REGIONAL ENERGY OUTLOOK
CENTRAL JAVA PROVINCE
YEAR 2005 - 2025

Regional CAREPI Technical Team
Yogyakarta and Central Java

Pusat Studi Pengelolaan Energi Regional
Universitas Muhammadiyah Yogyakarta
(PUSPER UMY)

Dinas Energi dan Sumber Daya Mineral
Provinsi Jawa Tengah

In collaboration with:
REGIONAL ENERGY OUTLOOK
CENTRAL JAVA PROVINCE YEAR 2005 - 2025

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PREFACE

With the deepest sense of gratitude and humility, all praises and thanks to Allah for giving us the strength to write this report entitled “Regional Energy Outlook of Special Region of Central Java Province Year 2005-2025”.

This report is part of the outcomes produced as part of of “Contributing to poverty Alleviation through Regional Energy Planning in Indonesia, CAREPI” program. CAREPI program is one of projects in cooperation between Indonesia and the Netherlands in the scheme of Energy Working Group (EWG) and a collaborative works between Center of Regional Energy Management Universitas Muhammadiyah Yogyakarta (Pusat Studi Pengelolaan Energi Regional, PUSPER UMY), Data and Information Centre for Energy and Mineral Resources Ministry of Energy and Mineral Resources (Pusdatin ESDM), The office of Mining and Energy Central Java Province, Center for Research on Energy Policy Institut Teknologi Bandung (ITB), Energy research Center of the Netherlands (ECN), SenterNovem Netherlands and European Union (EU).

This report consists of the database of energy demand and supply in 2005 and energy outlook 2005 to 2025 based on LEAP modeling from two scenarios, i.e. National Energy Policy (KEN) and Regional Energy Policy (KED). Energy and related data were collected and analysed from several sources that have contributed in the data collection process. They are PT. Pertamina, PT PLN (Persero) P3B Regional of Central Java and Yogyakarta, PT Indonesia Power, PT. KAI, BPS Central Java, PT. Angkasa Pura and related regional offices in Central Java Province. We would like to take this opportunity to convey our greatest appreciation to all contributors who have supported and provided the data and analyses for this book. We hope that the readers would be able to use this report as a reference of energy situation and outlook of Central Java until 2025, based on the data in 2005. We also welcome all feedback to improve the quality of this report.

Yogyakarta, 30 October 2009

Regional Technical Team of CAREPI
# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preface</td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>Table of Contents</td>
<td></td>
<td>4</td>
</tr>
<tr>
<td>List of Tables</td>
<td></td>
<td>6</td>
</tr>
<tr>
<td>List of Figures</td>
<td></td>
<td>7</td>
</tr>
<tr>
<td>1. INTRODUCTION</td>
<td></td>
<td>9</td>
</tr>
<tr>
<td>1.1</td>
<td>Task D-16 in CAREPI</td>
<td>9</td>
</tr>
<tr>
<td>1.2</td>
<td>Objectives</td>
<td>9</td>
</tr>
<tr>
<td>1.3</td>
<td>Scope and Boundary</td>
<td>10</td>
</tr>
<tr>
<td>2. GENERAL INFORMATION OF THE REGION</td>
<td></td>
<td>11</td>
</tr>
<tr>
<td>2.1</td>
<td>Macroeconomic Condition</td>
<td>12</td>
</tr>
<tr>
<td>2.2</td>
<td>Energy Issues</td>
<td>13</td>
</tr>
<tr>
<td>3. CURRENT ENERGY SITUATION</td>
<td></td>
<td>14</td>
</tr>
<tr>
<td>3.1</td>
<td>Energy Consumption</td>
<td>14</td>
</tr>
<tr>
<td>3.2</td>
<td>Energy Supply</td>
<td>15</td>
</tr>
<tr>
<td>4. ENERGY SCENARIOS</td>
<td></td>
<td>19</td>
</tr>
<tr>
<td>4.1</td>
<td>Energy Policies</td>
<td>19</td>
</tr>
<tr>
<td>4.1.1</td>
<td>National Energy Policy</td>
<td>19</td>
</tr>
<tr>
<td>4.1.2</td>
<td>Regional Energy Policy</td>
<td>21</td>
</tr>
<tr>
<td>4.2</td>
<td>Scenario Assumptions</td>
<td>22</td>
</tr>
<tr>
<td>4.2.1</td>
<td>Scenario Assumptions</td>
<td>22</td>
</tr>
<tr>
<td>4.2.2</td>
<td>Scenario Parameters</td>
<td>22</td>
</tr>
<tr>
<td>4.3</td>
<td>Energy Scenario Outcomes</td>
<td>24</td>
</tr>
<tr>
<td>4.3.1</td>
<td>Demand Side</td>
<td>24</td>
</tr>
<tr>
<td>4.3.2</td>
<td>Supply Side</td>
<td>27</td>
</tr>
<tr>
<td>4.3.3</td>
<td>Comparison KEN and KED result</td>
<td>31</td>
</tr>
<tr>
<td>4.4</td>
<td>Target Energy Mix dengan Scenario KEN dan KED</td>
<td>36</td>
</tr>
<tr>
<td>5. PRO – POOR ENERGY ACCESS</td>
<td></td>
<td>42</td>
</tr>
<tr>
<td>5.1</td>
<td>Poor Village Profile</td>
<td>38</td>
</tr>
<tr>
<td>5.2</td>
<td>Design of Proposed Energy Infrastructure</td>
<td>42</td>
</tr>
</tbody>
</table>
6. FEASIBILITY – MICRO HYDRO PROJECTS ........................................ 46
   6.1 Introduction .............................................................................. 46
      6.1.1 Background ........................................................................ 46
      6.1.2 Description of Location for PLTMH ...................................... 46
      6.1.3 Recent Condition ................................................................. 47
   6.2 Design and Development of Micro Hydro Project .................... 49
      6.2.1 Design Project PLTMH Sorosida ............................................ 49
      6.2.2 Scope of the Project ............................................................. 50
      6.2.3 Implementation of the Project .............................................. 50
   6.3 Utilization of Micro hydro ....................................................... 50
      6.3.1 Operation and maintenance ............................................... 50
      6.3.2 Final use of the electricity .................................................. 51
      6.3.3 Cost of the Project .............................................................. 51
7. CONCLUSION AND RECOMMENDATION .................................. 53

Annex 1
Annex 2
Annex 3
LIST OF TABLES

Tabel 2.1  RGDP Development and Inflation ....................................................... 11

Table 2.2 Regional Gross Domestic Product Central Java Province
   Based on Field of Employment in Year 2001 – 2005 ...................................... 11

Table 3.1 Oil Production Central Java Province in Year 2005 .............................. 14

Table 3.2 The Utilization of Large Scale Hydropower .................................... 15

Table 3.3 The Utilization of Small Scale Hydropower................................. 15

Table 3.4 Crude Oil Deposits .......................................................... 16

Table 4.1 Projection of Biodiesel Usage ......................................................... 22

Table 4.2 Projection of Bioethanol Usage ....................................................... 22

Table 4.3 Projection of Biofuel Usage ........................................................... 22

Table 5.1 Type of Energy Used in Desa Sokawera .......................................... 40

Table 5.2 Renewable Energy Potential in Kecamatan Sokawera..................... 40

Table 6.1 Description of Electricity Consumption in Sidoharjo Village .......... 46

Table 6.2 Electricity Consumption for House Hold in Sukoharjo Village ........ 47

Table 6.3 Design Characteristics of PLTMH Sorosido .................................. 49

Table 6.4 The Estimated Cost of PLTMH Sorosido Construction Project............. 51

Table 6.5 Operational and Maintenance Cost of PLTMH Sorosido .................. 51
LIST OF FIGURES

Figure 3.1  Final Energy Consumption per sector .......................................................... 14
Figure 4.1  Energy Consumption per sector up to 2025 using KEN scenario ................... 23
Figure 4.2  Energy consumption per type of energy to 2025 with KEN scenario .............. 24
Figure 4.3  Energy Consumption per sector until Year 2025 with KED scenario .............. 14
Figure 4.4  Energy consumption per energy type up to 2025 with KED Scenario .......... 26
Figure 4.5  Projected Petroleum Mining Capacity .......................................................... 27
Figure 4.6  Refinery Production .................................................................................... 28
Figure 4.7  Imported Fuel from other region ................................................................. 29
Figure 4.8  Plant Capacity Projections in central java province until the year 2025 .......... 30
Figure 4.9  Fuel usage in power Plant ........................................................................... 30
Figure 4.10  Biodiesel Plant Capacity Projections.......................................................... 31
Figure 4.11  Proyeksi Kapasitas Pabrik Bioethanol ....................................................... 31
Figure 4.12  12 Projected Capacity Vegetable Oil Factory ............................................. 32
Figure 4.13  Comparison between KEN and KED scenario per household sector up to 2025 ............................................................................................................. 32
Figure 4.14  Comparison between KED and KED Scenario per household sector energy-type up to 2025 ......................................................................................... 32
Figure 4.15  Comparison between KEN and KED Scenario per commercial sector up to 2025 ........................................................................................................... 33
Figure 4.16  Comparison between KED and KED Scenario per commercial sector energy type up to 2025 ......................................................................................... 34
Figure 4.17  Comparison between KED and KED Scenario per industrial sector up to 2025.... 34
Figure 4.18  Comparison between KED and KED Scenario per industrial sector energy type up to 2025 .......................................................................................................................... 35
Figure 4.19  Comparison between KED and KED Scenario per transportation sector up to 2025.............................................................................................................................................. 36
Figure 4.20  Comparison between KED and KED Scenario per transportation sector energy type up to 2025.......................................................................................................................... 37
Figure 4.21  Comparison between KED scenario and KED per other sectors up to 2025........ 38
Figure 4.22  Comparison between KED scenario and KED per energy type of other sectors up to 2025 .............................................................................................................................................. 38
Figure 4.23  Capacity added in powerplant up to 2025.......................................................................................................................... 39
Figure 4.24  the comparison of electricity energy estimation between KEN and KED scenario up to 2025.............................................................................................................................................. 39
Figure 4.25  the comparison of electricity energy Balanced between KEN and KED scenario up to 2025 .............................................................................................................................................. 40
Figure 4.26  Comparison of crude oil projection between KEN and KED sector scenarios in the year of 2025 .............................................................................................................................................. 40
Figure 4.27  Energy balance for petroleum up to 2025.......................................................................................................................... 40
Figure 4.28  Comparison between refinery output by sector scenario KEN and KED until the year of 2025 .............................................................................................................................................. 40
Figure 4.29  the comparison of refinery output by Fuel between KEN and KED until 2025 ..... 40
Figure 4.30  Distribution of oil fuels in Central Java Province .......................................................................................................................... 40
Figure 4.31  The initial condition of Energy in Central Java .............................................................................................................................................. 40
Figure 4.32  KEN Scenario of Energy Condition .............................................................................................................................................. 40
Figure 4.33  KED Scenario of Energy Condition .............................................................................................................................................. 40
Figure 5.1  Map of Banyumas Regency in Central Java Region ................................................. 40

Figure 6.1  Location Map of Pakuluran Hamlet, Sidoharjo Village, Doro Subdistrict, Pekalongan District ............................................................................................................. 45
CHAPTER 1

INTRODUCTION

1.1 Task D-16 in CAREPI

The activity of compiling this report on the Regional Energy Outlook for Central Java 2005 – 2025 is part of CAREPI’s activities in “Contributing to Poverty Alleviation through Regional Energy Planning in Indonesia” which is a cooperation among Pusat Studi Pengelolaan Energy Regional, University of Muhammadiyah Yogyakarta (PUSPER UMY) with The Office of Energy and Mineral Sources Central Java Province, Center of Energy Policy – Bandung Institute of Technology, Energy Research Center of Netherlands, SenterNovem – Netherlands, and European Union.

