User Guide for Agricultural, Construction and Mining Sector

Indonesia 2050 Pathway Calculator

Table of Contents

List of Tables

List of Figures

I. General Overwiew on Agricultural, Construction and Mining Sector

Agricultural sector, construction and mining also called as ACM sector includes agriculture, fisheries, plantation and livestock, construction and non-oil and gas mining and quarrying. Forestry and mining sub-sector of oil and gas are not included in this sector. Energy use in ACM sectors are classified as other sectors or "others" in *Handbook of Energy and Economic Statistics of Indonesia 2012*; covers 3.37% of total energy consumption in 2011 at the amount of 24.82 million BOE (barrels of oil equivalent) (PUSDATIN EMR 2012). Factors affecting the growth of the ACM sectors include government policies that support sectors growth such as food self-sufficiency and policy to require the processing of mineral resources domestically. Economic growth is predicted to emphasize more on the service industry so that growth in ACM sectors will be slower. In this I2050PC modeling, projection of this sector is considerably not related to plantations for biofuel production.

A. Agricultural Sector

Agricultural sector plays an important role in the national economy, especially in the provision of food for 230 million people in Indonesia with a population growth rate at 1.25% per year (in 2009). The other role of agriculture sector, namely are the provision of industrial raw materials, livestock feed, bioenergy, employment up to 40 million people each year (2005-2009), a source of state revenue as well as environmental conservation through environmentally friendly farming practices. Indonesia has achieved rice self-sufficiency in 2007. The achievement of self-sufficiency and sustainable self-sufficiency on major food commodities such as rice, corn, soybeans, beef and sugar have become the target of Ministry of Agriculture in 2010-2014. Diversification is also a concern of government to reduce the consumption of rice and wheat, as well as achieving diverse, nutritious, balanced and safe food consumption patterns which is also in line with the *Desirable Dietary Pattern* program. To face challenges from international market, Indonesian agricultural products need to be supported to increase the competitiveness in the global market. In conjunction with that, the Ministry of Agriculture has set a target to improve the welfare of farmers (Kementan, 2010).

Direction of general public policy development related to the 2010-2014 national agricultural sectors is food security as one of the national priorities with the core substance of the program as follows. (Kementan 2010):

1. Structuring regulations to ensure legal certainty over farmland, the development of new agricultural areas, controlling and optimizing the use of wastelands

2. The construction and maintenance of infrastructure on transportation and its facilities, irrigation, electricity connection, and communication technologies and national information systems that serve centers areas of agricultural production.
3. The increase of research and development efforts in agriculture to create superior seeds and improving the quality and high productivity of the national agricultural.
4. Encouraging investment in food, agriculture, and industry sector, as well as administering the subsidy system that ensures the availability of seed varieties, fertilizers, technology and post-harvest facilities which is appropriate in a timely manner and amount and also affordable.
5. Improving the quality of nutrition and food diversity
6. Adaptation and anticipation of food and agricultural systems on climate change

B. Construction Sector

The construction sector is closely related to the development of infrastructure such as transport networks and residential facilities. The sector is regulated through the relevant policies of spatial planning under the authority of the Ministry of Public Works (MPW [Kementerian Pekerjaan Umum (PU]). The MPW Law include rules concerning (i) Implementation of Spatial Planning, which focuses on the support of sustainable development based on spatial planning, (ii) Water Resources Management, which focuses on food security, water security (conservation and supply of raw water), and control of water damage force, (iii) Implementation of the Road which focuses on improving the connectivity and the smoothness flow of people and goods, (iv) Mentoring and Development of Settlement Infrastructure that focuses on improving basic public services, poverty allevation (society empowerment), as well as an increase in the orderly operation of the building structure and environmental management, and (v) Construction Development which focuses on improving the capacity and performance of the construction supervisors regionally and nationally (KemenPU 2012).

Policy direction on the National Long-Term Development Plan 2005-2025 related to the field of Public Works and arrangement of spatial planning is to embody an independent Indonesian society, advanced, just and prosperous through the acceleration of development in all sectors emphasizing on building a solid economic structure based on competitive advantage in various fields supported by qualified and competitive human resources and strengthening sustainable development. Indications of achievement of this policy with respect to growth in the construction sector, namely the implementation of a reliable transport network to reach all of Indonesia's areas, rural electrification, fulfillment of housing equipped with infrastructure and support facilities for the whole community and to embody cities without slums (KemenPU 2012).

