited extent. Therefore, there is a need to accelerate small scale power generation from sustainable energy resources by adopting proper implementation measures.

The government should also focus on accelerating adoption of off-grid applications in the country through various measures. The necessary actions to be adopted for some technologies are discussed here.

Target Setting and Identification of Regions for Off-grid Systems

- The Director General of New Renewable Energy and Energy Conservation (DGNREEC) will set phase-wise targets for promotion of off-grid systems. Besides DGNREEC will also identify regions suitable for development of these technologies and build up a database on suitable regions. This will help developers in making informed decisions.

Development of Supply Chain for Off-grid Systems

- The government shall focus on development of supply chain, and outlets to facilitate easy availability of off-grid applications and services in all areas of the country. The activities shall include:
  a) Introduction of new delivery models of distribution like renting, leasing, BOMT (build, operate, maintain and transfer), etc.
  b) Enterprise development programmes to develop entrepreneurs delivering RE applications and services locally.

Off-grid System Development and Demonstration Programme

[98] http://www.esmap.org/RE_RESOURCE_MAPPING_INDONESIA

- The MEMR shall carry out R&D programme, development, demonstration, and commercial application of off-grid technologies in view of improving the reliability and efficiency of off-grid energy resources and systems. The R&D programme should cover innovative micro generation technologies for:
  a) The use of small-scale combined heat and power in residential heating and cooling appliances.
  b) The use of power generated in-situ to operate residential appliances, and the supply of excess generated power to the grid.
  c) Industrial heating and cooling application using solar power.
  d) Solar/biogas/other RE for cooking applications.

Adoption of Programme for Solar Application Promotion

Few relevant solar applications and relevant programmes that can be promoted in Indonesia are described below.

Solar Photovoltaic Systems for Rural Home Lighting

- The government will encourage private participation to promote solar PV systems for rural home lighting.
- The use of solar PV can be implemented through the authorized ESCOs who can aggregate the solar home lighting proposals of the end users and submit them to the bank, along with the collateral guarantee to enable the bank to sanction the loan.

Solar Thermal Application for Cooking and Industrial Heating/Drying

- The DGNREEC, in consultation with the government departments shall initiate a programme for solar cooking / improved stove and encourage the manufacturers to develop a variety of solar cookers / improved stoves to meet the diverse consumer needs across the country.
- The DGNREEC, in consultation with the government departments shall initiate a time-bound programme for utilization of solar concentrating technology for industrial applications such as:
  a) Food processing, juice concentration, particularly sugarcane, milk pasteurization, etc;
  b) Wood processing;
  c) Solar-based drying, heating, air conditioning and refrigeration systems;
  d) Processing and preservation treatment for wood-bamboo composites.

Solar Thermal Systems for Water Heating Applications

- The DGNREEC, in consultation with other stakeholders shall initiate a nation-wide programme for making solar water heating mandatory in all buildings with defined floor area and appropriate roofing structure; provided that this is done in phases, after considering the situation prevailing in different parts or geographical regions of the country.[99]
- The DGNREEC shall formulate a definite time-bound programme in coordination with provincial and local governments or such other local bodies to amend building laws, bye-laws or rules and regulations to facilitate such mandatory use, so as to ensure that this programme shall be completed within a stipulated period.

[99] United States Agency for International Development; APEC Building Codes, Regulations and Standards

Feed-in Tariff

Indonesia has started the regime of feed-in tariff for power produced using different renewable energy sources. However, it is often argued that the non-transparent method for determining feed-in tariff becomes a problem for developers. In order to determine a transparent and suitable feed-in tariff, the following steps may be adopted.

- It is preferable that the DGNREEC notify regulations presenting the terms and conditions for determination of RE technology-wise feed-in tariff. This will bring consistency and transparency in the tariff determination process. This will help the investor to determine the possible tariff with the help of the parameters specified under the RE tariff regulation.
- Feed-in tariff based on cost plus methodology provides a better representation of RE price as compared to that based on avoided cost methodology. The avoided cost methodology of feed-in tariff determination considers the cost of providing electricity based on fossil fuels which are highly subsidized and less costly. Consequently, the feed-in tariff for RE becomes low. Alternatively, a cost plus methodology for feed-in tariff determination considers costs associated with renewable energy. As a result, price of RE becomes high. A feed-in tariff mechanism based on cost plus methodology should be based on normative parameters which are as follows.
  a) Capital cost
  b) Depreciation
  c) Operation and maintenance cost
  d) Loan repayment and interest on loan
  e) Working capital Return on equity

An example of feed-in tariff based on cost plus methodology in India is given below.

Example: Cost Plus Methodology followed in India

The Central Electricity Regulatory Commission (CERC) and the State Electricity Regulatory Commissions (SERCs) in India follow the cost-plus methodology for awarding feed-in tariff for renewable energy technologies in India. The CERC-specified FIT is applicable to RE projects owned or controlled by the Central Government, or in case where the generating company enters into or otherwise has a composite scheme for generation and sale of electricity in more than one state. The SERC determined FIT will be applicable to the RE projects commissioned in the respective states.

The exercise for tariff setting in the cost-plus approach is adjusted for performance standards set by regulators, where the rate-of-return on the capital investments is regulated, and a cap is imposed on clear profit earned by the generator. This methodology of tariff computation takes into account the recovery of fixed cost components such as interest on debt, operation and maintenance costs, and also assures a fixed return on an investor's equity. This makes it necessary for the regulator to validate project specific data pertaining to cost with the historical data/past trends and other supporting information.