This book contains forecasts on energy needs, supply and distribution in Central Java until the year 2025 based on a database of energy demand and supply in Central Java in 2005. This report is intended to be a reference for energy professionals and researchers by and large for community that need data and information about forecasts of energy needs and distribution in Central Java until year 2025.

1.2 Objective

Central Java Province is located in between two big provinces namely West Java and East Java and is located at longitude 5°40’ and 8°30’ South and latitude 108°30’ and 111°30’ East (including Karimunjawa Island). The longest span from west to east is 263 km and from north to south is 226 km (not including Karimunjawa Island).

Regarding its administrative status, Central Java Province is divided into 29 districts and 6 municipalities. The size of Central Java Province in 2005 is 3.25 million acre or about 25.04% of the total size of Java Island (1.07% of the size of Indonesia). It consists of 996,000 acre (30.60%) of rice plantation and 2.26 million acre (69.40%) of non rice plantation. Compared to previous year’s condition, the size of rice plantation in 2005 decreased around 0.02% ; however, the size of non rice plantation increased 0.01%.

The number of residents in Central Java Province is around 35 million people of which 21% of the residents belong to low income classes. Final energy consumption in
Central Java in 2005 was 43.84 million barrel of oil equivalents. The distribution percentages of usage based on types of energy are Coal (6.22%), Gasoline (25.21%), Kerosene (17.69%), FO (26.04%), ADO (26.04%), IDO (0.74%), Electricity (14.78%), LPG (1.95%), Wood (3.46%), and the rest are Avtur (0.53%) and also Coal briquette (0.20%).

In 2006, the Government of Indonesia issued Presidential Decree named Presidential Decree Number 5 Year 2006 about National Energy Policy. The application of National Mix Energy is in line with Presidential Decree No. 5 Year 2006, with percentage in each type of energy, such as:

- Crude oil is less than 20% of total primary energy use
- Natural Gas is less than 30% of total primary energy use
- Coal is less than 33% of total primary energy use
- Vegetable oil is more than 5% of total primary energy use
- Geothermal is more than 5% of total primary energy use
- Biomass, Nuclear power, Micro hydro, solar power, and wind power are more than 5% of total primary energy use
- Liquefied coal is more than 2% of total primary energy use

With the national energy targets above, regional policies are needed to achieve the National Energy Policy, supported by studies like this Regional Outlook Energy Central Java Province 2005 – 2025.

1.3 Scope and Boundary

The aim of collecting documents on Regional Outlook Energy Central Java Province 2005 – 2025 is to identify plans of energy needs and supply in Central Java until 2025 based on Regional Energy Policy (Kebijakan Energy Daerah or KED) to support National Energy Policy (Kebijakan Energy Nasional or KEN). The scopes of study in collecting Regional Outlook Energy Central are as follows.

a. The base year for compiling data of energy supply and demand is 2005.

b. Scenarios used are based on Regional Energy Policy (KED) scenario and National Energy Policy (KEN) scenario.

c. The Regional Energy Policy (KED) scenario, is mainly based on assumptions depicting the real conditions of the energy potential in Central Java.

d. Data are taken from BPS, Pertamina, PLN etc.
CHAPTER 2

GENERAL INFORMATION OF THE REGION

2.1 Macroeconomic Condition

The development of Regional Gross Domestic Product (RGDP) in Central Java Province in 2005, based on constant prices 2000, increased to 5.35% from 5.13% in the previous year (see table 2.1). Rate of inflation in Semarang in 2005 was 16.46%, which was lower than the national inflation rate (17.11%). Compared with inflation in 2004 (5.98%), it increased considerably.

<table>
<thead>
<tr>
<th>No</th>
<th>Development of RGDP (%)</th>
<th>Inflation (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>3.48</td>
<td>13.98</td>
</tr>
<tr>
<td>2</td>
<td>3.04</td>
<td>13.56</td>
</tr>
<tr>
<td>3</td>
<td>4.76</td>
<td>6.07</td>
</tr>
<tr>
<td>4</td>
<td>4.9</td>
<td>5.98</td>
</tr>
<tr>
<td>5</td>
<td>5</td>
<td>16.46</td>
</tr>
</tbody>
</table>

Table 2.1 Development of RGDP and Inflation

Source: Central Java in figure 2005

Real sector development in 2005 was fluctuating from the previous year. The highest growth was reached by electricity and clean water sectors with about 10.78%, however their role in the RGDP was only 0.82%. Agricultural sector provided 19.11% to the RGDP. Manufacturing industry sector offered 33.71%, while trade, hotel, and restaurant provided 19.92%. The RGDP data in each sector in 2001 – 2005 is shown in the table 2.2.

<table>
<thead>
<tr>
<th>No</th>
<th>Types of Activity</th>
<th>RGDP Based on Constant Price 2000 (Million) year</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Agriculture</td>
<td>26,417.424 27,725.086 27,157.596 28,606.237 29,924.643</td>
</tr>
<tr>
<td>2</td>
<td>Mining</td>
<td>1,190.372 1,227.652 1,295.356 1,330.760 1,454.231</td>
</tr>
<tr>
<td>3</td>
<td>Manufacturing Industry</td>
<td>30,737.651 31,957.829 33,496.797 35,464.673 36,685.630</td>
</tr>
<tr>
<td>4</td>
<td>Public Facilities (Utilities)</td>
<td>872.604 975.869 980.307 1,065.115 1,179.892</td>
</tr>
<tr>
<td>5</td>
<td>Construction sector</td>
<td>5,532.343 6,116.817 6,907.250 7,448.715 7,960.948</td>
</tr>
<tr>
<td>6</td>
<td>Commercial sector</td>
<td>26,773.496 27,262.408 28,658.037 29,363.184 31,137.477</td>
</tr>
<tr>
<td>7</td>
<td>Transportation</td>
<td>5,577.205 5,872.916 6,219.923 6,510.447 6,988.426</td>
</tr>
<tr>
<td>8</td>
<td>Financial sector</td>
<td>4,420.388 4,524.128 4,650.802 4,826.241 5,067.666</td>
</tr>
<tr>
<td>9</td>
<td>Social sector</td>
<td>10,868.007 10,140.012 11,949.959 12,643.261 13,232.226</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>112,389.490 115,802.718 121,316.027 127,258.633 133,631.138</td>
</tr>
</tbody>
</table>

Table 2.2 Regional Gross Domestic Product of Central Java Province based on Type of Activity for 2001-2005

Source: Central Java in figure 2005
2.2 Energy Issues

At present, energy supply in Central Java mainly comes from crude oil (fossil fuel) which covers about 70%. Meanwhile, the use of renewable energy is very limited at less than 3%. With this condition, actual measures need to be taken dealing with energy needs in the future.

Some measures that need to be done in support of the national energy policy are:

- Conversion program of Kerosene to LPG
- Development acceleration of the 10,000 MW Steam Power Plant program
- Development acceleration of infrastructure for Gas Pipe Network Kalimantan – Central Java.
- Development of infrastructure for LPG supply and distribution
- Policy on energy pricing to improve energy conservation and diversification
- Policy on developing energy infrastructure to assure energy supply, especially non-crude oil fuels.
CHAPTER 3
CURRENT ENERGY SITUATION

3.1 Energy Consumption
3.1.1 Fuel Based Final Energy

In 2005, final energy consumption in Central Java is 43.84 million Barrel Oil Equivalent, BOE (SBM=Setara Barel Minyak) with relative distribution per energy type such as Coal (6.22%), Premium (25.21%), Kerosene (17.69%), Gasoline (3.17%), Solar Oil (26.04%), Diesel Oil (0.74%), Electricity (14.78%), LPG (1.95%), Wood (3.46%), and Avtur (0.53%) as well as Coal Briquette (0.20%).

The use of each type of energy in Central Java is as follows:

- Avtur: 0.23 million Barrel Oil Equivalent (SBM)
- Kerosene: 7.75 million Barrel Oil Equivalent (SBM)
- Premium: 11.05 million Barrel Oil Equivalent (SBM)
- Solar Oil: 11.42 million Barrel Oil Equivalent (SBM)
- Diesel Oil: 0.32 million Barrel Oil Equivalent (SBM)
- Gasoline: 1.39 million Barrel Oil Equivalent (SBM)
- Electricity: 6.48 million Barrel Oil Equivalent (SBM)
- LPG: 0.85 million Barrel Oil Equivalent (SBM)
- Coal briquette: 0.09 million Barrel Oil Equivalent (SBM)
- Wood: 1.52 million Barrel Oil Equivalent (SBM)

3.1.2 Final Energy by Sector

The distribution of energy consumption by sector is as follows: Households (23.10%), Industrial Sector (20.73%), Commercial (11.92%), Transport (39.92%), Others\(^1\) (4.32%) as shown in Figure 3.1. The final energy by sector is as follows:

- Households: 10.13 million barrel oil equivalent (SBM)
- Industry sector: 9.09 million barrel oil equivalent (SBM)

\(^1\) The sector Others consists of agriculture, construction and mining.
Commercial : 5.23 million barrel oil equivalent (SBM)
Transportation : 17.50 million barrel oil equivalent (SBM)
Other : 1.89 million barrel oil equivalent (SBM)

Figure 3.1 Final Energy Consumption by Sector

3.2 Energy Supply

3.2.1 Domestic Resources

3.2.1.1 Petroleum

Oil production in 2005 is still on a small scale; this is because the processing method is conducted by people and still using conventional method (Traditional mining). The production in 2005 can be seen in Table 3.1 below.

