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Optimization Model of Decentralized Energy Planning Based Local Resources for Sustainable Rural Development in Malang District of East Java

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Abstract
This research will be the development of optimization models Decentralized Energy Planning in Malang in East Java , Malang regency due to the potential in the livestock sector and the Agriculture of substantial , but in 2011 there were 42 villages that still have not been electrified villages spread over 29 in 13 districts . The purpose of the development of optimization models Decentralized Energy Planning , in this study is to minimize costs and maximize efficiency district energy systems in poor rural East Java , maximizing the system reliability of renewable energy sources technologies , minimizing the use of petroleum products and maximize the use of existing local resources Malang district of East Java . Research also has the goal of environmental protection is the minimization of greenhouse gas emissions such as CO2 and NO . For rural energy planning in this study , used the Long- range Energy Alternatives Planning System (LEAP) which is based on the model of Linear Programming .This research has been conducted on the analysis of the energy situation in Malang in East Java . Sources of electrical energy are still not able to optimally meet the needs of the community in Malang East Java . But non- commercial energy such as biodiesel , and alternative energy such as micro-hydro power plant personnel has not been sought and utilized optimally . And also known elasticity of energy consumption in Malang on GDP at constant prices is bad , that is within the range of values which is above the 1.3 national energy elasticity . To describe the energy system in Malang district of East Java modules used in LEAP .
Keywords : Decantralized Energy Planning, Pertanian, Pembangunan Pedesaan, Berbasis daerah, Sustainable Development

1. Introduction

Malang Regency is a regency in East Java province , Indonesia . Based on Government Regulation No. 18 Year 2008 , the City Kepanjen established as the new capital city of Malang . Kepanjen city is currently feasible to improve itself so that later as the capital of the district . With an area of about 3238.26 km2 (source ; Central Management Brantas River Basin) , Malang regency is located on the second largest after the extensive sequence Banyuwangi from 38 districts / cities in the province of East Java .

According to the results Susenas Malang residents in 2010 numbered 2,447,051 inhabitants. This amount consists of 1,232,841 men (50.38 percent) and 1.21421women (49.62 percent). According to the Registration Data Population, among 33 districts in Malang is known that Singosari has the largest population, amounting to 155 026 inhabitants. District that has a population of at least is Kasembon with a population of 31 498 inhabitants. Malang regency has a lower inequality with Gini index value around 0.1190.

Malang has a cool climate with agricultural potential. Northern and eastern regions are widely used for apple plantation. Mountainous areas in the west many planted vegetables and become one of the main vegetable producer in East Java. Many southern areas planted with sugarcane and horticultural use, such as bark and watermelon. In addition to tea plantations, Malang also has the potential to perkebunanan coffee, and chocolate (Tirtoyudo District mountainous areas). Teak forests are common in the southern part of which is an area of limestone mountains. Coconut trees and cottonwoods are also commonly found in Malang

2. Gross Regional Domestic Product in Malang Regency

Gross Regional Domestic Product (GDP) is the total value of production of goods and services produced in a particular area and within a certain time (one year). In calculations based on the value of GDP at current prices and at constant prices (prices in a given year). In this publication, the base year used is the year 2000. Economic growth is a dynamic measure that is used to look at the economic level changes between periods. Table 2.1 shows that the stretching of Malang Regency economy in 2008 could grow 5.75 percent, and in 2009 declined to 5.25 percent. In 2010 the growth rate has increased again to 6.27 per cent.

As described earlier , the three dominant sector as a driver of economic development in Malang Regency (by contribution to total GDP respectively by 27.47 percent , 21.12 percent and 27.09 percent in 2010), is the agricultural sector , industrial sector and trade, hotels and restaurants . During the 2008-2010 period of economic growth in the agriculture sector tends to weaken . Growth rate in 2008 reached 4.38 percent in 2009 increased to 5.07 percent . growth rate in 2010 increased compared to the year 2009 as being 4.13 percent. Manufacturing sector , in 2008 the sector is able to grow 10.22 percent . in 2009 the growth rate slowed to 7.42

percent in 2010 and its growth rate increased again to 8.31 percent . Sector trade is the second largest sector after agriculture were able to grow 4.58 percent in 2008 and in 2009, slightly lower that grow around 3.86 percen, in 2010 the growth rate rebounded to 6.66 percent .

