CASINDO

Programme Summary Report

ORGANISATION OF THE SUMMARY REPORT AND ACKNOWLEDGEMENTS

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CASINDO was conducted and financed in the framework of the Indonesia – the Netherlands Energy Working Group (EWG). The EWG was established in 1995 to strengthen the co-operation between Indonesian and Dutch public institutions, private companies and research organisations in energy-related activities that are of mutual interest. The EWG is co-chaired by the Indonesian Ministry of Energy and Mineral Resources and NL Agency, on behalf of the Royal Netherlands embassy in Jakarta.

CASINDO would not have been possible without the energetic and stimulating support, the steering and the facilitation of NL Agency. In particular, the decision to merge three independent projects, carried out since 2006 within the framework of the EWG, into one single programme turned out to be an important success factor. These three projects were: the regional energy planning project, the Indonesia-Netherlands university cooperation project, and the vocational school project.

Tremendous gratitude is owed to the staff of the Ministry of Energy and Mineral Resources who have actively participated in and contributed to all working groups throughout the entire programme, and who had a leading role in establishing the regional energy fora in the five target provinces and in training their members.

Disclaimer

FOREWORD

At the basis of all development and growth trajectory lies the availability and the quality of sufficient human resources. Without adequately trained professionals, any development path will end prematurely. Without sufficiently strong human capacity, economic growth might be sheer coincidence. Without trained personnel, factories cannot be built or operate, finance will only be directed towards short-term wins instead of long-term investments, and policies will at best be fragmented and short-term. This also holds for the energy sector, where a variety of skilled professionals is needed in areas such as resource exploration, sound project development, financing, research, engineering, legislation, maintenance and, last but not least, the preparation of long-term visions, policy and planning. This is especially true when new sectors have to be developed, which is essentially the case for renewable energy and energy efficiency in many countries. This also holds for Indonesia, where the development of a renewable energy sector is one of the key challenges of the country's strive towards energy security, climate change mitigation and energy access for all.

To optimize renewable energy deployment and energy conservation, the Government of Indonesia has set the target for renewable energy at 25% in the year 2025, and suggests steps to be taken in the management of national energy to change the pattern from Supply Side Management to Demand Side Management. This change aims to streamline the energy needs, maximizing the provision and utilization of renewable energy and clean energy technologies. Moreover, the Republic of Indonesia has the commitment through the G-20 Pittsburgh forum and COP15 to reduce greenhouse gas emissions by 26% in 2020, 6% coming from the energy sector compared to 2009 data, which show an actual growth of energy consumption of on average 7% annually. Dependence on fossil energy in Indonesia is still high with oil supply taking up 43%, and coal supply catering for 34.5% of the total supply. Natural gas takes up 18.5%, while renewable energy sources provide for 4.1%. Furthermore, some 35% of Indonesia's population is still deprived of access to clean, modern energy services.

Reaching Indonesia's targets for renewables and for energy efficiency is an impressive task that requires a tremendous growth of hundreds of thousands, maybe even millions of skilled professionals in the coming years, at all levels varying from technical maintenance staff of solar home systems or micro-hydro power plants to policy makers at the national and the sub-national level.

A key success factor in implementing the energy policies and realizing Indonesia's targets is the institutional capacity of the energy management framework on a national scale. It is stated in Indonesian Government Decree Number 30, Year 2007, on Energy that one of the goals of national energy management is to realise professionalism in human resources. The availability of professionals in human resources development is key in achieving the targets of national energy management. Those targets are unattainable if there is a lack of competent professionals who can train energy officials and other individuals in the development of new renewable energies and in implementing energy conservation.

The CASINDO programme, under the auspices of the Indonesia-Netherlands bilateral energy cooperation, has taken up the challenge of building a core of sustainable and institutionalized capacity development on both the national level as well in the provinces of North Sumatra, Central Java, Yogyakarta, West Nusa Tenggara and Papua. The structures that were developed within this integrated and complex multi-partner project are capable of developing sound and evidence-based energy policy and planning at the regional level, contributing to strong energy policy at the national level, and moreover delivering thousands of educated and trained individuals at vocational, university and professional level every year to shape, develop and support the growth of the Indonesian renewable energy and energy efficiency sectors. Special attention has also been directed towards sustainable energy solutions for the poor, whose participation in a modern energy society is still far from business as usual. Having started in five provinces, we hope that the CASINDO results and its structure, working methods and experiences provide an inspiration as well as a blueprint, not only for the other provinces in Indonesia, but also for the many other countries that face the similar challenge of developing their renewable energy sectors.

We recommend to not only read this final CASINDO report, but also to have a good look at the many valuable individual deliverables that are published on the CASINDO website at www.casindo.info.

Mr Marcel Raats
NL Agency

Mr. Munir Ahmad
PUSDIKLAT KEBT KESDM

CONTENT

LIST OF TABLES AND FIGURES

List of tables

List of figures

ABBREVIATIONS AND ACRONYMS

BOE	Barrel of oil equivalent
BPS	BPS - Statistics Indonesia
Dinas Energi	Regional Energy Office
DME	Energy self-sufficient village
EE	Energy Efficiency
ETA	Education and Training Agency of MEMR
EWG	Indonesia – the Netherlands Energy Working Group
GDP	Gross Domestic Product
GRDP	Gross Regional Domestic Product
KEN	National energy policy
KL	Kilo litre
LEAP	Long-range Energy Alternatives Planning System
MBOE	Million barrels of oil equivalent
MEMR	Ministry of Energy and Mineral Resources
MoEC	Ministry of Education and Culture
OPEC	Organization of the Petroleum Exporting Countries
Pertamina	National oil & gas company
PLN	National electricity company
PLTD	diesel fuelled generators
QA/QC	quality assurance and control
RE	Renewable energy
RET	Renewable energy technologies
Rp	Rupiah
RIPEBAT	Master plan on new and renewable energy
RUED	Regional energy plan
RUEN	National energy plan
SHS	Solar Home System
SME	Small and Medium-sized Enterprises
SMK	Vocational school
TEDC	Technical Education Development Centre
TWG	Technical Working Group
TWh	Terawatt hour
UMY	Muhammadiyah University of Yogyakarta
UNCEN	University of Cenderawasih
UNDIP	Diponegoro University
UNRAM	University of Mataram
USU	University of Sumatera Utara
Wp	Watt peak

1. INTRODUCTION

1. INTRODUCTION

1.1 Background

Indonesia is a vast and populous country with a wealth of natural resources. It is commonly lacking the attention that is given to other developing economies such as China, India and Brazil. The East Asian financial crisis, occurring at the end of 1997, severely affected Indonesia and resulted in steeply rising prices for food. This triggered a mass popular uprising in Jakarta and other regions that eventually led to the resignation of President Suharto, mid-1998. Since then, Indonesia has embarked on a process of social, political and economic reforms that is still ongoing and is meant to bring about economic growth and a transition to democracy.

Since early 2000, the Indonesian economy started to recover slowly from the recession and the Gross Domestic Product (GDP) has been steadily increasing to approximately 6.5% by the end of 2011.

In May 2011, the Indonesian government launched a blueprint for economic growth. This blueprint complements the National Long-Term Development Plan for 2005-2025, and describes the strategies to accelerate economic growth in the coming 13 years. The target is an average annual economic growth rate of 7-8% up to 2025, which would make Indonesia the twelfth largest economy in the world (now the seventeenth).

Figure 1.1 Annual growth rate of GDP in Indonesia, adjusted for inflation, 2000-2011

Source : www.tradingeconomics.com

One of the main strategies involves developing six economic corridors that build and connect economic growth centres on five islands: Java, Sumatra, Kalimantan, Sulawesi and Papua.

A key component of the political reforms is decentralisation and regional autonomy, implemented in 2001 based on the new Law no. 22/1999, which was amended in 2004 with Law no. 32. Almost all powers and responsibilities have devolved from the central to the local government (except for key sectors such as defence, foreign policies, justice and monetary policy), including responsibilities for developing the energy sector. Hence, regional governments are now responsible for formulating energy policies for their own region and, consequently, must reform their institutional structure and strengthen their human capacity.

The energy-related responsibilities for the regional government are also clearly expressed in the Energy Law (Law no. 30/2007) that came into effect in August 2007. This law stipulates that the regional government must formulate a regional energy plan (RUED), based on the national energy plan (RUEN), and must develop regional regulation for the implementation of the plan. The decentralisation process, however, appears to be difficult and time-consuming. Regional institutions may be weak or poorly organised, because they have been left out of the political decision-making process for the last three decades. Many regions also lack human, technical and analytical capacity to conduct energy policy analysis and develop sustainable energy projects. This seriously hampers the development of the regional energy sector, and is further compounded by the current energy crisis in Indonesia, caused by insufficient investments over the past ten years. Regions experience power interruptions and load shedding, and have increasing difficulties to meet the rapidly growing energy demand. Furthermore, Indonesia – a former member of OPEC, but now a net oil importer – is confronted with the high global price of crude oil, while maintaining regulated energy prices.

To assist the regions in designing and adopting energy policies, the CASINDO programme (CApacity development and strengthening for energy policy formulation and implementation of Sustainable energy projects in INDOnesia) has been introduced in five provinces: North Sumatra, Yogyakarta, Central Java, West Nusa Tenggara and Papua. This report presents a summary of the methodology, and of the results achieved from June 2009 to May 2012.

1.2 Objectives

The CASINDO programme aimed to strengthen the knowledge and capacity of both national and regional staff to formulate and implement a sustainable energy policy. Apart from strengthening the human capacity, structures were put in place to ensure the sustainability the efforts after termination of the programme, in order to address the rapidly growing demand for this type of expertise in the coming decades. The overall objective of the CASINDO programme was to:

> *establish a self-sustaining and self-developing structure at both the national and regional level to build and strengthen human capacity to enable the provinces of North Sumatra, Yogyakarta, Central Java, West Nusa Tenggara and Papua to formulate sound energy policies and to develop and implement concrete sustainable energy projects.*

The specific aims of CASINDO were to:

1. Establish and train a technical team in each target province that can assist the regional government in designing and introducing a regional energy plan (RUED), and can help the local private sector and other stakeholders in bringing about a more efficient, cost-effective and sustainable use of energy.

2. Develop and establish the institutional structures by which human capacity for energy policy formulation and implementation can continue to be built in the regions also in the long-term, beyond the duration of the CASINDO programme.

Sufficient technical and analytical expertise is a precondition for the target provinces to be able to relate energy provision to local economic development planning, to design and introduce energy policies and to establish energy businesses. This human capacity has been built during the course of CASINDO, but the rapidly growing energy demand makes a larger reservoir of expertise indispensable. Therefore, new institutional structures are needed to ensure a sufficient level of knowledge among local policy makers, entrepreneurs, universities and technical schools.

1.3 Target provinces

CASINDO focused on five provinces: North Sumatra, Yogyakarta, Central Java, West Nusa Tenggara and Papua (Figure 1.2). They were selected by the Ministry of Energy and Mineral Resources, based on the identified need for assistance. A brief profile of each province is presented here.

North Sumatra is a mainly rural province. The roughly 13 million inhabitants live in 21 regencies and 7 urban areas. The capital Medan is the fourth largest city in Indonesia, with a population of about 2 million. The average Gross Regional Domestic Product (GRDP) per capita amounted to Rp8 million in 2008. Some 12% of the people live under the poverty line and about 31% lack access to electricity. The total primary energy supply amounts to 33 million barrel of oil equivalent (BOE), most of which is imported and dominated by oil products and natural gas. The CASINDO team was established at the University of Sumatera Utara.

Central Java consists of 35 regencies and cities with approximately 32.6 million inhabitants, of whom some 14% have an income below the poverty line. The average GRPD per capita in 2008 amounted to Rp4.8 million. The total energy supply in 2008 amounted to 58 million BOE, dominated by oil products and coal. Although the region is a net supplier of electricity into the Java-Madura-Bali (JAMALI) Grid, and despite the presence of large local (renewable) energy resources, the electrification ratio is only 73%. The CASINDO team was established at the Diponegoro University in Semarang.

Yogyakarta (formally 'Special Region of Yogyakarta') is surrounded by the province of Central Java. The estimated population in 2008 was 3.5 million people. Yogyakarta is divided into four administrative regencies (*kabupaten*) and one municipality (*kota*). Its GRDP per capita is about Rp5.5 million. The primary energy supply of 5 million BOE is completely imported; consumption is dominated by oil fuel. The share of villages connected to the utility grid is very high (100%), while the household electrification ratio is only around 80.5%. The CASINDO team was established at the Muhammadiyah University of Yogyakarta.

West Nusa Tenggara comprises the islands of Lombok and Sumbawa ,and is divided into 9 regencies and cities. It is a rural region with approximately 4.4 million inhabitants, of whom some 14% have an income below the poverty line. The average GRPD per capita amounted to Rp 3.8 million.

Figure 1.2 Geographic overview of the five target provinces

The total primary energy supply in 2008 amounted to some 6.6 million BOE, of which approximately 94% was imported. Coal constituted the largest share of the imported fuels (34%), but was consumed by a single very large mining company, followed by diesel oil (32%) and gasoline (20%). The regional electrification ratio is still below 50%, despite the fact that there are large local (renewable) energy resources. The CASINDO team was established at the University of Mataram.

Papua is located in the far east of Indonesia. Although the province is 2.4 times as big as Java, it has only about 2.5 million inhabitants, which makes it the sparsest populated province of the country. Papua comprises 29 regencies and municipalities, 9 of which were established in 2008. Over a third of the population is categorised as poor (2008 statistics data). Due to its mining activities, Papua has a rather high per capita income of Rp7.7 million; excluding mining it amounts to Rp4.2 million. The electrification ratio in Papua is very low: 20.8% of the population. Papua imports some 96% of its primary energy mix of 4.4 million BOE, dominated for 95% by oil products. The CASINDO team was set up at the Cenderawasih University in Jayapura.

1.4 The CASINDO consortium

The CASINDO consortium comprised the following organisations:

Programme coordinators:

Ministry of Energy and Mineral Resources (MEMR):

- Directorate General of New Renewable Energy and Energy Conservation (DGNREEC) – responsible for policy strategy;
- Data and Information Centre for Energy and Mineral Resources (DICEMR) –develops the national energy plan(RUEN) and initiates and coordinates the institutional set-up for the regional energy forums and technical teams;
- Education and Training Agency (ETA) – lead actor in energy training and coordinator of the capacity development of MEMR. The ETA provides training for national and regional governments and for the energy industry and universities. Its Education and Training Centre for Electricity, New and Renewable Energy and Energy Conservation (ETCENREEC) was the focal point at the national level for CASINDO.

ECN

Energy research Centre of the Netherlands (ECN), Policy Studies Unit:

- Management of the programme;
- Coordination of activities;
- Communication with the client NL Agency and other bilateral or international organisations.

Programme partners:

Center for Regional Energy Management (PUSPER) of the Muhammadiyah University of Yogyakarta(UMY):

- Implementation of the programme in the Yogyakarta region

Diponegoro University, Electrical Department(UNDIP):

- Implementation of the programme in Central Java.

University of Sumatera Utara, Engineering Faculty(USU):

- Implementation of the programme in North Sumatra.

University of Mataram (UNRAM):

- Implementation of the programme in West Nusa Tenggara.

University of Cenderawasih, Jayapura(UNCEN):

- Implementation of the programme in Papua.

The Institute of Technology Bandung (ITB):

- Technical assistance for the regional technical teams in energy planning, renewable energy, and energy and poverty;
- Coordinating body for the regional teams;
- Backstopping knowledge institute at the national level.

Technical Education Development Centre (TEDC), Bandung:

- Implementation of the programme at vocational schools in the five target provinces.

Eindhoven University of Technology (TU/e):

- Coordination and implementation of the education and research activities of the universities in the five target provinces.

ETC-Nederland

- Coordination and implementation of the education activities of the vocational schools in the five target provinces.

1.5 Joint Energy Working Group

The Indonesia – the Netherlands Energy Working Group (EWG) was established in 1995 to strengthen the cooperation in the field of energy. The EWG is co-chaired by the Indonesian Ministry of Energy and Mineral Resources and NL Agency, on behalf of the Royal Netherlands embassy. In the framework of the EWG, Indonesian and Dutch organisations jointly carry out energy-related activities.

Initially, the EWG focused mainly on the national level, but from mid-2000 onwards the scope widened to also include the regional level, as the decentralisation process asked for developing human capacity in the regions. Energy policy makers, universities and vocational schools in selected regions and Indonesian and Dutch research organisations started a cooperation to enhance energy policy formulation and the development of sustainable energy projects.

In 2009, as part of as the renewable energy support programme of the Netherlands Embassy in Jakarta, this cooperation was further intensified and extended to the province of Papua, and it also pursued better integration of national and regional energy policies. It was decided to integrate the three capacity development projects that were carried out since 2006 in the framework of the EWG in one single programme: CASINDO. These projects were (1) the regional energy planning project coordinated by ECN and implemented together with ITB in the provinces of North Sumatra, Yogyakarta, Central Java and West Nusa Tenggara; (2) the Indonesia-Netherlands university cooperation project comprising TU/e, USU, UMY and UNRAM; and (3) the vocational school project coordinated by ETC-Nederland and implemented together with TEDC.

1.6 Main achievements

CASINDO was a large programme, running from June 2009 to May 2012. The results can be summarised in four main categories:

1. The institutional structure has been established to facilitate regional energy policy formulation and implementation and the cooperation between national and regional policy makers, energy experts, the private sector and civil society. About 100 energy officials have been trained in the five target regions to strengthen these structures.

2. Each regional team in the five target provinces has developed a regional energy plan (RUED). This plan outlines energy demand and supply up to the year 2025 and presents scenarios for increased use of renewable energy and energy efficiency and for addressing the energy needs of poor villages that lack access to the electricity network. It is the basis for identifying

and developing concrete projects to ensure that sufficient energy can be supplied for meeting the rapidly growing demand. Some 80 regional team members have been trained.

3. A new education programme on sustainable energy was introduced at the five partner universities. This involved new curricula, new training material, and training of lecturers at Eindhoven University of Technology. The partner universities received research equipment for selected students at the University of Sumatera Utara in Medan and the Diponegoro University in Semarang. A new certificate programme on sustainable energy has been launched at the other three universities. The yearly capacity of these academic programmes is about 500 students.

4. Eleven technical schools in the five target provinces have introduced training modules on renewable energy technologies and energy efficiency. This involved new curricula and training of teachers. The role of the Technical Education Development Centre (TEDC) in Bandung was pivotal. TEDC also submitted a proposal to the Ministry of National Education to include the new training module in the national curriculum (Spectrum). This would greatly facilitate a country-wide rollout. Over 90 vocational school teachers have been trained, and approximately 220 students will attend the new training module every year.

1.7 Report outline

This introduction is followed by four chapters. Chapter 2 presents the institutional and organisational structures, established to ensure the implementation of the programme and a sustainable impact of the results. Chapter 3 presents the methodology and the outputs across the five provinces. Chapter 4 elaborates on the sustainability of the programme, and the final chapter of this report draws the main conclusions and offers recommendations (Chapter 5).

2. ORGANISATIONAL STRUCTURE

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To ensure that the programme would be effective and sustainable, the following institutional entity and organisational structure have been introduced:

- The regional energy forum and the regional technical team;
- Seven technical working groups.

This chapter describes the details.

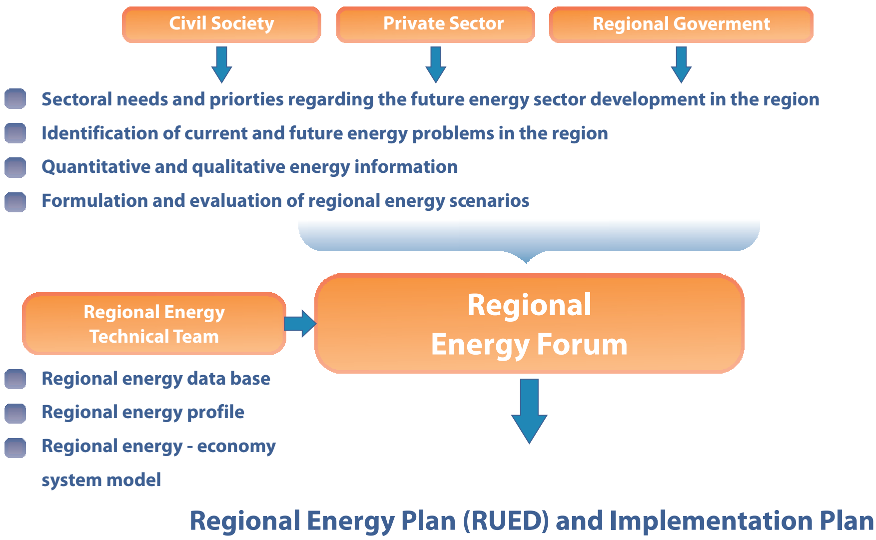
2.1 Regional energy forum and regional technical team

Regions are now to a large extent responsible for their own development, including that of their energy sector. This is emphasised by the new Energy Law no. 30/2007, prescribing regions to produce their own energy plan in line with the national energy plan. To assist the regions in this responsibility, CASINDO developed a new structure, comprising the regional energy forum and the regional technical team (Figure 2.1).

In each target province a regional energy forum was established through a decree signed by the governor or the head of Dinas Energi (regional energy office). The forum is chaired by the head of Dinas Energi and comprises high-level members of the regional government and stakeholders of the local energy sector (electricity utility PLN, oil & gas company Pertamina, the renewable energy sector, the private sector and civil society). The forum formulates energy policies and develops corresponding action plans. Policies are submitted to the regional government for final approval.

Forum members are supported by a regional technical team, also established in each province. This team has some ten to fifteen staff and is headed by the local university (although team members may come from elsewhere). The regional technical team has a function to analyze and prepare materials that will be discussed in the regional energy forum. To this end, the team uses an energy-economy database and a model for energy demand-supply scenarios. The team can provide quantitative and qualitative information, based on which the forum can formulate sound energy policies. Throughout the programme, these regional technical teams were trained and supported by the CASINDO consortium.