While adopting the cost-plus methodology in the case of renewable power projects due to the presence of a large number of tiny and widely distributed generating stations with diverse ownership, the regulators in India instead of awarding project specific tariffs, prefer the 'generic tariff approach' and specify generic tariffs for each technology. In the generic tariff approach based on cost-plus methodology, the regulator usually fixes the benchmark operating and financial parameters for each of the renewable energy technology separately. Benchmark pricing typically adopts a representative station for determination of tariff. The benchmark costs could result in the projects that are above the cost benchmark being unattractive. Therefore, the regulator needs to be cautious while deciding the

benchmark parameters for a particular RE technology. Along with the benchmark technology-specific performance parameters and financial parameters, the regulators also specify general parameters such as tariff period, control period, and tariff structure.

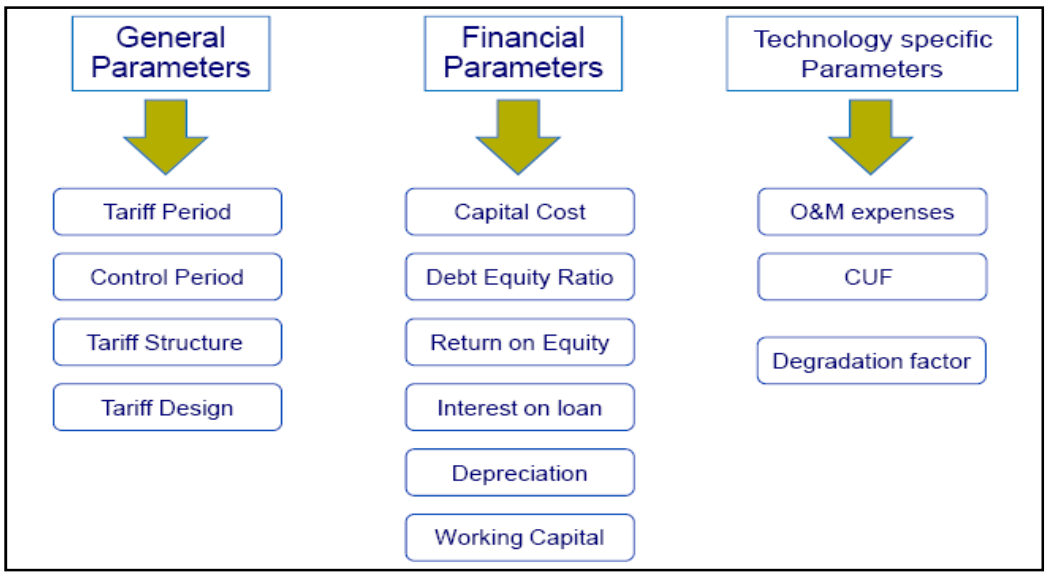

Figure 7.4 Generic RE tariff determination based on cost-plus methodology

Financial and Fiscal Incentives for Promotion of RE

Worldwide, a number of policies are designed to provide incentives for voluntary investments in renewable energy by reducing the costs of such investments. These policies can be characterized as falling into five broad categories: policies that (i) reduce capital costs upfront (via subsidies and rebates); (ii) reduce capital costs after purchase (via tax relief); (iii) offset costs through a stream of payments based on power production (via production tax credits); (iv) provide concessionary loans and other financial assistance, and (v) reduce capital and installation costs through economies of bulk procurement.

The RE investors in Indonesia are granted few fiscal and financial incentives such as tax benefits, import duty and VAT facilities and subsidies. Accelerated depreciation is also provided for renewable energy projects. However, there are various other incentives which are provided in several countries in the world. These instruments are discussed below.[100]

- **Production tax credits:** A production tax credit provides the investor or owner of qualifying property with an annual tax credit based on the amount of electricity generated by that facility. By rewarding production, these tax credits encourage improved operating performance. A production tax credit in Denmark provides DK 0.10/kWh (US 1.5 cents/kWh) for wind power, but few other countries have adopted similar credits.
- **Property tax incentives**: These incentives are implemented on many scales — state, county, city, town, and municipality. These are generally implemented in one of the three ways: (i) renewable energy property is partially or fully excluded from property tax assessment, (ii) renewable energy property value is capped at the value of an equivalent conventional energy system providing the same service, and (iii) tax credits are awarded to offset property taxes.

[100] Proposed incentives are the options available to decide on the right mix of incentives. Quantitative studies has to be conducted to determine the right mix of incentives.

- **Personal income tax incentives**: Credits against personal state income taxes are offered for purchase of and/or conversion to eligible renewable energy systems and renewable fuels. In some cases, taxpayers can deduct the interest paid on loans for renewable energy equipment.
- **Sales tax incentives**: Retail sales tax exemptions for eligible renewable energy systems and renewable fuels are provided. Most exempt 100% of the sales tax for capital expenses, and provide specific cents-per-gallon exemptions for renewable fuels. Some policies specify maximum or minimum sizes for eligible systems.
- **Pollution tax exemptions:** The Netherlands is a country where "green" power is exempt from new and rising fossil fuel tax on electricity generation that is paid by end-users. Starting in 2001, the fossil fuel tax rose to the equivalent of US 5 cents/kWh, providing a large tax incentive for Dutch consumers.

