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TRANSMISI, 14 (2), 2012, 61-67

Research Article

Estimated Energy Consumption Of Electricity At APJ Cilacap In 2011-2016 Using Leap Software

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Abstract

Electrical system in the Central Java Province is managed by PT PLN (Persero). The Electrical energy distribution is carried by the APJ (Service Area Network). One of APJ operating in the Central Java Province is APJ Cilacap, APJ Cilacap which is responsible to fulfill the electricity needs in the District of Cilacap and Kebumen. It makes APJ Cilacap as manager of the utility company should be able to provide the energy needs of electricity in both area. In addition of electrical energy demand's problem, the problems belong to SAIDI, SAIFI and line losses also becomes a problem of electrical energy distribution. Therefore, it needs to have the electrical energy planning so that energy needs, SAIDI, SAIFI and line losses can be known for the following years. In Preparation of Planning estimates that the software used are LEAP (Long Range Energy Planning System) version 2008.0.0.96. In Planning Making using two scenarios namely BAU (Base As Usual) is the result of scenario planning is still the same trend with the growth of base year or there is no policy affected and RPTL PLN which is based on RUPTL PLN (General Planning of Electricity Supply) in period 2012-2016. From the results of planning using LEAP, projected electricity supply, BAU scenario growth in electrical energy consumption, has the average value of customers equal to the Household sector in UPJ Cilacap, Majenang, Sidareja, and Kroya that is 0.41% per year, while the commercial sector, Industrial, and General are 5.39%, 2.33%, 4.60% per year, while UPJ Kebumen and Kroya for each sector 0, 51%, 4.27%, 7.40%, 4.48% per year. While the projections for electricity supply, outage rate index (SAIDI SAIFI), and losses, RPTL PLN scenario of electricity energy consumption growth follows a policy document RUPTL PLN year 2009-2019. Policy scenarios in RPTL PLN where the electrical energy consumption projections estimates the population growth of 0.3% per year, PDRB growth of 4.5% -5.83% per year, Electrification Ratio in 2019 is targeted at 97.5%, and 4.99% growth in connected power per year. For Policy in making electric energy losses in 2019 is targeted at 5.65%. While in making target of outage Index (SAIDI SAIFI) predicted value of SAIDI in the year 2019 at 77,44 minute/consument/years and the value of SAIFI in 2019 by 4,4 times /consument/years.

Keyword *: Electricity, SAIDI SAIFI, Energy losses, Planning, LEAP*

I. INTRODUCTION

1.1 Background

One of APJ operations in Central Java province is APJ Cilacap. Today, It is facing for supplying of electrical energy, so there is no balance between supply and consumption.

Besides it, the problem of loss energy or shrinkage of electrical energy and also the extinction rate index of SAIDI SAIFI to complex problems faced today.

Given the problems of energy supply, shrinkage of energy and extinction rate index, it is necessary for electrical energy supply planning to the balance between demand and supply, as set forth in this final plan.

1.2 Objectives

Objectives of this paper i.e.:

1. Applying the LEAP Software in the manufacture of electric power estimates.
2. Knowing the transformation of the output electrical energy consumption, number of customers of electric energy, Electrification Ratio, Power Installed, Losses or electrical energy losses and extinction RATES SAIDI SAIFI APJ Cilacap in 2012-2016 according to Business As Usual scenario (BAU) scenario RPTL and PLN.

1.3 Restriction of issue

In making this paper the author limit the issue as follows:

1. Areas used in manufacture of modeling estimation are PT PLN (Persero) APJ Cilacap.
2. Software used to transformation is LEAP.
3. Scenario planning is used is Business As Usual scenario (BAU) scenario RPTL and PLN.
4. Planning projections covered are electrical energy consumption, number of customers of electrical energy, Electrification Ratio, Power Installed, shrinkage or electrical energy losses and SAIDI SAIFI extinction rates .

II. BASIC THEORY

2.1 Classification of Electric Energy Costs and Consumption

PT PLN grouping expenses according to grouping of load distribution based on the group:

1. Household sector.
2. Commercial sector.
3. Industrial sector.
4. Public sector.
5. Social sector.

2.2 Electrical Energy Losses

Energy Losses when associated with the energy loss experienced by PLN is the difference between the energy that is ready to be sold with energy sold

$$\text{Losses} = \frac{\text{energy that is ready to be sold (kWh)} - \text{energy sold (kWh)}}{\text{energy that is ready to be sold(kWh)}} \times 100\ \%$$

2.3 The extinction rate of SAIDI and SAIFI.

Stating the value of outages often called SAIDI and SAIFI.