Table 3.1 Oil Production Central Java in 2005

<table>
<thead>
<tr>
<th>No</th>
<th>Company</th>
<th>Location</th>
<th>Production (Barrel/Year)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Traditional Mining</td>
<td>Cepu</td>
<td>829.53</td>
</tr>
<tr>
<td></td>
<td><strong>Total</strong></td>
<td></td>
<td><strong>829.53</strong></td>
</tr>
</tbody>
</table>

Source: Pertamina

3.2.1.2 Renewable Energy

Renewable energy in Central Java Province includes hydro power and geothermal. The utilization of water power is divided into two, namely the utilization of large-scale and small-scale hydropower. The utilization of large-scale hydropower in Central Java Province can be seen in Table 3.2 below.
Table 3.2 Utilization of Large Scale Hydropower

<table>
<thead>
<tr>
<th>No</th>
<th>Name</th>
<th>Location</th>
<th>Installed Capacity (MW)</th>
<th>Production (MWh/Year)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>PLTA Jelok</td>
<td>Jelok</td>
<td>20.48</td>
<td>125,583</td>
</tr>
<tr>
<td>2</td>
<td>PLTA Timo</td>
<td>Timo</td>
<td>12.00</td>
<td>73,584</td>
</tr>
<tr>
<td>3</td>
<td>PLTA Ketenger</td>
<td>Ketenger</td>
<td>8.04</td>
<td>49,301</td>
</tr>
<tr>
<td>4</td>
<td>PLTA Garung</td>
<td>Garung</td>
<td>26.40</td>
<td>115,632</td>
</tr>
<tr>
<td>5</td>
<td>PLTA Wadaslintang</td>
<td>Wadaslintang</td>
<td>16.80</td>
<td>73,584</td>
</tr>
<tr>
<td>6</td>
<td>PLTA Mrica</td>
<td>Mrica</td>
<td>180.90</td>
<td>380,000</td>
</tr>
<tr>
<td>7</td>
<td>PLTA Kedungombo</td>
<td>Kedungombo</td>
<td>22.50</td>
<td>70,746</td>
</tr>
<tr>
<td></td>
<td><strong>Total</strong></td>
<td></td>
<td><strong>2,877.12</strong></td>
<td><strong>888,431</strong></td>
</tr>
</tbody>
</table>

*Source: RUPED of Central Java in 2005*

The utilization of small-scale hydropower can be seen in Table 3.3. The province of Central Java also has potentially geothermal energy reserves. This geothermal energy is converted into electrical energy to fulfill the electricity needs of Central Java.

Table 3.3 The Utilization of Small Scale Hydropower

<table>
<thead>
<tr>
<th>No</th>
<th>Village</th>
<th>Sub District</th>
<th>Regency</th>
<th>Installed Capacity (kW)</th>
<th>Production (KWh/Year)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Purbasari</td>
<td>Karangjambu</td>
<td>Purbalingga</td>
<td>40</td>
<td>63,072</td>
</tr>
<tr>
<td>2</td>
<td>Tripis</td>
<td>Watumalang</td>
<td>Wonosobo</td>
<td>50</td>
<td>78,840</td>
</tr>
<tr>
<td>3</td>
<td>Giyombong</td>
<td>Bruno</td>
<td>Purworejo</td>
<td>10</td>
<td>15,768</td>
</tr>
<tr>
<td>4</td>
<td>Kalisalak</td>
<td>Kd Banteng</td>
<td>Banyumas</td>
<td>10</td>
<td>15,768</td>
</tr>
<tr>
<td>5</td>
<td>Sidoarjo</td>
<td>Doro</td>
<td>Pekalongan</td>
<td>24</td>
<td>37,843</td>
</tr>
<tr>
<td>6</td>
<td>Mudal</td>
<td>Temanggung</td>
<td>Temanggung</td>
<td>20</td>
<td>31,536</td>
</tr>
<tr>
<td>7</td>
<td>Tanjung</td>
<td>Mlongo</td>
<td>Jepara</td>
<td>104</td>
<td>163,987</td>
</tr>
<tr>
<td></td>
<td><strong>Total</strong></td>
<td></td>
<td></td>
<td><strong>258</strong></td>
<td><strong>406,814</strong></td>
</tr>
</tbody>
</table>

*Source: RUPED of Central Java in 2005*

### 3.2.2 Import / Export Transaction

#### 3.2.2.1 Petroleum

Most of the petroleum processed at the Cilacap refinery in Central Java province comes from outside Central Java. The amount of crude oil imported from other regions is 107,686.37 thousand barrel, which is processed in Cilacap. Since the large Block Cepu
refinery was not opened yet in 2005, the oil produced is still in small scale, so there were no oil exports in 2005.

3.2.2.2 Electricity

The electrical system in Central Java is part of the interconnection system between Java and Bali, therefore there will be import or export of electricity from other regions. But in 2005, the production of electricity in Central Java province is too low for its own demand so that Central Java still imports electricity from other regions as much as 4194.91 GWh.

3.2.3. Resource Potential

The province of Central Java has oil reserves in Block Cepu, which is situated on the border with East Java, the areas that are included in Central Java province are Kedung Tuban, Alas Dara and Kemuning. The amount of oil reserves in the three regions can be seen in Table 3.4 below.

<table>
<thead>
<tr>
<th>No</th>
<th>Location</th>
<th>Resources (MMSTB)</th>
<th>Reserves (MMSTB)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Kedung Tuban</td>
<td>80</td>
<td>-</td>
</tr>
<tr>
<td>2</td>
<td>Alas Dara</td>
<td>12</td>
<td>-</td>
</tr>
<tr>
<td>3</td>
<td>Kemuning</td>
<td>70</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>162</td>
<td>-</td>
</tr>
</tbody>
</table>

Source: [www.balithbangjatim.com](http://www.balithbangjatim.com)

The other potential energy found in Central Java province includes solar power, biogas and biomass. The Province of Central Java has a biomass potential of rice as much as 421,204.8 tons, Maize for 109,562.7 tons, 9,309.7 tons of Coconut, Sugar Cane for 10,495.7 tons and 8,198.5 tons of Trash. Cilacap has the greatest potential for Rice (34,170.7 tons), Grobogan District has the greatest potential for maize (21,808.3 tons), Kebumen Regency for Coconut (1503.7 tons), Sugar cane from Pati District (1962.2 tons), and Trash from Banjarnegara Regency (2808.3 tons).

Central Java Province has a potential for biofuels of 2,048.6 tons of cotton, castor oil of 1.6 tons, Coconut for 173,960.1 tons and 10,495.7 tons of sugar cane. Jepara has the greatest potential for cotton area (1372.1 tons), castor oil is from Grobogan District (31.91
tons), coconut is from Wonogiri District (56,193.2 tons), and sugar cane is from Pati Regency (1.962 tonnes).

Central Java Province has biogas potential, from: cattle (cow) of 3,224,383.20 tons manure, 5,803,320.60 tons of Goat manure, and 3,225,504.06 tons of chicken manure. Semarang has the greatest potential for cow manure (691,509.60 tons), Wonogiri District for goat manure (1,018,350.00 tons) and Brebes for chicken manure (311,984.46 tons).
CHAPTER 4
ENERGY SCENARIO

4.1 Energy Policy

The policy related to energy in Indonesia is divided into 2 based on the scope of energy policies issued by the government. The first policy is called National Energy Policy (KEN) being the target to be achieved as a whole (National) and Regional Energy Policy (KED) which is determined by the local government for each area, referring to the KEN and conditions of potential energy which exists in each region.

4.1.1 National Energy Policy

The policy on the management and utilization of energy in Indonesia is stated in the National Energy Policy document 2003 - 2020 (KEN), National Energy Management Blueprint 2005 to 2025 (PEN), and Presidential Regulation No. 5 Year 2006 on National Energy Policy (Perpres KEN). KEN regulation basically strengthens the document of PEN and KEN which is issued by the Ministry of Energy and Mineral Resources. Based on KEN regulation, the objective of national energy policy is to direct the efforts in maintaining security of energy supply in the country (Article 2 paragraph 1)

The legal basis of energy consists of:

1. Law Number 22 Year 1999 on Regional Government (State Gazette Year 1999 Number 60, Additional State Gazette Number 3952);
2. Law Number 22 Year 2001 on Oil and Gas

In an effort to create business activities of Oil and Gas which is independent, reliable, transparent, competitive, efficient, and environmentally conservation sound and encourage the development of potential and national role, the government has issued Law Number 22 Year 2001 on Oil and Gas. The activity of Hilir Migas business is focused on Processing, Transportation, Storage, and / or Commerce and it is conducted through the mechanism of fair, healthy, and transparent competition. However, the Government has the responsibility to ensure the availability and nonstop distribution of fuel which is a vital commodity and dominate people’s life in Republic of Indonesia.
3. Law No. 32 Year 2004 on Regional Autonomy
4. Law No. 30 Year 2007 on Energy
5. Government Regulation Number 10 Year 1989 on the Provision and Utilization of Electricity Energy (State Gazette Year 1989 Number 24, Additional State Gazette Number 3394);
6. Government Regulation Number 25 Year 2000 on the Authority of Provinces as Autonomous Regions (State Gazette Year 2000 Number 54, Additional State Gazette Number 3952);
7. In implementing the responsibility for setting and monitoring of business activities and distribution of fuel supply and gas transportation business in the pipeline, the Government has established an independent body of *Badan Pengatur Hilir Minyak dan Gas Bumi* (Government Regulation no. 67 Year 2002 and the Presidential Decree. 86 Year 2002).
8. Government Regulation No. 36 Year 2004 on Business Activities of *Usaha Hilir Minyak dan Gas Bumi*;
9. Government Regulation No. 3 Year 2005 on amendments to the Regulation No. 10 Year 1989 on the Provision and Utilization of Electricity Energy which stated that in order to implement regional autonomy in Electrical Power field, it is necessary to give local governments a role in electricity supply. To ensure the availability of primary energy to supply electricity for the public interest, the local energy resources are prioritized by focusing the use of renewable energy sources
10. Presidential Regulation No. 5 Year 2006 on National Energy Policy;
11. Presidential Instruction No. 1 Year 2005 on the Provision and Utilization of Bio Fuels (Biofuels) as Other Fuel;
12. ESDM No. 0048 of 2005 on Standards and Quality (Specification) and Control of Fuel, Fuel Gas, Other Fuels, LPG, LNG and Processing Results which is marketed within the country;
13. Regulation of the Minister of Energy and Mineral Resources No. 0007 Year 2005 on Requirements and Guidelines for the Implementation of Business Licenses in the Activity of *Usaha Hilir Minyak dan Gas Bumi*;
15. Decision of the General Director of Oil and Natural Gas No. 3675 K/24/DJM/2006 on March 17, 2006 on the specification of fuel types of SOLAR;
16. Decision of the General Director of Oil and Natural Gas No. 3674 K/24/DJM/2006 on March 17, 2006 on the fuel types of BENSIN
17. Decision of Governor. 541/40/2004 on the Coordination Team of Control & Distribution Monitoring of fuel in the province of Central Java (Secretariat for Economic Affairs Bureau of Central Java Province)
18. Decree of Chairman of TKP3BBM, No.541/11825/2005) on the Working Group (Public Complaints Unit and the Monitoring of kerosene fuel UPMP BBMT (BAPERMAS of CENTRAL JAVA PROVINCE)