Policy Measures to Create Fund to Finance RE/ Market for RE

The finance for supporting the sustainable energy options and sustainable development can be arranged in various ways. The options relevant for Indonesia are discussed below:

- **Eco-taxes**: Involves taxing a range of products and activities to reduce carbon emissions or other environmental impacts, including carbon taxation on fossil fuels, traffic congestion fees, and a direct tax on carbon emissions.
- **Domestic public financing:** Creates a specialized financial institution within the government to leverage the private capital necessary for sustainable energy. Domestic public funds can provide the financial backing necessary for a range of incentives including feed-in tariffs and loan packages for energy development projects.
- **International funding options:** Includes harnessing international funding sources such as the Clean Development Mechanism and Joint Implementation funds under the UN Framework Convention on Climate Change, World Bank loans, and bilateral development assistance.
- **Capacity building in the banking and financial sectors:** Aims at addressing a lack of available capital to invest in renewable energy sources, as well as a lack of available borrowing (soft loans, credit, grants, tied and untied loans) and guarantee instruments for renewables, based on the assumption that in the long term, the private sector, backed by commercial banks, will need to be the main source of renewable energy finance.[101]
    a) Public benefit funds: Public funds for renewable energy development are raised through a System Benefits Charge (SBC), which is a per-kWh levy on electric power consumption. Some analysts suggest that clean energy funds seem to be one of the more effective policies in promoting renewable energy which is to result from electricity restructuring. It is estimated that fourteen U.S. states will collect US$3.5 billion through 2011 in system benefits charges. Similar levies exist in some European countries for fossil fuel-based generation. In general, the funds serve a variety of purposes, such as paying for the difference between the cost of renewable and traditional generating facilities, reducing the cost of loans for renewable facilities, providing energy efficiency services, funding public education on energy-related issues, providing low-income energy assistance, and supporting research and development. Maharashtra state in India has successfully created a clean energy corpus of US$ 16.2 million (Rs.1billion)[102] by levying cess on electricity consumed by the industrial and commercial consumers in the state.

[101] World Institute of Sustainable Energy; Achieving 12% Green Electricity in the Grid by 2017

[102] Average annual exchange rate of Rs. 61.73/US$ for 2013 has been considered for conversion

b) Government procurement: Government procurement policies aim to promote sustained and orderly commercial development of renewable energy. Governmental purchase agreements can reduce uncertainty and spur market development through long-term contracts, pre-approved purchase agreements, and volume purchases. Government purchases of renewable energy technologies in early market stages can help overcome institutional barriers to commercialization, encourage development of appropriate infrastructure, and provide a "market path" for technologies that require integrated technical, infrastructure, and regulatory changes.

c) Revolving fund: Although the government has set up a revolving fund for geothermal development, the facility should be extended to all renewable energy options. The revolving fund helps in reducing upfront cost related barriers for adoption of sustainable energy options.

Human Resource Capacity Development[103]

The role of academic and R&D institutions is of prime importance in developing quality manpower to cater to the required RE addition targets in the energy mix. Although there are curricula on renewable energy in the country, there is need for further development. The RE industry requires huge manpower to meet its expansion plans. To meet the demands of the industry, there is a need to revise the curricula of educational and training institutions. The revision may be done at all levels of education through various courses and programmes. These probable courses and programmes are listed below.

- General renewable energy courses at school level
- Technician level programmes for skilled workers (9 months to 1 year)
- Diploma-level programme for supervisory personnel (1 to 2 years)
- Engineering and graduate courses
- Post-graduate courses
- Doctoral-level courses
- Management institutions for Masters in Energy Management (with emphasis on RE)
- Training institutes in the govt and non-govt sector for on-the-job training, offering certificate courses up to 3 months and providing training of trainers.

Along with development of curricula, laboratory infrastructure should be created to facilitate practical experiments by the students. To attract the best talent to this sector and to encourage students to undertake courses related to renewable energy, awareness about green jobs should be created.

Promote Formal Regional Business Incubators

Formal business incubators should be promoted where continuing technical and management advice and assistance can be provided to project developers. One target of such incubators will be entrepreneurs interested in forming operation and maintenance (O&M) contracts or project management contracts, which can provide services to several plants located in certain regions. Such organizations can provide a high level of expertise that would be affordable for single-project O&M and management staffing.

There are several instruments for business incubation. These instruments are: tax benefit, public private partnership, low cost loan, encouraging and facilitating private sector in technology tie-up, or technology transfer with foreign firms.

[103] World Institute of Sustainable Energy; Achieving 12% Green Electricity in the Grid by 2017

Ensuring Product Standards

In order to ensure product standards, the governments should

- Formulate and enforce regulations on product standards and requirements for manufacturers and installers to ensure quality of the product and increase consumer confidence.
- Support and promote testing and certification of renewable energy equipments so that consumers can make an educated choice at the time of purchasing the product.

7.11 Possibility of South-South Cooperation

Indonesia is at an early stage of renewable energy development. Thus choosing the right path of development is important. One way and most probably the best way of doing this is to learn from other countries that have shown considerable success in promoting sustainable energy. South-south cooperation is an option for Indonesia to benefit from experiences, knowledge, and technologies from other countries of almost similar social, economic, political, geographic conditions. In this section we have discussed possibilities of south-south cooperation from three aspects. The first one is knowledge and experience sharing with Nepal for its rural energy development programme, the next one is technology transfer from India for biomass based power generation and third one is collaboration with India for human resource development initiative in renewable energy sector.