3. Energy Situation Analysis in Malang Distric of East Java

3.1 Analysis of Electrical Energy Demand and Capacity in Malang Regency

Growth in demand for electrical energy power is very useful for the improvement of economic growth and prosperity. High energy consumption growth to be accompanied by economic growth rates higher as well, so the energy consumed is not in vain. Demand for electric power has increasingly become a necessity even primary consumed by the whole society without exception. Likewise, people in Malang in East Java, but ironically in the year 2012 there are still 45 villages in the district of Malang have not electricity. Malang Regency targeting entirely new electrified in 2015. Energy consumption growth in 2005-2009 Malang regency average of 5.2%, except in 2010, while the economic growth rate (based on current prices) the average is 11%. Comparison of the 2 parameter values produce energy very good elasticity, ie in the range of 0.325 in 2005-2009, except in 2010. When referring to the existing references, it can be said as the Malang region has a relatively good level of efficiency. This figure is far below the national energy elasticity which reached number 1. Even this figure is below the value of the elasticity of the developed countries, which is 0.5. However, the elasticity of the data also needs to be compared with calculations involving the energy consumption of other energy sectors such as gas, oil, and other energy sources in a variety of fields as well as transport and power.

Table 3.1

Energy Consumption in Malang regency in current prices (2006-2010))

Tahun	Konsumsi Energi (KWh)	Pertumbuhan (%)	PDRB (Milyar Rp)	Elastisitas Pertumbuhan (%)	Elastisitas Energi
2005	684891531	5,1965602	16,10	-	-
2006	734671718	7,2683315	19,03	18,2	0,4
2007	763653467	3,944857	21,70	14	0,3
2008	801682999	4,9799462	25,03	15,3	0,3
2009	840438643	4,8342853	27,73	11	0,45
2010	1097997964	30,6458208	31,39 2	13,2	2,3

Another calculation when using GDP data based on constant prices, the elasticity calculations become inefficient. The average growth in energy demand is 7.2% and economic growth is 5.72%, so the elasticity stands at 1.30. This figure is above 1 and has the same characteristics as the national energy elasticity, which is wasteful or inefficient. However, even this data is also needs to be studied and compared with energy elasticity calculations involving various energy sectors.

Table 3.2

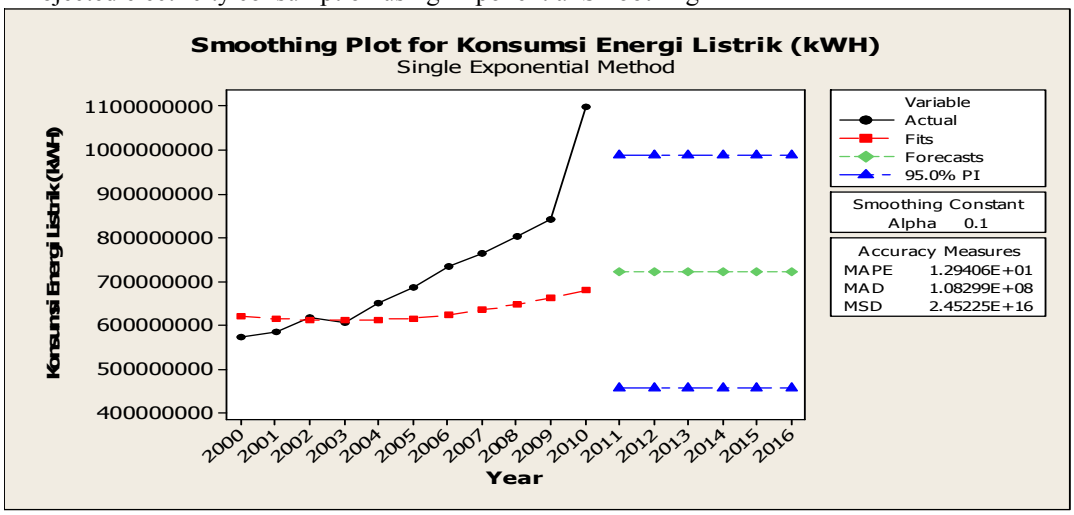
Elasticity of energy consumption in Malang in constant prices (2006-2010)