C. Mining Sector

Mining sector of mineral resources plays an important role in the supply of industrial raw materials, such as gold, silver, bauxite, nickel, granite, diamond and iron. In addition, the mining sector contributes to regional development through job creation, increases added value and economic activity. Currently, the value-added mining industry remains low despite the mineral potential is quite large. This is due to the lack of domestic industrial processing of mineral. With the enactment of Law No. 4 of 2009, holders of Mining Permit (IUP) are required to establish the raw material processing facilities in the country to provide maximum benefit for the prosperity of the people through increased employment, economic empowerment and increase revenues (KESDM 2010).

National policy direction for mining under the authority of the Ministry of Energy and Mineral resources are related to aspects of natural resources and the environment through improved management of mineral resources and mining. General policy of mineral and coal mining development is directed at two points, namely: (1) increasing the production and value-added of mineral and coal products; (2) reduce the negative impact of mining and geology disaster. The objectives are as follows (KESDM 2010):

1. Increased production and the type of mining products to meet the needs of domestic raw materials.
2. Establishing an efficient and productive mining which is supported by technological aspects, the quality of human resources and mining business management
3. Increased community participation, especially through cooperative in the Small-Scale Mining Business.
4. Mining business activities that support the development of the areas, especially of the eastern Indonesia.
5. The availability of geological information services / mineral resources, both for the purposes of exploration, spatial planning, reclamations of mined lands, and mitigation of natural disasters.

II. Methodology

Energy consumption in agriculture, construction and mining is calculated based on the following equation:

Energy Consumption = Activity x Energy Intensity

Activity in agriculture, construction and mining is represented by GDP growth-related sectors. Structure model of agriculture, construction and mining is presented are in Table 1.

Table 1. Structure model of agriculture, construction and mining

Structure	Activity	Energy Intensitiy Unit
Agricultural, Construction and Mining	GDP of agricultural, construction and mining sector	BOE/rupiah

The assumptions determination in a one pager and parameters that affect energy consumption forecast up to 2050 is conducted by expert judgment

A. Fixed assumption

1. GDP of agricultural sector, construction and mining in base year 2011

The GDP data from agricultural, construction and mining obtained from statistical data of are listed in following Table 2.

Table 2. GDP of agricultural sector, construction and mining in base year 2011 (BPS 2014)

Business Field Sector	GDP (billion rupiah)	Subsector GDP mix
Sector of Agricultural, Livestock and Fisheries	297,641	54%
a. Food Crops	154,154	
b. Plantation Crops	49,260	
c. Livestock and derivaties	40,040	
d. Fisheries	54,187	
Mining and Quarrying	94,988	17%
a. Non-Oil and Gas Mining	70,814	
b. Quarrying	24,174	
Construction (building)	159,123	29%
TOTAL	551,752	100%

2. Fuel consumption of agricultural, construction and minin in base year 2011

Fuel consumption data for ACM sector in base year for I2050PC modeling is taken from the *Handbook of Energy & Economic Statistics of Indonesia 2012* (see Table 3). Fuel mix of ACM sector in the base year 2011 consists of of 74.63% of ADO, 17.86% of gasoline, 5.26% of MFO, 1.85% of kerosene and 0.39% of IDO (EMR PUSDATIN 2012). Diesel oil dominates the fuel mix used in this sector as the engine technology used in agriculture, construction and mining mostly are diesel engines such as tractors, cranes, etc.

Table 3. Fuel Consumption of Transportation Sector (PUSDATIN ESDM 2012)

Type of fuel	Fuel Consumption (million BOE)
Gasoline	4,432
Kerosene	460
ADO	18,522
IDO	98
MFO	1,305
TOTAL	24,816