4.1.2 Regional Energy Policy

1. Regional Energy Policy (KED) which is issued by local governments refers to the KEN and conditions of the energy potential existing in their areas.
2. Guarantee the availability and nonstop distribution of fuel throughout the areas of Republic of Indonesia;
3. National Fuel Reserve policy;
4. Mechanisms and/or formulation of the price of a particular fuel prior to the existence of fair, healthy and transparent business competition;
5. Availability and distribution of certain types of fuel;
6. The capacity of minimum storage facilities that must be realized by Enterprises;
7. Administrative sanctions and / or fines for enterprises that do not provide national fuel reserves when needed;
8. Imposing sanctions for violations of business license;
9. Policies related to the determination of Commerce Region for specific fuel types;
10. Policies on market opening phase;
11. Opening or closing the import or export of fuel based on technical and economic considerations
12. Petroleum processing policies relating to the location, type and amount of fuel produced;
13. Incentives for fuel distribution in Remote Areas;
14. The policy of fuel storage associated with the location, type and the amount.
4.2 Scenario Assumptions and Parameters

4.2.1 Assumption Scenarios

Scenarios used have to support policy and to be based on law as mentioned above. Such scenarios should include the provision of fuel oil, usage of new renewable energy, and increase of the electrification ratio and other assumptions as described as follows

- Realize mix national energy based on Presidential regulation (Per-Pres) No. 5 Year 2006 with the percentage of each energy:
  - Crude Oil is Less Than 20% of total primary energy use
  - Natural Gas is More Than 30% of total primary energy use
  - Coal is More Than 33% of total primary energy use
  - Bio Fuels is More Than 5% of total primary energy use
  - Geothermal is More Than 5% of total primary energy use
  - Biomass, Nuclear, micro hydro, Solar, and Wind Power is More than 5% of total primary energy use
  - Coal liquefied is More Than 2% of total primary energy use

- Increasing electrification ratio up to 100% in 2020, in accordance with national policies on the above mentioned number 9

- Convert energy from kerosene to LPG, in accordance with national policies on the above mentioned number 18 and 19.

- Achieve energy elasticity less than one in 2025 in accordance with national policies on the above mentioned number 1 and 2.

- Start to use renewable energy such as bio-diesel and bio-ethanol to support the target of mix energy based on Presidential Rules No. 5 Year 2006 and president instruction no 1 year 2005

- The energy usage from natural gas that began in 2012 in accordance with national energy policy that is mentioned in numbers 17 and 18.

Other national policies are not included into the scenario but should be included because it became the legal basis and the basic policy which is used as reference for energy planning in the Central Java Province.
Assumptions mentioned above will be inputed in the LEAP model related to the energy consumption intensity, which will be conducted for incoming years based on the assigned targets. For the addition of power plant capacity inputed into the transformation sector of the model, changes to the existing generating capacity value to the year ahead in accordance with existing policies are made. Such as the addition of Geothermal Power Plant in Ungaran and PLTP Tanjung Jati Baru (B). In this scenario natural gas will begin functioning in 2012 with the source of natural gas from East Kalimantan natural gas pipeline to Semarang.

In accordance with CAREPI goal to reducing poverty in each region, there is a change in the activity of household sector, beginning with changing of people's living conditions from rural to urban. There is a poverty reduction which occurs both in villages and cities. This leads to the changes from agricultural land to industrial and construction sectors which resulting reduction of income value from the agricultural sector.

To reduce the dependence of fuel oil consumption, switches towards the usage of renewable energy such as biodiesel, bioethanol, and vegetable oils will be made. This will begin functioning in 2009. The source of biofuel is derived from Jatropha, cassava, kappas, coconut, and other green energy-producing plants.

4.2.2 Parameter Scenarios

4.2.2.1 KEN (National Energy Policy) Scenarios

For KEN Scenario, assumptions used are as follows:

- Population Growth is 1% per year, where this figure is taken from RUKN (National Electricity General Plan) 2007. This is due to the absence of other references that states the growth data like the above.
- Total PDRB growth is 6.1% per year where this figure is taken from RUKN (National Electricity General Plan) 2007. This is due to the absence of other references that states the growth data as above.
- The growth of electricity consumption for Household sector is 7.65%, 2.71% Commercial and Industrial 0.68%
- Ratio of electrification is 100% by 2020, This data is taken from the planned target of PLN in 2020.
Conversion from Kerosene to LPG and LPG in 2010 has replaced kerosene, this is in accordance with national policy that for kerosene conversion targets to LPG for the island of Java to be completed in 2010.

Renewable energy such as bio-diesel and bio-ethanol start to be used and the percentage of their use can be seen in the following tables. Shares from table 4.1, 4.2 and 4.3 are entered in the LEAP model as the target percentage in intensity projection from 2009 until 2025.

Table 4.1 Projection of Biodiesel Use

<table>
<thead>
<tr>
<th>Sector</th>
<th>2009</th>
<th>2010</th>
<th>2015</th>
<th>2020</th>
<th>2025</th>
</tr>
</thead>
<tbody>
<tr>
<td>PSO Transportation</td>
<td>1%</td>
<td>2.5%</td>
<td>5%</td>
<td>10%</td>
<td>20%</td>
</tr>
<tr>
<td>Non PSO Transportation</td>
<td>1%</td>
<td>3%</td>
<td>7%</td>
<td>10%</td>
<td>20%</td>
</tr>
<tr>
<td>Industry and Commercial</td>
<td>2.5%</td>
<td>5%</td>
<td>10%</td>
<td>15%</td>
<td>20%</td>
</tr>
<tr>
<td>Electrical Generator</td>
<td>0.25%</td>
<td>1%</td>
<td>10%</td>
<td>15%</td>
<td>20%</td>
</tr>
</tbody>
</table>

Table 4.2 Projection of Bioethanol Use

<table>
<thead>
<tr>
<th>Sector</th>
<th>2009</th>
<th>2010</th>
<th>2015</th>
<th>2020</th>
<th>2025</th>
</tr>
</thead>
<tbody>
<tr>
<td>PSO Transportation</td>
<td>1%</td>
<td>3.0%</td>
<td>5%</td>
<td>10%</td>
<td>15%</td>
</tr>
<tr>
<td>Non PSO Transportation</td>
<td>5%</td>
<td>7%</td>
<td>10%</td>
<td>12%</td>
<td>15%</td>
</tr>
<tr>
<td>Industry and Commercial</td>
<td>5%</td>
<td>7%</td>
<td>10%</td>
<td>12%</td>
<td>15%</td>
</tr>
</tbody>
</table>

Table 4.3 Projection of Biofuel Use

<table>
<thead>
<tr>
<th>Sector</th>
<th>2009</th>
<th>2010</th>
<th>2015</th>
<th>2020</th>
<th>2025</th>
</tr>
</thead>
<tbody>
<tr>
<td>Industry</td>
<td>0%</td>
<td>1%</td>
<td>3%</td>
<td>5%</td>
<td>10%</td>
</tr>
<tr>
<td>Sea Transportation</td>
<td>0%</td>
<td>1%</td>
<td>3%</td>
<td>5%</td>
<td>10%</td>
</tr>
<tr>
<td>Electrical Generator</td>
<td>0.25%</td>
<td>1%</td>
<td>5%</td>
<td>7%</td>
<td>10%</td>
</tr>
</tbody>
</table>

4.2.2.1 KED (Local Energy Policy) Scenario
Population Growth is 2.60 % per year, These figures are obtained by following the growth pattern of population census data from BPS for 3 periods before the year 2005.

Total PDRB Growth is 7 % per year, These figures obtained by following the pattern of GDP growth of 3 periods of census data before the year 2005 from BPS.

The growth of electricity consumption for Household sector 3.05 %, Commercial 2.74%, and Industrial 0.69%, These figures are obtained from a Jateng RUKD report in 2007.

Electrification ratio in 2020 is 100% This data is taken from the plan target of PLN in 2020 and targets for electrification ratio from MEMR for Central Java Province.

Conversion from Kerosene to LPG and LPG in 2009 LPG has replaced kerosene this is in accordance with local policy that kerosene conversion targets to LPG for Central Java province will be completed in 2009.

Renewable energy such as bio-diesel and bio-ethanol start to be used and the percentage of their use up to 2025 is similar to KEN Scenario. From table 4.1, 4.2 and 4.3 the target percentage is entered in LEAP as intensity projections from year 2009 until year 2025.

4.3 Energy Scenario Outcomes

In energy policy, each region has a policy named the Regional Energy Policy (Kebijakan Energi Daerah-KED) which must be suited with their local conditions and is also expected to support the National Energy policy (KEN).

The energy calculation outcome until the year 2025 of the scenario is generally divided into 2 groups: the demand and the supply side. On both sides two scenarios t KEN (National Energy Policy) and Ked (Regional Energy Policy) are given. From the second scenario you will see different results in accordance with the policies applied.

The results of energy projections of Central Java using LEAP (Longe-range Alternatives Planning System) is divided into 2 parts namely demand and supply in which the result can be seen as follows:
4.3.1 Demand Side
4.3.1.1 KEN

Energy consumption per sector of energy use based on the results of KEN policy is assumed to keep increasing until 2025. It is found out that in 2025, the use of Energy Consumption per Sector of energy use will increase up to 307.60% compared to that in 2005 as shown in Figure 4.1 below:

![Energy Consumption by sector](image)

**Figure 4.1 Energy Consumption per sector up to 2025 using KEN scenario**

From the graph 4.1 it shows that the largest energy consumer is the transportation sector, followed by industry sector, that is because the large BBM consumption in the transportation sector, and growth of vehicle activity also increased throughout the modelling period so that by the end of the year 2025 still the largest energy consumption is in the transportation sector.

The energy consumption of each type of energy based on the result of KEN policy increases similarly. It is described in Figure 4.2 below. From figure 4.2 it can be seen that conversion happened from kerosene to LPG which causes the increasing of LPG usage per
year. Oil fuel consumption decreases every year when seen from the total annual quantity percentage, although it increases in absolute numbers over the years, this is because in year 2009 the use of renewable energy such as biodiesel, bioethanol and vegetable oils started. From the images also can be seen that the usage of fuels still dominate until the end of 2025 although there was also increase in usage of renewable energy, this is because the intensity of the energy consumption from oil fuel is still too big.