2.3.1 SAIDI *(System Average Interruption Duration Index)*

Value is defined as the average value of the duration of failure for each consumer for one year.

$$\text{SAIDI} = \frac{\sum(\text{duration failure x number customer of failure})}{\text{Number of customer}} \text{ (minute/customer/year)}$$

2.3.2 SAIFI *(System Average Interruption Frequency Index)*

Value is defined as the average number of failures per customer served by the system per unit time (usually per year).

$$\text{SAIFI} = \frac{\sum \text{number customer of failure}}{\text{Number of customer}} \text{ (time/customer/year)}$$

2.4 APJ Cilacap

APJ Cilacap is an electric company that works administratively covered network cilacap service area. APJ Cilacap region covered 2 or 2 districts, namely Cilacap and Kebumen.

2.5 Theory of Electricity Planning

Electrification planning in Indonesia is carried out within scope of national and local levels. Electrification plan contained in Act No 30 2009.

2.6 Planning Assessment of electrical energy

In a good energy planning should be able to integrate all the sub sectors of energy, so that a proper balance of planned sector and related aspects into a single unit.

2.7 Method of Energy Planning Estimates

Energy estimation method used is as follows:

2.7.1 Method of Growth

In doing estimates with this method, the energy consumption data required several years, a minimum of two years. Further, annual data can be found a pattern of growth
.

2.7.2 Econometric Method

This method is done by making the magnitude of the correlation or relationship with other quantities of energy demand that affects, for example, energy demand is correlated with the population, so in making the estimate that is intensity of electrical energy.

2.7.3 Electrical Energy Intensity

The intensity of energy use is a parameter that states the amount of energy use to perform a particular activity. The intensity of energy consumption has unit of volume energy that divided by activity volume.

$$\text{Intensity} = \frac{\text{evergy volume use}}{\text{activity volume}}$$

2.8 Analysis of Energy Demand

In analysis of demand is Used by energy end use. Analysis energy used end use energy is the energy directly used by consumers, such as the use of electrical energy in electrical energy consumers.

2.9 Scenario Planning

Scenario planning is an assumption or policy direction in determination of planning to be done.

2.9.1 BAU scenario (Base AS Ussual)

BAU scenario or Base As Ussual, scenario is considered that the year-end projection of trend pattern of electrical energy consumption is equal to the base year.

2.9.2 RPTL PLN scenario

RPTL PLN scenario is scenario underlying in electrical power of PLN's planning estimates. RPTL scenario based on RUPTL (General Plan Provision of Electrical Energy) in 2009-2019 and combined with other planning documents.

2.10 Software planning

In this study data input into the software , which in this study using LEAP Software. The software used in this planning is LEAP software 2008.0.0.96 series.

2.10.1 LEAP Software

LEAP stands for Long Range Energy Alternatives Planning system. LEAP is software that can be used to perform analysis and evaluation of policies and energy planning. LEAP software was first developed by the Stockholm Environment Institute, based in central Boston, USA. The first version of LEAP was launched in 1981. LEAP version in 2000, LEAP has a window-based.

Figure 1. Early appearance sotfware LEAP version 2008.0.0.96

2.10.2 Expression of LEAP is used

Expression is a formula or a calculation formula for the projection of a variable. The following expressions in the leap, Growth Rate, and Interpolation, Time Series Wizard, Expression Builder.

2.10.3 Running LEAP Result

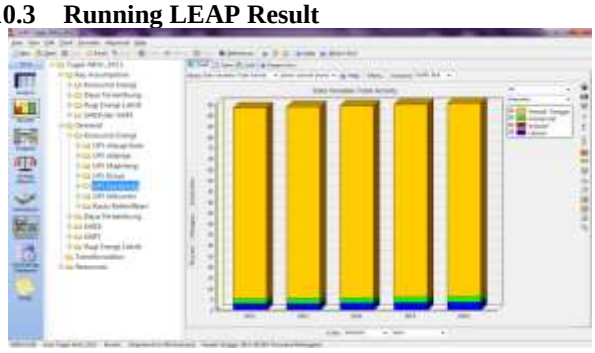


Figure 2. Running sotfware LEAP 2008.0.0.96 version

III. RESEARCH METHODOLOGY

3.1 Literature

Literature here is a learning process for the object to be examined, in this case about the planning, and softwareused i.e. LEAP software.