Rural Energy Development Programme of Nepal[104]

Nepal launched its rural energy development programme in 1996 to introduce decentralized renewable energy service in the remote parts of the country. The programme introduced micro-hydro power systems, improved cooking stoves, solar home systems and biogas. These systems generate energy services including lighting, communications, mechanical power and clean water. The lessons learnt from the programme were helpful in formulating Nepal's National Rural Energy Policy, 2006.

Indonesia has programme on micro-hydro power generation, biogas-based power generation, and improved cooking stoves. However, these technologies are yet to be applied on a large scale. Nepal's experience in large-scale promotion of these technologies may be helpful for Indonesia. Thus, analysing enabling factors in scaling up of sustainable energy in Nepal's remote villages are important.

Commitment of the National Government: Since the beginning of the programme, the government has shown strong long term commitment for the project. This has been reflected in the establishment of Alternative Energy Promotion Centre to lead the programme. The centre has formulated policies, legal and financial framework for rural energy development. The centre has also employed monitoring and evaluation systems that have documented social and economic costs and benefits of rural electrification programme.

Local Engagement: The local governments have worked to integrate this programme into local development planning. Also, local governments provided finance to support capacity development.

Finance for the Programme: Initially the Nepal Electricity Authority provided 80% of the financing needed to cover the capital investment required in construction and communities provided 20% of the cost. This commitment helped to attract foreign funding from partners such as the Danish International Development Agency, the World Bank, UNDP, NGOs, local governments, and ultimately banks, as well as from local governments, who contributed financing under subsidy

[104] UNDP; Case Studies of Sustainable Development in Practice

provisions and for capacity building. The community contribution to the project cost gradually increased from 20% in 1996 to 40% in 2006.

Community Mobilization and Local Partnerships: The programme was successful since it used existing local governance structures for energy service delivery. Community empowerment ensured effective local service delivery and longer term financial sustainability. The community participants were organized into village level functional groups based on common interests that included representatives of vulnerable groups. Collaboration was built up with local entrepreneurs and civil society organizations to provide better micro finance services.

Capacity Development at all Levels: The Rural Energy Development Programme focused on capacity development both at the national level and local levels. The objective of capacity development was to create appropriate policy framework at the national level and ensure effective energy service through community members at the local level. Capacity development activities focused on organizational and skills development, training in environmental and technological management, project design and implementation, monitoring and evaluation, resource mobilization, and vulnerable community empowerment.

Possibility of South-South Cooperation: The programme provides opportunity to develop south-south learning for Indonesia. Government's participation in the programme has contributed scaling up of the project. The programme also illustrates the possibility of capitalizing on existing government priorities for development using renewable energy options. For example, the programme directly contributed to increase women's participation in community life and decision-making process. Capacity development through the programme was designed using UNDP's capacity development expertise which is applicable for decentralized access programmes in other countries. The experience of Nepal may be shared with Indonesia to scale up the implementation of Indonesia's sustainable energy programmes for rural areas. Training programmes and workshops may also be arranged for capacity building of policy makers, local authorities and communities.

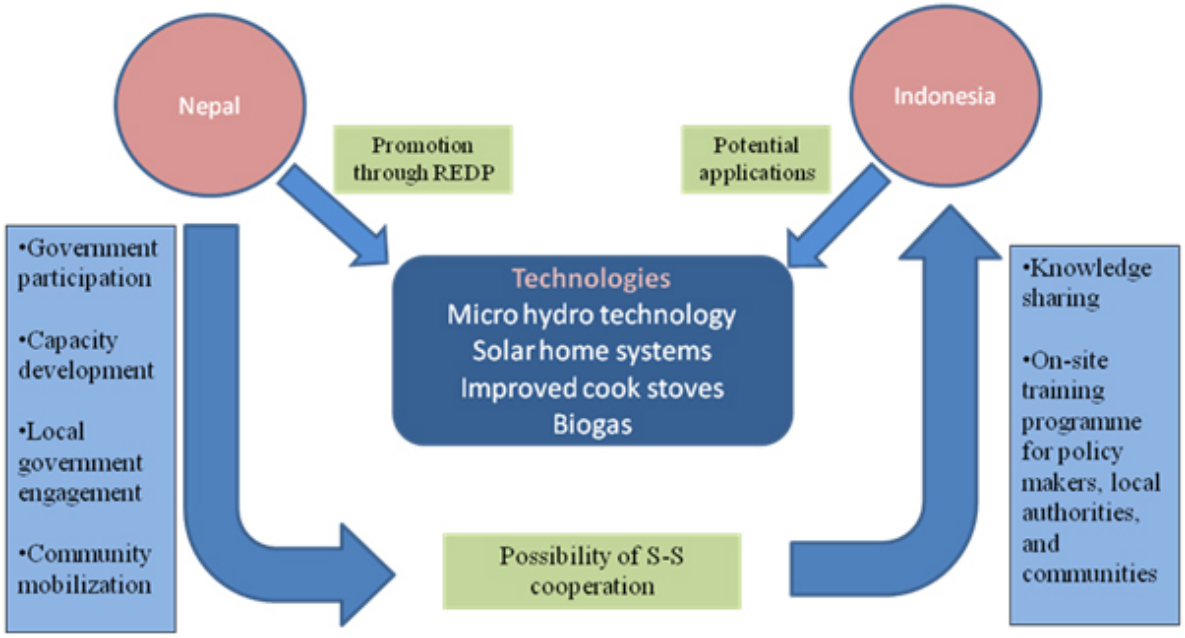

Figure 7.5 Possibility of South-South cooperation with Nepal

Rice Husk Based Power Generation in Rural India

'Husk Power Systems' (HPS) generates and distributes electricity in the remote villages of Bihar, a state situated in eastern India with a population of over 100 million. Almost 85% of households in the state do not have access to electricity and 82% of households use kerosene as the source of lighting.[105] Businesses turn to diesel generators for power. Although in some rural areas grid connection has been extended, the supply of electricity in those areas is unreliable and intermittent.