Tahun	Konsumsi Energi (KWh)	Pertumbuhan (%)	PDRB (Milyar Rp)	Pertumbuhan (%)	Elastisitas Energi
2005	684891531	5,1965602	10,99	-	-
2006	734671718	7,2683315	11,62	5,5	1,3
2007	763653467	3,944857	12,33	6	0,7
2008	801682999	4,9799462	13,03	5,6	0,89
2009	840438643	4,8342853	13,71	5,2	0,9
2010	1097997964	30,6458208	14,58	6,3	5

3.2 Electrical Energy Demand Projections in Malang

The phenomenon of electricity demand in Malang also affect the process of development and economic development in the district of Malang. In Malang, the use of electrical energy for domestic consumers and industry is bigger than the demand from other sectors. Projected electricity demand or consumption by exponential smoothing method showed a trend increase from year to year. With the regression method is also known that there is a significant positive relationship between the amount of electricity consumption by years of use.

- Projected electricity consumption using Exponential Smoothing



- Forecasting with regression methods

ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	1.926E17	1	1.926E17	40.076	.000[a]
	Residual	4.326E16	9	4.806E15		
	Total	2.359E17	10			

a. Predictors: (Constant), Tahun

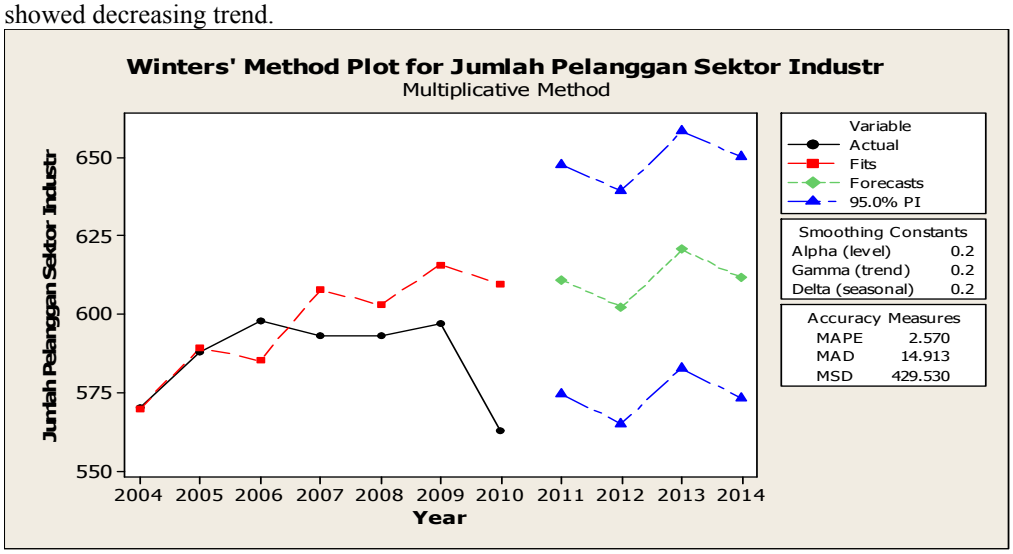
Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-8.318E10	1.325E10		-6.276	.000
	Tahun	4.185E7	6.610E6	.904	6.331	.000

a. Dependent Variable: Konsumsi Energi Listrik (kWH)

3.3 Projection of Number of Customers PLN in Malang

Projected amount of PLN customers for various sectors in Malang East Java using Winters method shows considerable upside for the industrial sector customers, businesses, and the public. As for the household sector showed decreasing trend.