3.2 Method of Data Collection

In this research, data collection was conducted from a survey data to institution or entities that provide the data required. In this study the data needed include:

No	Institution	Data Needed
1	BPS (*Statistic center*) Central java	Cilacap in rate, Kebumen in rate, PDRB Cilacap, PDRB Kebumen.
2	PT PLN Distribution Central Java DIY.	Document of RUPTL Region Distribution Central Java DIY in 2009-2019.
3	PT PLN (Persero) APJ Cilacap.	Electrical energy consumption data (kWh), Customer Number, attached Power (kVA), Energy Losses (kWh), and SAIDI

Table 1. List of stakeholder data needed

3.2 Method of Data Processing

Data are grouped in this study are data on the number of people, data GRDP (Gross Regional Product Dareah), while the electrical data from PLN APJ Cilacap is energy consumption data, the number of customers, Losses of electrical energy and SAIFI SAIDI data.

3.4 Method of Calculation Data

Once the raw data obtained is classified in accordance with the provision that have been determined, the next step is to perform data processing to be used in simulation model of planning. Calculations are carried out such calculations growth of GDP, Population, and intensity and the growth electricity ratio such as electrification, installed power, shrinkage or loss of electrical energy and SAIFI SAIDI value.

3.5 Preparation of stimulating estimate in LEAP

After data processing is complete, the next step is to input data which has been calculated into LEAP software.

IV. ANALYSIS AND DISCUSSION

4.1 Electrical Energy Consumption

From projection electrical energy consumption, so gotten value of projection number of customer with BAU scenario and RPTL as follows:

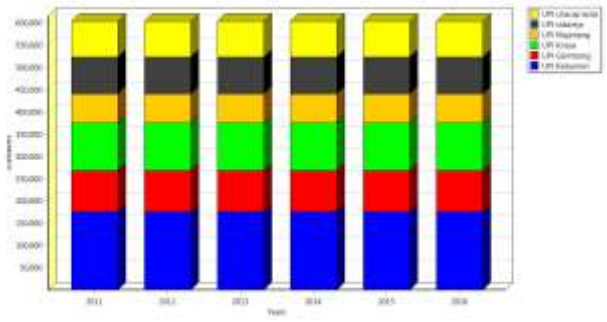
Table 2. Number electricity customers in BAU scenario in 2011- 2016

Sector	Years					
	2011	2012	2013	2014	2015	2016
Cilacap Kota	80.764	81.359	81.969	82.596	83.239	83.902
Households	75.061	75.369	75.678	75.988	76.300	76.613
Commercial	3.144	3.313	3.492	3.680	3.878	4.087
Industry	24	24	25	25	26	27
Other	2.535	2.652	2.774	2.902	3.035	3.175

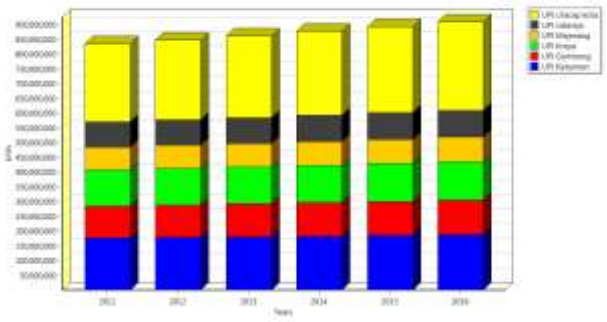
Table 3. Consumption of electric energy in BAU scenario 2011-2016

Sector	Years (kWh)					
	2011	2012	2013	2014	2015	2016
Cilacap Kota	264.241.471	270.377.737	277.190.986	284.094.451	291.302.693	298.828.534
Households	140.626.795	141.203.365	141.782.299	142.363.606	142.947.297	143.533.381
Commercial	32.770.948	34.537.302	36.398.863	38.360.761	40.428.406	42.607.497
Industry	8.169.615	8.359.967	8.554.754	8.754.080	8.958.050	9.166.773
Other	82.674.113	86.477.123	90.455.070	94.616.004	98.968.340	103.520.883

Average growth in number of customers and electric energy consumption in UPJ Cilacap for household sector, average growth 0,41 % per year, while commercial, industrial, and general sector were 5,39%, 2,33%, 4,60% per year. Also growth in UPJ Sidareja, UPJ Kroya, and UPJ Majenang. While UPJ Kebumen and Gombong value of growth household sector was 0,51% per year, while for commercial, industrial and general sector were 4,27%, 7,40%, and 4,47%. Following diagram and output number of customer and electric energy of RPTL scenario.