Figure 2.1 New institutional structure to prepare a regional energy plan (RUED) and implementation plan



2.2 Working structure

As the extensive programme involved some 140 team members, a clear working structure was needed, both for the technical aspects and for the embedding in the national and regional energy policy formulation. This working structure was found in creating seven technical working groups (TWG):

TWG I Energy policy analysis

TWG II Renewable energy action plan

TWG III Energy efficiency master plan

TWG IV Renewable energy project development

TWG V Pro-poor energy strategy

TWG VI University education and research programme

TWG VII Renewable energy and energy efficiency training modules for vocational schools (Sekolah Menengah Kejuruan -SMK)

A TWG aimed to achieve a particular programme objective through conducting a set of activities. A TWG consisted of delegates of the regional technical teams, the Ministry of Energy and Mineral Resources, the Institute of Technology

Bandung, the Technical Education and Development Centre in Bandung and the European partners. The TWGs met several times a year to discuss the approach and work plan, to assist team members in solving any problems, to ensure that the deliverables were produced on time, and to exchange experience and knowledge.

The TWGs regularly interacted with the Ministry of Energy and Mineral Resources and the Ministry of Education and Culture and the regional energy office, the regional energy forum and the regional education office to solicit feedback and to ensure that the activities became an integrated part of the national and regional energy policy formulation. Figure 2.2 presents an overview of the TWG structure.

The main objectives of each TWG were as follows:

TWG I:

- Develop regional energy balances for 2006, 2007, 2008;
- Develop an integrated regional energy modeling tool;
- Prepare a regional energy plan, including scenarios for renewable energy and energy efficiency;
- Create synergy between national and regional energy plans.

Figure 2.2 Organisational structure for Technical Working Groups

TWG II:

- Identify potential renewable energy sources in the region;
- Determine targets for renewable energy for the region in line with national targets;
- Develop policies and action plan to achieve the targets.

TWG III:

- Identify potential and costs for energy efficiency in the region;
- Determine targets for energy efficiency for the region in line with national targets;
- Develop policies and energy efficiency master plan to achieve the targets.

TWG IV:

- Identify suitable non-hydro renewable energy projects for the province;
- Conduct a needs assessment and develop a business plan;
- Identify potential investors;
- Construct the project.

TWG V:

- Review current pro-poor policies in Indonesia;
- Select suitable target community;
- Conduct needs assessment;
- Identify options that address identified needs;
- Formulate a pro-poor strategy.

TWG VI:

- Develop curricula for a new education programme on sustainable energy;
- Develop training material;
- Train lecturers of the five partner universities;

- Incorporate new education programme in the university and open the new programme to students;
- Develop and implement a number of research projects with the private sector.

TWG VII:

- Identify suitable vocational schools in target province;
- Develop curricula and training modules on renewable energy and energy efficiency;
- Train the vocational school teachers;
- Implement and evaluate the training modules.

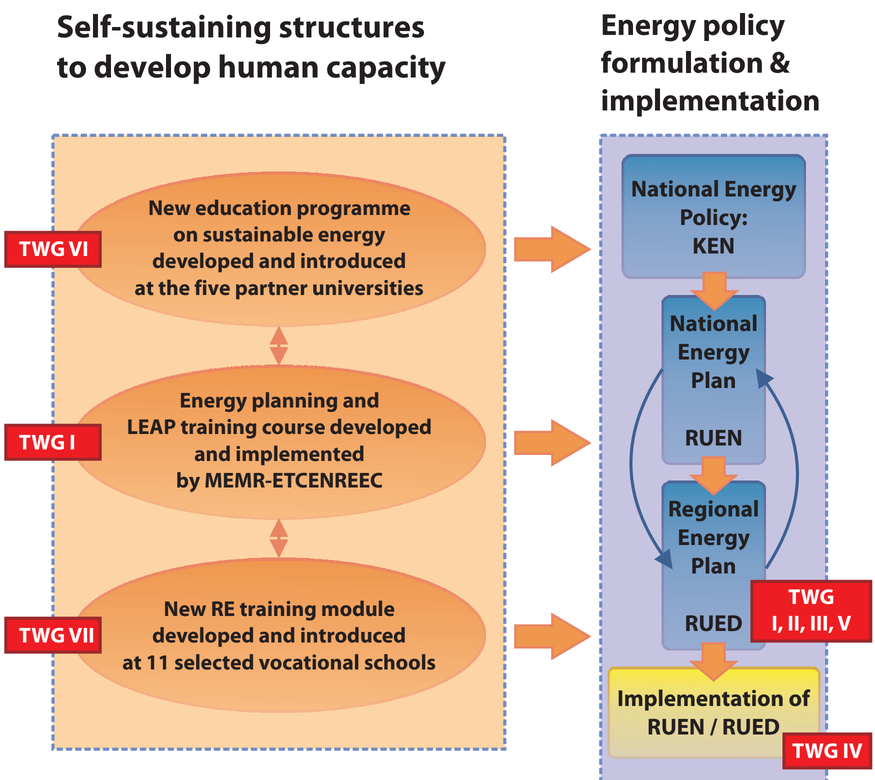
3. METHODOLOGY AND RESULTS

3. METHODOLOGY AND RESULTS

This chapter presents the methodology and the main results of the technical working groups (TWGs). Figure 3.1 illustrates the structures for human capacity development and the links with the relevant TWGs.

The left-hand side of Figure 3.1 shows the three components of developing human capacity needed to enable the five target provinces to formulate sound energy policies: a new education programme on sustainable

Figure 3.1 Structures for development of human capacity for energy policy formulation and implementation.



energy at partner universities (TWG VI); an energy planning and modelling training course for national and regional energy officials, integrated in the regular training programme of the Ministry of Energy and Mineral Resources (TWG I); and a renewable energy and energy efficiency training module for 11 vocational schools and rollout to another 23 schools (TWG VII).

The national/regional energy planning framework (the right-hand side of Figure 3.1) starts with the national energy policy (KEN), developed by the National Energy Council. Once the KEN has been approved by the House of Representatives, the Ministry of Energy and Mineral Resources will prepare the national energy plan (RUEN), which serves as a guideline for the regions to develop their regional energy plan (RUED). CASINDO was not directly involved in the preparation of the KEN and the RUEN, but its main focus was to assist the target provinces in developing their RUED.

The RUED comprises future energy demand-supply developments (TWG I), renewable energy (TWG II), energy efficiency (TWG III) and pro-poor energy strategies (TWG V). CASINDO also aimed to strengthen the interactions between national and regional energy planning and to facilitate renewable energy projects in the regions (TWG IV).

The next sections present the methodology and results of the seven TWGs.

3.1 TWG I: Energy policy analysis

3.1.1 Background

Most regions lack capacity to develop their own energy plans. Some do have primary forecasts regarding electricity planning, but they have not yet entered the implementation phase. Before any energy policy is to be developed, a reasonable level of knowledge is needed with regard to the current energy consumption and production, and the main drivers that determine them. A detailed and integral energy profile, including economic and social key factors, is a good starting point. Based on this profile and by making use of outlooks, plans and expectations of different stakeholders, energy scenarios can be developed.

3.1.2 Objectives

This TWG had three different but interlinked objectives. The first objective was to develop regional energy profiles and a modelling tool to support the planning, culminating in an integral assessment of the present and future regional energy situation, a Regional Energy Outlook (which may be considered as RUED, pending the official approval). Secondly, a regional technical team needed to be set up at a university to undertake this work. And third, collaboration of this team with the regional government and stakeholders needed to be arranged.

3.1.3 Methodology

For the regional energy profile, teams needed to collect and analyse basic data, delivered by companies, government institutions and others, to check them for completeness, accuracy and consistency. The teams were taught to act as auditor of the quantity and quality of the collected data. In case of data gaps, the team took the lead in presenting sound methodological methods to complete them. By performing this on an annual basis, a scheme of repeating and improving data collection develops over time. The Indonesian regional teams were supported by hands-on training in analysis, assessment and interpretation of the collected data as well as in filling data gaps.

For the Regional Energy Outlook, the modelling tool LEAP (Long-range Energy Alternatives Planning System) was chosen. This is a widely used software tool for energy policy analysis and climate change mitigation assessment. The advantages of this tool were multiple: most teams had some experience with it; it is a self-containing tool for both inputs and outputs; it has a user-friendly interface; modelling of energy systems is flexible and user-defined; both demand and supply are covered; data requirements are not excessive; and an Indonesian version of the training material is available.

A harmonised structure of the modelled energy system was used for all provinces, although not all elements exist in all provinces. If elements were missing, they were left open (Figure 3.2).

On the demand side:

- Households, divided into rural and urban, each subdivided into four income classes;
- Commercial, with six subsectors;
- Industry, with up to nine subsectors;
- Transportation, with passenger transportation by road (cars, motorcycles, buses), others (ferry, planes), and freight (truck, train, ship);
- Other sectors (agriculture, cons-truction and mining).

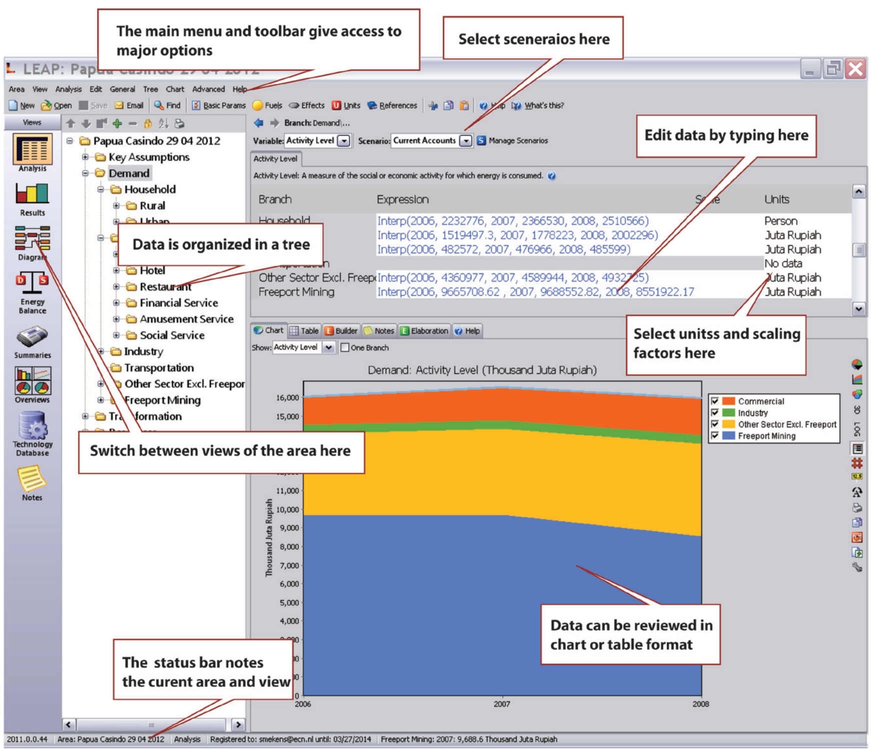
On the supply side:

- Electricity grid connected and off-grid: power plants and transmission system;

- Oil, gas and coal extracting and refining;
- Biofuel production;
- Primary and secondary energy resources.

The corresponding information from the energy profiles (years 2006-2008) was also entered in the tool, as such acting both as calibration of the energy balances and as scenario base year information. Based on the latest data, scenario assumptions were developed for a moderate and an optimistic growth scenario. For both scenarios, an energy efficiency and a renewable energy variant were set up, based on information from TWG III and II respectively. As the tool covers the period 2006-2025, the timing of required investments in new production capacity to meet the projected demand is one of the main outcomes that stakeholders can take into account when developing an implementation plan for their regional energy future.

Figure 3.2 Example of a LEAP to identify demand and supply for a regional energy system



3.1.4 Cross-regional analysis

Energy profiles: socio-economic and key indicators

One of the first activities of the regional teams was to determine the region's energy situation in 2006, 2007 and 2008. This obviously does not stand by itself; it is a consequence of the regions' economic and social structures and activities. The combined socio-economic and energy information was compiled in the annual regional energy profiles of each region.

These profiles show the large differences within Indonesia's provinces. Tables 3.1 and 3.2 contain the major socio-economic parameters with which to start any profile, namely population and Gross Regional Domestic Product (GRDP) in million Rp, for 2006 and 2008. The five target regions cover about 23% of Indonesia's 235 million inhabitants. They take up about 15% of the national GDP, both in 2006 and 2008. Regional numbers do change over time, and population and GRDP are the most noteworthy ones. While the average population increased with 2% between 2006 and 2008, Papua experienced a growth of 12%. GRDP increased with 13% on average; Papua again peaked with a 24% growth. It should be noted that for both West Nusa Tenggara and Papua the GRDP figures exclude the contribution of the large mining companies Newmont and Freeport. The reason for excluding them is that these firms have such a large impact on the regional GRDP (25% for West Nusa Tenggara, 55-60% for Papua) that a small fluctuation in their trade causes considerable variations in the regional numbers (also Figure 3.4).

Table 3.1 Macro-economic indicators of target regions, 2006

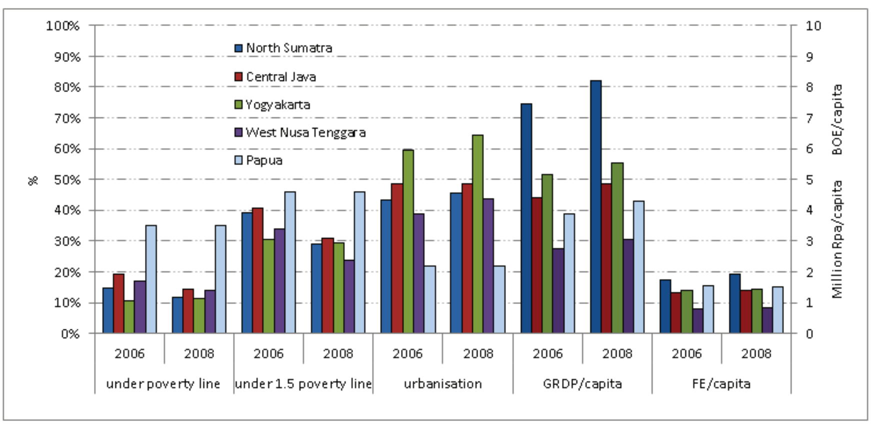
2006	population (persons)	GRDP (million Rp)	GRDP (million Euro)	area (km^2)	population density (person/km^2)	household size (persons)
North Sumatra	12,643,494	94,441,519	7,870	57,208	221	4.5
Central Java	32,177,730	141,896,376	11,825	32 544	989	3.8
Yogyakarta	3,392,001	17,535,354	1,461	3,186	1,065	3.7
West Nusa Tenggara	4,257,306	11,784,559	982	20,153	211	4.0
Papua	2,232,775	8,646,011	721	317,062	7	4.2

Table 3.2 Macro-economic indicators of target regions, 2008

2008	population (persons)	GRDP (million Rp)	GRDP (millionEuro)	area (km^2)	population density (person/km^2)	household size (persons)
North Sumatra	13,042,317	106,829,649	8,902	57,208	228	4.4
Central Java	32,626,390	158,445,260	13,204	32,544	1,003	3.9
Yogyakarta	3,468,502	19,210,123	1,601	3,186	1,089	3.4
West Nusa Tenggara	4,363,756	13,369,636	1,114	20,153	217	4.0
Papua	2,510,566	10,753,178	896	317,062	8	4.2

Tables 3.1 and 3.2 show the heterogeneity of the target regions, with Yogyakarta and Papua showing extremes in terms of population density. Yogyakarta is a special province, resembling a city state, surrounded by the province of Central Java and without any resources or energy production of its own. Yogyakarta is also known as the university city, accommodating more than 50 universities. Papua has a mostly rural population. Central Java has the largest population, followed by North Sumatra, but their population density is quite different. West Nusa Tenggara and Papua are the poorest provinces. As for household size, all provinces are seeing numbers above 3 persons and North Sumatra even 4.5. Little variation occurred in household size between 2006 and 2008. From these basic values, a number of derived key indicators are presented for each of the five regions in Figure 3.3, together with the share of people living below the poverty line and people living under 1.5 times the regional poverty line (about 15 Euro per capita per month).

Figure 3.3 Poverty and energy indicators of target regions, 2006 and 2008



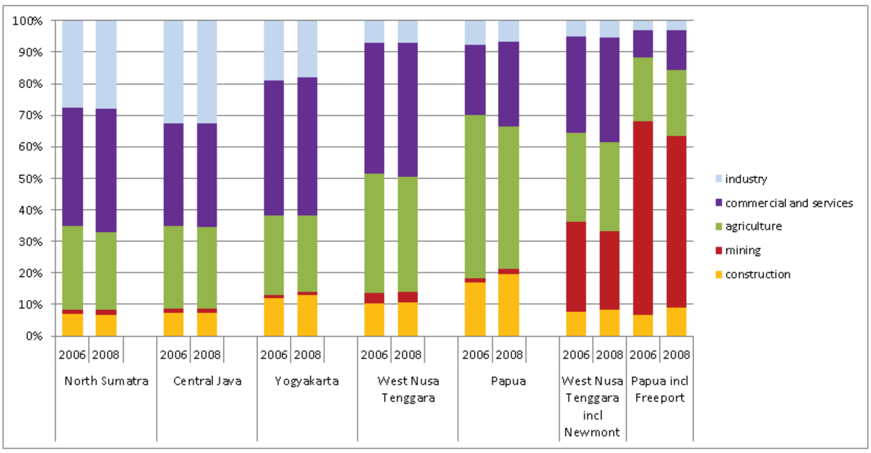
All regions, except Papua, remain just below the Indonesian national average of 15% poor people in 2008. The share of people living below 1.5 times the poverty line has been added to illustrate that a modest increase of the income division line doubles the number of people affected by poverty, having an income of less than USD 1 a day.

Urbanisation has progressed the most in Yogyakarta, with a rate of over 60% (and still increasing). In Papua a mere 20% of the population lives in urbanised areas. West Nusa Tenggara shows a rapid increase in urbanisation to 45% in 2008.

Of all regions, North Sumatera has the highest income per capita at Rp 7-8 million, whereas West Nusa Tenggara has the lowest income at around Rp 3 million. Papua has a higher income, even without taking into account the GRDP contribution from mining companies. Final energy (also excluding energy used by two large mining companies) per capita is low at less than 2 barrels of oil equivalent (BOE) for all regions, and in West Nusa Tenggara even less than 1 BOE.

Figure 3.4 illustrates the composition of GRDP. The effects of including Freeport and Newmont are clearly visible in the shares of Papua and West Nusa Tenggara. Both provinces also have the smallest share by industry and the largest agriculture shares. It is not clear why North Sumatra has such a high income per capita. The composition of the GRDP of Central Java is similar, but the income per capita is considerably lower. In all regions the GRDP compositions have barely changed between 2006 and 2008.

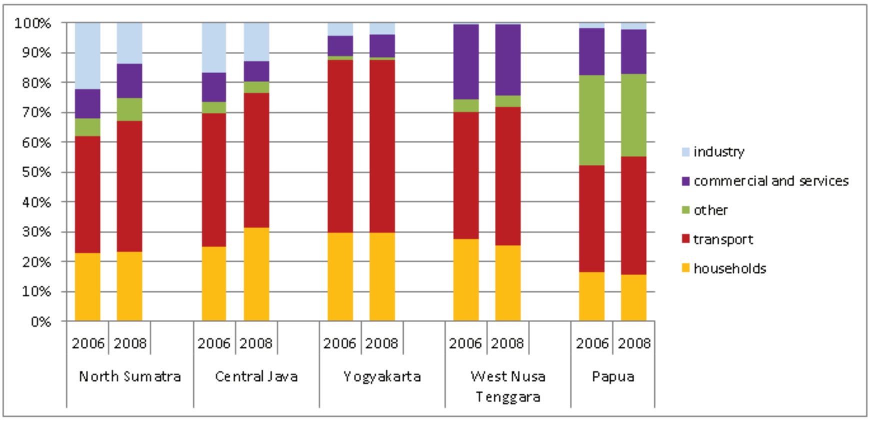
Figure 3.4 Composition of GRDP across sectors in target regions, 2006 and 2008



Energy profiles: final energy and supply

Figure 3.5 shows that in all regions, transportation is the largest energy consuming end user, followed by households, except in Papua, where the sector 'other', which includes agriculture, is the second largest energy user.This high transportation level also results in high oil consumption. In all regions, gasoline, diesel and fuel oil dominate the fuel mix with shares above 50%. Kerosene is still important and occupies the second place; electricity comes third.

Figure 3.5 Final energy composition across end use sectors in target regions, 2006 and 2008



Because transport plays such an important role in energy use, it is worthwhile to compare road transport in the five regions (Table 3.3). The most popular means of transportation is the motorcycle, with intensities ranging from about 1 motorcycle per 10 persons (Papua, West Nusa Tenggara) to almost 1 motorcycle per 3 persons (Yogyakarta). This trend is still increasing and there are no signs of saturation. Car ownership is also increasing, but to a much lesser extent. Bus transport, mostly minivans, varies according to the level of urbanisation; it is the highest in Yogyakarta and the lowest in West Nusa Tenggara and Papua. Truck freight transport remains fairly stable, but is not high.