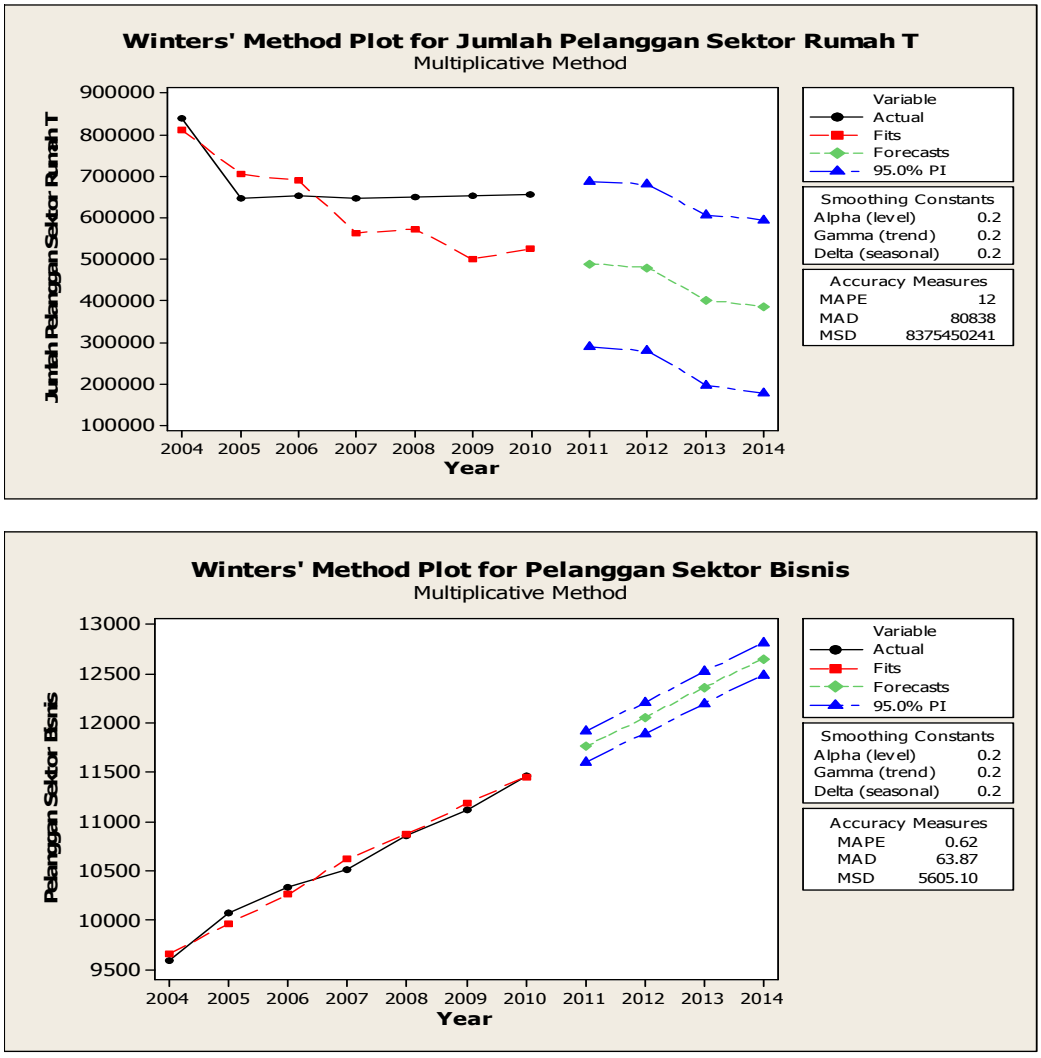
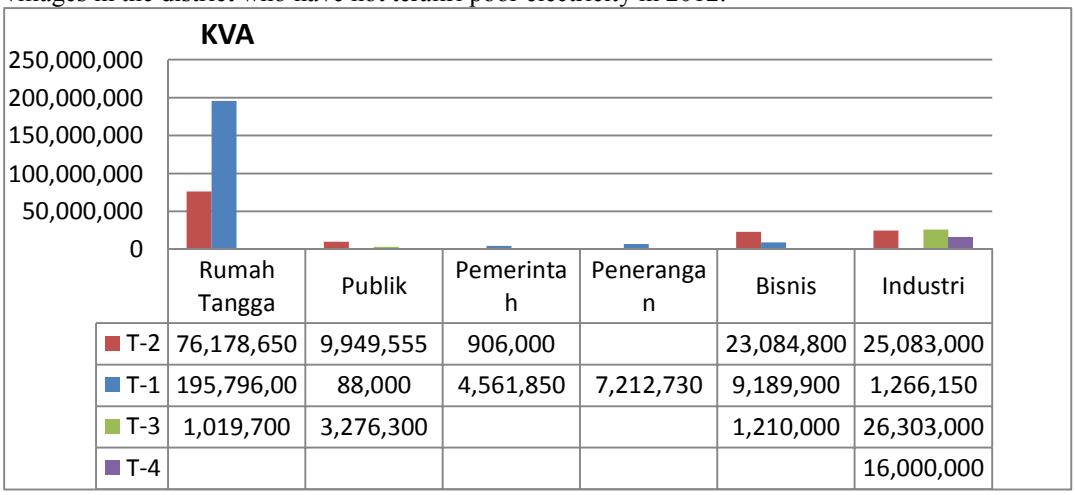


Figure 3.1 Winters Method For Number Customer PLN In Malang

3.4 Electricity Production in Malang

Electricity production by type of customer in Malang in East Java is the biggest customer for the type of household at the rate of R-1, followed by the industrial sector at rates I-3 as shown in table 5.12. The production is still not able to reach areas of rural geography is difficult to reach by the installation of electricity, so many villages in the district who have not teraliri poor electricity in 2012.