(a) Number of customer BAU scenario



(b) Energy consumption BAU scenario

Figure3. Number of Customers and Electric Energ consumption in 2011-2016 UPJ Cilacap with BAU Scenario.

While projection of electrical energy consumption and number of customers RPTL scenario is as follows:

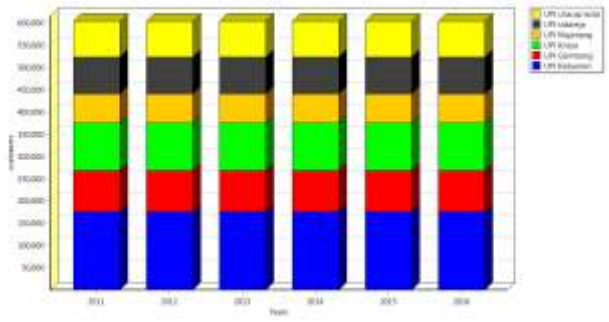
Table 4. Number of customers of PLN RPTL scenario in 2011- 2016

Sector	Tahun					
	2011	2012	2013	2014	2015	2016
Cilacap Kota	80.659	81.151	81.661	82.192	82,745	83.322
Households	74.979	75.204	75.430	75.656	75.883	76.111
Commercial	3.120	3.267	3.423	3.591	3.770	3.961
Industry	24	25	27	28	29	31
Other	2.535	2.655	2.782	2.918	3.063	3.219

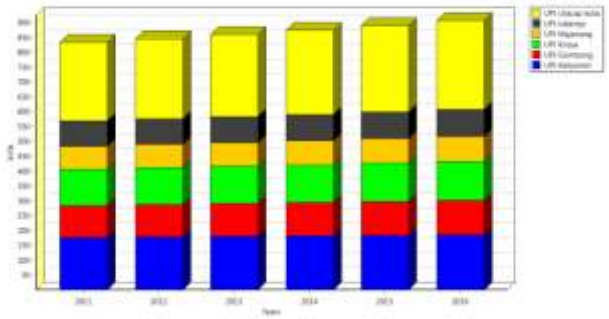
Table 5. Consumption of electric energy of RPTL scenario in 2011-2016

Sector	Years (kWh)					
	2011	2012	2013	2014	2015	2016
Cilacap Kota	264.020.366	270.243.032	276.865.837	283.919.640	291.438.007	299.457.474
Household	140.472.737	140.894.155	141.316.838	141.740.788	142.166.011	142.592.509
Commercial	32.524.697	34.051.818	35.684.035	37.429.381	39.296.691	41.295.583
Industry	8.350.665	8.742.775	9.161.846	9.609.962	10.089.392	10.602.606
Other	82.672.337	86.534.284	90.703.119	95.139.509	99.885.914	104.966.777

Average growth in number of customers and electric energy consumption in UPJ Cilacap was 0,30 % per year. While growth energy of commercial, industrial, and general sector were same 4,88% per year. Also, growth in UPJ Sidareja, UPJ Kroya, and UPJ Majenang. While in UPJ Kebumen and Gombong average growth in all of other UPJ were same 0,30% per year. While growth of commercial, industrial and general sector in all UPJ were same 4,88 % per year. is graph diagram of electrical energy consumption projection :



(a) Number of customer scenario RPTL



(b) energy consumption RPTL scenario

Figure 4. electrical senergy consumption and number customer UPJ Cilacap of RPTL scenario in 2011-1016

4.2 Ratio of electrification and power connected

From projection result got electrification ratio value as follow:

Table 6. electrification ratio in BAU scenario 2011-2016

UPJ	Years (%)					
	2011	2012	2013	2014	2015	2016
Cilacap Kota	80,02	82,52	85,01	87,51	90,01	92,51
Sidareja	69,75	73,53	77,31	81,09	84,88	88,66
Kroya	84,03	86,02	88,02	90,02	92,01	94,01
Majenang	79,77	82,30	84,83	87,36	89,88	92,41
Gombong	80,28	82,74	85,21	87,67	90,14	92,60
Kebumen	85,74	87,52	89,31	91,09	92,87	94,65

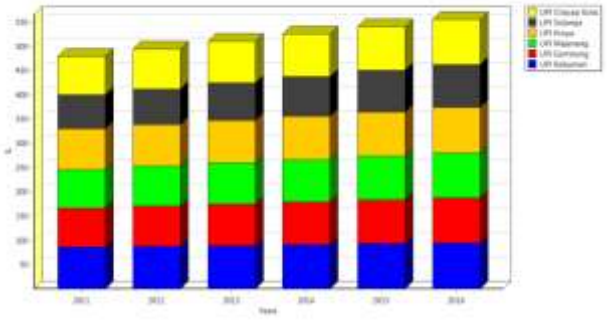
In UPJ Cilacap average growth every year was 2,94% in accordance with specified scenario. While average growth for UPJ Sidareja, kroya, and Majenang were 4,91%, 2,27%, and 2,29%. average growth in UPJ Gombong and Kebumen were 2,90 % and 2 %.