Table 3.3 Transport indicators in target regions, 2006 and 2008

	Cars/1000 persons		Motorcycles/1000 persons		Buses/1000 persons		Trucks/billion Rp	
Province	2006	2008	2006	2008	2006	2008	2006	2008
North Sumatra	19	21	167	215	2.3	2.3	1.8	1.8
Central Java	12	15	159	200	1.4	1.6	2.1	2.0
Yogyakarta	25	28	270	322	5.2	6.4	2.1	2.1
West Nusa Tenggara	4	5	91	112	0.8	1.1	1.6	1.9
Papua	12	14	88	104	0.2	0.7	1.4	1.4

Regarding energy supply, only electricity is presented in detail in Table 3.4. Each region, except Yogyakarta, has its own power plants, owned by the state electricity producer PLN. In West Nusa Tenggara and Papua, most capacity is provided by diesel fuelled generators (PLTD). In North Sumatra and in Central Java there are some large (>300 MW) gas and coal power plants, listed under the heading 'other'. Apart from some hydropower, hardly any large-scale renewable

Table 3.4 Electric power capacity in target regions, 2006 and 2008 (MW capacity)

Province	PLTD		Hydro		Other		Captive power	
	2006	2008	2006	2008	2006	2008	2006	2008
North Sumatra	33	33	122	122	1031.0	1129.0	425.5	425.5
Central Java	0	0	598	608	2000.7	2000.7	-	-
Yogyakarta	0	0	0	0	0.0	0.0	69.6	69.6
West Nusa Tenggara	128	148	0	1	0.1	0.3	204.0	204.0
Papua	105	121	7	8	0.0	0.2	16.6	16.6

energy sources are exploited, although there are large potentials of hydro and geothermal. Yogyakarta and Central Java are the only target regions that do not need to cover their own demand by power plants, because they are connected to the JAMALI (Java-Madura-Bali) grid. Yogyakarta is purely a consumer, but Central Java is capable of exporting some excess electricity to the grid. Captive power is the capacity installed at or directly for (industrial) end users, i.e. not connected to the PLN grid and not destined for external consumers. The end use balance does not show the amount of electricity produced by these captive power plants, but it does show the fuel input.

Access to electricity is also quite diverse across the regions, as is shown in Table 3.5. The island of Java is better equipped than the more remote regions. In West Nusa Tenggara, the difference between the high level of village electrification and the low numberof household connections is quite significant. In Papua, both are very low compared to the other regions

Table 3.5 Electricity indicators in target regions, 2006 and 2008

	Household electrification ratio		Village electrification ratio	
Province	2006	2008	2006	2008
North Sumatra	68.63	68.63	83.08	83.08
Central Java	73.73	72.72	99.79	86.06
Yogyakarta	79.78	84.48	100.00	100.00
West Nusa Tenggara	39.83	39.83	97.49	98.35
Papua	23.86	29.15	19.66	24.30

Results of energy profiles

In each region, a system is now in place to collect, analyse and present annual updates of the energy profiles, following the methodology developed in CASINDO. Moreover, after a number of discussion meetings, the stakeholders are now aware of the relevance of having established such an annual profile.

Those regions that have close contacts with the regional energy office (Yogyakarta, Central Java and to some extent West Nusa Tenggara), will be able to continue this process, given that there is some financial and, even more important, institutional support from the authorities through the regional energy office. The teams need to develop some sort of independent quality assurance and control (QA/QC) of the energy profile data and consistency, either by themselves or by involving a third party. During the programme, ECN fulfilled this role, and provided the teams with inputs and suggestions to take up such QA/QC.

The LEAP database

Based on the profiles, the teams developed a database in the LEAP model containing the data for 2006, 2007 and 2008. Most of the data could be retrieved directly from the profiles: activity per (sub)sector and the fuel intensities related to these activities for the end-use side and efficiencies, capacity and production on the supply side.

In addition, the teams also needed to provide information on the load duration curve for electricity. Although not readily available from the state electricity company PLN, each region could define such a curve and a linearised version covering nine time slices was entered in the LEAP model.

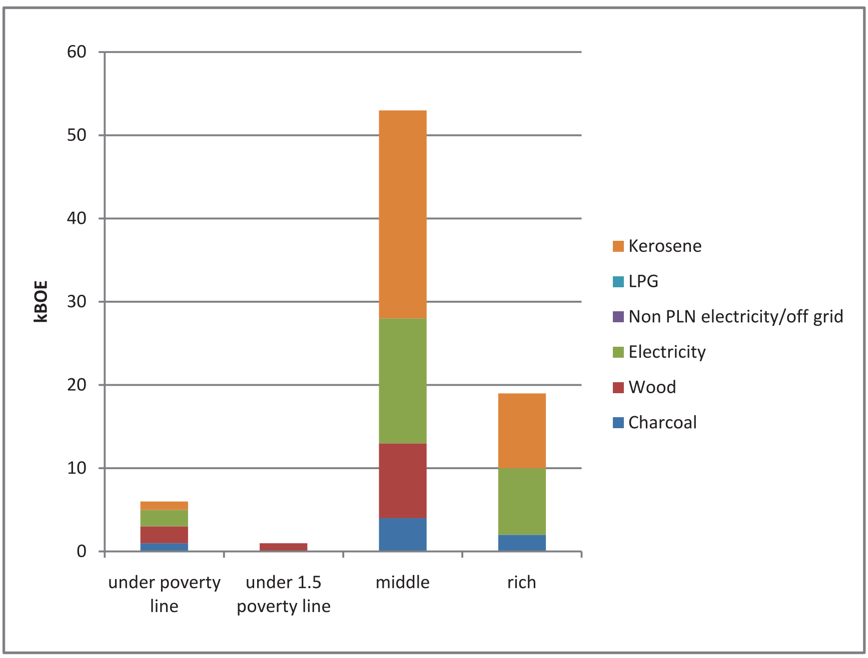
These activities were very similar to what had been done by the teams in the predecessor of CASINDO, the CAREPI project. The initial idea was to collect all profile data into a single LEAP database, thus covering the period 2005-2008. However, some teams found out that the 2005 data had been collected and estimated using a different methodology, or even from other data sources (e.g. oil data from BPS or from Pertamina) and sometimes showed considerable deviations compared to the 2006-2008 data. Therefore, 2006 is used as base year in CASINDO, and 2009 is the start year for the scenario analysis.

The major difference at the end-use side, compared to the CAREPI versions of the regional databases, is that a different approach was used for households. Where before the structure of the profiles was followed: an urban-rural distinction with four income classes each and per income class a fuel intensity per fuel, the teams were invited to distinguish household energy use into devices. Based on the same energy consumption data and with some additional assumptions, energy use was allocated to cooking, lighting, refrigeration, air-conditioning and other (electric) uses. Cooking ended up being the most complex activity where additional assumptions needed to be made: an electric rice cooker is commonly used next to a fossil-fuelled stove and each of these fossil stoves should have related efficiencies (or annual fuel use) with LPG and kerosene performing better than charcoal/briquette and wood stoves. All electric uses are obviously linked to the electrification ratio and supplemented with off-grid electricity use, which was assumed to be mainly for lighting.

The device shares and fuel use was cross-checked with some bottom-up assumptions, sometimes backed by survey material, on e.g. duration of use and number of lights and frequency of renewal of LPG containers. The obtained data were then entered in LEAP and the resulting energy balances were compared with those from the profiles.

The figures below illustrate the enhanced richness of the CASINDO models regarding household energy use. Figure 3.6 shows the current situation before CASINDO, Figure 3.7 shows the outcomes of the end use device analysis performed under CASINDO.

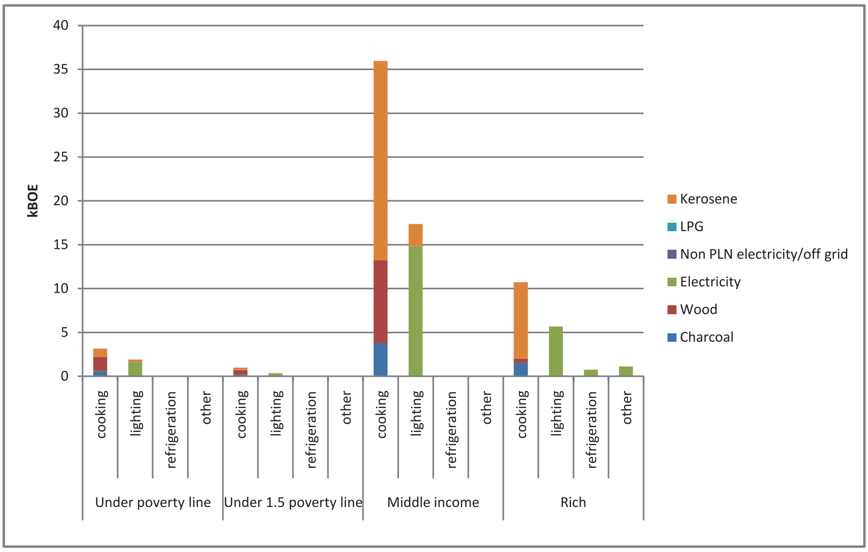
Figure 3.6 Household final energy demand using fuel intensities (Sumbawa, NTB, 2008)



Result of energy scenarios

For the projections, the teams developed a business-as-usual (BAU or reference) scenario in which already implemented policy measures (e.g. the phase-out of (subsidised) kerosene in households and other end-use sectors) were incorporated. This BAU scenario serves as the benchmark for the other scenarios. Commonly two main scenario streams were developed; a moderate one and an optimistic one. One of the differences between both is the faster electrification ratio increase in the optimistic scenario.

Figure 3.7 Household final energy demand using end use devices (Sumbawa, NTB, 2008)



Most teams had the liberty to make their own assumptions, often agreed upon during stakeholder discussion sessions.

Some of the teams also incorporated the outcomes of the working groups on energy efficiency (TWG III) and renewable energy (TWG II) in sub variants of the moderate and optimistic scenarios, while others included them in the two main scenarios. Discussions were held with the different regional stakeholders about assumptions and scenario parameters. Two variants were created; a moderate and an optimistic variant. For each of them a scenario was developed, in which the potentials of renewable energy and energy savings are realised (Table 3.6).

Table 3.6 Overview of scenario assumptions

	moderate	optimistic
Yogyakarta	Electricity efficiency improvement in households and commercial sectors RE capacity added	Higher efficiency improvement More RE capacity added
Central Java	GRDP growth 7% ; population growth 2.6%; 60-70% of RE potential deployed in 2025	GRDP growth 6.1% ; population growth 1%; 100% of RE potential deployed in 2025
NTB	Electricity efficiency improvement for lighting and refrigeration 50% of RE potential implemented	Electricity efficiency improvement for lighting and refrigeration 75% of RE potential implemented
North Sumatra	Higher GDRP growth for industry compared to other sectors; Approximately 33% of the RE potential used in the power plants	Change in population structure: the share of rural population decreases
Papua	Improved EE for lighting, refrigerators and A/C; approx. 20 % of electrification ratio potential implemented. Capacity of RE power plants approximately 0.2 times capacity of fossil power plants in 2020. Capacity of RE power plants approx. 3.6 times capacity of fossil power plants in 2025.	Improved EE for lighting, refrigerators and A/C; approx. 30 % of electrification ratio potential implemented. Capacity of RE power plants approximately 1.5 times capacity of fossil power plants in 2020. Capacity of RE power plants; approx. 3.5 time capacity of fossil power plants in 2025.

Although not part of the EE and RE scenarios, most teams had to include a saturation assumption on transport in view of the fast growth in the recent years. Extrapolating this growth for another 20 years would lead to vehicle stock numbers which could not be absorbed by the infrastructure (roads, rail and airports).

In anticipation of the expected regional energy plan (RUED), the teams developed a scenario that could act as one. Discussions were held with the different stakeholders about the effects of the agreed assumptions and scenario parameters.

In order to illustrate the implications for future policy makers, the outcomes of the scenarios are represented for the short term (2010 and 2015) as well as for the long term. In this final report the focus has been put on some major indicators. For the development of the RUED, the teams need to further elaborate the work they have performed under CASINDO by producing more detailed regional analyses of their projected energy situation.

A first comparison is made of final energy consumption per sector and per fuel. The results for the main scenarios, business as usual (BAU), moderate (MOD) and optimistic (OPT) are illustrated in Figures 3.8 and 3.9. The results are given compared to the 2008 final consumption (=100%).

From these preliminary results, it is clear that transport continues to be the main sector, especially private road transport. Households remain the second largest energy consuming end use category in all regions in the short term. Later their role is overtaken by mostly the commercial sectors or industry in North Sumatra. The impact of the large mining companies in West Nusa Tenggara and Papua also is clear, even with a conservative approach for this study that their energy consumption will stay at the 2008 level. Because energy consumption of the mining companies is kept constant over the planning period, energy consumption of the region compared to 2008 increases more when these companies are not included. Less developed regions such as West Nusa Tenggara and Papua will experience quite a large growth in energy consumption compared to well developed regions such as Central Java and Yogyakarta.

Because transport is the main energy consumer, gasoline and diesel (ADO) continue to dominate the fuel consumtion. Most region see a complete phase out of kerosine, except Papua and North Sumatra. Electricity increases in all region, but faces supply constraints.

Figure 3.8 Final energy consumption shares by sector for 2010, 2015 and 2025 (2008 final consumption = 100%)

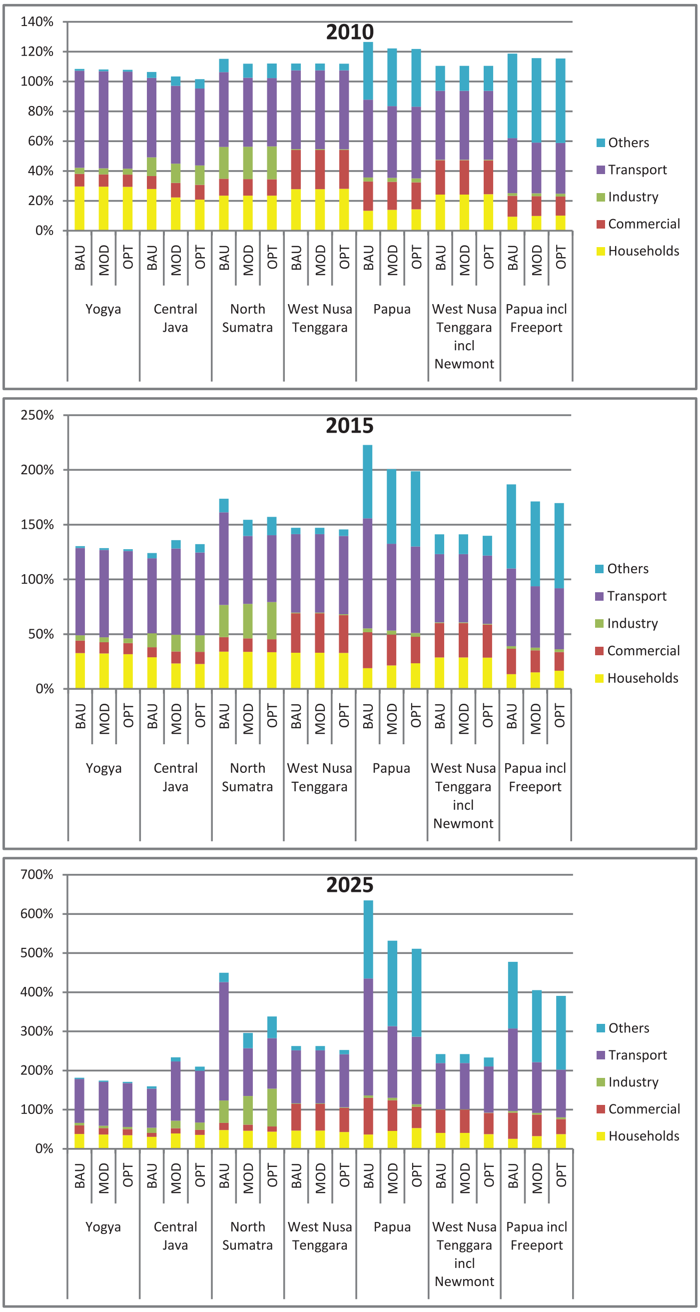
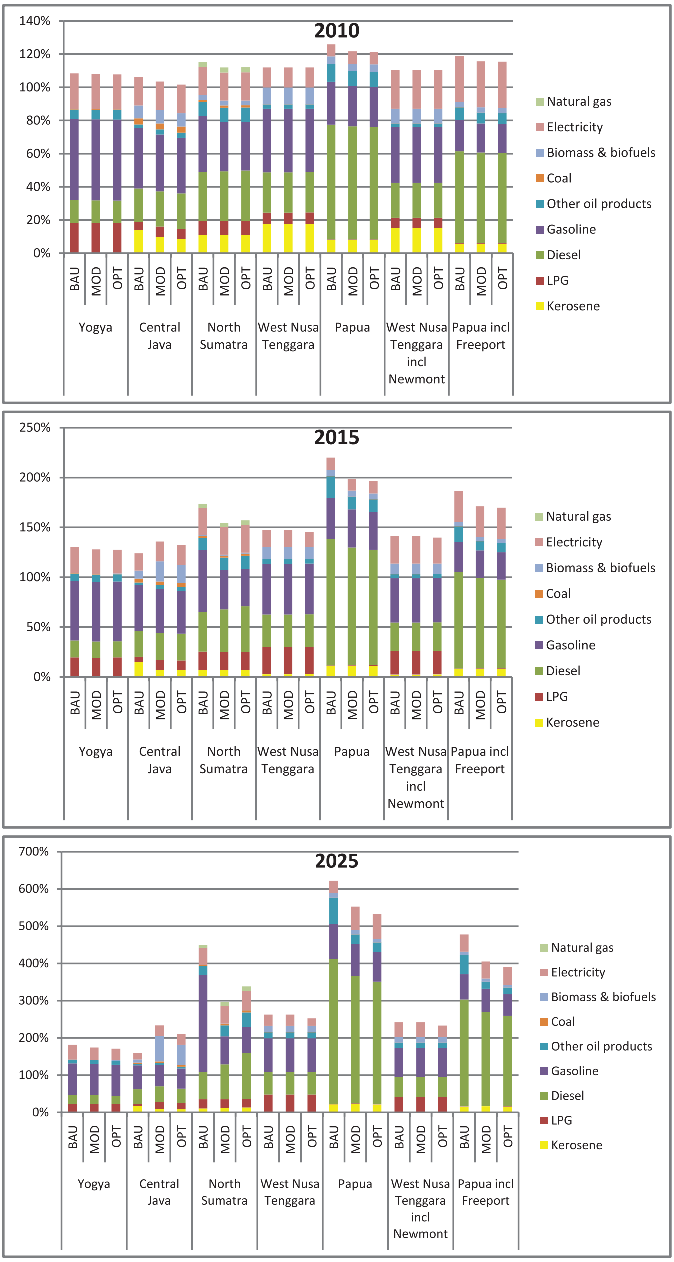


Figure 3.9 Final energy consumption shares by fuel for 2010, 2015 and 2025 (2008 final consumption =100%)



Most regions included domestic renewable electricity production in their policies, therefore it is worth while to output these ambitions into perspective. This can be done by comparing the renewable electricity supply to the total electricity supply (excluding grid losses). The shares already include the electricity that is produced by grid connected hydro and geothermal power plants and is thus more than the share of off-grid renewable production (Table 3.7).

Table 3.7 Renewable electricity share

	2010			2015			2025		
	BAU	MOD	OPT	BAU	MOD	OPT	BAU	MOD	OPT
Yogyakarta	0.0%	0.0%	0.0%	0.0%	0.2%	7.3%	0.0%	1.7%	14.2%
Central Java	6.2%	10.1%	7.7%	6.9%	15.5%	24.8%	6.9%	46.0%	69.9%
West Nusa Tenggara	0.5%	0.4%	0.4%	15.8%	32.6%	40.3%	13.9%	29.1%	44.0%
West Nusa Tenggara included Newmont	0.2%	0.2%	0.2%	9.0%	18.6%	21.9%	9.7%	20.2%	26.5%
North Sumatra	10.5%	10.5%	10.5%	33.4%	33.3%	33.2%	26.3%	25.4%	23.9%
Papua	3.0%	3.3%	3.4%	2.1%	29.8%	28.0%	0.9%	97.4%	97.9%
Papua included Freeport	0.6%	0.7%	0.7%	0.6%	8.9%	8.7%	0.5%	97.4%	97.9%

It should be noted that for West Nusa Tenggara, the Newmont mining company continues to run on electricity produced from coal and diesel, while in Papua in the MOD and OPT scenarios, the Freeport company switches to grid electricity in 2020 and 2025. The large share of renewables in Papua in 2025 can be explained by the fact that grid connected electricity is dominated by hydro plants. Also Central Java sees a large potential of electricity generated by hydro.

For the sake of further comparison, several key indicators are chosen, in particular final energy per capita (Table 3.8) and per GRDP (Table 3.9) and electricity consumption per capita (Table 3.10).

Table 3.8 Indicators : final energy per capita

	2008	2010			2015			2025		
BOE/capita		BAU	MOD	OPT	BAU	MOD	OPT	BAU	MOD	OPT
Yogyakarta	1.42	1.50	1.50	1.50	1.72	1.70	1.69	2.18	2.09	2.05
Central Java	1.38	1.44	1.40	1.38	1.62	1.77	1.73	1.93	2.83	2.54
West Nusa Tenggara	0.82	0.89	0.89	0.89	1.05	1.05	1.04	1.50	1.50	1.45
West Nusa Tenggara included Newmont	0.95	1.00	1.00	1.00	1.16	1.16	1.14	1.59	1.59	1.53
North Sumatra	1.92	2.11	2.05	2.05	2.96	2.66	2.73	6.37	4.38	5.23
Papua	1.45	1.64	1.58	1.58	2.20	1.99	1.99	3.77	3.29	3.33
Papua included Freeport	2.05	2.17	2.12	2.12	2.61	2.41	2.41	4.01	3.55	3.60

Table 3.9 Indicators : final energy per GRDP

	2008	2010			2015			2025		
BOE/million Rpa		BAU	MOD	OPT	BAU	MOD	OPT	BAU	MOD	OPT
Yogyakarta	0.26	0.25	0.25	0.25	0.23	0.23	0.23	0.19	0.18	0.17
Central Java	0.28	0.27	0.26	0.26	0.24	0.27	0.26	0.19	0.27	0.25
West Nusa Tenggara	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.28	0.28	0.27
West Nusa Tenggara included Newmont	0.25	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.23
North Sumatra	0.23	0.24	0.23	0.23	0.26	0.23	0.22	0.35	0.20	0.20
Papua	0.34	0.37	0.36	0.36	0.45	0.40	0.40	0.62	0.48	0.45
Papua included Freeport	0.27	0.29	0.28	0.28	0.36	0.33	0.33	0.53	0.42	0.40

Table 3.10 Indicators : Electricity consumption per capita

	2008	2010			2015			2025		
BOE/million Rpa		BAU	MOD	OPT	BAU	MOD	OPT	BAU	MOD	OPT
Yogyakarta	0.28	0.30	0.29	0.29	0.35	0.33	0.32	0.47	0.40	0.36
Central Java	0.24	0.23	0.23	0.23	0.23	0.26	0.26	0.21	0.35	0.34
West Nusa Tenggara	0.08	0.10	0.10	0.10	0.12	0.12	0.11	0.17	0.17	0.11
West Nusa Tenggara included Newmont	0.20	0.21	0.21	0.21	0.23	0.23	0.21	0.26	0.26	0.20
North Sumatra	0.25	0.31	0.31	0.32	0.47	0.47	0.48	0.65	0.71	0.76
Papua	0.09	0.10	0.10	0.10	0.12	0.12	0.13	0.20	0.20	0.24
Papua included Freeport	0.55	0.50	0.51	0.51	0.44	0.43	0.44	0.39	0.40	0.44

Energy and electricity consumption per capita remain low, except in North Sumatra. The reasons for this are not clear; further analysis is needed to determine the cause of this.