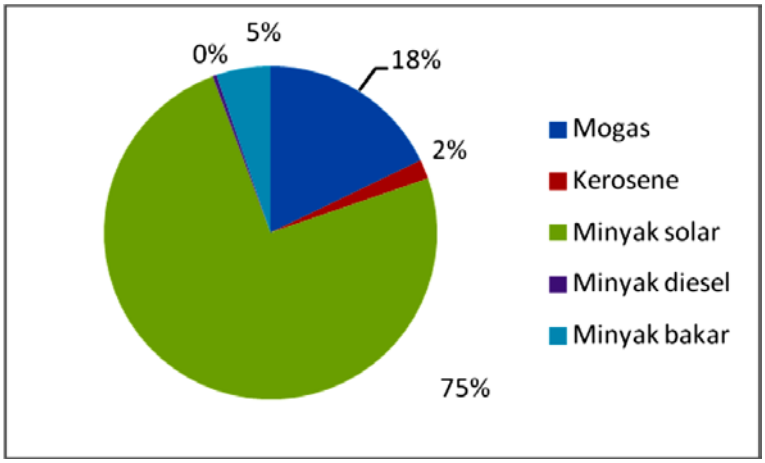

Figure 1. Fuel mix of agricultural, construction and mining in 2011 (PUSDATIN ESDM 2012)

3. Energy intensity of agricultural, construction and mining in base year 2011

Energy intensity of agriculture, construction and mining in the base year is calculated from the total energy consumption of related sectors divided by its GDP value in 2011 amounted at 0.044979 BOE/million rupiahs.

B. Trajectory assumption

One pager to projected energy use in agriculture, construction and mining consists of three factors, which include GDP growth, changes in energy intensity and fuel mix in related sectors.

1. GDP growth of agricultural, construction and mining sector

GDP growth of agriculture, construction and mining assumed to be increasingly higher at Level 4. Currently, GDP of ACM sector is affected more by the growth of agriculture subsector appropriately with sub-sector GDP mix which is equal to 54%, while the GDP mix for the mining and construction sub-sectors respectively by 17% and 29%. ACM sector growth projection at Level 1 is assumed as yet being influenced by the growth of the agricultural subsector. Meanwhile, ACM sector growth at a

higher level is assumed to be more influenced by the growth of other sub-sectors, namely mining and construction subsectors. The projected growth of this sector in I2050PC modeling considerably unrelated with the activities of the plantation for biofuel production. Thus, GDP growth rate assumptions are based only on historical data of GDP growth fom 2004 ranged at 3.9% to 6%. At Level 4 the GDP growth is assumed to be 6.5% to accommodate the extremely high growth sectors scenario which is equal to the projected growth rate of medium level industry.

Level 1

Level 1 assumes agricultural, construction and mining, growing at an average growth of 4.15% until 2050. This growth rate is lower than historical data due to market share of agricultural sector is increasingly declined compared to other two sectors. The decline in market share occurred due to the increasingly uncompetitive harvest resources price.

Level 2

Level 2 assumes the growth rate of agriculture sector, construction and mining at 4.75% supported by the growth of plantation subsector especially oil palm for food and other plantation crops; also by construction sector which increasingly grows along with the economic growth. Policies that support the achievement of GDP growth at this level is assumed to include government support to enhance the development activities of transportation and decent housing also completed with supporting infrastructure.

Level 3

Level 3 assumes growth in agriculture, construction and mining by 5.65% supported by growth in construction and mining subsector is increasingly higher than the agricultural sector. Mining subsector growth is assumed to be driven by implementation of regulations requiring holders of IUP establishing optimally raw material processing facilities in the country and also due to the developed mining operations that support the development of the areas, especially on the eastern Indonesia.

Level 4

Level 4 assumes agriculture, construction and mining grow at 6.25% due to the economic growth of all sectors with the increasing grow of construction and mining sector market share. Growth in this sector is assumed has been supported by the implementation of policies that support such as land and infrastructure provision in the agricultural sector.

Table 4 . Assumption of GDP level Asumsi of agricultural, construction and mining sector

Parameter	Level 1 2050	Level 2 2050	Level 3 2050	Level 4 2050
GDP Growth	4,15%	4,75%	5,65%	6,25%

Source: based on expert judgment

2. Changes in energy intensity of agriculture, construction and mining

Indonesian economy is predicted to continue to grow until 2050, which implicates on the energy intensity of agriculture, construction and mining. Energy intensity in these three sectors is predicted to rise, but the increase is assumed to be decreasingly lower from Level 1 up to Level 4. Changes in the intensity of the Level 1 up to Level 4 are assumed to be less discrepant due to of low level of innovation on the technological equipment. Energy intensity is projected to be indirectly affected by technological innovations that can improve the efficiency of appliances which consume energy, but more influenced by the growth of the sector activity. Thus, energy intensity continued to increase up to 2050.