While electrification ratio of RPTL scenario are:

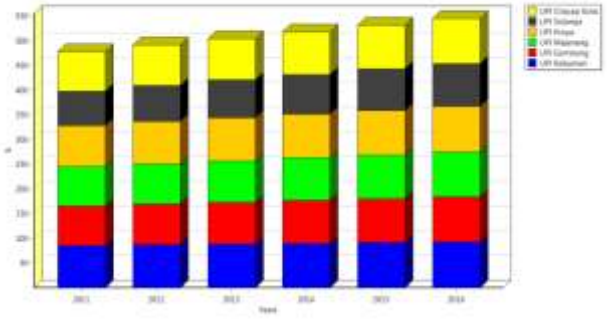
Table 7. electrification ratio of RPTL scenario in 2011-2016

UPJ	Tahun (%)					
	2011	2012	2013	2014	2015	2016
Cilacap Kota	79,74	81,96	84,18	86,40	88,62	90,84
Sidareja	69,47	72,98	76,48	79,98	83,49	86,99
Kroya	83,75	85,47	87,19	88,91	90,62	92,34
Majenang	79,49	81,74	83,99	86,24	88,50	90,75
Gombong	80	82,19	84,37	86,56	88,75	90,94
Kebumen	85,46	86,97	88,47	89,98	91,48	92,99

In UPJ Cilacap average growth of electrification ratio as much as 2.64% per year , UPJ Sidareja, Kroya, and growth ratio of Majenang electrification per year each by 4.60%,1.97% and 2.68%, while in the UPJ Kebumenen and Gombong growth rate of electrification ratio as much as 2.60% and 1.70% per year. Here is a graph diagram electrification ratio:



(a) BAU scenario



(b) RPTL scenario

Figure 5. projection of electrification ratio of APJ Cilacap in 2011-2016

From projection result was got power connected value as follow:

Tabel 8. Power Connected of BAU scenario in 2011-2016

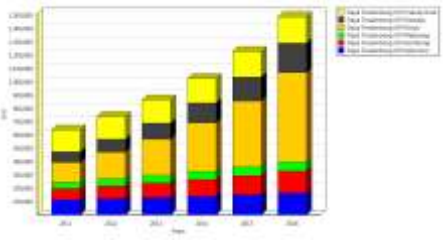
UPJ	Years (kVA)					
	2011	2012	2013	2014	2015	2016
Cilacap Kota	162.340	168.768	175.452	182.400	189.623	197.132
Sidareja	80.190	98.193	120.237	147.230	180.283	220.757
Kroya	147.283	199.539	270.335	366.251	496.196	672.247
Majenang	49.752	53.061	56.589	60.352	64.366	68.646
Gombong	83.826	96.165	110.321	126.560	145.189	166.561
Kebumen	113.865	122.200	131.145	140.745	151.048	162.105
APJ Cilacap	637.256	737.926	864.079	1.023.538	1.226.705	1.487.447

Average growth in installed power UPJ Cilacap was 3.96% per year, while average growth in Sidareja, Kroja, and Majenang were 22.45%, 35.48%, and 6.65% per year. For UPJ Gombong average growth per year was 14.72%, while in UPJ Kebumen was 7.32% per year. While RPTL projection scenarios are as follows:

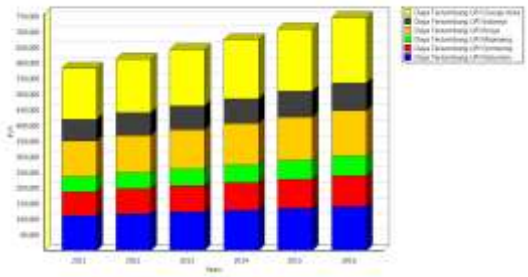
Table 9. power connected of RPTL scenario in 2011-2016