As last indicator, because this is quite often communicated by the Indonesian government, the final energy elasticity to GRDP is given for 2008 as reference and for 2025 as last year of the analysis period. The long term target of the government is to reduce this elasticity below 1, i.e. final energy grows at a slower rate than GRDP. (Table 3.11).

Table 3.11 Indicators : Final energy elasticity to GRDP

	2008	2010-2025 average		
		BAU	MOD	OPT
Yogyakarta	0.79	0.63	0.58	0.56
Central Java	0.07	0.51	0.83	0.81
West Nusa Tenggara	0.87	1.03	1.03	0.98
West Nusa Tenggara included Newmont	2.52	0.96	0.96	0.91
North Sumatra	0.84	1.40	0.87	0.90
Papua	-0.23	1.48	1.26	1.20
Papua included Freeport	3.86	2.11	1.50	1.42

Both West Nusa Tenggara and Papua show exceptional values for 2008, which is related to the impact of the mining companies and the decrease in energy consumption in 2008 compared to 2007 in Papua.

3.1.5 Main findings and observations

Despite the experiences gained in the previous CAREPI project, it turned out that the collection and assessment of energy and related demographic and macro-economic data remained the main and almost insurmountable obstacle for most teams. This resulted in a significant delay in producing the energy profiles for 2006-2008, and also affected the degree of detail and to some extent the quality of the regional energy scenarios. Therefore, the numbers presented in the tables in the previous section should be handled with caution; they are only preliminary and should be elaborated further by the regional teams.

Another important observation is that even a relatively simple tool such as the LEAP model requires the user to have a very good understanding of the energy sector and all the relevant parameters to be able to design, evaluate and understand the results of the scenario. Energy scenarios cannot simply be developed overnight; this is a continuous process that requires input from different types of expertise over a longer period. The numbers produced by an energy model cannot be taken for granted. Sufficient time must be taken to analyse them and to check their consistency and, if needed, to adjust the input parameters.

In all regions, the energy situation is dominated by the transport sector – disregarding the single large mining companies in West Nusa Tenggara and Papua. This situation continues in the scenario projections, which is a clear indication that if regional governments want to tackle the energy problems in their region, including the subsidised fuels, transport is their target sector, but a difficult one to handle.

Even if most regions do have a considerable potential for off-grid renewable electricity generation, the produced electricity will not be sufficient to satisfy the projected demand. This means that much more effort will be needed to first of all explore more or other types of renewable energy sources and secondly to ensure that they can be deployed.

In CASINDO, energy efficiency measures have only been explored for a limited number of applications or sectors. It is very likely that much more potential for savings can be identified, thus relieving the burden on the electricity supply side and on fossil fuels. The regions covered in CASINDO mostly import fossil fuels from other regions in Indonesia or from abroad, and put a considerable strain on the regional energy demand and budget.

All in all, the CASINDO experience should allow the teams to further elaborate on the methodology to determine their regional energy outlook, which can be further developed into the RUED which must be produced once the KEN and RUEN are published (probably in the second half of 2012). Regional governments should ensure that sufficient means are made available to continue the work done in the framework of CASINDO and to allow the regional teams to further strengthen their capacity.

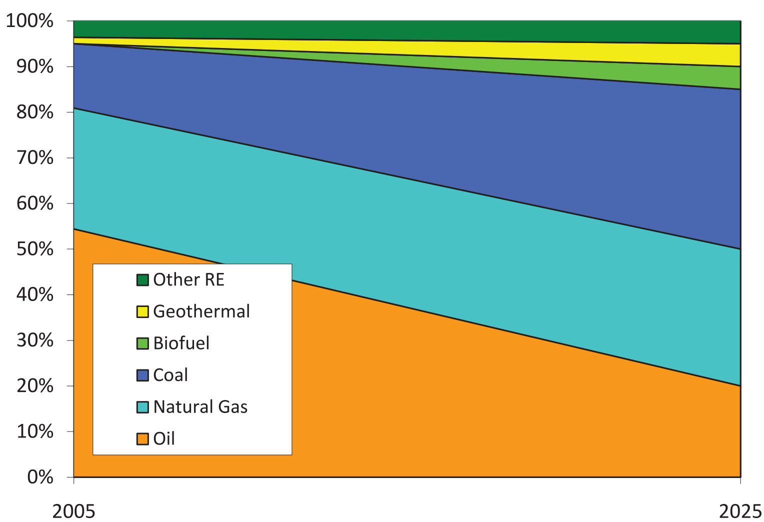
3.2 TWGII: Renewable energy action plan

3.2.1 Background

Indonesia already developed a master plan on new and renewable energy development in 1997 (Rencana Induk Pengembangan Energi Baru Terbarukan, RIPEBAT). This was an implementation plan of the national energy policy at that time (Kebijakan Umum Bidang Energi, KUBE), particularly for substituting oil fuel use.

In 2006, the government launched its Presidential Decree no. 5 on national energy policy. This was an important regulation, because it mentioned a clear target for the primary energy mix up to 2025, including for renewable energy. This is shown in Figure 3.10.

Figure 3.10 Primary energy mix target for 2025 (Source: Presidential Decree no. 5/2006)



Conforming to the Presidential Decree No 5/2006, the master plan on new and renewable energy development was updated for the period of 2010 – 2025 (The new RIPEBAT).The total renewable energy share in the primary energy mix is targeted to increase from 7.9% in 2007 to 15.5% in 2025, consisting of 5% biofuel, 5% geothermal, 5% hydropower, and 0.5% other renewable energy (biomass, wind and solar). A more ambitious target of 25% new and renewable energy utilisation in 2025 was presented by the government in a strategy called ' Indonesia's energy Vision 25/25'. However, this vision has not yet been translated into official policy. Table 3.12 illustrates the official renewable energy utilisation target.

The national energy policy and master plan on new and renewable energy are not specified for the provincial or regional level. Therefore, a master plan or action plan on new and renewable energy still needs to be developed for each province or regency/city, in line with the national plan.

Table 3.12 Renewable energy utilisation target for Indonesia, 2007-2025 in MBOE (Source: Master plan on new and renewable energy 2010, RIPEBAT, MEMR)

Type of energy	2007	2010	2015	2020	2025
Biodiesel	0,001	2,8	10	34,2	87,5
Bio-ethanol	-	1,2	4,7	15,2	38,2
Pure Plant Oil	-	1,3	6,3	16,3	36,3
Biomass	5,9	6,6	7,8	9,4	11,5
Wind	0,01	0,02	0,2	0,6	1,3
Solar	0,04	0,1	0,2	1,1	1,9
Geothermal	13,9	16,7	54,9	103	163,1
Mini/Micro Hydro	2,8	3,2	5,5	10	18,8
Large Hydro	55,5	57,9	80,2	118,2	144,7
Total	78,151	89,82	169,8	308	503,3

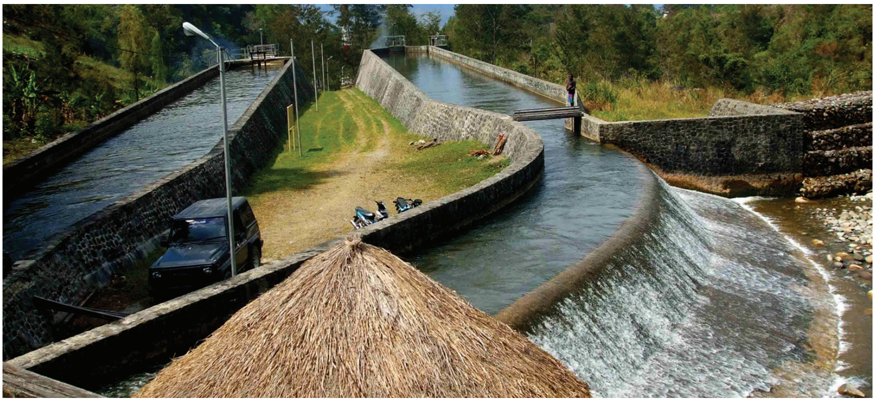
3.2.2 Objectives

The objectives of TWG II were to define a realistic target for renewable energy development in the target provinces, and to implement the target of renewable energy in the national energy policy. The scope of work of TWG II comprises the identification of renewable energy potential in the five provinces, the evaluation of current policies; analysis of development opportunities; setting of a target for renewable energy development; and formulating an implementation strategy and action plan.

3.2.3 Methodology

The renewable energy development target in the Presidential Decree no. 5/2006 and the updated master plan for 2010-2025 (the new RIPEBAT) cannot be directly implemented at the provincial level, as conditions in each province are different. Therefore, each province should formulate its own target and action plan for renewable energy. The provincial target should represent the regional condition, so data about supply and demand are collected from the field.

Figure 3.11 Walesi Microhydro, Jayawijaya Regency, Papua



There are four main steps to conduct the analysis: (1)analyse the current situation; (2) Analyse the supply – demand situation; (3) develop scenarios for future RE situation and set renewable energy target for the province; and (4) develop a renewable energy action plan to achieve this target.These steps are circular and interrelated (Figure 3.12).

Step 1: analyse the current situation

This step aims to identify the renewable energy potential, the current renewable energy development policy and renewable energy utilization in the region. TWG II teams conducted surveys at the sites and had discussions with the regional energy office to collect data and information and to assess the renewable energy potential which consists of hydro, geothermal, solar, wind, biofuel, biogas and biomass.

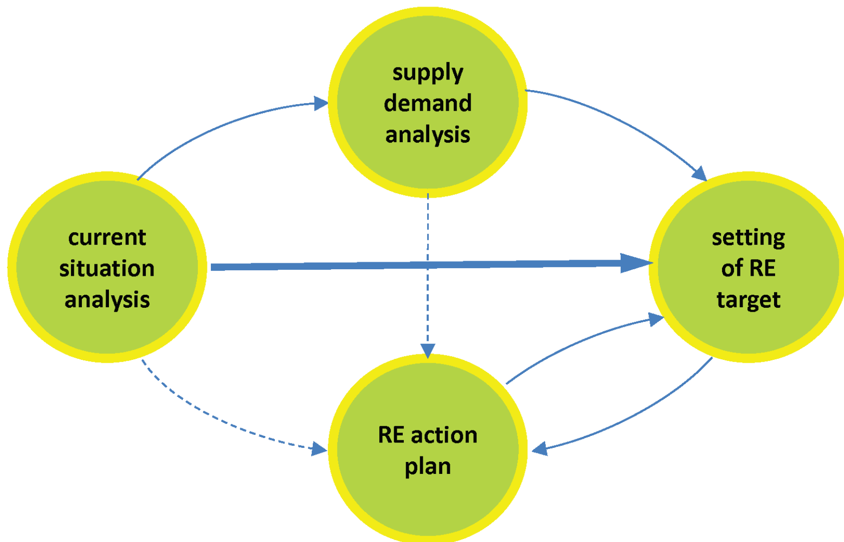
Step 2: analyse supply - demand situation

Based on the identified potential, the development opportunities are analysed, i.e. increasing electrification, decreasing oil fuel consumption, and generating income.

Supply-demand analysis is conducted to calculate the feasible development of the renewable energy potential; first, a micro-analysis of some cases in the renewable energy supply-demand, followed by a macro–analysis, generalising them for the whole province.

The real condition in the field shows that not the entire renewable energy potential can be developed, because of lack of demand or absence of a transmission line. In this case, renewable energy can be divided into tradable and non-tradable (utilised at the site) energy.

Figure 3.12 Flow diagram of steps, comprising the methodology for developing a renewable energy action plan



Step 3: analyse future RE situation and set the renewable energy target

Based on the current conditions in the field, the supply-demand analysis, the current national energy policy and future developments regarding renewable energy, the regional energy forum sets the renewable energy target for the province.

Step 4: develop a renewable energy action plan

After the renewable energy target is formally approved by the regional government, the renewable energy action plan is drawn up by the regency/city, comprising the implementation strategy for each type of renewable energy, institutional structure for the investment plan, identification of human resources and technology requirements necessary for achieving the target.

3.2.4 Cross-regional analysis

The five provinces show differences in current renewable energy utilisation (Table 3.13). North Sumatra has the highest use, because it has large hydro power plants, whereas Yogyakarta has the lowest use.

Table 3.13 Primary energy mix of the five provinces, 2010 (1000 BOE)

Type of energy	N-Sumatra	Central Java	Yogyakarta	W-N Tenggara	Papua
Oil Fuel	24,435	37,070	3,805	3,659	4,988
Nat Gas	3,516	592	120	22	4
Coal	389	11,240	2,859	2,564	3,290
Renewable	1,419	552	-	6	72
Total	29,758	49,454	6,784	6,250	8,354
	%	%	%	%	%
Oil Fuel	82.11	74.96	56.08	58.53	59.71
Nat Gas	11.81	1.20	1.77	0.36	0.04
Coal	1.31	22.73	42.14	41.01	39.39
Renewable	4.77	1.12	0.00	0.09	0.86

The approach for calculating primary energy in this study is as follows:

- The calculation of primary energy consumption should be based on the final energy mix (from demand side).
- The primary use of oil fuel (petroleum refinery product) is assumed to be the same as oil fuel consumption.
- LPG is assumed to be covered for 50% by crude oil and 50% by natural gas.
- The primary use of electricity is calculated first from renewable energy and other non-coal. The electricity from coal comes last.
- The exported/imported electri-city is generated from coal.
- The average power plant efficiency is 34% (for Central Java).

The starting conditions in the five provinces were different. West Nusa Tenggara already had a renewable energy target for electricity generation, but that target was too optimistic. Central Java already had a renewable energy target in its regional energy development planning. The other three provinces lacked such policy.

Information about the renewable energy potential in the five provinces is collected from Dinas Energi and other regional government offices, and also through site visits. Hydro potentials consist of large hydro and small hydro. The biofuel potential is based on various sources, such as coconut, palm oil, nipah and sago. In this study biomass consists of agricultural waste, and in Central Java and Yogyakarta also municipal waste. The biogas potential is based on cow manure. Table 3.14 shows the renewable energy potential in the five provinces.

Table 3.14 Renewable energy potential in the five target provinces, 2010

Type of energy	unit	North Sumatra	Central Java	Yogyakarta	West Nusa Tenggara	Papua
Hydro	MW	3,095	540	1.25	212	22,236
Geothermal	MW	3,680	780	-	145	-
Biofuel	BOE	1,750,795	611,052	-	240,610	5,625,726
Biomass	BOE	7,084,846	445,592	12,082	667,479	844,553
Biogas	BOE	161,105	897,067	1,342	236,472	119,012

Table 3.15 shows the installed capacity of renewable energy in 2010 in the five provinces. Hydro consists of large and small hydropower plants. The table includes all renewable energy capacities that have been built in the regions, but some of them may not be running well.

Table 3.15 Installed capacity of renewable energy in the five target provinces, 2010

Type of energy	unit	North Sumatra	Central Java	Yogyakarta	West Nusa Tenggara	Papua
Hydro	MW	938	327	-	1	9.07
Geothermal	MW	12	60	-	-	-
Biodiesel	KL/year	114,896	2,433	-	-	6,882
Bioethanol	KL/year	-	657	-	-	-
Biogas	m^3	70	196	-	98	-
Solar	MW	0.25	0.23	0.01	0.45	0.43

The renewable energy utilisation in 2010 in the five provinces is shown in Table 3.16. The data are calculated from the installed capacity and the capacity factor (utilisation of capacity). Information about the utilisation of the capacity is collected from DinasEnergi, local people, or site visits to the plant. The capacity utilisation of solar home systems entails an aggregation of capacity utilisation in a specific region and/or in a specific year. For example, the capacity factor of a solar home system built in 2009 is 90% and that of the one built in 2008 is 80%.

Table 3.16 Utilisation of renewable energy in the five target provinces, 2010 (1000 BOE)

Type of energy	North Sumatra	Central Java	Yogyakarta	West Nusa Tenggara	Papua
Hydro	1,228,360	429,427	-	1,274	36,537
Geothermal	73,879	146,572	-	-	-
Biofuel	729,635	3,100	-	-	27,503
Biogas	161	2,606	-	1,301	172
Solar	221	662	29	641	1,264
Total	2,148,245	582,358	29	3,215	64,969

Tables 3.14, 3.15 and 3.16 show the current (2010) or initial conditions that are the result of the first step of analysis. The second step was to analyse potential opportunities, i.e. increasing electrification (rural electrification), decreasing oil fuel consumption (replacing kerosene use in household), and generating income (for commercial use).

Table 3.17 shows the example of West Nusa Tenggara. 'Tradable' means that the energy can be traded to the other regions; it can be developed to its maximum capacity. 'Local' means that the energy can only be used at the site; the utilisation is determined by local demand.

Table 3.17 Potential opportunities for renewable energy in West Nusa Tenggara

Type of energy	Opportunity	maximum capacity
Hydro	connect to grid(tradable)	198.75 MW
Hydro	rural electrification (local)	12.57 MW
Geothermal	connect to grid(tradable)	145 MW
Biofuel - crude jatrophaoil - cake	 commercial (tradable) household use (local)	 115,186 BOE 125,424 BOE
Biomass	electricity (local)	667,479 BOE
Biogas	household use (local)	10,220,185 m^3/year

The realisation of the renewable energy potential is examined in the supply-demand analysis. Table 3.18 shows the draft action plan for renewable energy in Papua. The numbers show the maximum result that can be reached by the province, to meet the national energy policy target. This draft provides the basis for the regional energy forum to determine the renewable energy development target.

Table 3.18 Draft action plan for renewable energy in Papua, 2010-2025 (BOE)

		Utilisation			
Type of energy	Type of use	2010	2015	2020	2025
Small hydro	grid	7,209	7,500	8,000	8,500
	off-grid	29,328	44,206	63,438	94,132
Large hydro	grid	-	85,918	162,656	4,228,717[1)]
Biodiesel	commercial	27,503	115,060	140,778	166,397
Bioethanol	commercial	-	-	1,178,968	1,783,310
Biogas	local	172	621	2,245,613	3,025,527
Biomass	local	-	-	-	4,814.9
	industry	-	-	460	919
Solar	local	757	800	850	900
Wind	local	-	-	5	10
Total		64,969	254,103	3,802,574	9,310,735

[1])Urumuka hydro dam with capacity of 3 GW up-and-running

TWG II aimed to formulate a realistic renewable energy target and action plan to achieve this target and submit these to the regional energy forum that made the final decision on the target. Table 3.19 shows the renewable energy target in the five provinces in 2025.

Table 3.19 shows that the renewable energy targets for 2025 differ among the provinces. Assuming an energy consumption growth in the five provinces of 5.5% per year, the shares of renewable energy production in the total energy consumption in 2025 are 18.0% for North Sumatra, 3.6% for Central Java, 0.2% for Yogyakarta, 8.8% for West Nusa Tenggara, and 44.9% for Papua. The average share of renewable energy in 2025 in the five provinces is estimated at 11.6%, whereas the national target is 15.5%. The renewable energy share in the primary energy mix in 2025 in the five provinces is shown in Figure 3.13.

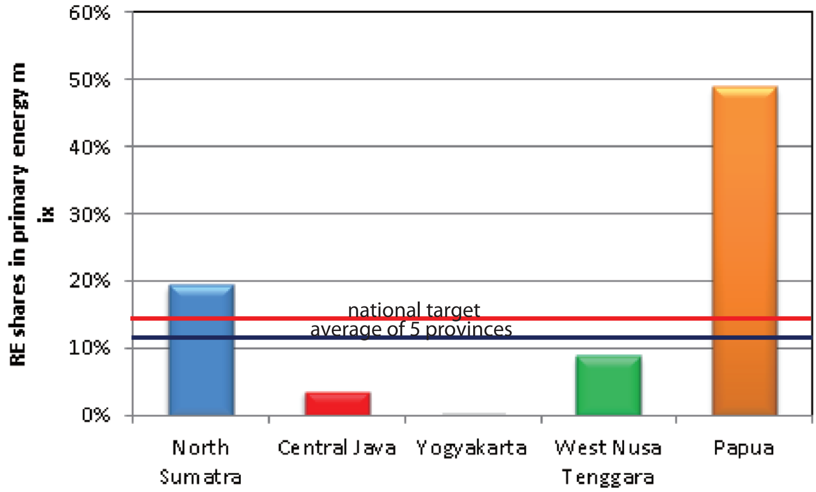
Table 3.19 Renewable energy target in the five provinces for 2025 (1000 BOE)

Type of energy	North Sumatra	Central Java	Yogyakarta	West Nusa Tenggara	Papua
Small hydro	250	274	0,17	102	103
Large hydro	8.069	419	-	-	4.229
Solar energy	4	6	-	1,5	0,9
Biogas	16	29	27	10	3.026
Geothermal	2.964	3.093	-	600	-
Biomass	1.057	45	0,45	400	2,3
Biodiesel	729	10	-	250	166
Bioethanol	200	501	-	-	1.783
Wind energy	2	10	0,03	1,5	0,01
Total	13.291	4.387	27	1.365	9.311

It should be noted that the renewable energy shares in Figure 3.13 can be reached if all supporting policy measures and infrastructure are realised. The current main barrier to renewable energy development is fossil fuel subsidy. Moreover, renewable energy development should be supported by sufficient capital and capacity, coordinated planning, and appropriate energy pricing policy.