The state of Bihar is primarily an agrarian economy and producing huge quantities of rice husk as residue. HPS developed a biomass gasification system which uses rice husk to generate electricity. Each power plant has a capacity of 35 kW to 100 kW and these power plants generate producer gas from rice husk to generate power. The system produces enough electricity to cater to the needs of 300 to 500 households for almost 8 to 10 hours a day.[106]

Apart from producing electricity, the added advantage of these gasification generators is its by-product-silica, which is used as an ingredient in making cement. The rice husk ash produced as a residue is used to make incense sticks and rice husk balls are used as fuel for cooking. Moreover, the HPS initiative saves 42,000 litres of kerosene and 18,000 litres of diesel per year.[107]

Technology: Sackloads of rice husk are poured into the gasifier hopper every 30 to 45 minutes. The biomass burns in a restricted supply of air to give energy-rich producer gas. The gas passes through a series of filters which clean it, and it is then used as the fuel for an engine that drives the electricity generator. Electricity is distributed to customers via insulated overhead cables. Key features of the technology are outlined below.

- **Multi-fuel gasifiers:** Gasifiers can use multiple types of feedstock such as
  - Rice husk
  - Wheat husk
  - Mustard stems
  - Corn cobs
  - Wood chips
- **Unique gasifier design:** Allows for easy disposal of biomass char, lack of which results in tar formation.
- **Remote plant monitoring system:** Low cost system to monitor plant performance via internet.
- **Pre-paid meters:** Consumers get their meters charged with the amount of money they have and the meter automatically disconnects supply after the credit is exhausted.
- To minimize the cost, locally available gasifiers are used with modified gas engines that are able to operate on 100% producer gas.
- HPS uses standard biomass gasification technology which is suitable for rice husk based power generation.

Dependence on Local Resources: Gasifiers are manufactured by a local company and optimised for rice husk (a difficult material to gasify). But gasifiers can also work with other types of agricultural residue or with wood. The engines are manufactured by a local partner who worked with HPS to develop an engine that could run on gas generated by gasification of single fuel alone (rather than dual-fuel operation with diesel fuel).

[105] Census of India, 2011
[106] Winrock International India (WII), Access to Clean Energy
[107] http://www.devalt.org/knowledgebase/pdf/Case%20Study-3.pdf

For day-to-day management, every power plant has one operator and one husk loader, wherein the operator carries out the routine maintenance. In addition, two more people are associated with these plants- one of them handles husk buying and ensures a regular supply of raw material, and the other employee is an electrician in charge of the cluster of villages.

In an effort to secure easy availability of rice husk, recently rice mills are being built up adjacent to the power plants and milling of rice is done free of cost. After milling, the husk is taken and used for power generation. Otherwise, HPS enters into a contract at a fixed price with the rice husk suppliers.

Business Mechanism for SET Delivery: HPS follows a demand-driven approach and supplies electricity only to villages with sufficient demand for electricity. In the beginning, the HPS team conducts household level surveys and quantifies the potential demand in watt-hours. The electricity is supplied to the villages where at least 250 households agree to take electricity connection. However, a token installation charge of US$1.71[108] is collected from the willing households along with verbal willingness. A differential pricing system is being followed by HPS. Every household is charged US$2.57 (Rs. 150) per two CFLs of 15W, where shops and businesses pay a per month charge of US$3.42 (Rs. 200). For households seeking connection to operate fans and television sets etc. charges are calculated on similar wattage basis.

Social Factors: Lack of reliable supply of electricity to the families has led to such rapid expansion of the rice husk based power plants in the state of Bihar. Even in villages with grid power, households and businesses choose to connect to the HPS supply because of its greater reliability and lower cost.

- Availability of good-quality lighting throughout the evening serves many purposes of the households. Children can study unhindered, housework is easier, and families can relax and socialise.
- Women enjoy extended working hours with the availability of light which allows them to engage in other productive works with higher flexibility.
- Better lighting increases security, and reduces frequency of snake-bites and dog-bites – a common cause of emergency hospital admission in Bihar.
- Removing kerosene lamps and diesel based generators by biomass based power reduces exposure to smoke and fumes. This in turn diminishes negative impacts on health. Further, the risk of fire in bamboo made houses has been reduced.
- The telecommunication system has been facilitated as the use of mobile phones has increased connectivity manifold. In one village, mobile phone ownership increased from 10% to 80% of households after HPS supply was installed.

[108] Average annual exchange rate of Rs. 58.48/US$ for 2013 is considered for conversion.