UPJ	Tahun (kVA)					
	2011	2012	2013	2014	2015	2016
Cilacap Kota	163.048	172.129	180.718	189.736	199.204	209.144
Sidareja	68.756	72.187	75.789	79.571	83.541	87.710
Kroya	114.137	119.832	125.812	132.090	138.681	145.601
Majenang	48.978	51.422	53.988	56.682	59.510	62.480
Gombong	76.716	80.544	84.563	88.783	93.213	97.865
Kebumen	111.393	116.952	122.788	128.915	135.348	142.102
APJ Cilacap	583.928	613.066	643.658	675.777	709.498	744.902

For average growth in power installed each UPJ same was amount of 4,99 % per year. This is because in accordance with RUPTL PLN policy where growth of power installed was 4,99%. The following graph power connected:



(a) BAU scenario



(b) RPTL scenario

Figure 6. projected power connected per APJ Cilacap in 2011-2016

4.3 Shrinkage of electric energy or electric energy losses in network

In determining target value based policy of RUPTL PLN scenario. From Determination target result so shrinkage of energy or electric losses in network as follow:

Table 10. shrinkage of energy of scenario RPTL in 2011-2016

UPJ	Years (%)					
	2011	2012	2013	2014	2015	2016
Cilacap	6,26	6,00	5,95	5,90	5,85	5,8
Sidareja	6,26	6,00	5,95	5,90	5,85	5,8
Kroya	6,26	6,00	5,95	5,90	5,85	5,8
Majenang	6,26	6,00	5,95	5,90	5,85	5,8
Gombong	6,26	6,00	5,95	5,90	5,85	5,8
Kebumen	6,26	6,00	5,95	5,90	5,85	5,8

Target value of electrical energy losses each UPJ were same and experiencing decreased per year, this is because the value of losses for next years was targeted to experience decreased each year. Value decreased in 2011 to 2012 of 0.26%, while the decrease for 2012 to 2016 of 0.05% per year. Here is graph of shrinkage energy or energy lossesin the network :

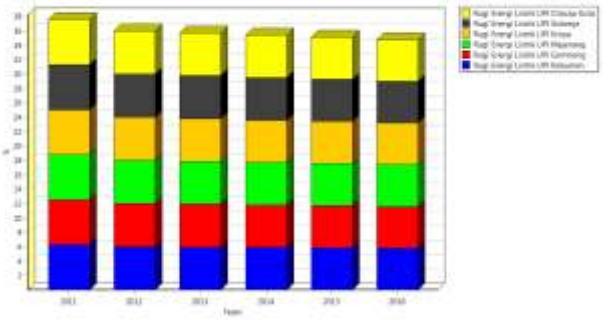


Figure 7. shrinkage energy value per UPJ APJ Cilacap per year 2011-2016 RPTL scenario

4.5 SAIDI and SAIFI Value

From the result of determination target was got SAIDI value due to interference as follows:

Table 11. SAIDI of RPTL scenario in 2011-2016

UPJ	Years (minute/consument/years)					
	2011	2012	2013	2014	2015	2016
Cilacap Kota	199,78	164,79	135,99	112,18	92,53	76,36
Sidareja	61,61	50,82	41,94	34,59	28,53	23,55
Kroya	79,08	65,23	53,83	44,41	36,63	30,23
Majenang	203,75	168,06	138,69	114,41	94,36	77,87
Gombong	258,97	213,61	176,28	145,42	119,94	98,98
Kebumen	229,61	189,39	156,30	128,93	106,34	87,76

SAIDI index value in each UPJ SAIDI value was almost same pattern every year. Where target value in each SAIDI UPJ experiencing decline. Where the decline based policy each year in all UPJ were same 17,50 % per year. Where average target decline index SAIDI each UPJ Cilacap Kota, Sidareja, Kroya, Majenang, Gombong, and Kebumen were 27,63, 8,52, 10,94, 28,18, 35,82, and 31,76 minute / customer /year. Here is graph diagram of SAIDI :

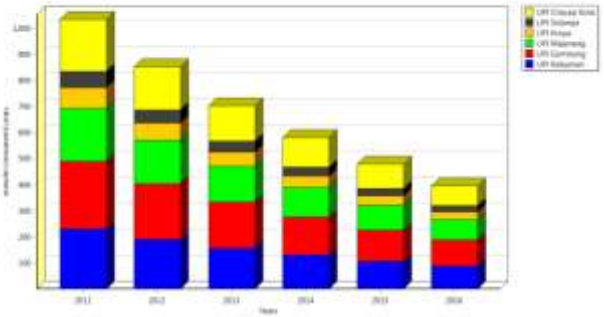


Figure 8. target SAIDI of RPTL scenario in 2011-2016

While target SAIFI value as follows :