The action plan is the detailed implementation plan of the renewable energy development target for each type of renewable energy for each location or regency, including the institutional set up to implement the action plan. Ideally, this process should involve the lower levels of government in the province, i.e. regencies or cities. However, not all five regions have a sufficiently strong regional energy forum.

Figure 3.13 Target of renewable energy share in the primary energy mix for 2025 in the five provinces



3.2.5 Main findings and observations

As the national energy policies give general directions, regional governments should develop a detailed policy, including a regional target and an action plan, for the province, regencies and cities. Regional governments should therefore have sufficient human capacity to formulate their energy policies, in particular renewable energy policies.

The methodology to formulate renewable energy policy, presented in this chapter, can be used also by other provinces. Therefore, the province needs to establish a regional energy forum that is responsible for preparing the regional energy policies, including the policy on renewable energy. The policies prepared by the forum are submitted to the regional government to become formal regional energy polices.

Other important aspects that should be included in the policy are an institutional set-up and budgeting mechanism for the implementation of the renewable energy action plan, and a guideline and mechanism for monitoring the implementation.

The renewable energy action plan is not only meant for the regional government, but serves as an overall planning framework for achieving the regional renewable energy target that can be used as guidance by all stakeholders, including the public and the private sector.

Bottom-up planning of renewable energy, formulated by regional governments and energy stakeholders, will be easier to implement in the field, because the local people have better knowledge about their needs and their potential.

Figure 3.14 Centralized PV at Gili Terawangan, West Nusa Tenggara

Figure 3.15 GeothermalEnergy in Dieng, Wonosobo Regency, Central Java

3.3 TWG III: Energy efficiency master plan

3.3.1 Background

Indonesia has launched a series of efforts in the framework of its national energy conservation plan(2005) to realise an average 1% reduction in energy intensity per year until 2025. This derives from the national energy policy 2005-2025, which distinguishes four types of instruments:

1. Information: e.g. awareness campaigns and training in demand-side management.
2. Incentives: e.g. duty and tax reductions.
3. Regulation: mandatory audits for the large energy users, labelling and standardisation schemes.
4. Price: market-based energy pricing.

Efforts to reduce the energy intensity run parallel to Indonesia's efforts to increase the electrification rate and reduce frequent black-outs by improving the energy infrastructure. This places an additional burden on the administrations involved. In a 2008 review of Indonesia's energy policy, the International Energy Agency (IEA) expressed strong doubts regarding the chances of realising this 1% energy reduction, partly due to the current scale of energy efficiency and conservation efforts.

The IEA identified three key points of action:

1. Market-based pricing to reflect the supply and externality costs of an energy carrier.

2. Developing the necessary focus, scale of activity and accountability.

3. Prioritisation and cost-effective targeting through a clear quantitative base.

These points are influenced by many other conditions, including large subsidies on energy carriers, a state-owned energy utility (PLN) and the merge of pro-poor fiscal policies with energy pricing. Hence, to fully realise the large energy saving potential for Indonesia, the current efforts need to be combined with a major reform of the energy sector.

3.3.2 Objectives

TWG III aims to contribute to the reform through a quantitative financial assessment of energy efficiency measures across several sectors. This is carried out for each target region to produce a regional energy efficiency master plan. In this section the results of all regions are combined to illustrate the similarities and differences in potential savings and costs.

Currently, the energy efficiency and conservation efforts target large users (over 6000 BOE), who, under government regulation no. 70/2009, are required to appoint an energy manager and conduct an energy audit. This strategy assumes that the potential savings are largest among large users. Furthermore, from an administrative point of view, it is less complex to start with a small number (500-600 companies) of large users with many common energy characteristics than to target the household level with its large variety in energy consumption, income, literacy and education. TWG III therefore has chosen to complement the national approach by targeting the more fragmented user groups, such as households and small to medium-sized enterprises (SMEs).

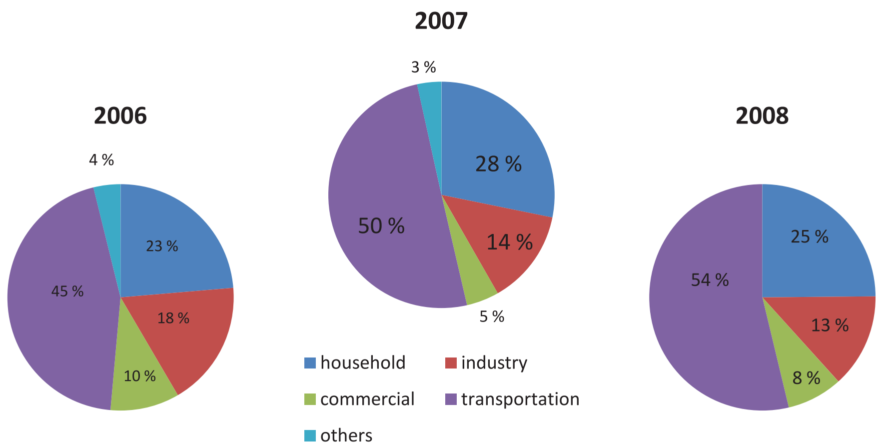
3.3.3 Methodology

The selected group of households and SMEs is not only fragmented, but also has limited aggregated data on energy use. PLN provides total energy use per connection category, but no aggregated data on the nature of energy use. Information about electrical appliances, duration of use and appliance efficiency needs to be gathered to identify the energy and cost savings of investments. Appliance efficiency has to be based on the best available alternative in the market, as Indonesia does not have an appliance labelling scheme.

The lack of data and the fragmented nature of the group require a bottom-up approach in which samples can provide usage information for groups at varying income levels. The approach focuses on the financial details and considerations for consumers to invest in a certain energy efficiency measure, namely the initial investment, the payback period and the total savings. However, in view of time and capacity limitations, an initial selection needed to be made. This was done by using PLN data to identify the sector with the largest energy use. Figure 3.16 shows the data for Central Java.

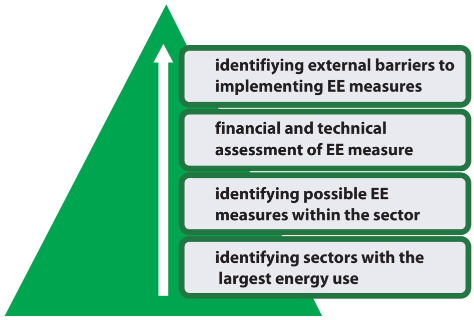
The figures for Central Java are typical for most of the target regions (except for Yogyakarta with its considerably lower energy consumption in the industry sector), where the transport, household and industry sectors are usually the largest consumers. However, TWG III decided to omit the transport sector from its analysis, as policies to improve transport efficiencies are complex and often demand involving fuel pricing, improved public transport, large infrastructural investments and consumer awareness.

Figure 3.16 Share of energy use per sector in Central Java, 2006-2008



The methodology adopted for TWG III is illustrated in Figure 3.17. After choosing the two or three most relevant sectors in terms of energy savings, the energy consumption within the sector was used to gather information about consumption of subgroups. For example, within the industry sector in North Sumatra, palm oil refineries use a considerable amount of diesel. The only caveat would be typical plants or consumers whose energy consumption is lower than the 6000 BOE that would subject them to a mandatory audit by the government. By means of surveys, the energy consumption behaviour and appliances of a small sample of the (sub)sector were gathered.Depending on the sector, a maximum of threeenergy efficiency measures were selected to calculate their net present value (NPV). This was done for the total lifetime of the energy efficiency appliance or measure.

Figure 3.17 Selection process of energy efficiency measures



This allowed for analysing the potential financial barriers regarding investment cost, payback period and the level of savings. Other external barriers, such as level of awareness, availability of the energy efficiency appliance and technical capacity (especially in the case of industrial measures) were identified through surveys and interviews.

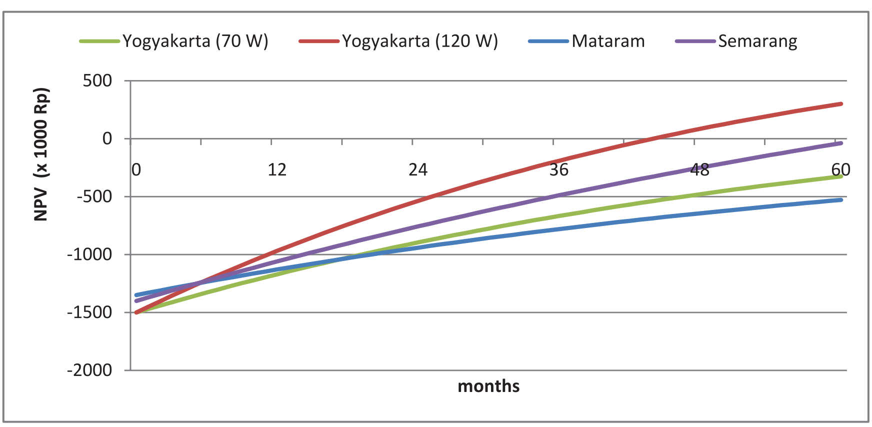
The last step consisted of policy analysis and formulating recom-mendations. Based on the financial and external barriers, policy measures such as investment sub-sidies or awareness campaigns were introduced and penetration scenarios were made. The main goal was to prove - to a high degree - the potential energy savings through government intervention, and not to provide precise figures. The fact that energy markets in Indonesia are not liberalised or operated by private parties, however, creates some confusion, as government and electricity provider are seen as one and the same organisation. To account for this difference in market structure, the approach was altered slightly by adding a perspective of government savings. As Indonesia heavily subsidises energy carriers, reducing energy demand will also reduce government expenditure. This was introduced into the calculations as the difference between actual generation costs and the price to consumers. When subsidies were recommended, these data would also show whether or not the costs of the subsidy are lower than the abated subsidies due to the reduced energy demand, hence providing a way to test the feasibility and attractiveness of the proposed policy mechanism.

3.3.4 Cross-regional analysis

The financial analyses for each of the five regions do not only show variations in the final results, but also in the selected sectors. Differences in potential are attributed to factors such as size of population or sector, average connection threshold, income level and sector characteristics. As the household sector was among the largest user groups in every region, it was included in the analysis of all regions. The household sector presents a very interesting case, as the challenges seem to exacerbate the main barriers to energy efficiency in Indonesia. Households get energy at subsidised prices, which take up large shares of government budgets. The sector consists of a very fragmented and complex user group, due to differences in energy use, income, education, access to information and geographical location. To assess the barriers associated with the household sector within the given time and resources, a large homogenous user group was selected. This was usually the largest city in the region; Yogyakarta, being relatively small, was handled in its entirety.

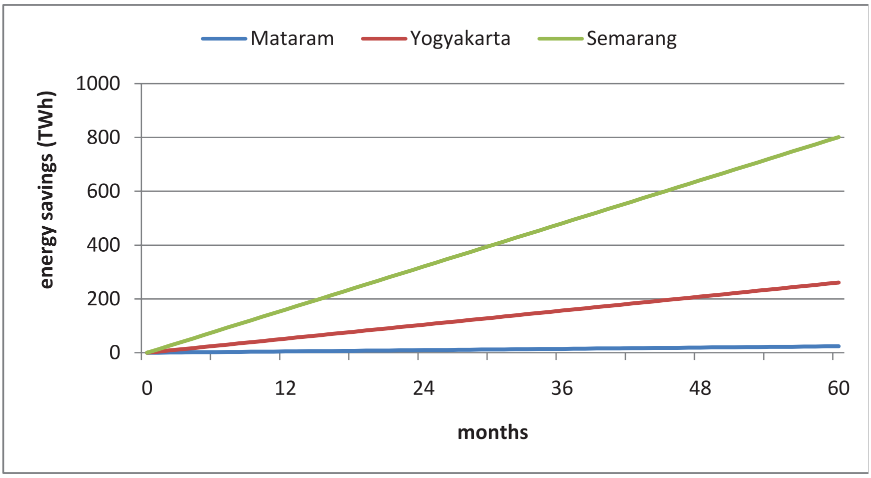
Within the household sector the most promising energy efficiency measures in all regions are lighting and refrigeration. As both applications have strong connections to pro-poor energy strategies and have a direct impact on the standard of living, they are of considerable interest to the government. The potential for energy efficiency lighting varies amongst groups, as the costs for energy efficiency bulbs are currently very competitive and their longer lifetime often results in savings. This explains the current high penetration of energy efficiency lighting in households (approximately 70% of electrified households). A refrigerator, however, is a far more difficult appliance, as the investment costs are often too high to allow for interesting payback periods for consumers and final energy cost savings. Figure 3.18 shows that for a five-year time span – assumed to be the maximum term that households will use to evaluate an investment – the minimum payback period is 44 months with a maximum saving of Rp 250 thousand, for a middle class connection group of 900 kVa per month at a price of Rp 605 per kWh. It should be noted that this high figure was mainly due to the availability of differentiated data on current refrigerators in Yogyakarta. For higher income and energy price groups, the conditions are better, but savings still do not warrant immediate replacement.

Figure 3.18 Net present value analysis for replacing refrigerators with more efficient units in Yogyakarta, Mataram and Semarang



The potential savings (Figure 3.19) are very large, and of great public interest, as they reduce energy demand at peak loads, reducing the need for brownouts and the total amount of energy price subsidies.

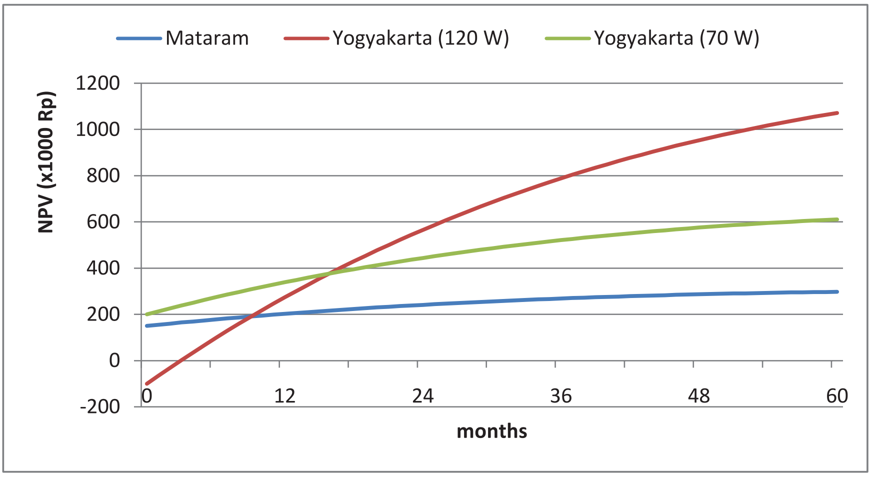
Figure 3.19 Total potential energy savings for replacing refrigerators with more efficient units in Yogyakarta, Mataram and Semarang



To improve the financial conditions, several scenarios were modelled, such as a 50% investment subsidy and a 25% increase in energy price. Although the results improved, they still did not justify the investment for households. The currently selected scenario assumes that owners will immediately replace their current refrigerator, and therefore the investment cost is the total cost of a new refrigerator. An alternative scenario is analysing consumers in the market for a new refrigerator. Here the investment cost is the difference between an energy efficient and a regular unit. Figure 3.20 shows that the financial characteristics are far more favourable, and that often the purchase of a more efficient unit involves lower costs. The potential savings are lower compared to the previous scenario that assumed immediate replacement, but are still considerable. Consumers in the market for refrigerators - in all regions - currently have no information to judge the difference in associated energy costs, and choices are based solely on price and aesthetic or additional features. This supports the need for energy-labelling of household appliances and for information campaigns.

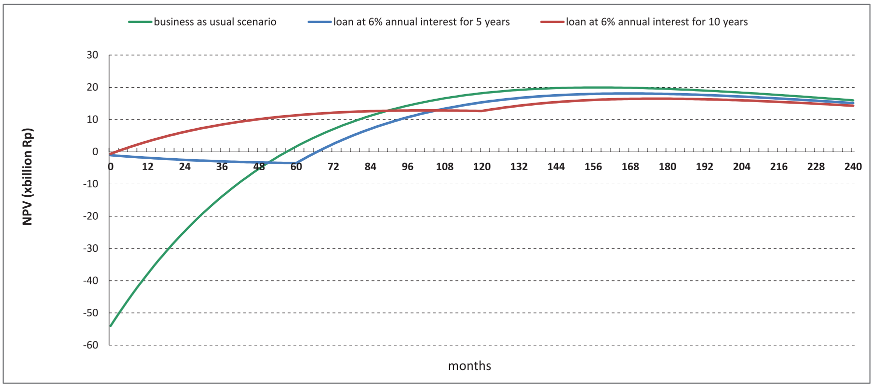
Refrigeration is an example of a national energy efficiency policy that can lead to savings across Indonesia. In the industrial and commercial sectors, more targeted regional policies require the involvement of the regional

Figure 3.20 Net present value analysis for consumers in Mataram and Yogyakarta, currently in the market for a new refrigerator



government. For example, in North Sumatra the industrial sector is dominated by palm oil refineries that use diesel generatorsfor several hours to start the productionprocess. A possible intervention is to use the liquid waste from the process to make biogas, and use an adapted generator to power the plant. Liquid waste is produced in such large quantities that excess can be sold to PLN, thus further improving the financial conditions of the investment. In the business-as-usual scenario, the total savings and payback period are positive, but private plant owners perceive the investment cost as too high (Figure 3.21).

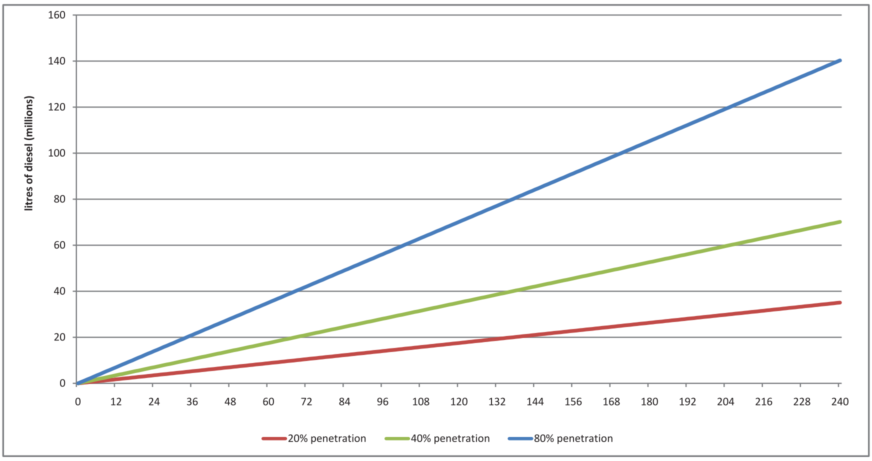
Figure 3.21 Net present value for investing in electricity generation through waste streams at one palm oil mill



Access to finance is a common barrier to both energy efficiency and renewable energy investments in Indonesia, and private operators are reluctant to invest in their own savings. Although the government has announced the availability of low interest loans at 6% per year for a maximum of five years, few programmes provide examples or best practices for industrial partners. On a regional level, the government does not have a capable and dedicated body that is involved in this programme, and the terms and conditions of the programme remain unclear to many industrial partners.

Figure 3.22 shows three scenarios for the millions of litres of diesel that can be saved when four hours at start-up are mitigated. The savings associated with the potential of 1.2 TWh of electricity generated per plant are not included. Nevertheless, even if 20% of the palm oil mills adopt this energy efficiency measure, an average of two million litres of diesel per year can be saved. To realise this, regional governments should involve both palm oil mills and local financial institutions to create a stakeholder platform for sharing experiences. It is currently unclear if banks are aware of the positive and low-risk financial characteristics of these investments, or if companies are aware of the potential savings and additional income generation. Similar scenarios are found in other regions. In West Nusa Tenggara, for example, introducing solar water heaters in the tourism sector displays the same barriers of high investment costs, while savings and payback periods can be attractive.

Figure 3.22 Potential savings on diesel in North Sumatra

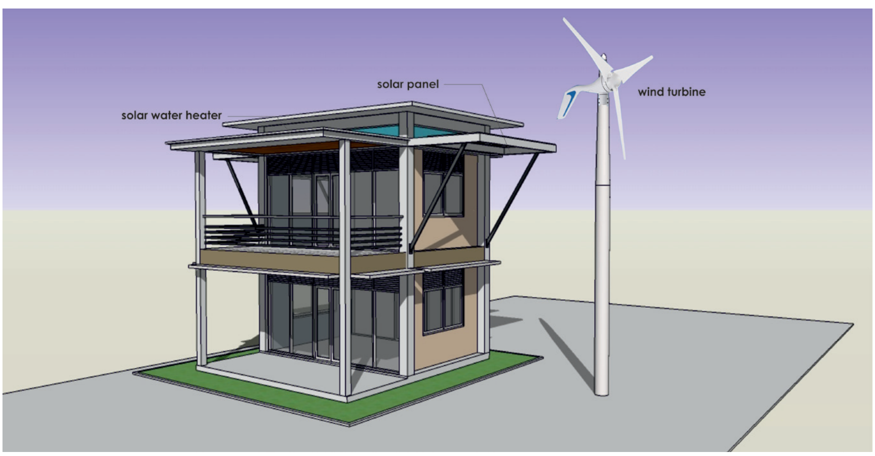


3.3.5 Main findings and observations

The potential for energy efficiency is very large in Indonesia. Despite the low and subsidised energy prices in the household sector, consumers can still save on energy costs and regions can realise considerable reductions in energy demand. Both national and specific regional policies and regulations have been identified that increase the attractiveness of investments in energy efficiency. However, the main barriers differ largely between sectors. In the household sector a barrier is the lack of information and awareness, while the main barriers for SMEs are a lack of technical capacity and access to finance. TWG III recommends that the supportive policy mechanisms to tackle barriers should not take the shape of direct energy subsidies across sectors, but rather appeal to consumer behaviour and take measures that remove the specific barriers per energy consumer group. This requires additional government capacity and responsibility at both a national and regional level.