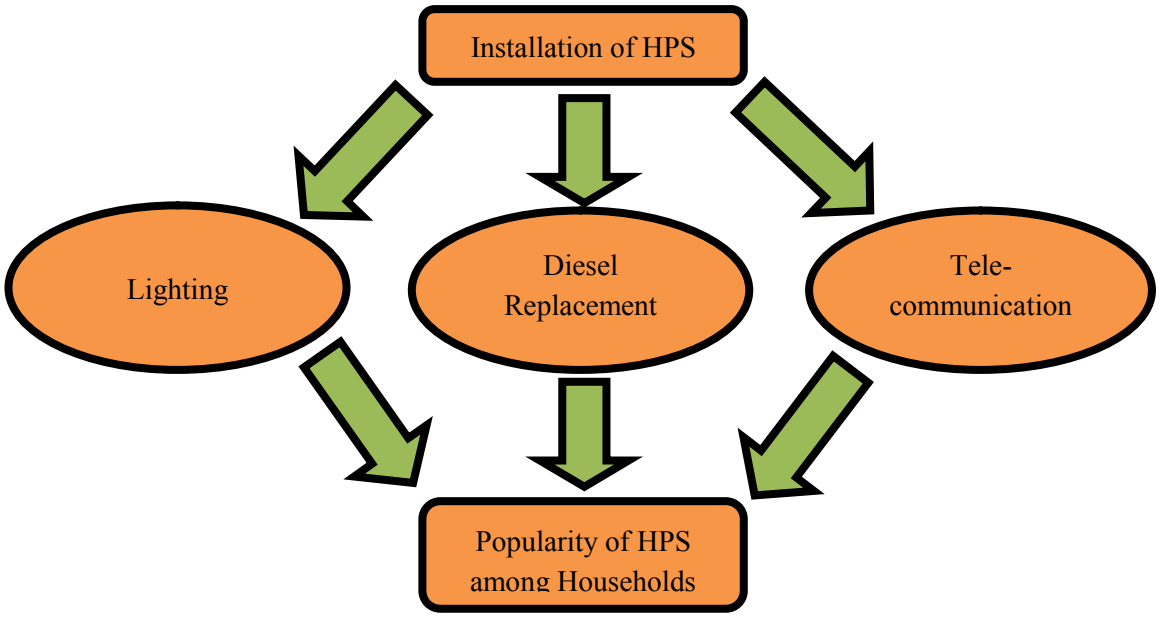

Figure 7.6 Benefits of HPS for households

Affordability: Households spend US$3.42[109] (Rs.200) per month for kerosene for lighting. By switching to electricity supplied by HPS they are able to save 85.5 cents (Rs. 50) to US$1.71 (Rs. 100) every month. Thus electricity supplied by HPS is very much affordable for the village households. Moreover, the actual value of savings is accentuated by access to electricity as they now involve in more economic and non-economic activities which were hitherto unknown to them.

Access to electricity has helped in business growth. Some new businesses like photocopying and mini cinemas have come up because of HPS supply. Rice mill owners have also benefited since they are paid about US$25 per tonne of rice husk which increases the earning of rice mill owners by an extra US$300 per year.

Possibility of South-South Cooperation: HPS is now exploring business opportunities in Tanzania and Uganda. HPS is keen to establish relationships with concerned businesses or institutions or organizations who are interested in building up rice husk based power plants in their country. The technology is suitable for Indonesia where rice production is high. The best practices for the husk power systems that suits Indonesia's condition are as follows.

- Use of locally available resources and minimum dependence on foreign products
- Use of waste in the form of rice husk for power generation, thus making the supply of raw material sustainable
- Creating employment at the local level for less qualified persons
- Productive use of by-product of the power generation process

Biomass Gasification, Ankur Scientific Pvt. Limited[110]

Ankur Scientific Pvt. Ltd manufactures biomass gasifier systems for biomass gasification. Biomass gasification is one of the best options for off-grid renewable energy. Two types of gasification technologies are available. One is single fuel mode and the other is dual fuel mode. A comparison of these two modes is discussed in Table 7.3.

[109]Average annual exchange rate of Rs. 58.48/US$ for 2013 is considered for conversion
[110]Mr. Ashok Chaudhury, Ankur Scientific Pvt. Ltd.; Biomass Gasification and Distribution Power Generation

Table 7.3 Comparison of single fuel mode and dual fuel mode

Single fuel mode	Dual fuel mode
Only biomass is used as fuel.	Biomass and diesel are used as fuels. 60–75% diesel is replaced.
1.3 kg of wood or 2 kg of rice husk is used for generating 1 unit of electricity.	4 kg of woody biomass or 5–6 kg of rice husk is required to replace 1 litre of diesel.
Uses producer gas engine generator set	Uses diesel engine generator set

Ankur manufactures gasifiers with capacities ranging from 10 kWe to 1.6 MWe. The technology used by Ankur is described below.

