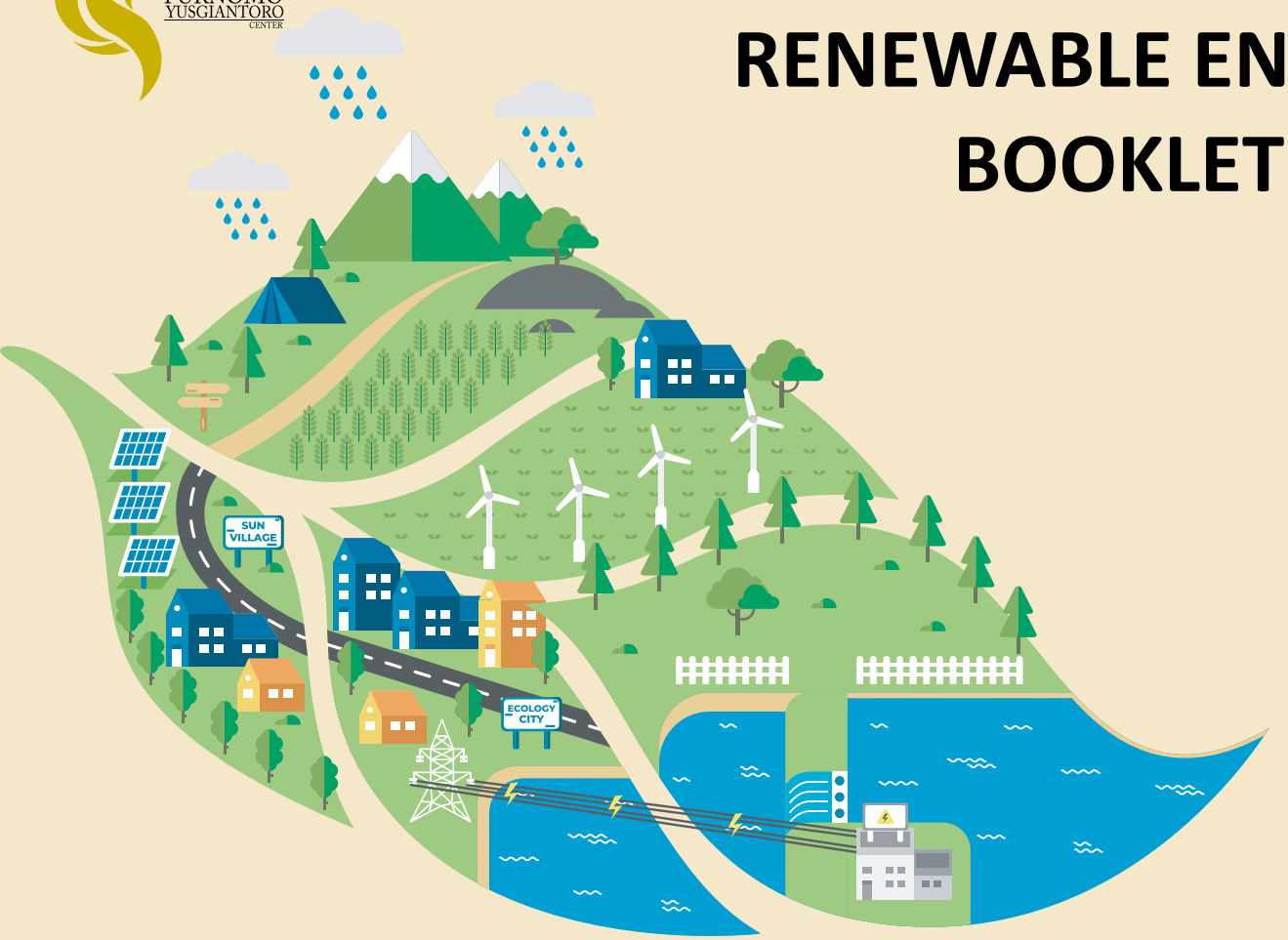
The PURNOMO YUSGIANTORO CENTER

PYC INDONESIA RENEWABLE ENERGY BOOKLET 2019



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BY: PURNOMO YUSGIANTORO CENTER (PYC)

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PREFACE

Greetings from Purnomo Yusgiantoro Center (PYC),

PYC, as a non-profit organization, devotes to independent, in-depth research that leads to provide policy solutions and/or recommendations in research fields of energy and natural resources at the local, national and global level. As a part of its programs, the PYC research team publishes “The Indonesia Renewable Energy Booklet 2019” to provide public information of Indonesia's renewable energy development.

This is the second booklet published and provides updated Indonesia’s renewable energy policies and development, while potential and challenges remain the same since last year. Data are compiled up to the fourth quarter of 2019 and obtained from various sources, including the Indonesia Ministry of Energy and Mineral Resources, IRENA, and World Bank. To make it easy to read, data are presented attractively in infographics.

We hope that the PYC Indonesia Renewable Energy Booklet 2019 can be beneficial to our readers.