Figure 1 shows, ADO dominates the energy consumption of ACM sector, so that technological innovations in diesel engines affects the overall energy consumption. Some innovations that support the growth of sector among others are the technology of superior seeds with high productivity and prepared to adapt to climate change on agriculture; green construction activity in the construction sector, as well as the application of the good mining practices principle in the mining sector. Green construction is the practice of building construction using environmentally responsible and resource-efficient processes. Green building limits the environmental impact through energy and water saving and also by using recycled materials or renewable resources to achieve maximum resource efficiency (BLS 2015). Good mining practices or Praktek Pertambangan Yang Baik dan Benar covers licensing, mining engineering, occupational safety and health (OSH), mining environmental management and monitoring, including reclamation and post-mining activities, conservation of mineral resources and the development and empowerment plans for community of mining areas (Suyartono, 2003) These all are stipulated in the Law No. 4 of 2009 concerning mineral and coal mining.

Level 1

Level 1 assumes the energy consumption of agricultural, construction and mining is stable with the growth of energy intensity at 7.5% by 2050 compared to base year.

Level 2

Level 2 assumes by 2050 the increase in energy intensity of agriculture, construction and mining at 6% compared to the base year. This efficiency is generated due to slowing growth of those sectors, technological innovation in the agricultural sector and the implementation of good mining practices.

Level 3

Level 3 assumes in 2050 the efficient use of energy in agriculture, construction and mining increased so that the energy intensity only increased by 3.5% from the base year. This efficiency is generated due to slowing growth in those sectors, technological innovation in the agricultural sector and the implementation of broader and continuous good mining practices.

Level 4

Level 4 assumes in 2050 the efficient use of energy in agriculture, construction and mining increased so that the energy intensity only increased by 1% compared to the base year. The efficient use of energy is generated due to the decreasingly slower growth of those sectors, technological innovation in agriculture and mining also the implementation activities of green construction.

Table 5. Assumption on energy intensity level of agriculture, construction and mining

Parameter	Level 1 2050	Level 2 2050	Level 3 2050	Level 4 2050
Energy Intensity	7,5%	6%	3,5%	1%

Source: based on expert judgment

3. Fuel mix of agriculture, construction and mining sector

The level of fuel mix in agriculture, construction and mining sector is stipulated by Ministerial Regulation on MEMR No. 20/2014 concerning to the use of biodiesel. Biodiesel can be applied to these sectors without having to modify the engine due to its direct use on low speed machines.

Level 1

Level 1 assumes fuel mix on agricultural, construction and mining by 2050 is equal to base year.

Level 2

Level 2 assumes by 2050 biodiesel market share has replaced 30% demand of ADO which is accordingly with the Ministerial Regulation of MEMR No. 20/2014.

Level 3

Level 3 assumes by 2050 pure biodiesel market share has replaced the demand of ADO at 40%.

Level 4

Level 4 assumes by 2050 pure biodiesel market share has replaced the demand of ADO at 50%.

Table 6. Assumption on fuel mix of agriculture, construction and mining sector

Parameter	Level 1 2050	Level 2 2050	Level 3 2050	Level 4 2050
Market share of biodiesel	0%	30%	40%	50%

III. Calculation Result

Energy demand of agriculture, construction and mining based on scenario of Level 1 for "Energy Intensity" one pager at energy intensity growth of 7.5% compared to the base year is presented in Figure 2.