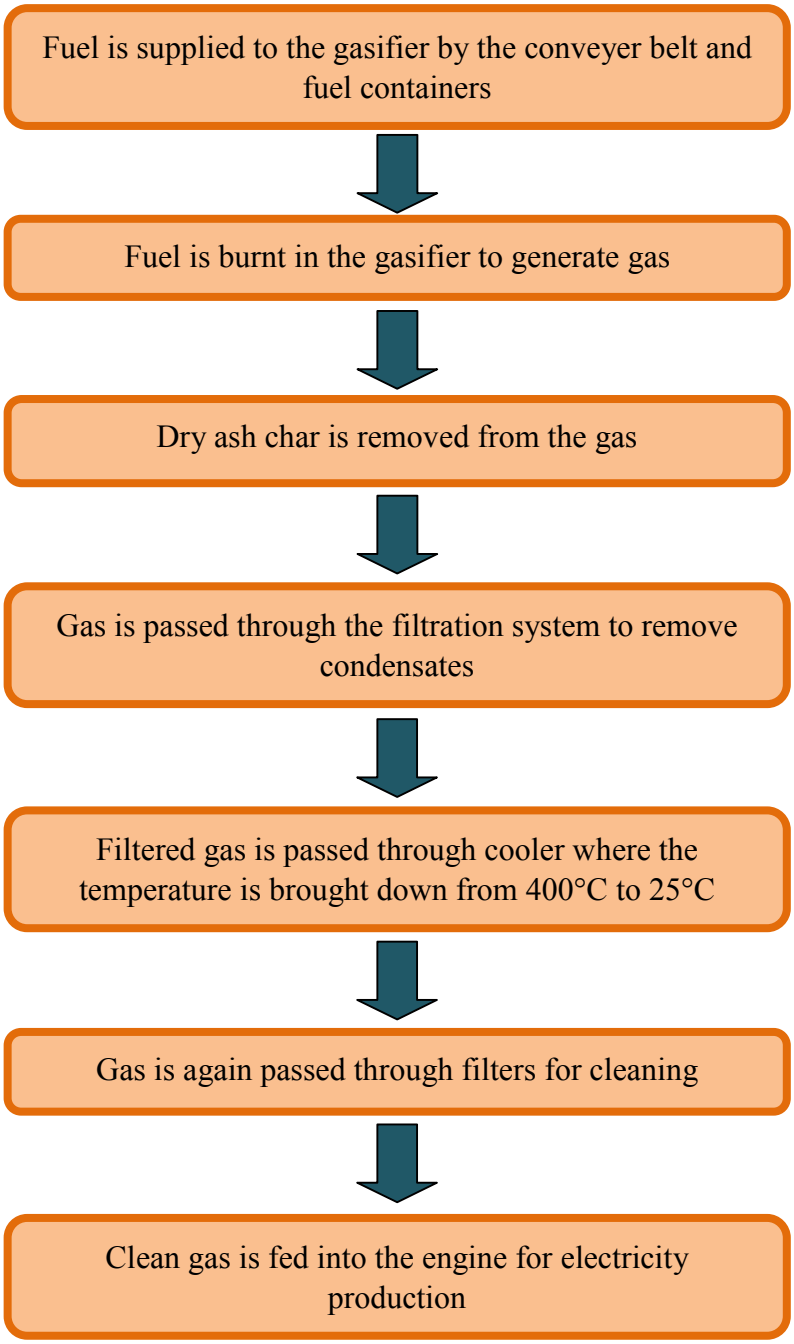

Figure 7.7 Stages in biomass gasification technology

Possibility of South-South Cooperation: Ankur Scientific Ltd. has experience in building gasifier systems of different capacities suitable for different needs. The technology can be used for power generation in single fuel mode and dual fuel mode. Indonesia's huge potential for biomass based power generation may be tapped by using Ankur's technology. Moreover, Indonesia's remote regions where power is generated using diesel can adopt dual fuel mode technologies to replace 60–75% diesel by biomass. Thus there is immense potential for technology transfer from Ankur Scientific, India to Indonesia for biomass based power generation.

Human Resource Development Initiative in India[111]

The Ministry of New and Renewable Energy in India started a manpower development effort in 1999-2000 for project planning, system design, product development, operation, maintenance and repair of deployed systems. A scheme was introduced for renewable energy training and study tours, and short duration training programmes of one to two weeks within and outside the country. A National Renewable Energy Fellowship Scheme was also instituted during 1999-2000. To fulfil the requirements for more manpower, these schemes were modified during the year 2008-09 with the following provisions:

- Training of professionals working in the Ministry and its attached offices and autonomous bodies at specialized institutions;
- Training of professionals working in State Nodal Agency/Government/ Utilities on different aspects of technology, its development, and project management;
- Training of manpower on social/economic, trade, legal trade, IPR, administration, managerial and environmental aspects;
- Training of manpower working on various aspects of renewable energy with R&D institutions, NGOs, community based organizations, banking and financial institutions etc.
    a) Organization of training-cum-study tours;
    b) Development of training modules including pedagogy through expert(s)/expert institutions(s);
    c) Addressing long-term HRD needs: In order to gravitate students and professionals in the field of renewable energy, and also to prepare manpower through universities/technical institutions, the following actions are taken as part of the scheme:
        i) Enlarge coverage of renewable energy fellowship scheme by covering more universities/institutions and also R&D institutions, to conduct research on all aspects of renewable energy. This way the R&D programmes will not be limited to a few technology institutions; rather it will have larger spread across the country;
        ii) In order to address the curriculum needs of technical institutions to cover renewable energy, there is an urgent need to develop model curricula for inclusion in the Industrial Training Institutes (ITIs), diploma and degree courses. The curricula and the course material so developed would be circulated to all such institutions through State Technical Education Boards and All India Council for Technical Education (AICTE).

The modified scheme has been fulfilling the short term requirement of manpower. However, to ensure that long term requirement for manpower is met, there is need to develop an institutional framework in existing institutions for quality education and training in renewable energy sector. In this direction, new provisions have been added to the HRD Scheme. These are as follows:

- There will be augmentation of the existing national renewable energy fellowship scheme by providing fellowship to 400 students/researchers from existing 50 students/researchers.