	Rumah Tangga	Publik	Pemerintah	Penerangan	Bisnis	Industri
T-2	76,178,650	9,949,555	906,000		23,084,800	25,083,000
T-1	195,796,00	88,000	4,561,850	7,212,730	9,189,900	1,266,150
T-3	1,019,700	3,276,300			1,210,000	26,303,000
T-4						16,000,000

Sources: PLN East Java, Malang Branch 2011

Figure 3.2 Electricity production in Malang regency Rates by Type, 2010

3.5 Analysis of Potential Reneweble Resources In Malang

Biogas is a source of energy derived from waste organic waste, human and animal waste. Lots of potential energy that can be utilized by the community in Malang. One of them is by using cow dung into biogas as a substitute for LPG and other energy. The high cattle population in the district of Malang has not been utilized fully for alternative energy biogas. Evident from the existing livestock population 400,000 in 2012, a new 5% are used for biogas. Dairy cow population is quite high (225,000 head) so it is still possible to build a biogas digester 60.000an. Energy that does not damage the environment with the use cow manure into energy efficient alternative and appropriate.

In 2011 has built a pilot biogas plant 13 units spread across the districts in the regency of Malang, Malang regency government did business partnerships with community members in a variety of places, namely, Ngasen Village, District Ngajum, Jabung village Jabung District, Village District Sitiarjo Sumbermaningwetan , Village Rejosari Bantur District, and Village District Sitirejo Wagir, and the cost of such partnerships could reach Rp 2.5 million to Rp 3 million for a three intalasi usable household.

In Malang, there are some villages that use the river as a source of alternative energy that generates electricity by utilizing micro-hydro technology, so the hamlets untapped commercial power can use it. Until now there are about 38 villages spread across several districts in Malang regency has not powered. However, most of the village has utilized the potential energy of water to generate electricity. Government of Malang regency, East Java, has established five micro hydro power plant. Generated electricity to supply the needs of thousands of families who have not 3 electricity.

Malang has a large potential for the development of micro-hydro. Microhydro fit in Malang developed to overcome the energy crisis. In addition, to create an energy independent country. As in Kepanjen become energy self-sufficient village for small industrial supply. In addition to micro-hydro power plants, Malang regency government to develop solar power. Power plants built in rural areas who have difficulty accessing electricity, such as residents who live in hilly areas.

Micro Hydro Sumber Maron is a simple power plant in the village district Suko rock show poor districts, micro hydro Sumber Maron is built by a villager and their insight and collaboration with the University of Muhammadiyah Malang and the Australia Indonesia Partnership. PLTMH Sumbermaron generating electrical energy by 35 KWA. Generated electricity used to power irrigation pumps and clean water that had been relying on electricity from PLN. Costs incurred to pay monthly electricity before the PLTMH average of about USD 20 million. But after the PLTMH costs much cheaper, even making a profit for the managers.

Biodiesel is the energy source of plants that can produce diesel fuel, such as jatropha, coconut, rambutan. Malang Regency which is an area of sugar cane fields and coconut reserve the enormous potential to produce biodiesel, but so far not many people who use these plants as biodiesel feedstock.