![Energy Consumption by type of energy](image)

Figure 4.2 Energy consumption per type of energy to 2025 with KEN scenario

4.3.1.2 KED

The energy consumption per sector is predicted to be increasing until 2025. It was known that in 2025 the energy consumption per sector grows by 298.91% in 2005 as seen in figure 4.3 below.
Figure 4.3 Energy consumption per sector up to 2025 with KEN Scenario

Figure 4.3 for scenario KEN sector shows that the largest energy consumer is the transportation sector followed by industrial sector. Household sector was ranked 3rd after industry. Percentage of energy consumption by sector changed barely from year to year, this because the growth of energy consumption activities for each sector did not change significantly.

The energy consumption per energy type based on the KED policies is considered to be increasing consistently up to 2025 as like the energy consumption per sector as seen in the following Figure 4.4.
As KED is very likely to KEN regarding the end use side, the same conclusions remain valid.

4.3.2 Supply Side

For Central Java Province the primary energy supply comes from petroleum, hydropower, geothermal, and biomass. While the secondary supply for electricity energy comes from power plants, that consist of steam power plant, fuelled by coal, oil gas, geothermal and hydropower.

4.3.2.1 Crude oil

Central Java province has an oil refinery located in the Block Cepu with installed capacity in 2005 of 1,106,040 BOE and which is people owned mining, processed traditionally. But in year 2009 began operating Block Cepu, that results in increased total capacity oil mining in Central Java province, as shown in the following figure 4.5 below.
4.3.2.2 Refinery

1. Oil Production

   In 2009 Central Java Province has a new oil refinery that is Cepu portable refinery so the oil production increased as shown in Figure 4.6 below.

2. Imported Fuel

   Along with the conversion process from kerosene to LPG the LPG consumption from year 2009 until the year 2025 has been increased, but this increase was not accompanied by the increase of LPG production at existed oil refineries so in year 2009 Central Java province began import LPG from other regions. Current supplies are sufficient for Premium and Solar consumption but from the projection made for both scenarios KEN (National Energy Policy) and KED (Regional Energy Policy) Central Java province began importing in 2017 Premium and Solar Oil in 2022, as shown in the picture below 4.7.
4.3.2.3 Electricity

1. Power Plant Capacity and Power Plant Fuel

The existing power plant capacity in Central Java province for both scenarios KEN and KED grow with the construction of new power plant such as PLTP in Guci and Ungaran, Tanjung Jati B power plant and other power plants as shown in Figure 4.8 below.

Fuel consumption in power from 2005 until the year 2025 increased as shown in the figure 4.9. This is because the growth in electrical energy consumption. But started in 2012 Fuel consumption began to decline due to the replacement of fuel from oil to natural gas and renewable energy.
4.3.2.4 Renewable Energy

1. Biodiesel

With the energy policy of biodiesel usage meant to reduce consumption of diesel oil, automotive diesel oil and fuel oil, it will be required to build factories that produce biodiesel. Consistent with the increased use of biodiesel, the total factory production capacity must also increase, if no import from other regions is wanted. Biodiesel plant capacity projections can be seen in the Figure 4.10 below:

From the graph above can be seen that the capacity of biodiesel plant began operating in 2009 and increase annually consisted with the increased use of biodiesel on demand side.
2. Bioethanol

With the energy policy of bioethanol usage to reduce consumption of premium, it will be required to build factories that produce bioethanol. Consistent with the increased use of bioethanol, the total factory production capacity must also increase, if no import from other regions is wanted. Bioethanol plant capacity projections can be seen in the graph 4.11 below.

Figure 4.11 Proyeksi Kapasitas Pabrik Bioethanol
From the graph above can be seen that the capacity of bioethanol plant began operating in 2009 and increase annually consisted with the increased use of bioethanol on demand side.

3. Vegetable Oil

With the energy policy of vegetable oil usage to reduce consumption of diesel oil, automotif diesel oil and fuel oil, it will be required to build factories that produce vegetable oil. Consistent with the increased use of vegetable oil, the total factory production capacity must also increase, if not want to import from other regions. Vegetable oil plant capacity projections can be seen in the graph 4.12 below.

![Projected Capacity Vegetable Oil Factory](image)

Figure 4.12 Projected Capacity Vegetable Oil Factory

From the graph above can be seen that the capacity of vegetable oil plant began operating in 2009 and increase annually consisted with the increased use of bioethanol on demand side.

4.3.3 Comparison between KEN and KED results

4.3.3.1 Household Sector

On the end year of the simulation using LEAP software shows that KEN scenario energy demand in the household sector is more higher than KED scenario, difference between +/- 23 million BOE in KEN and +/- 21 million BOE n KED as indicated in Figure 4.13.
The simulation using LEAP software shows that for KEN scenario the energy consumption on household sector in 2025 is higher than KED scenario as illustrated in figure 4.13. From the graph can be seen that population migrate from rural to urban areas in both scenarios. With population growth and rising of the urban standard living causes urban energy consumption also increased throughout the year.

Energy consumption in the household sector is also changes with the conversion of kerosene began in 2007 for both scenario. Where in KEN scenario conversion program ended in 2010 and for KED scenario ended in year 2009 as shown in figure 4.14 below. For electricity consumption in household sector also increase and the electrification ratio reached 100% by 2020 for both scenarios.
4.3.3.2 Commercial Sector

The simulation result using LEAP software shows that for KEN scenario the energy consumption in commercial sector in 2025 is about 1 million BOEs smaller than KED scenario as illustrated in Figure 4.15. From the graph can be seen that percentage of energy consumption per sector not changed significantly, which the trade sector is still the largest energy consuming and was followed by the restaurant sector.

![Figure 4.15 Comparison between KEN and KED Scenario per commercial sector up to 2025](image)

While energy consumption per type of energy used slightly change due to the conversion process from kerosene to LPG having a similar target as household sector. In the commercial sector renewable energy began to be used in early 2009 replacing the diesel oil consumption. Biggest energy consumption in 2025 from the commercial sector is LPG and was followed by electricity and diesel oil as seen in the graph below.

![Figure 4.16 Comparison between KED and KED Scenario per commercial sector energy type up to 2025](image)
4.3.3.3 Industrial Sector

The simulation result using LEAP software indicates that for KEN scenario the energy consumption on industrial sector in 2025 is 2 million BOE smaller than KED scenario as shown in figure 4.17. From the graph can be seen that the percentage of energy consumption per sector has not changed significantly, the biggest energy consumption annually is sector of non-metal industry, followed by textile and chemical industries.

Energy consumption projections per type of energy used slightly change due to the conversion process from kerosene to LPG with a same target as household sector. Biggest energy consumption is from coal and was followed by electricity and diesel oil as shown in the picture below.

4.3.3.4 Transportation Sector
The simulation using LEAP software shows that for KEN scenario the energy consumption in transportation sector in 2025 is 3 million BOE smaller than KED scenario as shown in figure 4.18. Projections The vehicle type that consumes the most energy is passenger car followed by motorcycles and trucks.

Figure 4.19 Comparison between KED and KED Scenario per transportation sector up to 2025

Energy consumption projections in transportation sector per type of energy used is still dominated by fuel (Fossil fuel), although renewable energy has started to be used in 2009 but the usage percentage is still too small compared with the fuel usage. Energy type that most be used is premium, followed by diesel oil, and started year 2009 the renewable energy is in third place after a diesel oil, as shown in the graph 4.20 below

Figure 4.20 Comparison between KED and KED Scenario per transportation sector energy type up to 2025

4.3.3.5 Other sectors

1
The simulation using LEAP software indicates that for KEN scenario the energy consumption on transportation sector in 2025 is 1 million BOE smaller than KED scenario, as indicated in Figure 4.21. From the graph can be seen that the biggest annual energy consumption is still dominated by the construction sector. And the percentage of energy consumption in the agricultural sector declined due to changes in land usage from agricultural land into industrial settlements and resulting in the construction sector increasing annually.

Energy consumption projections in other sector per type of energy either used for KEN or KED scenario is still dominated by fuel (Fossil fuel). In other sector conversion process also occurs from kerosene to LPG, which began in 2007 and ended in 2010 for KEN scenario and in year 2009 for KED scenario. Renewable energy begin to be used to reduce the dependence on fuel consumption in year 2009 for both scenarios as shown in the graph 4.22 below.
4.3.3.6 Estimation of electricity energy

In Central Java province there are additions of power plant capacity to support the growth of electrical energy consumption each year in accordance with government policy on 10.000MW power development program in Indonesia. The new power plants in Central Java province are scheduled to use coal, geothermal and hydropower. The addition of power plant capacity for KEN and KED scenario shown in the graph below.

Electricity generated by power plants using LEAP software is determined based on the amount of electricity demand, which for the KED scenario is greater than KEN scenario as shown in the graph 4.24 below.
In 2005 Central Java Province imports electricity from other regions, through a interconnection system, JAMALI (Java-Madura-Bali), but with the addition of power plant capacity in the following years, Central Java province has no need of supplies from other regions because of the existing generating capacity is capable to serve the development of domestic electrical energy needs. But in year 2021 for KEN scenario and 2022 for KED scenario Central Java province will begin importing electricity from other regions, because the export target for KEN scenarios are 6,098 MBOE and 5,099 MBOE for KED scenarios and these target make constant till end year. To view details about the balance of electric energy in Central Java Province can be seen in the graph 4.25 below.

4.3.3.7 Estimation of petroleum production
From the simulation result using LEAP software, it can be seen that for KEN Scenario the total petroleum production in 2025 is the same as KED Scenario, that is, 3.600 millions SBM, as shown in Figure 4.26.

Projections of refinery in Central Java province, as seen in the graph 4.27 below is a self-consumption by the Central Java province. Because of its capacity is too small when compared with the growth of oil consumption, Central Java province needs to import oil from other regions to meet the demand.

Figure 4.26 Comparison of crude oil projection between KEN and KED sector scenarios in the year of 2025

Figure 4.27 Energy balance for petroleum up to 2025
4.3.3.8 Projection of Oil Refinery

The result of simulation using LEAP software showed that in 2025 the total product of crude oil for KEN and KED scenario is the same; that is about 116 million barrels of oil equivalent (BOE), as shown in Figure 4.28.

The software LEAP simulation reported that both KEN and KED sector scenarios will produce the total amount of crude oil in 2025. The product will be 116 million barrels of oil equivalent, as shown in Figure 4.29.
Production of oil refinery in Central Java province is governed by PT. Pertamina as a (BUMN) state firm entitled to regulate the distribution policy and oil distribution in Indonesia. But by using LEAP software it can be seen for the distribution of oil fuels as shown in the graph 4.30 below that almost 60% of the fuel oil produced at the refinery were exported to other regions. However, in year 2009 until year 2025 central Java province also imports oil from other regions, this is because conversion process from kerosene to LPG which is not followed by additional refinery capacity for processing LPG. Then to adjust the LPG demand in central Java province needs to import LPG from other regions.