This TWG recommends two time frames to prioritise energy efficiency. In the short term, regional governments can benefit from targeted awareness campaigns for low-income households and cooperation with financial institutions to develop sector associations or platforms focussed on energy efficiency. This is best achieved by creating actively engaged regional energy efficiency agencies (comparable to the Energy Efficiency Clearing House at the national level) that provide SMEs with tools to enjoy favourable energy efficiency policies. These agencies are crucial to achieve the defined goals

Figure 3.23 Energy Efficiency demonstration house constructed at UMY



UMY constructed a demonstration house, applying efficient and renewable energy technologies. Electricity is generated by the solar panels of 100 Wp each and a 400 W wind turbine. A roof-mounted solar water heater provides hot water. The construction materials and the ventilation design provide a constant inside temperature of 23 °C during the day.

and actions and to assume responsibility over the programmes. At a national level, it is vital that labelling schemes for household appliances are not delayed further. Local or regional governments should be required to identify sectors or industries with high energy savings.Regulation and budgets should be set on green procurement for public buildings and on services for the construction sector to develop experience in 'green' construction.

For the long term, national policies should phase out inefficient and dated products (through labelling schemes), reduce subsidies on household energy prices and provide regional governments with a platform to exchange and share ideas. Regional governments should aim to create regulations that stimulate private parties to invest in energy efficiency measures and that reduce the financial risks. It is believed that the technical capacity of regional governments to carry out these objectives will be improved in the long run through more knowledge sharing between regional governments – preferably through the recommended regional energy efficiency agencies – and by increasing the responsibility and budgets of regional governments for these activities.

3.4. TWG IV: Renewable energy project development

3.4.1 Background

Indonesia has significant ambitions to increase the use of renewable energy, envisioning many benefits, such as reduced dependence on fossil fuels, job creation, diversifying energy sources, developmental benefits, and health benefits.

However, small-scale renewable energy projects are inherently different from large-scale centralised energy planning. They often require special knowledge and a specific type of support to take off.

3.4.2 Objectives

The main objective of TWG IV was to build human capacity for identifying and developing small-scale renewable energy projects, and to implement a project example in each target region. The following intermediate objectives were set:

- Conduct a needs assessment as the basis of the technology choice (this links to the same activity in TWG V, but there it serves a pro-poor policy).
- Identify suitable non-hydro projects for each target province. As small-scale hydro projects were already developed in the predecessor project Carepi, the focus turned to other possible resources for households.
- Develop a business plan. Regional technical energy teams had to become acquainted with presenting the project to potential funders.

- Identify potential funders for the implementation of their project.
- Construct the project. The minimum required was a demonstration unit.

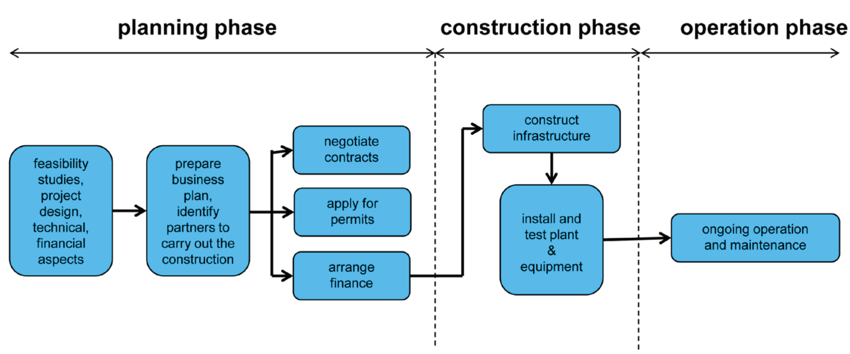
3.4.3 Methodology

The methodology consisted of the standard project cycle (Figure 3.24). The regional teams were learning-by-doing. A step-by-step approach offered teams a practical guide towards the implementation of small-scale renewable energy projects.

Based on the outcome of the needs assessment conducted in TWG V (pro-poor energy strategy), each regional technical team selected a renewable energy technology that would be the focus of TWG IV. Once that was done, they took the following steps:

- Conduct a feasibility study. Teams analysed every technical, financial and other aspect of the project, including the timeframe for completion of the various phases. For the feasibility study, teams carried out several field visits, took measurements or obtained them from their construction partners.
- Develop a business plan. Teams complemented the data gathered during the feasibility study with technical data obtained from the technology providers, construction contractors and interviews with potential users.
- Identify partners. As teams do not have the capacity (technical or physical) to do the construction work of the project, they had to find partners for the construction phase. Such partnerships then worked on a mutual benefit basis: the regional teams provided their partners with a completed feasibility study, while the partners brought in construction skills, in some cases promotion material, necessary permits and contracts and also (part of) the finance for construction.

Fig 3.24 A typical project cycle



- Construct (or start construction of) the project. Teams were required to be present at the construction of at least the first few units of the chosen technology to become familiar with the process. They also monitored the functioning of the units for a certain period, both to appreciate the importance of after-sales service and to monitor the performance of the selected technology.

3.4.4 Cross-regional analysis

Table 3.20 summarises similarities and differences between the five target regions in methodology, implementation and results.

North Sumatra

In North Sumatra the remote villages of Sei Siarti and Selat Beting were chosen, located in the district Labuhan Batu, Panai Tengah Regency. The needs assessment showed that the villages lack affordable fuels, due to their remoteness. LPG supply is limited and traditional fuels like kerosene are considerably more expensive because of transport costs. Of all their energy needs, lighting seems to be the most pressing one.

Table 3.20 Methodology, implementation and results in five target regions

Indicator	North Sumatra	Central Java	Yogyakarta	West Nusa Tenggara	Papua
Main issues with methodology	Technical and financial feasibility of the project	None	None	Securing finance	Many, incl. Data collection, understanding technology, writing business plan
Choice of technology	Solar home systems	Household biogas	Household biogas	Household biogas	Solar home systems
Energy service provided	Electricity for lighting & entertainment	Cooking fuel	Cooking fuel	Cooking fuel	Electricity for lighting & entertainment
Partnerships established	Regional dinasenergi	Hivos& multi-finance institution	Hivos	Hivos	Regional dinasenergi
Implementation level achieved	None	Few units (incl. Demo unit)	Demo unit	Demo unit	None
Level of community involvement	Low	High	Medium	Low	Medium
Status of project	Ongoing; tied to dinas budget-cycle	Ongoing; tied to users' ability to arrange finance	Ongoing; tied to users' ability to arrange finance	Stalled, due to users' inability to raise finance	Ongoing; tied to dinas budget-cycle

For cooking, villagers can still collect firewood, except in the wet season, when they also use kerosene or LPG. Therefore, the technology chosen was the solar home system (SHS), an established option for off-grid electrification that can provide households with at least the basic amount of electricity needed for lighting and entertainment.

When designing the project, the main issue was a correct understanding of the relationship between the limited funds and the right capacity of the chosen technology to meet the basic energy needs of the target community. The initially proposed capacity was significantly larger than necessary and would provide a high level of energy service to a limited number of households, instead of providing the largest possible number of households with basic amenities. In the end, SHSs of either 50 or 80 Wp will most likely be installed (resp. Rp4.6 and Rp6.1 million per unit). This is sufficient for lighting an average-sized home and for powering a radio and a small television.

A partnership was established with the Dinas Energi, the regional energy office, which finances part of the SHSs through its rural electrification budget. Because the budget is not sufficient to provide off-grid electrification to all of the 2500 village households, it is important that the most cost-efficient option is implemented.

Government funding does implicate some challenges. Any further implementation is tied to the budgetary cycle of Dinas. As a financer, Dinas also chooses the contractor and sets the requirements for system warranty and maintenance, which might narrow down the involvement of the identified partners for the construction of the project. And government procedures are often at odds with market-based, user-focused provision of energy services.

Central Java

The team in Central Java has the most significant results, both in personal involvement and in practical solutions. Activities focused on Sruni village, a community of well-organised dairy farmers, close to Semarang. The village is connected to the PLN grid, so most households enjoy (fairly regular) electricity supply. Cooking, however, continues to be done on firewood. This fact and the nuisance of excess cow manure made household biogas an obvious technology choice: biodigestion is a simple process to turn manure into energy for cooking. It has many advantages, such as relieving the burden of women to collect firewood, preventing health risks from smoke and fire, reducing deforestation, improving hygiene and sanitation, and providing opportunities for women in the national domestic biogas programme. Furthermore, it strengthens the integration of agriculture and cattle breeding, improves agricultural output through the use of biogas slurry, and creates jobs in the biogas construction sector. Environmental awareness and the relation between environment and economic progress are promoted, and greenhouse gas emissions from livestock and organic waste disposal are controlled.

The technical team in Central Java established a close working relationship with the Dutch development organisation Hivos, which is rolling out a household biogas programme across a number of provinces in Indonesia. Hivos provided technical expertise, and a trained constructor built the biodigesters. The technical team promoted the technology through socialisation events, and searched for additional finance to support implementation of biodigesters in Sruni (at a partly subsidised price of Rp3.7 million, which is still rather high for a poor household). The team involved the local dairy cooperative to investigate how the latter could act as a multi-finance institution, allowing local farmers to finance their biodigesters with small amounts of their milk sales.

The strong involvement of the regional technical team, especially in organising and assembling relevant stakeholders, bore fruit: a first demonstration unit was installed in Sruni in the second half of 2010, much sooner than in other regions. This is also the only region where the first few user-financed units were constructed, with more applications having been submitted by users. The most popular size of a biodigester amounts to 4 m^3, designed to digest manure of three cows and to provide fuel for a domestic stove for about four hours a day. This is sufficient for a medium-sized household.

Yogyakarta

The process and result in Yogyakarta resemble those in Central Java. The chosen technology in the village of Segoroyoso, in the Bantul regency, was also household biogas, and for the same reasons as in Central Java. Most households are connected to the PLN grid, so there is no need for additional energy for lighting. LPG is widely available, but villagers find it relatively expensive, and continue to cook mainly on firewood. More over, animal husbandry is an important source of livelihood for the local community, which ensures sufficient feedstock for the biodigesters.

Figure 3.25 Biogas digester installed in Sruni village, Central Java

A Biogas digester is a simple technology that turns manure into gas for cooking or heating water. Cow dung is collected from the shed, mixed with water and fed into the digester, which is located right next to the house. Pipes from the digester bring the gas to the kitchen.

Hence, both the need and potential solution to improve the provision of energy for cooking are present, making household biogas a viable option.

Again an active partnership was established with Hivos. With CASINDO finance, a demonstration unit was built in the village, and the technology and its benefits were widely disseminated by the regional technical team, which prompted the interest of other residents. The owner of the demonstration unit agreed to showcase the technology and explain its benefits to future interested users. Other finance options were also researched by the team, but they were not realised. As a result, the project implementation was not as broad as in Central Java.

West Nusa Tenggara

Similar to Central Java and Yogyakarta, the technology chosen for implementation in the village of Jeruk Manis in Lombok was household biogas, although the choice was less straightforward. Jeruk Manis is also a community of cow breeders, however, compared to breeders in Java, their income levels are much lower. In addition, only about a quarter of the households have electricity; others meet their lighting needs with kerosene lamps. Nevertheless, during the needs assessment the villagers expressed energy for cooking as their most pressing problem, which is why household biogas was chosen as the best solution.

Again, cooperation with Hivos was established to bring the technology to the location. The technical team conducted socialisation events and a demonstration unit was constructed to showcase the technology. Despite this, the community's interest did not translate into additional applications, mainly because of the very low income of villagers (even the subsidised price of Rp 3.7 million for the smallest digester is almost ten times the average monthly household income in JerukManis). Additional financial sources, or at least a favourable finance scheme, would have been necessary for a real take-off of the project, but that option did not materialize.

Papua

In Papua, activities focused on Enross, a small community of fishermen in a village built on stilts, just outside the city of Jayapura. The village has no regular provision of energy services whatsoever. The villagers mentioned lighting as the most pressing energy need, since kerosene and candles for lighting cost money, whereas firewood for cooking is still mainly free. This is a similar outcome as in North Sumatra. The technology choice was therefore the same: solar home systems (of 50 Wp), sufficient to power a few light-bulbs and a small entertainment device.

Figure 3.26 50 Wp Solar home system installed at home in Engross village, Papua.

However, several challenges arose, such as obtaining good data on the energy needs of the community, understanding the roles of the different stakeholders, and establishing the connection with a market-based energy service.

For the finance and construction of SHSs, the regional team also partnered with Dinas Energi, and Engross was included in the list of locations for the off-grid electrification programme of Dinas Energi. Since Engross is much smaller than the target villages in North Sumatra, Dinas could commit sufficient funding to install a 50 Wp SHS in all 115 households of Engross, even though the per unit cost (about Rp 5.6 million) was significantly more expensive than in North Sumatra. The contract with the provider of the systems includes requirements for after-sales services. Budget for the implementation of the project is available but is tied to the budgetary cycle of Dinas, and therefore could not be realised during the implementation of CASINDO.

3.4.5 Main findings and observations

Several successful initiatives for small-scale renewable energy projects offer valuable lessons and could be replicated at a wider scale, but more project developers with the right knowledge and skills are needed to achieve this.

The understanding of a market-based, user-focused approach is limited. Selecting a technology and designing a project to fit the actual community needs was a novel approach to most of the regional technical teams, but they understood and appreciated it quickly. An important outcome is that teams are able to advise their regional energy office on how to prepare an energy programme, based on user needs.

Organisations with a market-based focus offer more benefits for a partnership than the government, because they address more critical success factors. On the other hand, a partnership with the government leads to improved governmental programmes, at least in the planning stage. When designing a small-scale renewable energy project for the poor, special attention should be given to:

- A financing scheme. Even very simple, seemingly inexpensive technologies might be difficult to finance for low-income households. Projects must therefore include a financing scheme with spread payments over a long period of time, or a subsidy to reduce the cost for the users.
- A proper introduction of a new technology through socialisation events is crucial for community acceptance.
- After-sales service and maintenance: a framework for monitoring the equipment should be put in place, with clear responsibilities for maintenance. In remote locations, where regular monitoring is complicated, users should be trained in maintenance and basic repairs.

Arranging finance was the most challenging part due to the teams' limited awareness of finance possibilities and Indonesia's under-developed banking and finance sector. To reduce reliance on government funding for renewable energy project development, both will need to improve.

3.5 TWGV: Pro-poor energy strategy

3.5.1 Background

The situation of poor people – low income levels, often living in remote areas and following traditional lifestyles – calls for a strategy that can be significantly different from that for the middle and high-income population. So far, pro-poor energy programmes in Indonesia have had mixed results. Many regions would benefit from a better informed process of designing interventions. That is why TWG V aimed to formulate an energy strategy for each of the five target regions, aimed at addressing the needs and priorities of poor communities with limited or no access to electricity and other modern forms of energy. For this strategy, the energy situation and needs of poor communities must be better understood and integrated into the programme planning stage. The activities conducted within TWG V allow the regional teams to advise policy makers on how to prepare more focused and effective policies or programmes targeted at the poor.

3.5.2 Objectives

TWG V aimed to develop a pro-poor energy strategy with concrete proposals for the target community, which could be generalised to the regional level. To achieve this, a number of sub-objectives were defined:

- Review of pro-poor policies in Indonesia: what can be learnt from policies and programmes that impact the energy situation of the poor;
- Select a suitable target community: teams need to get engaged in a representative (poor) community, to get a good grip on its energy challenges and look for practical solutions;
- Conduct a needs assessment;
- Identify options to address identified needs (this objective overlaps with TWG IV, but in this case is not for concrete interventions, but for generalisation in a wider programme for all communities in a similar situation);
- Formulate a regional pro-poor energy strategy: with insights from the evaluation of existing measures and a better understanding of a poor community's needs and priorities, a simple pro-poor energy strategy with a clear improvement target can be designed.

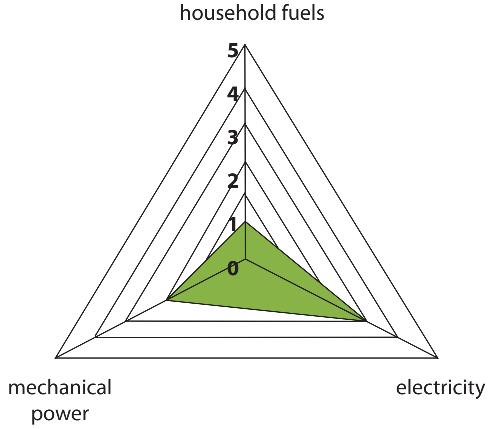
3.5.3 Methodology

The methodology of TWG V was elaborated for each sub-objective. The regional technical teams had to review national, regional and local energy policies and programmes, and evaluate their direct or indirect effect on the energy situation of the poor. To select a suitable community, the teams had to analyse socio-economic data for a number of locations in their region, consult with the regional energy office, conduct field visits, establish contact with community leaders and then make a final decision on a target location.

For community interaction, a people-centred approach had to be chosen, involving interactive participation and taking due note of indigenous knowledge and local energy practices. The appreciative inquiry was suggested (but not imposed) as a means to collect the relevant data on the target community's energy needs and priorities. The result of this activity was also an important input for choosing the renewable energy technology to be deployed in TWG IV (Section 3.4).

Identifying options to address needs involved finding a practical solution to the most pressing energy need in the community.

Fig 3.27 Triangle diagram of the energy situation in a community



Source: Diagram and scale adapted from the Poor People's Energy Outlook (Practical Action 2010)

Designing the pro-poor strategy consists of three parts:

1. An improved methodology for planning pro-poor programmes.

2. A simple strategy for the target location, following four steps:

   a. a clear description and explanation of the current energy situation , using a triangle graph, representing the three main energy services (Figure 3.27);

   b. a clear and realistic target for improvement (in a second triangle diagram);

   c. explanation of the intervention needed to reach the targets;

   d. a timeframe for implementation (preferably linked to a government cycle), with responsibilities for implementation and an estimation of the costs.

3. A generalisation of the proposed programme to the regional level.

3.5.4 Cross-regonal analysis

The content of TWG V was very policy-oriented and hence its approach was quite new to most regional technical teams. Especially assessing pro-poor energy policies and programmes proved to be quite a challenging task, but it was nevertheless conducted thoroughly.

A summary of the assessment of some of the main policies is presented in Table 3.21.

For the needs assessment, teams conducted field visits, engaged with local community stakeholders, organised a workshop and carried out a survey and semi-structured interviews. Most teams used the appreciative inquiry approach, although to different degrees of formal adherence. All teams managed to engage the community and put its members in the centre of the discussion. While some regions (most notably Papua) showed discrepancies in the data on the community energy use, all teams were able to identify the community's highest priority. The final technology choice in each region, based on this needs assessment, can be found in Section 3.4 (Table 3.20), which contains the report of TWG IV.

Designing a potential intervention for the target locations was successful, but generalising it up to the provincial level proved challenging. Only for Yogyakarta a comprehensive strategy was developed that could cover a significant part of the cooking energy needs of poor populations in the province as a whole. Beside household biogas, it includes the promotion of jathropha oil. The strategy also provides a detailed financial analysis of the proposed interventions and a roadmap for implementation, including possible finance schemes and a definition of roles for all stakeholders. In this strategy, the community, farmer groups and local entrepreneurs are owners and responsible for managing the energy infrastructure installed in their communities; the local administration office provides the energy facilities and infrastructure, allocates budget for energy alternatives in the region and supervises the implementation of the projects. The regional energy office continues to focus on alternative energy programmes for infrastructure provision and capacity building, while various financial institutions are requested to provide credit schemes for farmers. Finally, the local university has important roles in implementing the strategy, such as providing training and education, mentoring and assisting in the operation of energy alternatives, and conducting applied research and development.

Also for Papua, the importance of capacity building and the availability of the right technical skills were explicitly included in the strategy. There, collaboration between the technology distributors– the university and local vocational schools (SMKs) – is included as a crucial factor for successful implementation of solar-powered electrification.

Table 3.21 Review of pro-poor policies in five target regions

Policies/programmes	Policy objectives		Implementation		Policy objective likely to be achieved?	Impact on poor & suggestions for improvement
	Main objective	Secondary objective	To-date	Future		
National level						
Reduce consumption of lower quality fuel (gasoline and diesel) in transportation	Reduce burden on the budget, caused by fuel subsidies	Reduce emission from transport	Between 2011-2013	Fuel price diversified for private and public use	Yes, the cost of fuel subsidy will be reduced	Savings from reduced subsidies can be used for other programmes, including pro-poor
Provincial level						
Papua Kampung mandiri terang ('the shine of the village'); programme of provincial Dinas Energi Survey investigation and design in villages across the province to identify energy potential and implement the solution	Identify & implement best energy solution for native people		The aim to survey 100 villages per year is probably not fully achieved	Not likely, because of conflict of interest, low population density, and no strict supervision of implementation	Maybe over a long period of time	Limited success in improving the energy situation of some villages (by providing off-grid electricity for lighting)
North Sumatra MEMR regional office programme on implementation of SHSs	Provide electricity to unconnected villages	Reduce use of kerosene for lighting	2600 SHSs distributed since the start in 2003	By 2013 a total of 4200 SHSs	Yes, even more; in 2010 alone the government set aside budget for 2000 units	Due to lack of maintenance and manpower all equipment is likely to break and stop operating. Dinas should carry out capacity building on SHS maintenance in all locations

Policies/programmes	Policy objectives		Implementation		Policy objective likely to be achieved?	Impact on poor & suggestions for improvement
	Main objective	Secondary objective	To-date	Future		
West Nusa Tenggara Substitute kerosene for tobacco drying with coal gasification and LPG	Sustain energy supply for tobacco drying	Diversify energy supply; introduce new drying technology	Start in 2010; some farmers received partly subsidised new drying technology; now fuel needs to be provided		Yes, although initially some farmers were reluctant to adopt the new technology	Farmers get technology that is cheaper than kerosene, so production costs will decrease; government should improve introduction of this technology and find a supplier for stable delivery of fuel
Central Java Desamandirienergi ('energy self-sufficient village')	Promote using local energy potential (biofuel and othertechnologies), operable by local community		By the end of 2009, only half of the targeted 850 DMEs was formed	3000 DMEs by 2014	partly	People totally rely on the government for the implementation;interest is lost since lower price of kerosene
Yogyakarta Solar home system programme	Help households to overcome the high upfront cost of the SHS		Slow; end of 2007 only some 175 units distributed;newer data still missing		Partly	Temporary provision of solar electricity to off-grid households, but limited ownership of equipment reduces maintenance and thus lifetime

3.5.5 Main findings and observations

Developing a pro-poor strategy requires a deep understanding of the energy situation of the poor, setting ambitious but realistic targets, defining roles and responsibilities for implementation, and, crucially, setting up a rigorous monitoring framework. The policy evaluation reveals that most existing governmental pro-poor energy programmes are well-intentioned, but lack one or more critical success factors.