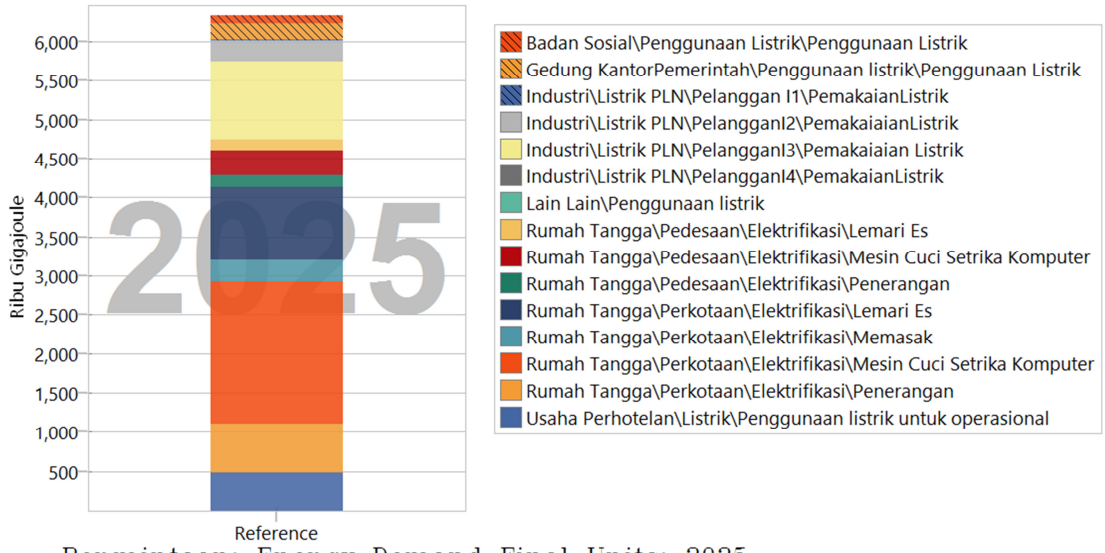
Bioethanol is the energy source of plants that can produce gasoline. Such as: fermentation of cassava or sugarcane. In Malang nobody utilize cassava or sugar cane to produce bioethanol.

4. LEAP modeling results in Malang in East Java

Energy planning modeling results using the Long Range Energy Alternative Planning System (LEAP) for some scenarios show that by 2025 the household sector and the industry sector is still the dominant sector in the use of electrical energy. To use natural gas sector is still dominated by rural and urban households. Most rural households still using kerosene and wood for cooking. Emitters of greenhouse gases is the largest industry sector and power generation.

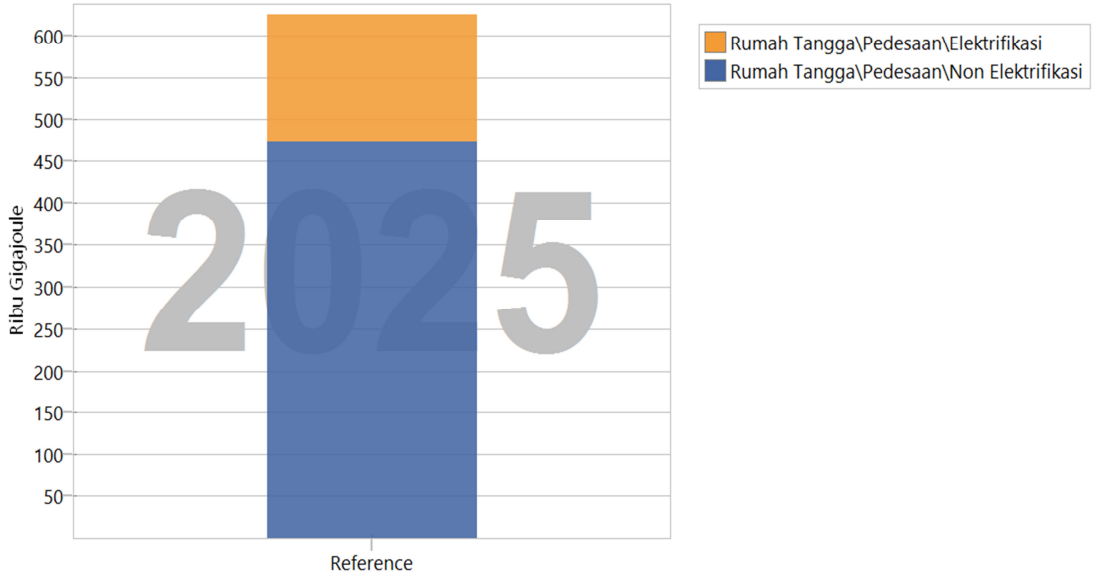
Permintaan: Energy Demand Final Units: 2025