![Figure 4.30 Distribution of oil fuels in Central Java Province](image)

### 4.4 Target of Energy Mix using KEN and KED Scenario

The initial condition (2005) of energy use in Central Java Province is shown in Figure 4.31. The use of oil fuel is the highest (88.93%), Geothermal energy is on the second rank (6.01%), and the third rank with 4.41% is renewable energy.
When the KEN scenario is applied in 2025, the use of Refined Fuel Oil (BBM) can be decreased until 43.44%. Conversely, geothermal energy will remain small (0.31%). Coal will increase until 39.92%. In the scenario, there will be a utilization of Natural Gas, Renewable Energy and Vegetable oil of about 4.77%, 1.27% and 10.28% as a result of the decreasing of fuel and geothermal as shown in Figure 4.32.

However, if the KED Scenario is applied in 2025, the use of fuel will be declined until 43.48%. Geothermal energy will also remain small 0.29%), while coal will increase until 38.63%. For this scenario the utilization of Natural Gas, Renewable Energy and vegetable oil will be about 4.79%, 1.28% and 11.17% as a result of the declining of fuel and Geothermal Energy as shown in figure 4.33 below.
In conclusion, the KED scenario will produce more optimum result than the KEN scenario. However, from the two scenarios, no one can realize the target of the energy mix as stated by Presidential Decree No. 5 year 2005. This is because the percentage of new renewable energy usage is still too small compared with fossil fuel. For the target of geothermal energy usage in Central Java province, it is not possible to achieve the energy target mix by 5% because of the existing potential energy there is not sufficient to reach the target. But at least with the optimization of the energy potency, fossil fuel consumption trends is expected to reduce in order to supply electrical energy.
CHAPTER 5

PRO – POOR ENERGY ACCESS

5.1 Description of Poor Village Profile

5.1.1 General Information of Desa Sukawera

Desa Sukawera is administratively located in Kecamatan Cilongok (Cilongok Sub-district), Banyumas Regency. Banyumas is one of 35 Regencies in Central Java region. Geographically, Banyumas is positioned between 108°39’17” - 109°27’15” East Longitude (EL) and 7°15’05” - 7°37’10” South Latitude. Administratively, Bayumas Regency has the boundary in the north with Tegal dan Pemalang Regency, in the south with Cilacap Regency, in the east with Purbalingga, Banjarnegara dan Kebumen Regency and in the west with Cilacap dan Brebes Regency. The location of Banyumas Regency in Central Java Region is shown in Figure 5.1. In the northern are of Banyumas Regency is Western Part of Serayu Utara Mountain Range. Highest level of Serayu Utara Mountain Range is Slamet Mountain (3,428 ASL) and other mountains such as Kucing Mountain (1,520 ASL) and Manis Mountain (2,163 ASL) are located nearby. Based on geological feature, this mountain range is extended from Bandung Depression in West Java. In the south east area is a part of the Western Part of Serayu Selatan Mountain with the highest level of Jampang Mountain (809 ASL) which is boundary are to Banjarnegara Regency.

Figure 2.1: Map of Banyumas Regency in Central Java Region
Based on geographical feature, Sokawera is situated at 600 to 800 m ASL with the large parts of the area is hilly topography condition. Most area in Desa Sokawera is used for plantation which includes natural forests and rice/paddy farming (lahan sawah). The access road to the villages is unpaved-roads which are only suitable for motorbike and bicycle. The average annual rainfall (1996 to 2006) which was taken from Logawa and Cikidang Cilongok rainfall stations is about 2,500 mm. The rain session usually occurs from November to April with the highest rainfall rate is about 3,071 mm. Based on the high rainfall rate; the risk of natural disasters in Sokawera is local flood and landslide. The dry session is from May to October with the peak month of dry is on August and September. In dry session, some rice farming in Sokawera with rainfall irrigation system will be faced on water crises. Sokawera village is also located in drainage basin (Daerah Aliran Sungai, DAS) of Mengaji (Mengaji River). This river is a main source for semi-technical irrigation and for household activities. Most of Mengaji River drainage basin is still natural forest and has high capacity storage to receive the water from rainfall. Covered area of Mengaji River is about 6,000 Ha.

Generally, the real social and economic condition in Sokawera community can be described from the demography, social and economic activities of the community itself. The population of Sokawera Village in 2007 is 7,101 people which are distributed in 1,775 households. About 1,420 households (80 %) are working on home industry of coconut sugar with small sugar production capacity of about 5 kg/day and small farming. Another economic activity that is usually carried out by Sokawera community is farming worker (buruh tani) and collecting firewood for cooking which are taken from forests. They also have additional income from the livestock trade such as cows, goat, chicken, etc., however, it cannot be calculated as monthly income. The average income per household based on these economic activities is in the range of Rp. (IDR) 8,000 to 17,000 per day. Sukawera community is also common with informal economic activity of interhousehold barter and sharing. It includes everything from household production and consumption of goods and services. This economic system is household survival strategies in community to save their money. According to the gender, the proportion of male and female is 51 % (3,622 person) and 49 % (3,480 person) respectively. The population growth of Kecamatan Sokawera in
2007 is 0.20 %. The population growth of Desa Sokawera is relatively low due to the urbanization movement has been occurred.

Economic performance of Desa Sokawera can be summarized from their GDP (gross domestic products) of Kecamatan Cilongok. The agriculture sector was the backbone of the local economy, contributing 43.53 % to the total GDP in 2006. The trade sector contributed 15.84 %, which was followed by the service and industrial sector with the contribution of 13.08 % and 8.43 % respectively. The high agricultural sector contributed in the GDP originates from the five sub-sectors of food crops, plantation, animal husbandry and its products, and forestry. Although the GDP increases from 2002 to 2006 which indicates that positive economic growth in Kecamatan Cilongok (with range of annual GDP growth is about 8.13 to 15.32 %), Sokawera village is still categorized as “kawasan tertinggal dan tumbuh lambat” (poor and low economic growth area) in Banyumas Regency. This village is the isolated area and has relative static growth of social and economic activities compared to other villages in Kecamatan Cilongok which have the better access in trade and economic. The village is also categorized as a traditional village due to the average educational level of community is still low; the production only meets to the daily household needs and the limited communication with other villages.

5.1.2 Energy Profile of Desa Sokawera

The energy situation and potential of Desa Sokawera presented in this section is a result of focus group discussion (FGD) and semi-structured interview from PRA analysis (discussed in previous chapter). Table 5.1 presents the type of energy which is used in community. Cooking and lighting are the principal energy services needed in the households activities and constitutes approximately 80% of the total energy consumption in households. Firewood is still dominated as the principal energy source for cooking which is prevalent to a greater or lesser extent in almost all households (is about 80 % of total households in Desa Sokawera), irrespective of their income level. Other related issue and phenomena from this situation is that the government conversion program of kerosene to LPG for cooking has not been effectively implemented in Desa Sokawera.
Table 5.1. Type of Energy Used in Desa Sokawera

<table>
<thead>
<tr>
<th>No</th>
<th>Activities</th>
<th>Type of Energy Supply</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Electricity</td>
</tr>
<tr>
<td>1</td>
<td>Cooking</td>
<td>-</td>
</tr>
<tr>
<td>2</td>
<td>Lighting</td>
<td>√</td>
</tr>
<tr>
<td>3</td>
<td>Production (Local Entrepreneur)</td>
<td>-</td>
</tr>
<tr>
<td>4</td>
<td>Ironing</td>
<td>√</td>
</tr>
<tr>
<td>5</td>
<td>Transportation</td>
<td>-</td>
</tr>
</tbody>
</table>

Source: FGD In Depth Interview, PUSPER UMY

Number of households connected to the utility grid (PLN) is approximately 50% and mainly used for lighting. The rest of households use traditional pico-hydro particularly in Dusun Kubangan, and kerosene lamp (mostly compressed lamps, but some use wick lamp) for lighting. Major households connected to PLN are registered as a customer class of R1. Based on interview and observation during PRA study, it can be gathered information that the households which are connected to grid do not use the electrical source for cooking. Due to it needs the high electricity input. For rural households, their connection capacity is mostly 450 watt (R1 class) and it means the connection capacity does not meet with the electricity stoves which needs around 300 to 900 watt. Therefore, household only use electricity for lighting and entertainment such as TV or radio. Some renewable energy potentials have been identified in the survey and FGD activities which can be developed as a solution for energy source alternative in Sokawera. Several renewable energy potentials in Desa Sokawera were identified from the result of the site visit, interview and FGD as shown in Table 5.2.

Table 5.2. Renewable Energy Potential in Desa Sokawera

<table>
<thead>
<tr>
<th>No</th>
<th>Type of Energy</th>
<th>Source</th>
<th>Potential Energy</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Biofuel</td>
<td>Jatropha</td>
<td>More than 2000 Ha of potential area</td>
</tr>
<tr>
<td>2</td>
<td>Biogas</td>
<td>Livestock</td>
<td>NA – but each household usually has cows/goats/sheep</td>
</tr>
<tr>
<td>3</td>
<td>Micro-Hydro</td>
<td>Mengaji River</td>
<td>Has gross head about 14 m (about 20 kW)</td>
</tr>
</tbody>
</table>

Source: FGD In Depth Interview, PUSPER UMY, Analyzed
Renewable energy source of biofuel from Jatropha plantation is one of potential plants in Desa Sokawera. Referring to area of the not-farming land is more than 2,000 Ha; those lands can be cultivated with Jathropa for biofuel production. Due to the limited knowledge regarding to Jathropa plantation, the building capacity on Jathropha cultivation and corp method to the community is needed. Livestock production concentrates on cattle cows, buffaloes, goats and sheep. Cows and buffaloes are used to work the fields, but rarely marketed. With the amount of cows in Sokawera is significant because almost each household has livestock, the biogas energy is promised energy with large potential source which can be used.

5.2 Design of Proposed Energy Infrastructure

Based on the available energy potentials and the needs assessment from the PRA results, several energy service programmes were proposed. These potential energy programmes were also planned and designed in relationship with important issues of (1) the sustainability of the programmes through cultural and social approach, (2) the optimization of the available renewable energy sources, and (3) the improvement of the better quality life through the energy programme. The potential proposed energy programmes in Desa Sokawera are described as follows:

1. Biogas Energy Package (BGEP) for cooking purposes. This program was proposed due to this energy service is high portion of energy used in Sokawera community. The packet consists of four sub-programs which are:
   a. Development a pilot installation for complete biogas energy infrastructure which is efficient and low-cost construction based on the capacity of 2-4 cows for household level.
   b. Community assistance in terms of cultural approach for transferring the knowledge and implementing the biogas energy program. The program is also followed by the extension for the cow husbandry.
   c. Assistance on the potential cooperation (koperasi), local entrepreneur or local financial unit which is potential and interest in this program.
   d. Assistance on fertilizer process from the biogas residue. The fertilizer can be used by former group for farming or can be sold as the additional income for household.
2. Biodiesel Energy Package (BDEP) for household. The packet consists of three sub-programs which are:
   a. Development a pilot installation of complete simple-biodiesel process for oil production in order to be used in kerosene stove or modified kerosene stove.
   b. Community assistance in terms of cultural approach for transferring the knowledge and implementing the Jathropa cultivation.
   c. Assistance on the potential cooperation (koperasi), local entrepreneur or local financial unit which is potential and interest in this program.
3. Micro-Hydro Power Plan (MHPP). The packet is to develop an installation of MHPP for electricity in Dusun Kubangan (one of dusun which does not access to PLN grid).