Pro-poor energy strategies need to be embedded in the wider framework of energy planning: often different offices run different programmes that may have the same aim, but are not sufficiently coordinated. For example, a community which is due to be electrified within a couple of years is provided with SHS, while many other communities cannot even expect a grid connection in the mid-to long-term.

A pro-poor energy intervention needs to be based on solid information, to provide solutions for the most pressing energy needs as defined by the community (i.e. it is no use to provide biogas for cooking when people feel a stronger need for electricity, and vice versa).

Right from the start, target communities need to be involved in the process: they should have a chance to voice their needs, but also need training to understand the provided equipment.

Monitoring of the implementation and equipment performance must be an integral part of the strategy, as should be an after-sales service to ensure that malfunctioning but reparable equipment is not discarded.

Any pro-poor intervention should be based on the principle of maximisation of basic energy services: the aim should be to provide at least the minimum energy service to as many households as possible, and not a higher (often unsustainable) level of service to a smaller number of households.

The majority of the above ideas were new to most of the regional teams. However, community involvement and a closer look at initiatives quickly made them realise that effective provision of energy to the poor involves much more than a top-down distribution of a SHS to households that find themselves on an arbitrarily composed list. This realisation was translated into developing regional pro-poor energy strategies, developed to different degrees of sophistication.

Together with the work conducted in TWG IV, the teams learnt to appreciate the importance of small-scale renewable energy technology for the poor. Often, it is the most effective way to reach remote communities. However,

Figure 3.28 Firewood use for cooking

Many poor households cannot afford LPG or kerosene, and still rely on wood for cooking. This is very time-consuming and inefficient. If cooking is done indoors, the smoke also constitutes a real health hazard development of sustainable market-based renewable energy solutions is still not properly understood. It is therefore important that pro-poor government intervention explores the complementarity with market-based solutions and not regard them as mutually exclusive. Cooperation with Hivos was an excellent opportunity to learn about the benefits of a well-coordinated market-based programme.

3.6 TWG VI: University education and research programme

3.6.1 Background

In TWG VI the existing cooperation between the Eindhoven University of Technology (TU/e) and five Indonesian partner universities was continued and further strengthened, with the aim of making the partner universities leading organisations in sustainable energy and energy efficiency in their region. These partner universities are:

- Muhammadiyah University of Yogyakarta (UMY), Yogyakarta.
- University of Mataram (UNRAM), Mataram.
- University of Sumatera Utara (USU), Medan.
- Diponegoro University (UNDIP), Semarang.
- University of Cenderawasih (UNCEN), Jayapura.

In each of the five regions, a needs assessment was conducted to verify whether a demand existed for people with an academic education in sustainable energy and energy efficiency. The Indonesian universities contacted local industries, companies, institutes and entrepreneurs to obtain information on whether they would be interested in hiring personnel with these skills. Almost all interviewed stakeholders expressed interest in either experts in efficient use of energy or experts in sustainable energy technologies.

3.6.2 Objectives

To become a local leader in this area, each university had to improve itself in education, researchand development, and in relationships with the local industry.

Objectives of TWG VI were:

- Develop and implement an academic education programme.
- Install demonstration units at each of the universities, to make their ambition public to visitors and to attract students.

- Develop research projects, as part of an overall research agenda.
- Establish relationships with industries and companies to identify research questions.

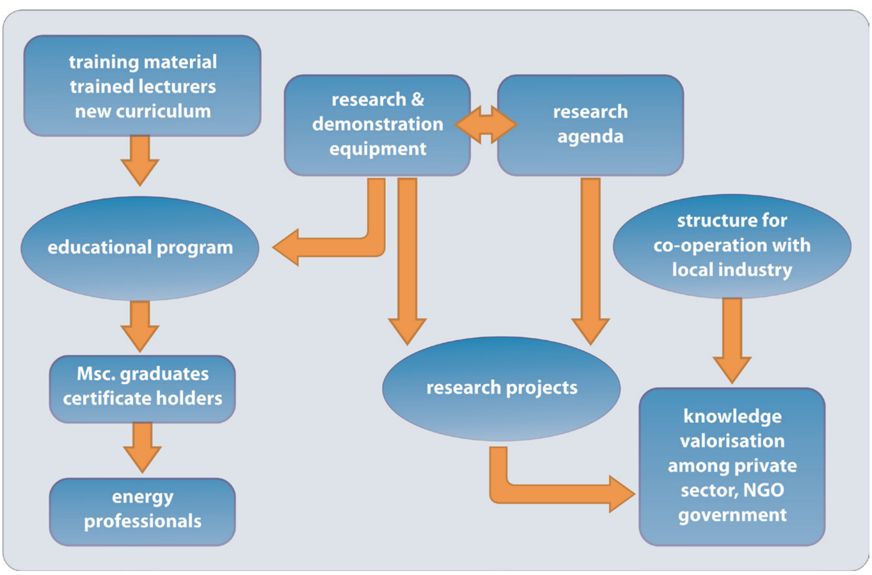
3.6.3. Methodology

An integral approach was chosen, including training of lecturers, workshops in co-operation with local industry, research, and purchase of equipment (Figure 3.29).

Important input for an education programme is knowledgeable lecturers with sufficient material to develop courses. The output consists of students with either a master degree or a certificate in sustainable energy and energy efficiency.

Research and demonstration equipment are important input components, because practical courses are as important as theoretical knowledge. An integrated research agenda ensures that projects contribute to the overall research objectives of the university. A structure in which university and local industries can easily contact each other ensures that research projects contribute to valorisation of knowledge outside the university.

Figure 3.29 Components of the university education and research programme



3.6.4 Cross-regional analysis

Universities differed in level and knowledge of sustainable energy and energy efficiency. Although they carried out the same activities and followed a similar timeline, differences were allowed, depending on local needs, available resources and experience in research areas. Each university chose strategic areas within which education and research would be developed (Table 3.22).

Each university formed a group of lecturers and responsible managers to conduct the programme. During the project, some lecturers left or were replaced. It remained important to ensure the involvement of a sufficiently large group of enthusiastic and skilled people with different backgrounds and interests, to prevent the project from weighing too heavily on team leaders and designated lecturers.

As two of the universities, UNCEN and UNDIP, had not co-operated with TU/e in a previous project, they were offered the opportunity to catch up by organising two additional workshops to improve knowledge and establish relationships with TU/e.

Table 3.22 Strategic areas selected by universities

Universities	**Topics**			
UNDIP	Biogas	Photovoltaic systems	Energy efficiency in transport	Energy efficiency in industry
UMY	Solar energy	Wind energy	Energy management	Energy economics
UNRAM	Biogas	Photovoltaic systems	Pyrolysis of biomass	Wind energy
UNCEN	Biomass	Biofuels	Photovoltaic systems	Hydropower
USU	Biogas	Solar power	Wind energy	

Education programmes

Each of the five partner universities developed an education programme on sustainable energy and/or energy efficiency. Lecturers were trained at TU/e and at the partner universities, and received training material. The university programmes differ in contents as local needs, resources and interests influenced their set-up, structure and focus on topics. All universities developed a degree programme (master) or non-degree programme (certificate).

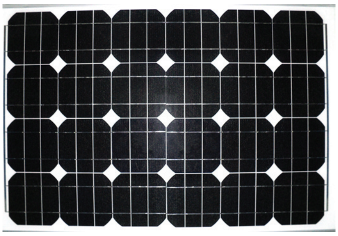
Figure 3.31 shows that UNDIP and USU will establish a master's programme on sustainable energy and energy efficiency, as soon as the Ministry of National Education approves the applications. Until then they will offer certificate programmes. UNDIP submitted all documents in 2011, but the first proposal was rejected for administrative reasons. It was resubmitted at the end of 2011, and the procedure can be finalised around May 2012, allowing the first master students to start in September 2012. USU has started its master's programme as a specialisation of the Mechanical Engineering degree. After a few years, USU will go through the same procedure to gain an official status for this degree programme.

UMY, UNRAM and UNCEN have developed a certificate programme. In 2011, the Mining Engineering Bachelor and Diploma degree at UNCEN needed to be revised as part of the regulations concerning curricula for bachelor education. Staff of UNCEN saw this as an opportunity to include a course on sustainable energy within this revised curriculum. This curriculum has been approved. Sustainable energy will also be part of the Electrical Engineering department. A certificate is rewarded to students who complete a single semester course.

UMY, the only privatised university in the project, does have more authority to revise curricula without government permission. The faculties of Engineering, Agriculture and Economics jointly developed a multi-disciplinary certificate degree.

UNRAM initially envisioned a post-bachelor certificate programme of six months, but later decided to compress it to three months and to include it in the existing curriculum for bachelor education. These changes will most likely increase the number of students. The seven courses are offered as electives within the faculty of Engineering. For a certificate, a student has to finalise three to four courses.

Figure 3.30 Demonstration and research equipment installed at UNRAM and UNCEN



50 Wp polycrystal solar module with battery, inverter, accu, regulator and LED lamp installed at UNCEN

A methane biogas digester storage tank installed at the renewable energy laboratory of UNRAM, March 2011

Figure 3.31 Overview of education programmes and targeted participants in the five regions

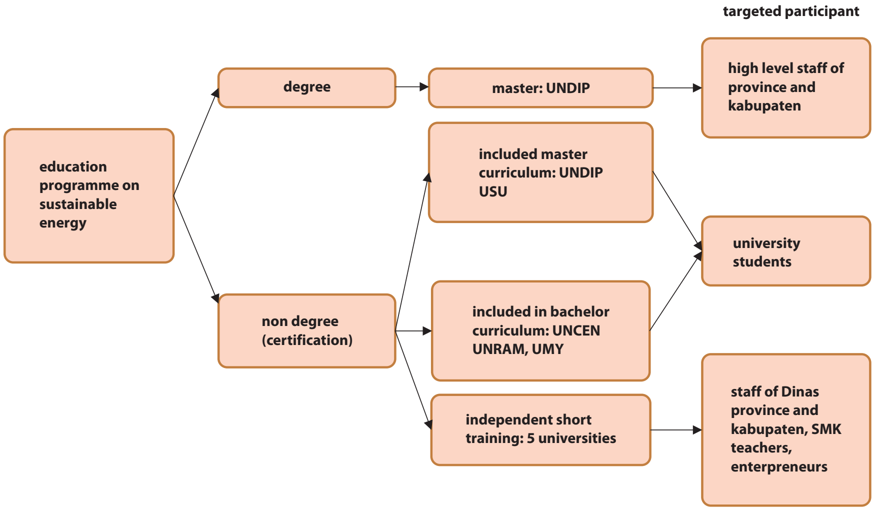


Figure 3.31 has been designed by Prof. M. Ashari of ITS, Surabaya. As an external expert, he has evaluated the education programmes through visiting and discussing the programme with different stakeholders, reading formal documents and analysing the curricula

All universities also offer short courses to government officials or other interested professionals. This allows the universities to validate their knowledge and obtain additional funding for their education programme.

At UMY, UNRAM and UNCEN, the courses are part of the common curricula and should not lead to additional costs. At USU, the courses are part of a new and extensive specialisation within the faculty of Mechanical Engineering (almost as extensive as a master's programme). This will bring about additional costs, most of which should be covered by tuition fees and government funding. USU will have to grow towards a sufficiently large group of students to recover costs. This also goes for UNDIP, but here recovery of costs is more uncertain, as a completely new programme involves more costs.

Within universities it is a common approach, though, to start a new programme and accept a financial gap for several years until the number of students increases. Chances are that the government will compensate for this gap for some years. After five years, it can be concluded whether the education programme can be continued.

Demonstration units

Demonstration units allow the university to show its ambition and to stimulate visitors, but they are also useful for research and experiments. The procurement

Table 3.23 Installed demonstration equipment at the five partner universities

Demo equipment	university
Photovoltaic systems for demonstration of solar energy	UNCEN
Energy survey equipment	UNCEN
Tools for briquetting of rice husk	UNCEN
Solar powered adsorption refrigerator	USU
Biodigester of plexiglass	USU
Biomass demonstration unit, producing biogas that is connected to a dual fuel engine	UNRAM
Biomass demonstration unit in which biomass is burned to produce bio-oil (pyrolysis oil), syngas and char	UNRAM
Solar energy demonstration unit	UNRAM
Wind energy demonstration unit	UNRAM
Solar home system	UMY
Demonstration house	UMY
Small-scale wind generator	UMY
Weather station	UMY
Solar water heater	UMY
Renewable energy science kits for laboratory	UMY
LED lights (set of different intensities)	UMY
Digester and several tanks for upgrading of biogas	UNDIP
Smoke meter, digital gas analyser, data logger and auto scanner for improving the efficiency of engines	UNDIP
Solar energy sitting ground,generating electricity for charging laptops, mobile phones, etc.	UNDIP

of this equipment has taken a long time, due to the complicated procedure that had been agreed upon at the beginning of the project.

For a demonstration unit, a research proposal is needed with a well-organised plan for purpose and use. Proposals were assessed for many aspects such as completeness (research objectives, methods, relation to other research at university and local applications), logical list of equipment, and market conformity of prices. TU/e demanded at least three quotations. Despite this time-consuming procedure, the equipment has been successfully installed at all universities within the project period (Table 3.23). Most research projects could even be finalised.

Research projects

The research agendas of the universities are derived from the defined strategic areas. At each of the five Indonesian partner universities research projects have been prepared, started up, carried out and finalised. The universities wrote a research proposal, including a budget for the necessary equipment. TU/e staff checked these proposals for similar issues, such as the proposals for purchasing of demonstration equipment. At some universities the equipment lists and/ or proposals for both types of equipment were combined. The projects are presented in Table 3.24.

Table 3.24 Research projects at the five partner universities and interested industry

Project	University	Interested/involved industry
Biogas purification by membrane contactor coupled with algae photo-bioreactor	UNDIP	Algae sector
Installation and testing of a solar photovoltaic system of 1000 Wp as sitting ground	UNDIP	The sitting ground could be used at more public places;solar power can be relevant as alternative energy source for industry in Central Java
Effect of driving parameters on fuel consumption and emission of light-duty vehicles	UNDIP	Transport sector
Rice husk as ground material for production of charcoalbriquette, using hydraulic Jack tool press for home industry scales	UNCEN	Farmers and home industry
Development of solid catalyst from calcite of Jayapura and its positive influence on the process of biodiesel production from nipahfruit	UNCEN .	Many industries (transport,electricity)
Development of a prototype of solar-powered adsorption refrigerator, together with the data acquisition system for teaching and research equipment	USU	Dealers of installations in remote, non-electrified areas
Problem-solving on cacao plantations, using bio-methanisation technology	USU	Small-scale farmers, producers at large plantations
Automatic control of parallel operation of solar plant and micro-hydropower plant	UNRAM	Producers and installers of micro-hydropower equipment
Design of temperature control of a coal-fuelled tobacco dryer, using automation air circulation system	UNRAM	Cooperation research between university and PT. Djarum, PT. SadanaArif Nusa
Solar and wind hybrid power generation for the Lombok Geomagnetic Observatory	UNRAM	The Geomagnetic Observatory and other research institutes in remote areas
Use of a mosque dome for installation of a wind turbine for energy production	UMY	Could be interesting for implementation at buildings with similar towers/other mosque
Research of thermal performance of a solar water heater, using paraffin wax for heat storage	UMY	Solar heater producers

As CASINDO offered the opportunity of starting up new projects or scaling up existing ones, each university developed a fair basis to continue or expand research.

Knowledge valorisation

For all universities it has become more important to co-operate with the private sector, because financial means for fundamental research are reduced. The current trend is that most research has to become applicable within several years, which asks for co-operation with companies and industries. For the universities this was a great new challenge. They put in a lot of effort to invite the private sector to workshops (Table 3.25). Each university had a different approach. Some started with workshops to expose local governments and industries to certain research topics; another university defined the need of local industry beforehand and invited relevant speakers to the workshop.

Table 3.25 University workshops, topics and number of participants

University	Workshops
UNDIP	Energy auditing (60) Energy efficiency (>45) Auditing energy (45)
USU	Use of slaughterhouse waste though bio-methanisation (40)
UNCEN	Hydropower as a replacement of fossil fuels (27) Biogas/biofuels as replacement of fossil fuels (24) In-depth hydropower valorisation (30)
UNRAM	Use of biomass/biogas (>55) Use of photovoltaic systems and wind energy (40) Energy efficiency (40)
UMY	Launching the energy consortium Yogyakarta (35) Energy efficiency and energy saving through intelligent building engineering (25) Clean development mechanism for community perspective (125)

The workshops realised remarkable results. At one of the workshops of UNDIP, major opportunities to improve energy efficiency in hotels appeared, and its students are now doing research at these hotels. At USU, it was demonstrated that one lecturer with expertise and a network can organise an interesting workshop, in this case for the slaughterhouse industry. Staff of UNRAM appeared very capable of approaching local industries (such as the tobacco industry) and raising their interest in future research of their university.

Research projects of UNRAM aim at providing solutions to local energy-related problems. One example involves research into a suitable temperature control for coal-briquette fuelled tobacco drying with air circulation. UNCEN will start research projects, together with the local government, to determine the tidal energy potential in the Merauke region and the hydropower potential in two other regions. PLN and the oil palm industry have expressed their interest in co-operating with UNCEN as well.

UMY chose a different approach for organising workshops, as the region has few large industries. Spin-offs in the Yogyakarta region are found in relationships with communities to develop research and small-scale projects on for example biodigestion.

3.6.5 Main findings and observations

The new education programmes on sustainable energy are well established. As they have been formally approved by the boards of the five partner universities, they can be fully integrated in the existing curriculum. Academic tuition in the new programmes is guaranteed for at least the coming five years. Annually, over 500 students are expected to follow these programmes.

The lecturers have been trained intensively to teach the subjects on renewable energy. They will need to maintain and improve their knowledge and skills and regularly update the education material, but this is common practice at universities.

Figure 3.32 Demonstration and research equipment installed at USU and UNDIP

Wind and solar sensors on top of the roof of the Engineering faculty of USU, March 2011

Biogas analysis and improvement system installed at UNDIP, October 2011

Some lecturers went abroad for a PhD or master's degree on sustainable energy. When they return to their university after graduation, they will become leading persons in improving education and research.

The five partner universities have acquired the capacity to become an interesting partner for the local private and public sector in the field of renewable energy and energy efficiency. The new research equipment, installed at the partner universities by CASINDO, facilitates more advanced research projects and increases the chances of obtaining research assignments from the private sector. For universities, this is an important criterion for achieving a higher qualification level, which enhances qualification for funding by the Indonesian government.

The valorisation workshops in every target province strengthened the working relationships with the local industry. The new laboratories and the experience gained in the research projects carried out during CASINDO are expected to generate consultancy assignments from local companies.

3.7 TWG VII: Renewable energy and energy efficiency training module for vocational schools

3.7.1 Background

In the policy document 'Vision 25/25', Indonesia states that 25% of the total energy provision for the country should come from non-fossil sources. This ambition requires a drastic increase of the deployment of renewable energy technologies and of properly skilled people for installation, operation and maintenance. Recently, MEMR estimated that by 2025 it would need about 110,205 people with these skills.[1] This does not incorporate the need of non-governmental sectors, which will presumably be high (an overall quantitative picture is not yet available).

In the past five years, the Indonesian medium technical schools (SMK) saw an increasing demand for professionals with training in renewable energy and energy efficiency. CASINDO supported the schools in getting a better picture of this demand and in developing new curricula, training materials and conducting teacher trainings. As a result, several SMKs have been quite entrepreneurial in integrating renewable energy technologies in their curriculum and in promoting this education.

3.7.2 Objectives

TWG VII aimed to develop and introduce renewable energy training modules at eleven vocational schools in the five target provinces. This involved the identification of suitable SMKs, settling cooperation agreements with each of them, the development of curricula, the training of trainers and teachers, and the preparation of new training material.

3.7.3 Methodology

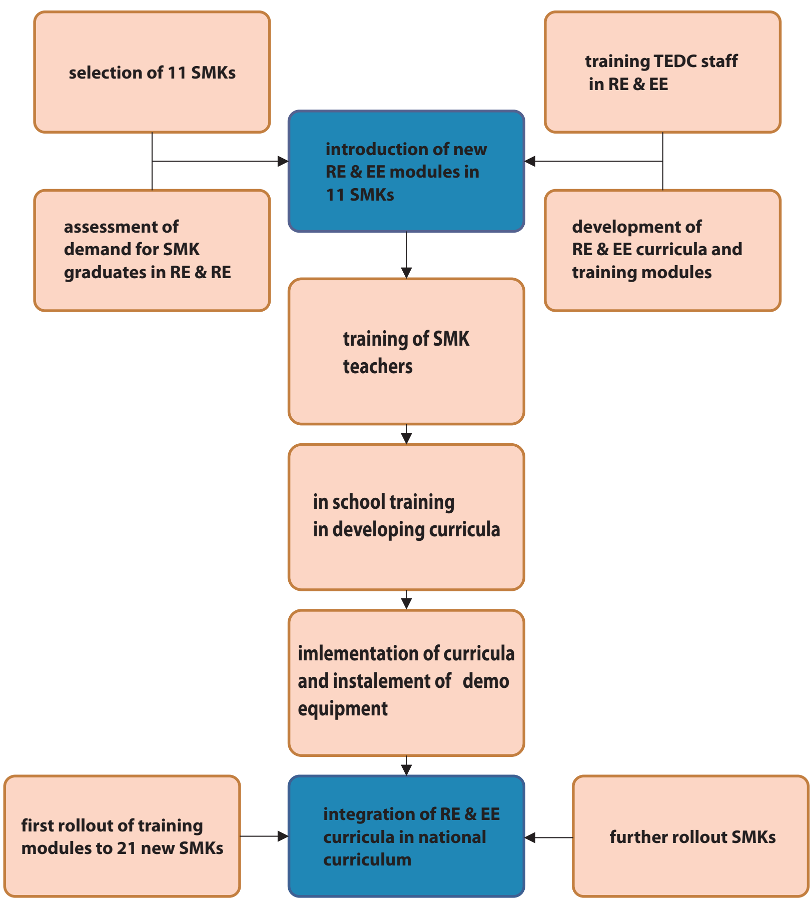
The methodology is depicted in Figure 3.33 and consisted of:

- Selection of eleven SMKs in five target provinces, based on school potential.
- Assessment of demand for SMK graduates in renewable energy and energy efficiency technologies in the target provinces.
- Training staff of the Technical Education Development Centre (TEDC) in Bandung in renewable energy and energy efficiency technologies.
- Developing new renewable energy and energy efficiency technologies training modules.