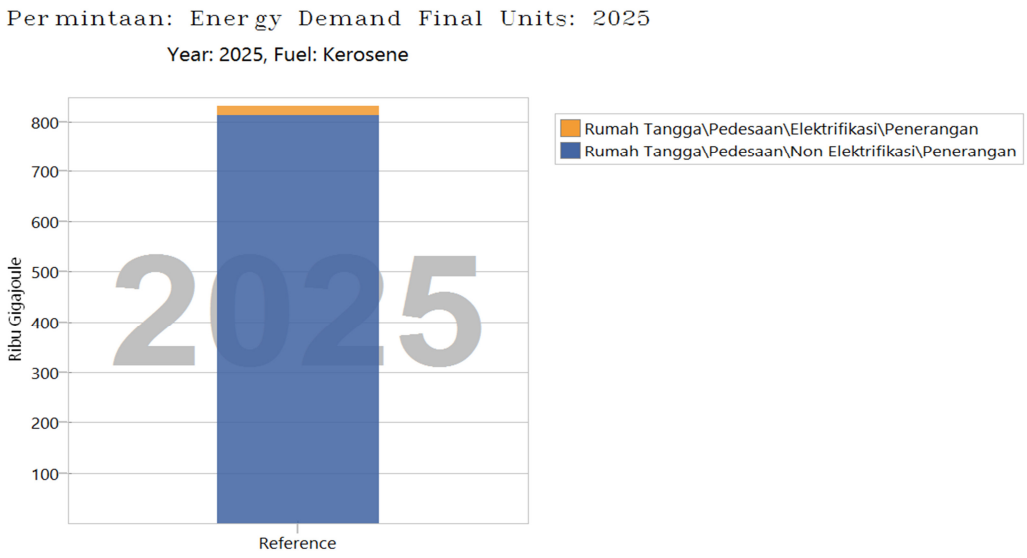
Year: 2025, Fuel: Listrik

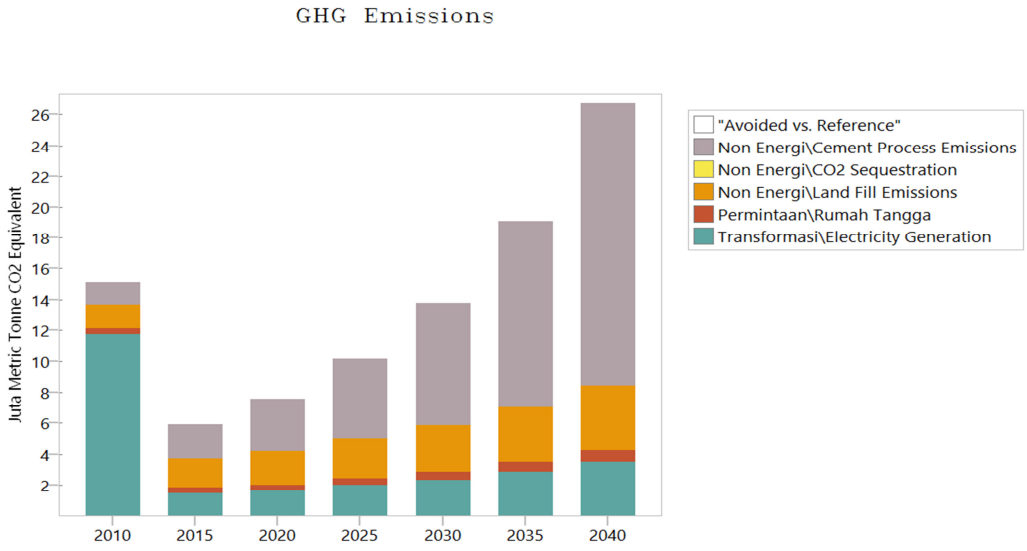


Permintaan: Energy Demand Final Units: 2025

Year: 2025, Fuel: Wood







6. Conclusion

The conclusion of this study is :

1 . Results of analysis of energy situation in Malang in East Java . Sources of electrical energy are still not able to optimally meet the needs of the community in Malang East Java . But non- commercial energy such as biodiesel , and alternative energy such as micro-hydro power plant personnel has not been sought and utilized secaraoptimal .

2 . Diagram of the energy system in Malang in East Java by Using Reference Energy System (RES) of the Long -range Energy Alternatives Planning System (LEAP) describe the different types of energy consumption (domestic, industrial , hospitality , business entities) and the sources of energy supply (crude oil , biogas , micro- hydro) .

3 . Based on elasticity analysis found that the elasticity of energy demand with GDP at constant prices , generating the elasticity of energy demand is still poor in figure 1.3 , above the national energy elasticity , so it can be concluded that the energy consumption in Malang still not efficient or wasteful .

4 . Decentralized Energy Planning with expected allocation of energy resources to meet the energy needs of the district can be achieved optimally in Malang.

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