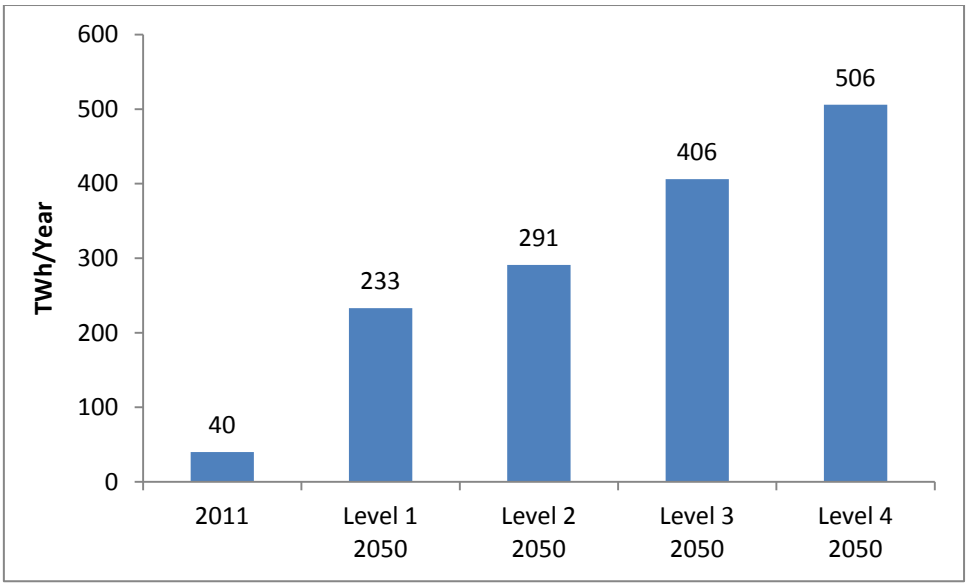

Figure 2. Energy demand of agriculture, construction and mining subsector at 7.5% energy intensity growth

Energy demand of agriculture, construction and mining based on Level 1 scenario for "GDP Growth" one pager is equal to 4.15% as presented in Figure 3. The scenario of "energy intensity" of one pager at Level 4 causes a decrease in energy demand in year 2050 at 6% compared to Level 1. The insignificant decline of energy demand is due to technological innovations applied to this sector has

already reached saturation point. The agricultural sector in Indonesia also does not use mechanized farming system as the wet farming system is applied.

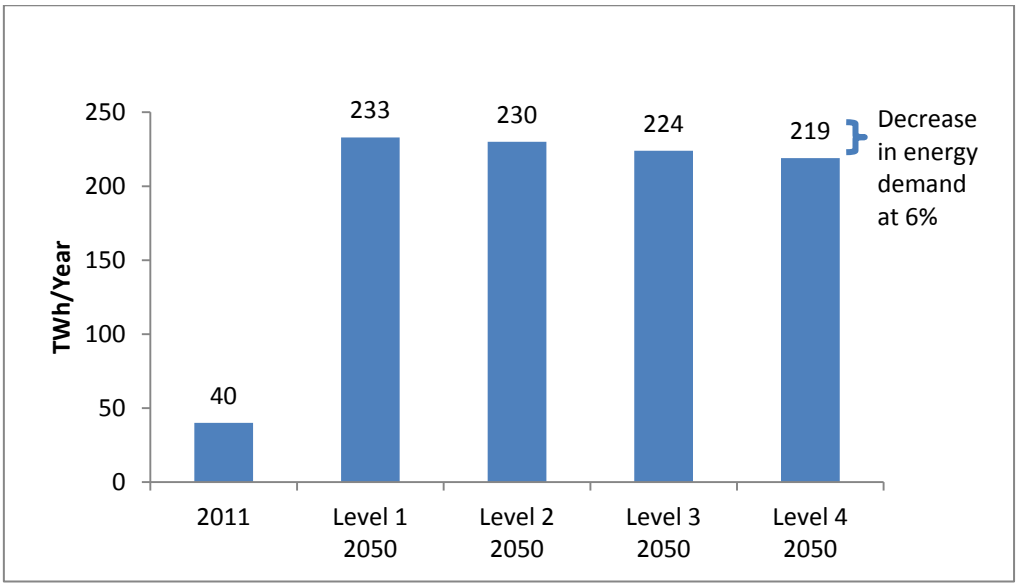

Figure 3. Energy demand of agriculture, construction and mining subsector at 4.15% GDP growth per year

Fuel mix of agriculture, construction and mining until 2050 based on the scenario of a "fuel mix" one pager is presented in Figure 4.