Many studies show that the key constraint to energy supply by the renewable energy for rural community is access to the initial capital needed to purchase the equipment or to build the infrastructures to harness the resource. This leads rural communities to choose energy options that are cheap on a day-to-day basis, but which offer a poor quality of energy supply and are expensive over the longer term. In addition, the current economical condition in community of Desa Sokawera, particularly for poor household show that they cannot finance the proposed energy programme (i.e. Biogas for Cooking) based on their income. Thus, financial way by other institutions/sources is need in order to implement the proposed programme to the community. Several alternative formal sources for financing the proposed programme are Banking, Micro Finance Institution, Usaha Kecil dan Menengah (UKM). There are three reasons to involve the UKM in this scheme. First, the performance of UKM shows the good achievement in order to produce the economic activities in the rural community. Second, UKM involves the investment and technology development for increasing its productivity. Third, UKM has flexibility in the economic activities compared to the larger units. In addition, UKM in Indonesia plays the important role for reserving the local worker, increasing the economic units and supporting the household income. Other informal organization which has a potential unit for financing the programme is Koperasi (Cooperation). The cooperation can perform sustainable programme due to the cooperation is familiar unit in the community and local farmers for financing their needs in household and farming sector. However, the
assistantship of both units (UKM and Cooperation) by university is still needed in order to plan the appropriate financing scheme for proposed energy programme in Sokawera.

The regional energy office also plays an important role in this financial scheme. The office can propose the regional budget for financing the subsidies or pilot programme in Kecamatan Sokawera. The regional office is also able to propose the budget for building capacity in the community for assistantship, mentoring and developing the proposed programme. Several alternative scheme are described below that can be chosen which scheme is appropriate for implementing in Desa Sokawera. These schemes involve all financial stakeholders, i.e. Banking, Micro Finance Institution, Usa ha Kecil dan Menengah (UKM), Cooperation and Regional Energy Office as well.

1) Subsidies Scheme

Subsidies are granted either to service, commodities or activities that are viewed by governments as crucial to the livelihood of low income people or to maintain economic sectors viewed as strategic, i.e. agricultures, energy, etc. Subsidies occur when the budget do not cover the cost of production on energy. Subsidies can be either direct such as payments that reduce the cost of energy infrastructures to an investment, or indirect such as changes the prices, taxes and the provision of recurrent inputs such as training or the prevision of infrastructure. Much of logic of the subsidy rests on the assumption that there will be a supply response. Many forms of subsidy are known to have side-effect that are harmful to more self-sustaining development in the longer time or do not reach the intended beneficiaries. In addition, the capability of regional government budget to subsidy the programme is limited. Therefore, the programme cannot be running well if this financial scheme will be implemented totally.

2) Credit Scheme

Credit is a financial intermediation between economic agents with credit and those with deficit. For various reasons (confidence, pooling the resource of several small leaders, skills, etc) an intermediate, generally a financial institution, is necessary to implement the financial link between the incomes, i.e. when the crops are sold and the expenses, various forms of the credit were develop to support both poor and wealthy farmer. However, the
types of credit widely used in the agricultural sector (in example) are not suitable for funding the rural energy scheme for poor communities, particularly when the pay-back period is spread over a medium term period. The costs of recovering small loans in isolated areas are usually fairly high. Most of the banks do not have experience to deal with the rural credit in energy sector, i.e. for small or micro scheme. Because of the risk, banks are inclined to impose guarantees that poor rural communities have difficulty meeting. Loans are a relatively new concept in financing the energy supply for rural communities in Indonesia. Therefore, in this scheme, they (credits/loans) can be implemented by cooperation or UKM which provide the quarantines requested by the Bank or Financial Institutions.

The credit scheme is more appropriate for local entrepreneurs, i.e. food industry of “tahu and tempe” and rice milling industry which are available in Kecamatan Sokawera. These local industries can provide the guarantee for financial institutions which is needed for credits and loans scheme. The credits and loans can finance the proposed biogas and biomass package programme for local entrepreneurs. However, the low interest of credits and loans must be considered for this proposed programme.

3) Combination of Various Funding Resources

The last proposed scheme is a combination of various funding resources which involves a range of types of funding such as grants, subsidies, loans and contributions in kind. This kind of scheme is a lesson learned from the implementation of energy financial programme which was successfully employed in Nepal by USAID and Intermediate Technology. The combination financial scheme is an appropriate scheme for financing the development of (1) the biogas installation for households, (2) the Jatropha oil for household, in Desa Sokawera.
CHAPTER 6
FISIBILITY STUDY OF MICRO HYDRO PROJECTS

6.1 Introduction
6.1.1 Background

Pekalongan has the electrification ration of 80%. It means that about 20% of Pekalongan citizen do not have electricity from State-Owned Power Plan (PLN). 3% of them are in Sidoharjo village of Doro sub district. This village is ± 7 km away from PLN service. The only available electricity source is from traditional electric wheel that produce electricity that can only be used for 12 hours a day. Every family will only get 50 W from the traditional electric wheel.

6.1.2 Description of Location for Micro Hydro Project (PLTMH)

1. Location

Sidoharjo village is situated in an altitude of 800 – 1050 m above the sea level with the village center in 07° 09' 20.88" South Latitude and 109° 41' 33.96" East Longitude.

The location for survey of visibility study in Sidoharjo village, Doro, Pekalongan is described in the map below.

Figure 6.1 Location of Pakuluran, Sidoharjo Village, Doro, Pekalongan Regency
2. **Accessibility**

Pakuluran, Sidoharjo Village is in Doro Sub District, Pekalongan Regency. This Sub District is 25 Kilometers from Pekalongan City. The access to this city is asphalt road that can be reached using public transportation like buses or personal vehicle. The road from Doro Sub District to Pakuluran Village is gravel road of 8 km in length. This road can be accessed using motorcycle or other two-wheeled vehicles and pick-up trucks that are operated only once a day.

6.1.3 **Recent Condition**

1. **Electrical Power**

   For the time being, PLN has not been able to supply electricity to all the Sidoharjo Village, Doro Sub District; one of the area is Pakuluran, Sidoharjo village. The capacity of the Sorosido Micro Hydro Project that is planned to be used is 12 KW, this capacity can supply the electricity power for 89 houses in two areas in Sidoharjo village.

2. **The electrical power needs**

   The electrical power need in Pakuluran area is shown in Table 6.1.

<table>
<thead>
<tr>
<th>No.</th>
<th>Costumer</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>A.</td>
<td>Domestic Use</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Sidoharjo area</td>
<td>69 units</td>
</tr>
<tr>
<td>B.</td>
<td>Usage for Public and Social Facilities</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Schools</td>
<td>1 Unit</td>
</tr>
<tr>
<td>2</td>
<td>Musholla (Small Mosque)</td>
<td>3 units</td>
</tr>
<tr>
<td>C.</td>
<td>Productive Use</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Rice mill</td>
<td>1 Unit</td>
</tr>
<tr>
<td>2</td>
<td>Machinery</td>
<td>1 unit</td>
</tr>
</tbody>
</table>

   From the table above, we can see that the needs for electricity for domestic use for Pakuluran village are 69 units, 4 units for public and social facilities, and 2 units for productive use. It is estimated that the electricity for domestic use will reach its highest
usage at night time, while the public and social facilities and productive use of the electricity will mostly be used in day time. It also means that there will not be a contemporaneous use of electricity for domestic, public and social facilities and productive use.

For domestic usage of electrical power, MCB (miniature circuit breaker) is proposed to be used. The standard is 0.5 A (110 W, 220 V) for all houses in the village. From Table 6.2, we can see the load assumption in every house. It is assumed that 20% of the houses that are registered will need the power more than 0.5 A (1 A max). The calculation from the total of the house is as follow: 120% * 69 Houses = 83 Houses

Table 6.2 Electricity Consumption for House Hold in Sukoharjo Village

<table>
<thead>
<tr>
<th>Type of Load</th>
<th>Power per Appliance [W]</th>
<th>Penetration Factor (No. per HH)</th>
<th>Installed Power per HH (P_{inst}) [W]</th>
<th>Operating Factor During Peak Hours (OF) [%]</th>
<th>( P_{peak} = P_{inst} * OF ) [W]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lighting / bulb</td>
<td>15</td>
<td>2.00</td>
<td>30.0</td>
<td>90%</td>
<td>27.00</td>
</tr>
<tr>
<td>Radio / Cassette</td>
<td>20</td>
<td>0.70</td>
<td>14.0</td>
<td>60%</td>
<td>8.40</td>
</tr>
<tr>
<td>Television</td>
<td>80</td>
<td>0.50</td>
<td>40.0</td>
<td>60%</td>
<td>24.00</td>
</tr>
<tr>
<td>Fan</td>
<td>40</td>
<td>0.20</td>
<td>8.0</td>
<td>30%</td>
<td>2.40</td>
</tr>
<tr>
<td>VCD Player / Karaoke</td>
<td>50</td>
<td>0.36</td>
<td>18.0</td>
<td>50%</td>
<td>9.00</td>
</tr>
<tr>
<td><strong>Total installed power per home</strong></td>
<td><strong>110</strong></td>
<td><strong>64.36</strong></td>
<td><strong>70.80</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

In theory, this micro hydro project will not have enough energy supply if every electronic device in every house is all used simultaneously. The calculation for this theory is as follow:

\[
g_n = g_{inf} + \frac{1 - g_{inf}}{\sqrt{n}}
\]

Note: \( n \) = the total number of houses installed
\( g_{inf} \) = the simultaneous factor for the unlimited number of houses

\[
g_{inf} = \frac{\sum (P_{inst_i} * \text{operating factor}_i)}{\sum P_{inst}}
\]

The load peak demand is:

\[
P_{load \ peak} = \frac{n * g_n * \sum P_{inst}}{4}
\]

From the above formula, the calculation is:
\[ g_{\text{inf}} (0.5A) = \frac{70.80}{110} = 0.64 \]

\[ g_n (0.5A) = 0.64 + \frac{1 - 0.64}{\sqrt{83}} = 0.68 \]

And the final load peak is:

\[
P_{\text{load max}} (0.5A) = 83 * 0.68 * 0.11 \text{ kW} = 6.21 \text{ kW}
\]

\[
P_{\text{losses in distribution}} = 10\% * 12 \text{ kW} = 1.20 \text{ kW}
\]

\[
P_{\text{el peak load}} = 7.41 \text{ kW}
\]

From the data above, we can conclude that the load peak is only 7.41 kW. This is still smaller than the designed power; that is about 12 kW. Therefore, it is estimated that the surplus power can be used for 140 houses (with the assumption that the power in every house is about 0.5A).