[1] Human resources needed for MEMR related to renewable energy within the framework of the Strategic Plan 2010-2015, issued by the Directorate General of Electricity and New Energy of the Ministry of Energy and Mineral Resources, 2010.

- Introducing the new training modules in the SMKs.
- Training teachers of the selected SMKs.
- In-school training to develop curricula for these SMKs.
- Implementation of the new curricula and installation of demonstration equipment.
- First rollout of new training modules to other SMKs.
- Institutional embedding in the national curriculum.
- Further rollout to other vocational schools.

Figure 3.33 Overview of the methodology applied for TWG VII



3.7.4 Cross-regional analysis

Selection of SMKs

In the five target provinces, 359 SMKs covered Technology and Engineering. This group was narrowed down with criteria such as possession of ISO 9001:2000 certification and government ranking in relevant streams, resulting in a total of seventeen candidates. They were all visited by the CASINDO team,which led to the final selection of eleven SMKs, based on the spreading of renewable energy technologies per province and geographical data.

All SMKs had previously undertaken initiatives to put education in renewable energy on the agenda, informed by the companies and knowledge institutions in their network. The SMKs opt for a broad introduction in renewable energy technologies in the first two years, and an in-depth training with practical components in two technologies in the last two years. Table 3.26 shows the participating SMKs and their renewable energy programmes. All schools intend to involve their students in development, management, maintenance and repair of small-scale power plants for on-the-job training.

Table 3.26 Selected vocational schools and their renewable energy programmes[a]

province	school	subject
Papua	Jayapura, SMKN 3	1. MHP, 2. PV
	Merauke, SMKN 3	1. PV, 2.WE
North Sumatra	Doloksanggul, SMKN 2	1. MHP, 2. PV
	Balige, SMKN 1	1. MHP, 2. biomass
	Rantau Utara, SMKN 2	2 . biomass, 2. PV
West Nusa Tenggara	Kuripan, SMKN 2	1. MHP, 2. biomass
Yogyakarta	Yogyakarta, SMKN 2	1. PV, 2. WE
	Pengasih, SMKN 2	1. MHP, 2. biomass
Central Java	Blora, SMKN 1	1. biomass, 2.PV
	Magelang, SMKN 1	1. MHP, 2. biomass
	Banjarnegara, SMK SwastaPanca Bhakti	1. MHP, 2. biomass

[a] MHP = micro-hydropower; PV = photovoltaic,WE = wind energy

Before realising formal integration of the new subjects in the school curriculums through the national curriculum Spectrum, the schools will use the space for local content in the existing curricula and open extracurricular activities.

Seven SMKs will conduct courses in micro-hydropower, six in photovoltaic, two in wind energy, and seven in biomass.This means that every province has at least one vocational school focussing on micro-hydropower (North Sumatra and Central Java have two). All provinces, except West Nusa Tenggara, conduct photovoltaic power. Biomass is taught in all provinces except Papua, and wind energy is only taught in Papua and Yogyakarta. Of the eleven selected SMKs one is private and ten are public.

The demand for graduates

The expected main trends in the field of renewable energy have already been presented in Tables 3.14, 3.15 and 3.16. The demand for SMK graduates in renewable energy and energy efficiency technologies was assessed in three ways. Regional or local authorities were asked to give an indication of the main energy sources in their regions. SMKs were interviewed about the positions of their alumnae and their perception of the local labour market. And the Eindhoven University of Technology extracted data from interviews with some ten energy supply companies per province about their perception of the demand for skills in renewable energy technologies.From the TU/e interview data, the number of people could be derived who had followed energy-related programmes in vocational schools.

Table 3.27 shows that companies in four provinces distinctly incorporate SMK trainees in their workforce, but relatively few with a background in renewable energy or energy efficiency, becausethe SMKs in these provinces did not structurally offer those learning packages.

Table 3.27 Employees with energy-related SMK-training in 50 energy supply companies in the target provinces[a]

Province	Central Java	North Sumatra	West Nusa Tenggara	Papua	Total
Employees	9,944	29,371	983	12,333	52,633(incl. Yogyakarta 52,851)
SMKtrainees	2,138	338	3,783	6,822	7,081
energy-related SMKtrainees	64	413	64	217	758

[a] For Yogyakarta only the total number of employees was available

Training of staff of the Technical Education Development Centre in Bandung

For the planned training of SMK teachers, about twenty staff members of the Technical Education Development Centre in Bandung (TEDC) followed training in a specific field of renewable energy. They were trained in preparing curricula, syllabi and training modules. Moreover, TEDC organised an internal workshop on the development of a national curriculum for renewable energy technologies.

Training of SMK teachers

Some 100 SMK teachers received six weeks of training at the TEDC. The new modules represent two levels: a basic level, with basic knowledge of the most relevant technologies and an advanced level, with a specialisation in a technology, relevant for the region. TEDC played a pivotal role in developing these modules and introducing them in the SMKs.

In-school training for the development of curricula

The in-school training had two components. The general training/workshop addressed the context for school level curriculum development and the central place of the school level syllabus, in which content standards and competencies are defined. The training was not only for teachers, but also for the school director and the heads of curriculum development of each SMK. The enrichment training/workshop focused on the preparation of curricula, syllabi and modules, and was intended for teachers. All lecturers and instructors were part of the TEDC core group for development of renewable energy technologies in SMKs. Local authorities were often invited for the opening of all trainings and workshops. All SMKs have defined the standard competencies for renewable energy technologies as part of the general competency standards, and have produced syllabi. Some 100 SMK teachers and 30 school directors and heads of curriculum development received these in-school trainings.

Demonstration equipment

After completing their training, the SMK teachers had gained a better understanding of the need for demonstration equipment in their schools. TEDC elaborated a list of demonstration equipment, with technical specifications and an indication of their prices.

Figure 3.34 Training given by TEDC staff

SMK teachers learn how to press Jatropha seeds to obtain crude oil

Vocational students are being taught how to assemble a 80 kW wind turbine

The listing was first used for the purchase of equipment, but later on served as a part of the dossier that TEDC had prepared for the Ministry of Education and Culture.

Rollout to other SMKs

The target SMKs had to invest so much time and effort in integrating the new subjects in their school, that they could not give priority to the roll-out to other SMKs in their region.[2] The rollout has thus mainly taken place by TEDC, through its trainings of some 100 teachers of 21 new SMKs, of which 16 were located in other provinces.

Embedding in the national curriculum Spectrum

Without integration in the national curriculum (Spectrum) of the Ministry of Education and Culture, SMKs would be forced to make ad-hoc arrangements. Agreement was reached with the ministry to submit a dossier that would facilitate a decision to integrate education on renewable energy technologies in Spectrum. Once the national curriculum is approved, initially approximately 300 students per year will follow lessons on renewable energy and energy efficiency technologies. This number will grow with another annual 400-600 in the following two years.

3.7.5 Main findings and observations

CASINDO contributed substantially to the inclusion of renewable energy technologies in the educational practice of the Indonesian SMKs. However, this only makes sense when there is a clear demand for these skilled professionals. At the outset of the programme, the eleven SMKs in the target provinces expressed an emerging need, but useful data were lacking. The databases of the two most important ministries (Education and Energy) were not geared to make an assessment of the current demand, or projections of future demand. CASINDO's activities related to the SMK stimulated the sense of urgency for having such projections. Recently MEMR conducted a first study on its own human resources needs in renewable energy technologies (Section 3.7.1), which is a promising step in getting macro-estimates of the demand. It is highly recommended to promote the concept of 'green jobs'[3] in the new labour market analysis of the need for professionals in renewable energy technologies.

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2 The only exception was SMKN 3 Jayapura. This school did promote integration of the new technologies in other schools.

3 According to the United Nations Environment Program, a green job is "work (...) that contribute(s) substantially to preserving or restoring environmental quality. (...) this includes jobs that help to protect ecosystems and biodiversity; reduce energy, materials, and water consumption through high efficiency strategies; de-carbonize the economy; and minimize or altogether avoid generation of all forms of waste and pollution."

The cooperation with TEDC was essential for the introduction of tuition in renewable energy technologies in the SMKs. To this end, TEDC was required to upgrade its own staff. The time between this upgrading and the actual training of SMK teachers was rather short. To cater for the increasing demand for trainings, more TEDC staff should be equipped with expertise in this new field, and the expertise of the already operating staff should be upgraded, especially in biomass.

The official inclusion of renewable energy technologies in the national curriculum Spectrum is a big leap forward towards rolling out this education to new SMKs. TEDC should remain the leading institution in this process. The future trajectory should be decided upon by a core group, representing the Ministry of Education and Culture, the Ministry of Energy and Mineral Resources, TEDC, and two or three pioneering SMKs.

Cooperation between the SMKs, TEDC and universities proved to be fruitful in joint courses, demonstration equipment, or contacts with the private sector. This cooperation on an individual basis will be more effective when the regional educational offices participate in the regional energy forums.

4. SUSTAINABILITY OF THE CASINDO ACTIVITIES AND RESULTS

4. SUSTAINABILITY OF THE CASINDO ACTIVITIES AND RESULTS

As CASINDO aimed to ensure the sustainability of its activities and results (see Chapter 1), new institutional structures were set up. They serve to continue the building of human capacity for energy policy formulation and implementation and they are dynamic and adaptable to changing needs and circumstances.

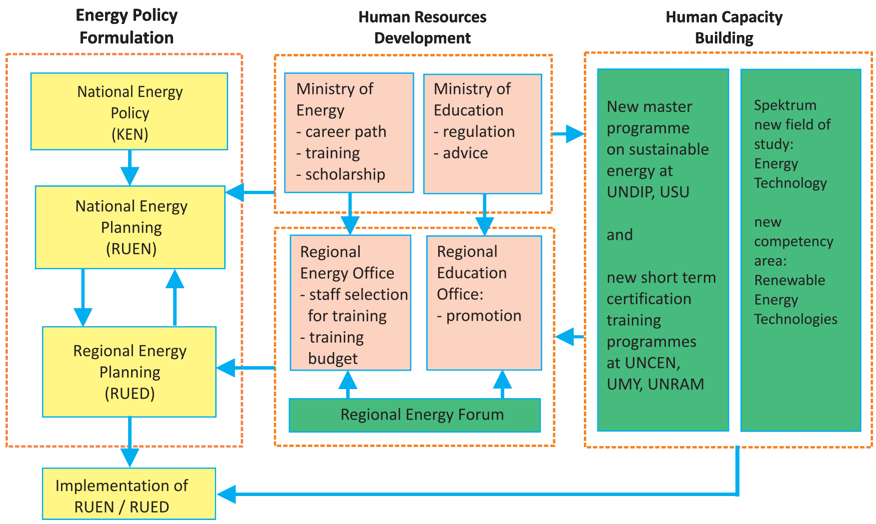
The following new structures have been established (Figure 4.1):

1. A regional energy forum and a regional technical team in each of the five target provinces (TWG I,II,III,IV and V);
2. Curricula for an academic programme on sustainable energy at five partner universities (TWG VI);
3. Training modules on renewable energy and energy efficiency for eleven vocational schools (TWG VII).
4. Training programme on integrated energy planning (Ministry of Energy and Mineral Resources – Agency for Education and Training).

The national and regional government provide guidance, advice and (if necessary) regulation for the formal establishment of the regional energy forum, and for the new education programmes, the new training modules and the training course on integrated energy planning. The new structures, in turn, provide training and education to build sufficient human capacity for the energy policies of the regional government. To strengthen this process, the national or regional government may consider establishing a career path, relating posts to education requirements.

This chapter describes the long-term impacts: the embedding of these new structures in the existing institutions, the interactions between these new structures, their strengthening for sustainability, and a rollout of the results to other provinces.

Figure 4.1 New structures and their interaction with policy formulation and human resources development[a]



[a] Green boxes show the new structures; pink and yellow boxes show the institutions and policies with which they interact

Self-sustaining and self-developing structures

- The regional energy forum and the regional technical team

This structure is well-established in all target provinces. It is self-sustaining, because it is embedded in the annual planning and budget cycle of the regional government. It is also self-developing in the sense that the technical team members, through their education and research activities at the university, incorporate the most recent developments in their analysis.

- Curricula for an academic programme

The new programme on sustainable energy is incorporated in the curricula of the five partner universities, after formal approval of the university board. This guarantees continuation of the programme, provided that there are enough students to make it financially viable. The content of the new education programme will continuously be updated, according to new insights.

- Training modules for vocational schools

The new modules for SMKs in the five target provinces will likely be part of the national curriculum for vocational schools (Spectrum) under the responsibility of the Ministry of Education and Culture. This greatly facilitates the sustainability and the rollout to other Indonesian provinces.

- Training programme on integrated energy planning

Integrated energy planning, implemented in all five target provinces, is now incorporated in the regular training programme of the Agency for Education and Training of the Ministry of Energy and Mineral Resources. In the coming years, this course will be funded by the Agency, and interested regions can apply for it. Exchange of staff between the training agency and the energy policy departments of the ministry ensures regular updating of the training material.

Interaction between the new structures

Major emphasis has been put on creating synergy between national and regional policy makers, and universities and vocational schools, in order to strengthen the capacity development. This integrated approach produced more sustainable and significant impacts than the sum of the individual new structures could have done. Optimal synergy was created by aligning the different training programmes and materials, allowing usage of each other's research facilities, involving universities and vocational schools in energy policy formulation, and jointly organising dissemination and valorisation activities. The Ministry of Finance has approved a proposal from MEMR and made available a budget to continue and further strengthen this structure.

Long-term impact

In the light of rising global energy prices, growing environmental concerns and the decreasing domestic oil production in Indonesia, the government will strive to shift away from fossil fuels. Much expertise on renewable energy, energy efficiency and energy planning will be needed to bring about this shift. The government may consider developing a policy on human resources development for national and regional energy officials, which relates career positions to educational requirements. For example, a master degree in sustainable energy could become a requirement for the position of head of the regional energy office (Dinas Energi). This could be supported by creating a budget for scholarships and training. This would greatly enhance the knowledge and skills within the government, and would also further increase the demand for the newly designed education programmes, thus strengthening their sustainability.

5. CONCLUSIONS AND RECOMMENDATIONS

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At the start of the CASINDO project, in June 2009, the following results were expected:

- Strengthened institutional and technical capacity at the national level and in the five target provinces.
- Regional energy profile and regional energy outlook, developed for the target provinces.
- New education programme on sustainable energy and associated research programme, established at the five partner universities.
- New renewable energy and energy efficiency training modules, introduced at eleven vocation schools in the five provinces.
- Energy-related priorities and best practices for energy services provision, identified in each of the five provinces.

During implementation, it appeared that the anticipated duration of 2.5 years was extremely short for a large and complex project with such great ambitions. This was compounded by the fact that CASINDO experienced several setbacks that were beyond the control of the project team, including:

- Political unrest in the province of Papua, resulting in security problems that forced the team to delay the start for several months.
- Due to institutional problems, the formal establishment of the regional energy forum in North Sumatra was delayed.
- The high staff turnover of regional teams, due to illness, changing positions, studying abroad, or for other reasons.
- The procedures for institutional embedding of the new education

programmes for universities and vocational schools were much longer than anticipated, which hindered an effective implementation.

- Different planning and budget cycles for CASINDO and the regional governments made it difficult to complete all small-scale renewable energy projects before the end of the project.

In spite of these setbacks and thanks to a six-months extension, CASINDO achieved the intended results. The methodology and preliminary results were presented in October 2011 at a national seminar in Jakarta, attended by some 200 participants from all 33 Indonesian provinces. The activities and results are recorded in over 30 technical reports. They can be downloaded from www.casindo.info.

The main conclusions and recommendations:

1. The regional energy forums and the regional technical teams, established in the five target provinces, seem to be the appropriate institutional structure for regional energy policy formulation. This structure is mandated by the head of the regional energy office or the governor, which provides it with sufficient authority. The forum comprises all regional stakeholders, to ensure support for the policies. For sustainability, this structure should become part of the annual planning and budget cycle of the regional government.

2. Establishing the regional CASINDO teams at the local universities may appear to have had serious disadvantages, as team members are on the payroll of the university and thus also have responsibilities that distract them from the CASINDO activities. However, this is outweighed by the fact that the CASINDO activities are now strongly embedded in existing structures that will remain intact in the foreseeable future. Therefore, the impact of CASINDO is likely to be more sustainable than when teams would have operated as a new institutional entity.

3. The technical working groups (TWGs) for each of the main outputs proved to be a very effective and efficient structure for organising the work. TWG meetings were held on average two to three times a year, and aimed to discuss the progress, the problems and the work plan for the next period. Team members highly appreciated the TWG as an opportunity to exchange information with other regions and with the national/regional government. In this sense, the TWGs initiated a network for Indonesian universities and institutes on energy planning, renewable energy and energy efficiency. The Ministry of Finance has approved a proposal of the Ministry of Energy and Mineral Resources to continue and extend this network.

4. Regional energy planning, in particular data collection, turned out to be laborious and time-consuming. Much data on the regional energy sector is available, but they show a large variety in sources, accuracy, coverage or consistency, and are not always easily accessible. The energy-economic databases, created within CASINDO by the regional teams, contain all the relevant data from many sources in a consistent and transparent way: a wealth of essential information for sound regional energy planning and policy formulation. It is therefore strongly recommended to make sufficient funds available to maintain and update this database. Together with the energy model LEAP, which was also developed by the regional teams, it forms an excellent set of tools for developing the regional energy plan (RUED) as stipulated in the Energy Law no. 30/2007.

5. National targets for the future energy mix, for the share of renewable energy or for energy efficiency cannot be simply translated into regional targets. A detailed regional analysis must be conducted to assess the extent to which the national target can realistically be achieved in the region. This analysis must be conducted by experts from the region, because they have the most accurate knowledge of the energy situation and priorities. The CASINDO results show that regional targets can vary for different provinces. Therefore it is recommended to duly take this regional analysis into account when establishing a national target. A combined bottom-up and top-down approach will result in more realistic national targets, and thus in a more accurate assessment of the necessary investments.

6. The main barrier for a more rapid uptake of energy efficiency and renewable energy in Indonesia is the unequal level playing field of those new technologies and the traditional fossil fuels and electricity with their subsidised, and thus artificially low, prices. CASINDO analysis confirms that the regions have a huge potential for energy efficiency and savings, in particular in small and medium-sized enterprises, and in the commercial and household sector. However, due to the detrimental investment environment, so far only a small fraction has been tapped into. Recently, the government put in place attractive feed-in tariffs for biomass and geothermal electricity generation, which makes energy efficiency and renewable energy more attractive.To fully realise the identified potential, barriers such as low awareness, lack of information, insufficient investment and lack of technical capacity must be addressed soon.

7. Despite the significant progress in achieving the Millennium Development Goals, the number of poor in Indonesia is still around 30.2 million, based on a poverty line of USD 1.25 per day. However, if the poverty line were set at USD 2 per day, as suggested by the Asian Development Bank, the number of poor would increase to at least 117 million, almost half the population.

This highlights the urgency of pro-poor energy strategies, as energy provision improves their livelihoods. This requires a deep understanding of the local energy and socio-economic situation and, consequently, a higher involvement of the communities. Another important lesson is that the pro-poor energy strategy should not be designed in isolation, but must be embedded in the wider framework of energy planning. Last, but certainly not least, for successful community-based programmes it is essential that monitoring, after-sales services and maintenance are integrated components, and that communities acquire sufficient skills to operate and maintain these new technologies.

8. The new academic programmes on sustainable energy and the associated research programmes greatly contribute to meeting the expected rapidly growing demand for human capacity in renewable energy and energy efficiency. The introduction of these programmes not only involves new curricula, training material and trained lecturers, but also requires embedding in the university structure. This often implies re-allocation of resources, which must be approved by the university management. A new master's programme requires formal approval of the Ministry of Education and Culture, which can be a very lengthy process. These institutional issues turned out to be the most time-consuming and hardest to address. The financial viability of the new education programmes was another challenge. Especially in the first year, when the new programme is not yet widely known and the number of applications is limited, additional financial support, possibly in the form of scholarships, is needed.

9. The new training modules for vocational schools address the expected demand for technical expertise to construct, operate and maintain the installations for renewable energy and energy efficiency. This is vital to achieve the ambitious targets set in the National Energy Policy. The Technical Education Development Centre (TEDC) in Bandung played a key role in developing modules and training teachers. TEDC also put a lot of effort in pursuing the inclusion of new modules in the national curriculum for vocational schools (Spectrum) of the Ministry of Education and Culture. The latter proved to be a prerequisite for most of the selected vocational schools to incorporate the new modules in the existing curriculum. Inclusion in the national curriculum Spectrum and a study on the 'green job' will also greatly facilitate a further rollout to other vocational schools.

ANNEX I:
CONTACT DETAILS CASINDO PARTNERS

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