Table 12. SAIFI of BAU scenario in 2011-2016

UPJ	Tahun (Times /consument/years)					
	2011	2012	2013	2014	2015	2016
Cilacap Kota	8,38	7,48	6,75	6,10	5,45	4,96
Sidareja	4,04	3,61	3,25	2,94	2,63	2,39
Kroya	2,67	2,38	2,15	1,94	1,73	1,58
Majenang	6,33	5,66	5,10	4,61	4,12	3,75
Gombong	7,89	7,05	6,36	5,74	5,13	4,67
Kebumen	7,85	7,01	6,33	5,72	5,11	4,65

Target value in SAIFI each UPJ experiencing decline. Where the decline based policy each year in all UPJ were same 9,90 % per year. Where average target decline index SAIFI each UPJ Cilacap Kota, Sidareja, Kroya, Majenang, Gombong, dan Kebumen were 6,52, 3,14, 2,07, 4,93, 6,14, dan 6,11 minute / customer /year.

Here is graph diagram of SAIFI:

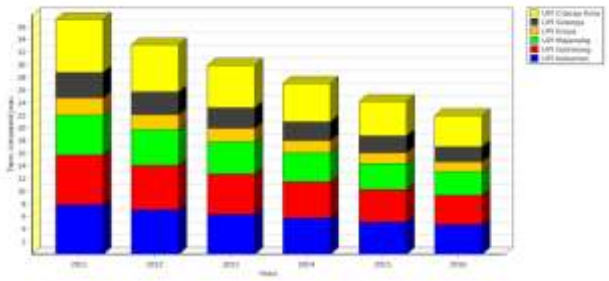


Figure 9 SAIFI interference target UPJ APJ Cilacap of scenario RPTL in 2011-2016

V CLOSING

5.1 Conclusion

Based on research that has been done, it can be concluded some of the following:

1. LEAP can be used to project number of customers, electric energy needs, values Connected Power, Electrification Ratio, Energy Losses and SAIDI SAIFI Value.
2. Average growth in number of customers and electric energy consumption in BAU scenario for UPJ Cilacap household sector average growth of 0.41% per year, while the Commercial sector, Industrial, and General were 5.39%, 2.33%, 4,60% per year. Also in UPJ Sidareja, UPJ Kroya, and UPJ Majenang. While in UPJ Kebumen and Gombong household sector growth rate was 0.51% per year. while for commercial, Industrial, and general sector in all UPJ were4,27%, 7,40%, dan 4,48%.
3. While average growth of number of customer in household sector in UPJ Cilacap was0,30 % per year. While growth energy in Commercial, Industrial, and general sector were same 4.88% per year. Also growth in UPJ Sidareja, UPJ Kroya, and UPJ Majenang. While in UPJ Kebumen and Gombong average growth in all of other UPJ were same 0,30% per year. While growth in the Commercial, Industrial, and General in all UPJ were same 4.88% per year.
4. Projection ratio of electrification and power connected ratio of BAU scenario period 2011-2016 average growth ratio of electrification per year in UPJ Cilacap, Sidareja, Kroya, Majenang, Gombong and Kebumen were 2,94%, 4,91%, 2,27%, 2,29%, 2,90 %, dan 2% per year.
5. For electrification ratio projection and power connected RPTL PLN scenario period 2011-2016 in UPJ Cilacap, Sidareja, Kroya, Majenang, Gombong, and Kebumen growth constellation electrification were 2,64%, 4,60%, 1,97%, 2,650%, 2,63%, and 1,81% per year.
6. Average growth power installed BAU scenario in UPJ Cilacap was 3,96% per year. While average growth in Sidareja, Kroya, dan Majenang were 22,45%, 35,48%, and 6,65 % per year. For UPJ Gombong Average growth per year was 14,72%, while in UPJ Kebumen was 7,32% per year.
7. While Average growth power installed RPTL scenario in each UPJ were same 4,99% per year. This is because in accordance with RUPTL PLN policy where power installed that average were 4,99%.
8. Target of electrical energy losses RPTL scenario each UPJ were same and experiencing decreasing each year, this is because energy losses for next are targeted years experiencing decreasing each year. Decline value in 2011 to 2012 as much as 0,26%, while decreasing for 2012 to 2016 the decline are 0,05% per year.
9. Average growth SAIDI interference in UPJ Cilacap was22,67% per year, while Average growth in UPJ Sidareja, Kroya, and Majenang were 43,58%, 25,94%, and 147,40%. For Average growth in UPJ Gombong and Kebumen were 55,92 % and -21,18%. For target index SAIDI of RPTL PLN scenario in period 2011-2016 assumption policy pattern for value of all UPJ were same. For target index SAIFI of RPTL PLN scenario in period 2011-2016 assumption policy pattern for value of all UPJ are same. The decreasing based on policy each year in all UPJ are same 9,90 % per year, where average target decline index SAIFI each UPJ Cilacap city, Sidareja, Kroya, Majenang, Gombong, and Kebumen were 6,52, 3,14, 2,07, 4,93, 6,14, and 6,11 minute / customer /year.