[111] http://www.mnre.gov.in/schemes/human-resource-development/

JRF/SRF/RA will be open for all universities, technical institutions, and national laboratories. The M.Tech. and integrated M.Sc. will be implemented in empanelled educational institutions having M.Tech./integrated M.Sc. courses in energy studies/renewable energy with specialization in any branch of renewable energy. A maximum of 20 such institutions with 15 seats per institution will be selected based on open advertisement. For rest of the fellowships, the selection will be made through open advertisement and evaluation of the received applications by a committee of experts.

Table 7.4 Distribution of fellowships over the years

Course	Duration	Intake every year	Fellowship 1st year	Fellowship 2nd year	Fellowship 3rd year (stabilized number for subsequent years)
M.Tech	2 years	200	200	400	400
M.Sc.	2 years	100	100	200	200
JRF	2 years	40	40	80	180*
SRF	3 years	40	40	80	120
RA	3 years	20	20	40	60
TOTAL		**400**	**400**	**800**	**960**

*This includes 100 integrated M.Sc students joining JRF

- Provision of financial assistance will be made to educational and research institutions to setup infrastructural facilities such as laboratory, library and other teaching aids. Educational institutions will be provided one–time financial assistance of Rs. 50 00 000 (US$ 85 499.33)[112] each to upgrade existing laboratory facilities and library facilities for undertaking renewable energy educational programmes. A maximum of five institutions will be provided such grant every year. The selection of such institutions will be done either through open advertisements or selection of five accredited institutions for M.Tech/integrated M.Sc. fellowships. In addition, advanced training institutes of Ministry of Labour will also be provided grant for upgrading trainers' training facility for renewable energy.
- A renewable energy chair will be created in every institution, which will act as a focal point for renewable energy education in the institution. At least one educational institution every year will be provided with one time grant for the purpose. Such chairs will be instituted in 15 educational institutions. Such educational institutions which have been active in the field of renewable energy education can be considered for creation of an RE chair. While 12 chairs will be dedicated to science and technology aspects of Renewable Energy, 3 chairs will be dedicated to legal, environmental, management and economic aspects of renewable energy in institutions such as National Law Institutes, Indian Institute of Managements (IIMs), Institute of Economic Growth, Delhi University, etc. To facilitate sustainability of this concept, a onetime grant of Rs.15 million (US$256 497.95)[113] is being provided to the selected institutions which may be kept in fixed deposits and the salary and research grant may be provided through interest of this fixed deposit. The respective institutions may also augment funds from their routine grants.
- Integrated M.Sc. & Ph.D programme will be initiated in various fields of renewable energy by instituting scholarship schemes. Ministry may institute scholarship of Rs. 4,000 (US$68.40)[114] per month to selected students at post-graduate level during their PG studies followed by awarding

[112] Average annual exchange rate of Rs. 58.48/US$ for 2013 is considered for conversion
[113] Average annual exchange rate of Rs. 58.48/US$ for 2013 is considered for conversion
[114] Average annual exchange rate of Rs. 58.48/US$ for 2013 is considered for conversion

NREF for a period of a maximum of five years. 100 such fellowships every year may be granted in ten accredited institutions.

- The Ministry will be empanelling the educational institutions and other entities to undertake short-term training courses on a regular basis. While some of these short term training courses will be supported by the Ministry as per the provisions of the scheme, institutions will be encouraged to undertake self financing courses on various aspects of renewable energy.
- In addition, the Ministry has taken initiatives to incorporate solar lighting, solar thermal and small hydro power in the regular syllabi of ITI courses of certain streams. The course materials have been prepared and passed on to Directorate General of Employment and Training (DGET) and it has been incorporated in the syllabi of certain streams of ITI courses so that about 16-60 hours will be devoted on renewable energy skill development during the regular two-year ITI course. DGET is also planning to start a special programme of skill development under their Craftsman Training Programme (CTP) and Modular Employment Skill Development Programme (MES), wherein they provide special training for 60-960 hours.
- In addition to these initiatives, the Ministry has launched a special fellowship scheme titled 'National Solar Science Fellows Programme', under which 10 eminent scientists will be awarded fellowship of Rs. 1.2 million (US$20 519.84) [115] per annum, contingent grant of US$8,549.93[116] (Rs. 0.5 million) per annum and research grant of US$25 649.79 (Rs.1.5 million)[117] per annum.

Possibility of South-South Cooperation: India has been developing courses at various levels of education for human resource development. The Ministry of New and Renewable Energy, Government of India, has taken the initiative to encourage education and training through various educational institutions in the country. The government of Indonesia may enter into a collaboration with the government of India for developing programmes and course curriculum for renewable energy education. Moreover, institution level cooperation may also be built up with premier academic institutions such as Indian Institute of Technologies (IITs) and Indian Institute of Managements (IIMs). The cooperation may be extended up to student and faculty exchange programmes. Thus, there is good scope for South-South Cooperation in the field of human resource development.

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[115] Average annual exchange rate of Rs. 58.48/US$ for 2013 is considered for conversion
[116] Average annual exchange rate of Rs. 58.48/US$ for 2013 is considered for conversion
[117] Average annual exchange rate of Rs. 58.48/US$ for 2013 is considered for conversion

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