6.2 Design and Development of Micro Hydro Project

6.2.1 Design of Sorosido Micro Hydro Project (PLTMH Sorosido)

1. **The Design of PLTMH**

   PLTMH Sorosido will use Sorosido river flow. This project aims to supply the electrical power which will be used in 2 areas in Pakuluran, Sidoharjo village, Doro sub district, Central Java Province that has 69 houses which have not received electricity supply from PLN.

2. **Capacity and output**

   PLTMH Sorosido is in an altitude of 20.20 m and the generator efficiency is 0.71. The output power is 12 kW with designed debit 80 liter/second. Debit is available almost throughout the year based on the result of Flow Duration Curve (FDC) analysis, from the data of rainfall for the last 16 years (1990 – 2005). The average output which will be produced by PLTMH Sorosido is 10 kW, after being reduced for about 4% for maintenance and restoration, and 10% of circuit power lost.

3. **Conclusion**
The design of PLTMH is as shown in the table below:

Table 6.3 Design Characteristics of PLTMH Sorosido

<table>
<thead>
<tr>
<th>Set-up</th>
<th>Design Characteristic</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Utilizing the Sorosido river flow</td>
<td></td>
</tr>
<tr>
<td>Debit Design:</td>
<td>80 l/s</td>
<td></td>
</tr>
<tr>
<td>Gross Head:</td>
<td>25.42 m</td>
<td></td>
</tr>
<tr>
<td>Net Head:</td>
<td>22.20 m</td>
<td></td>
</tr>
<tr>
<td>Capacity Design:</td>
<td>12 kW</td>
<td></td>
</tr>
<tr>
<td>PLTMH</td>
<td>Max power utilization:</td>
<td>7.53 kW</td>
</tr>
<tr>
<td></td>
<td>Village:</td>
<td>12 kW</td>
</tr>
<tr>
<td></td>
<td>Potential Power Product annually:</td>
<td>98,964 kW</td>
</tr>
<tr>
<td></td>
<td>Percentage of accomplishment:</td>
<td>95%</td>
</tr>
</tbody>
</table>

6.2.2 Scope of the Project
The PLTMH project will limit the activities like:

- Building the Weir and Intake, Headrace Canal, Forebay and Penstock,
- Building the Power House, including Tailrace and Protection Wall,
- Installing mechanical equipments like Cross Flow turbine and synchronous generator,
- Installing electrical equipment, such as control panel and air ballast

6.2.3 Implementation of the Project
The implementation of this project will take 6 – 8 months including initial preparation of a project (a detail design, Bidding, determining the best bidder), construction work (civil works, M & E, transmission and distribution network), tryouts as well as operator training and inauguration.

6.3 Utilization of Micro hydro
6.3.1 The Operation and Maintenance
The PLTMH will be operated for max 14 hours a day and will be utilized mostly at night time; whereas, in day time it will be used for home industry. Generator will periodically be turned off for maintenance and reparation. Two local citizens will be the adviser or operator of the PLTMH. Their duties are to operate and maintain the electrical and mechanical equipments:
• Turning the generator on/off if necessary.
• Control the electricity usage in groups or turning off the electricity on agreed schedule.
• Observing the generator daily by controlling every part of the generator.
• Cleaning the Intake & Weir, Headrace and Forebay from wastes and sedimentation.
• Keeping the Power House clean.
• Maintaining discipline in taking care of the generator as the operating procedure.
• Turning off the generator immediately if there is a problem with the turbine and electricity.
• Maintaining the whole parts of the building/civil work.
• Observing and taking note accurately of the kWh-meter in Power House everyday and keeping the log book.
• Being an operator and the village coordinator to guide guests or tourists who visit the PLTMH facilities.

6.3.2 Final Utilization of the Electrical Energy

Rice mill and carpentry machines are already available in Pakuluran. The owners of those machines are still used diesel generator to run those machines.

This PLTMH with the electric power available is expected to be able to maximize the operations of those machines, especially in day time. As a result the final utilization of this electrical power can increase the welfare and improve the economic condition of the local citizen.
6.3.3 Cost of the project

1. Cost for construction

The estimated cost for construction this PLTMH Sorosido can be summarized as follow:

Table 6.4 The Estimated Cost of PLTMH Sorosido Construction Project

<table>
<thead>
<tr>
<th>No.</th>
<th>Work Item</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Civil Works</td>
<td>388,842,000</td>
</tr>
<tr>
<td>B</td>
<td>Mechanical and Electrical Equipments</td>
<td>151,500,000</td>
</tr>
<tr>
<td>C</td>
<td>Sites Acquisition</td>
<td>10,000,000</td>
</tr>
<tr>
<td>D</td>
<td>Construction Supervision</td>
<td>66,041,000</td>
</tr>
<tr>
<td>E</td>
<td>Unpredicted cost</td>
<td>54,064,000</td>
</tr>
</tbody>
</table>

TOTAL COST: 670,447,000

2. Operational and Maintenance Cost

The estimates cost for operating and maintaining the PLTMH Sorosido can be summarized in the table below:

Table 6.5 Operational and Maintenance Cost of PLTMH Sorosido

<table>
<thead>
<tr>
<th>No.</th>
<th>Personnel Fee</th>
<th>IDR / year</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Operator Salary</td>
<td>1,500,000</td>
</tr>
<tr>
<td></td>
<td>UPT Staff Salary</td>
<td>900,000</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3,000,000</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>No.</th>
<th>Maintenance and reparation of civil buildings</th>
<th>IDR / year</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>The investment fee for civil works is taken from Budget</td>
<td>388,842,000</td>
</tr>
<tr>
<td></td>
<td>Operational and maintenance fee (percentage from civil building)</td>
<td>0.70% 0.2 to 1.2% per year</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>No.</th>
<th>ME maintenance and reparation</th>
<th>IDR / year</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>The investment fee for ME is taken from RAB</td>
<td>151,500,000</td>
</tr>
<tr>
<td></td>
<td>Operational and maintenance fee (percentage from ME work)</td>
<td>2% 1 to 3% per year</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>No.</th>
<th>Maintenance and reparation of transmission network</th>
<th>IDR / year</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>The investment fee for transmission network is taken from Budget (assumption: 15% from civil works)</td>
<td>58,326,300</td>
</tr>
<tr>
<td></td>
<td>Operational and maintenance fee (percentage from transmission)</td>
<td>2% 1 to 3% per year</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>No.</th>
<th>Administration and Overheads Cost</th>
<th>IDR / year</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td></td>
<td>1,000,000</td>
</tr>
</tbody>
</table>

Average Annual O&M Cost 13,818,420
CHAPTER 7

CONCLUSION AND RECOMMENDATION

7.1 Conclusion

1. There are two scenarios made; KEN (National Policy for Energy) and KED (Local Policy for Energy). The KEN scenario is established to support the President regulation no 5 year 2006, while KED scenario is established based on the internal discussion among many parties, including ITB (Bandung Technology Institute) and ECN.

2. Using the scenario requirements’ attached, the targets on KEN scenario of 2025 energy mix as stated in President Regulation no. 5 can be achieved because the use of geothermal and renewable energy can be maximized.

3. The process of kerosene conversion into LPG will run until 2010 for KEN scenario and 2009 for KED scenario. After the conversion time is over, kerosene will no longer be on demand.

4. The development of electricity supply will refer to two electricity plans. KEN scenario refers to RUKN (General Plan for National Electricity) and RUKD (General Plan for Local Electricity); the purpose is to create synchronization in creating projects of electrical energy supply.

5. The Target of electrificated ratio for two scenarios is 100% in 2020

6. For both scenarios, the number of poor people is expected to decline, this can be seen from the used assumptions on the increasing ratio of electrification and the growth of GRDP.

7. In both scenario, energy supply increases from some supply sources like PLTMH, Penambahan, PLTP (Geothermal Power Plant) Semarang, and some new coal-fueled PLTU (Steam Power Plant) like PLTU Tanjung Jati, Cilacap, and Rembang. Petroleum mining in Cepu, joint cooperation with Exxon Mobil, has been prepared to supply the petroleum Energy.

8. In Central Java Province Pro-poor case has been conducted in Sokawera village, located in Kecamatan Cilongok (Cilongok Sub-district), Banyumas Regency. The reason is, the village is in remote area with unsupported access to energy supply.

9. From the Pro-poor activities in Sokawera Village resulted that the people are very enthusiastic and supported.

10. Mikrohidro FS activities in Central Java has been conducted in Sidoharjo village located in the Doro sub district, Pekalongan Regency. Where there is potential for micro hydro energy 98,96 kW.

11. From the FS activity resulted that the cost needed to built PLMTH is Rp. 670,447,000
7.2 Recommendations

1. To support the accomplishment of the target mix of 2025 as regulated in President Regulation no. 5, 2006, serious steps on the utilization and management of Geothermal and renewable energy are needed.

2. Legal framework needs to be established to guarantee that coal supply from outside of Java Island, like Kalimantan and Sumatra can run smoothly, so it will not disrupt the electric power supply.

3. The assurance on the implementation of installing the gas pipeline which channels the gas from East Kalimantan until Semarang needs to be made, so that the target of energy mix 2025 can be achieved, as stated in President Regulation no.5, 2006.

4. Energy assets like geothermal, hydro power need to be developed maximally in order to decrease the fuel oil dependency. This can be done by promoting these assets to private-owned companies, so they, joint cooperation with government institution can manage these assets.

5. To support the utilization of renewable energy sources, such as bio-diesel, bio-ethanol and vegetable oil, a factory that produces those bio-fuel energies need to be established. Thus, the government should build cooperation with PT. Pertamina as a state-owned company whose business is in petroleum.

6. In terms of supplying the bio – fuel, the farmers need to have counseling, so that they are willing to grow the plants that produce the bio – fuel, and legal framework also needs to be established to give security guarantee to the farmers starting from the planting process until selling the products to the market.

7. From the FS results should be followed up with detailed design to built PLTMH soon, so the people can enjoy the electric energy.

8. From the results of Pro-poor activity should be followed up for real, by the local governments and the people according to the submitted proposals by CAREPI team.