5.2 Advice

Based on research that has been done it can be given several suggestion, there are:

1. LEAP software can also be used to projection other energy, is modeled in accordance with wishes users and can also to be used to see emission impact from energy.
2. To get better value projection, should use data trend in several years, so gotten better growth average data.
3. To get level of truth from software LEAP plan should be made also planning the same with using other software that supports.
4. The result of this research can be used as a comparison with the planning undertaken by institution involved in this case is PT PLN APJ Cilacap.

References

[1] Sulasno. 2001. *Mechanical and Electrical Power Distribution System Power Edition I.* London: National Publishers Diponegoro University.

[2] Pradana, AP Hendra. 2009. *Circuit Breaker Arc of Fire Extinguishing Media Types of SF6 with Hydraulic Drive System and Springs For Protection At 150 Kv substation Srondol*. Semarang : Diponegoro University.

[3] Winarno,Oetomo Tri. 2007. *Energy Planning and Energy Profiles*. Bandung: Center for Regional Energy Policy(ITB).

[4] Suhono. 2010. *Demand and Supply Planning Study of Electrical Energy in Sleman Regency using LEAP software*. Yogyakarta : Gajah Mada University.

[5] Dewayana , R Kakka. 2009. *Projection of Needs and Provision of Electrical Energy in Central Java Using LEAP Software.* Semarang : Diponegoro University.

[6] Sumarno, Radiktyo Nindyo.2010. *Recloser Placement Optimization of Power System Reliability Of The Genetic Algorithm.* Semarang : Diponegoro University.

[7] Yusgiantoro, Purnomo. 2000. *Energy Economics: Theory and Practice*. Jakarta:Pustaka LP3ES Indonesia.

[8] Winarno,Oetomo Tri. 2007. *LEAP Long-Range Energy Alternatives Planning System.* Bandung : Center of Regional Energy Policy (ITB)

[9] Carepi tim at Yogyakarta and central java. 2009. *Energy Planning in Central Java 2005-2025*. Semarang : Diponegoro University.

[10] .., Textbook, Chapter III issues affecting losses Electrical Energy.

[11] Rosmawati, Siska Diyah.2001. *Effect of Electric Energy Distribution Losses Against Income At PT. PLN (Persero) Distribution West Java and Banten*. Bandung : UNIKOM

[12] Kep.Men Year : 2003 Guidelines for General Planning of Electricity.

[13] ...., WCS book of APJ Cilacap PT PLN (Persero) Distribution Central Java and DIY.

[14] ...., statistic Data in 2008,2009,2010 PT PLN (Persero) Distribution Central Java and DIY.

[15] ...., Electricity Supply Business Plan (RUPTL) in 2009-2019 PT PLN (Persero) Distribution Central Java and DIY.

[16] ...., Calculation SAIDI SAIFI in APJ Cilacap , 2009

[17] ...., Calculation SAIDI SAIFI in APJ Cilacap , 2009

[18] …., PT PLN Distribution Central Java and DIY.

[19] ...., Act No. 30 2007

[20] ...., Act No. 302009

[21] ------,Geographical Location of Cilacap. http:// www.cilacapkab.go.id

[22] ----------, Geographical Location of Kebumen, http:// *kebumenkab.go.id*

[23] ....., Cilacap in numbers in 2009, National Statistics Provinsis Cilacap, 2009

[24] ....., Kebumen in numbers in 2009, National Statistics Provinsis Kebumen, 2009

[25] ....., PDRB Cilacap 2009 , National Statistics Provinsis Cilacap, 2009

[26] ....., PDRB Cilacap 2009 , National Statistics Provinsis Cilacap, 2009