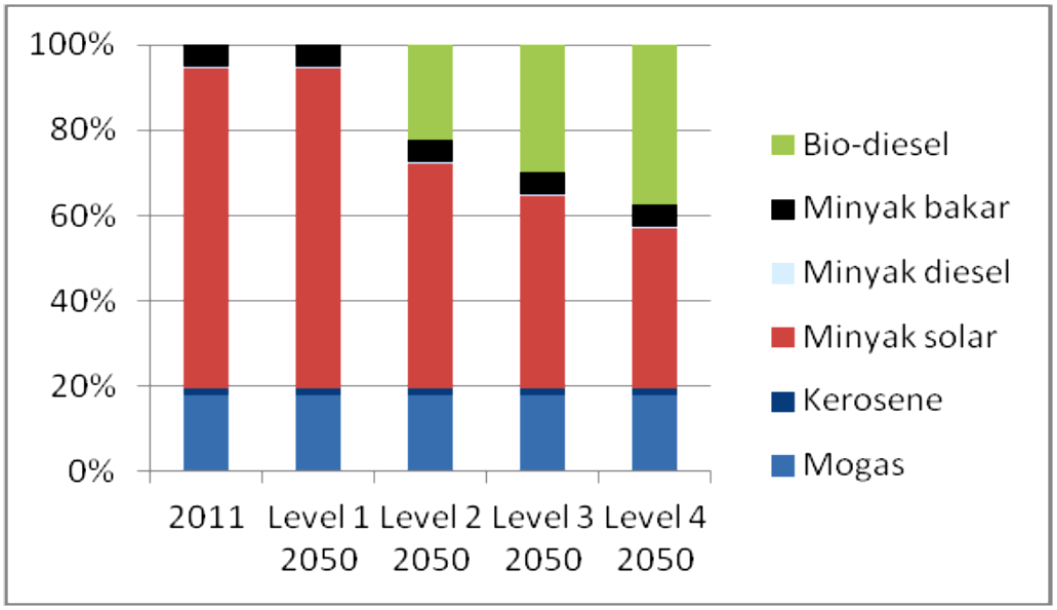

Figure 4. Fuel mix of agricultural, construction and mining

Based on a variety of levels in a one pager of agriculture, construction and mining sector; the potential reduction of total energy demand of these sectors could reach up to 57%. If the scenarios

for the entire one-pager of ACM sectors selected based on high energy demand scenarios, ie scenarios Level 4 is selected for a "GDP growth" one pager and Level 1 scenario is selected for a one pager of "Energy Intensity" also "Fuel Mix", therefore the total energy demand in the year of 2050 will reach at the amount of 311 million BOE. Meanwhile, if low energy demand scenario is selected, where scenario of Level 1 one is selected for one pager of "GDP growth" and Level 4 scenario is selected for “Energy Intensity" and "Fuel Mix" one pager", this combination can reduce the total energy demand up to 134 million BOE in 2050. The potential reduction in total energy demand of ACM sectors is presented in Figure 5.

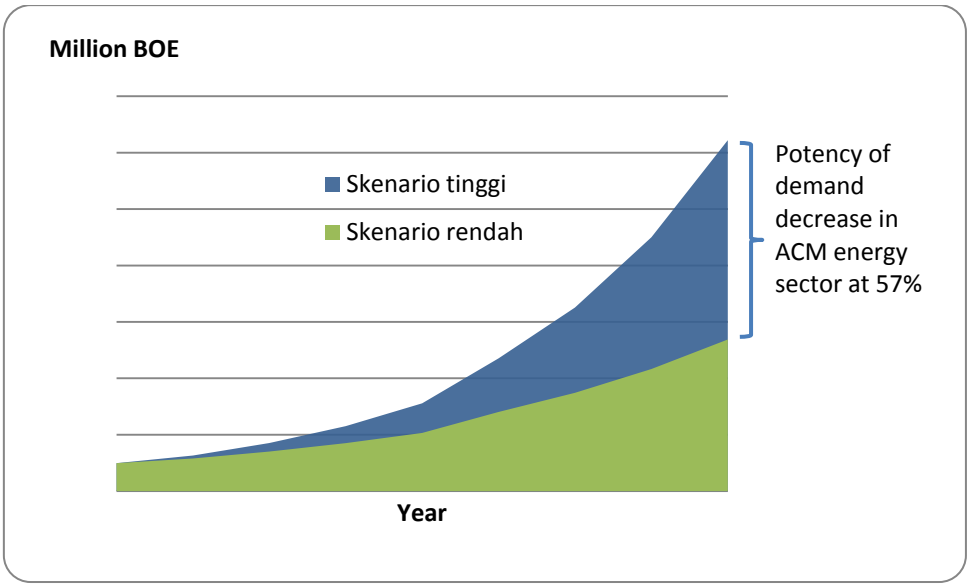

Figure 5. Comparison of total energy demand of ACM sector for high scenario and low scenario

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