Jakarta, 3 January 2020

Filda Citra Yusgiantoro, ST, MBM, MBA, PhD
Chairperson of the Purnomo Yusgiantoro Center

BACKGROUND FOR THIS BOOKLET

Fossil energy has been the major source of energy in the world since its introduction in the 18th century. The discovery of fossil energy changed the domination of firewood as the main source of energy. The energy shift sparked global industrial revolution which led to an increase of energy consumption and rapid economic growth. The increase of energy consumption created a high demand for the fossil energy which initiated global exploration and exploitation. Although fossil fuel provides an extensive amount source of energy, it also brings huge environmental impact. In the late 20th century, the increasing global awareness of environmental sustainability brought up the issue of fossil fuel's contribution to climate change. This led to numerous international pledges to mitigate climate issues. Renewable energy, then, plays an important substitution role on fossil energy as a more environmentally friendly source of energy. Indonesia also pledges to participate in the global movement of renewable energy utilization as a part to mitigate climate changes. The utilization of renewable energy in Indonesia began in 1923 when Plengan hydro power plant was first operated. The government, through its pledge in COP21 Paris, created a plan for renewable energy to make up 23% of Indonesia's energy mix by 2025. Thus, to achieve this renewable energy target, it is important for all stakeholders to have an overview of the current development, the potential and challenges of renewable energy in Indonesia.

HOW THIS BOOKLET IS STRUCTURED

This booklet consists of four chapters:

- Chapter 1 presents the international and Indonesia's regulations on renewable energy. This chapter also provides related regulations on renewable energy from 2003 to 2019.
- Chapter 2 illustrates the current development of renewable energy in Indonesia. It covers the updated data on renewable energy installed capacity and production, as well as the renewable energy balance.
- Chapter 3 looks at the potential of renewable energy in Indonesia by type of resources and on each province.
- Chapter 4 gives insights on the renewable energy development in Indonesia, including the highlights in 2018-2019 and future challenges.

HOW THIS BOOKLET WAS PREPARED

This booklet was compiled through literature studies and secondary data collection. Some of the data displayed are processed by the PYC research team.

ACKNOWLEDGMENT

This booklet was prepared by the Purnomo Yusgiantoro Center. The booklet benefitted from an internal PYC review, as well as valuable comments and guidance from Prof. Purnomo Yusgiantoro and Luky A. Yusgiantoro, PhD.

The contributed researchers for this booklet are Akhmad Hanan, Diwangkara Bagus Nugraha, Haryanto, I Dewa Made Raditya Margenta, Massita Ayu Cindy and Muhammad Razin Abdullah. We'd like to extend our gratitude to Inka B. Yusgiantoro, PhD and Alexander Ery Wibowo, JSD for their guidance. We would also like to thank Dwiki, Felicia, Galih, Nurmasyidah, Pingkan and Zaenal for their assistance.

PYC would also like to acknowledge the contributions of a number of parties that have provided invaluable insights and comments on the booklet.

For further information and feedback regarding this booklet, please contact us through research@purnomoyusgiantorocenter.org.

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GLOSSARY

BOE	: Barrel of Oil Equivalent
BPP	: Biaya Pokok Penyediaan (Cost of Power Generation)
CBM	: Coal Bed Methane
CGI	: Chevron Geothermal Indonesia
CGS	: Chevron Geothermal Salak
CO_2	: Carbon Dioxide
DGNREEC	: Directorate General of New and Renewable Energy and Energy
GDE	: PT Geo Dipa Energy
GDP	: Gross Domestic Product
GoI	: Government of Indonesia
GW	: Gigawatt
HEES Indonesia	: Handbook of Energy and Economic Statistics of Indonesia
IO	: Izin Operasi (Operating Licenses)
IPB	: Izin Panas Bumi (Geothermal Permits)
IPP	: Independent Power Producer
KEN	: Kebijakan Energi Nasional (National Energy Policy)
km	: Kilometer
kW	: Kilowatt
kWh	: Kilowatt Hour
LTSHE	: Lampu Tenaga Surya Hemat Energi (Solar Power Energy Saving Lamps)

GLOSSARY

m^2	: Square Meter
m^3	: Cubic Meter
MBOE	: Million Barrels of Oil Equivalent
MEMR	: Ministry of Energy and Mineral Resources
MMSCFD	: Million Standard Cubic Feet per Day
MoF	: Ministry of Finance
MT	: Million Tons
MTOE	: Million Tons of Oil Equivalent
MW	: Megawatt
NRE	: New and Renewable Energy
OPEX	: Operating Expenses
PGE	: PT Pertamina Geothermal Energy
PLN	: Perusahaan Listrik Negara (State Owned Electricity Company)
PLTBg	: Pembangkit Listrik Tenaga Biogas (Biogas Power Plant)
PLTBm	: Pembangkit Listrik Tenaga Biomassa (Biomass Power Plant)
PLTM	: Pembangkit Listrik Tenaga Minihidro (Mini Hydro Power Plant)
PLTMH	: Pembangkit Listrik Tenaga Mikrohidro (Micro Hydro Power Plant)
PLTP	: Pembangkit Listrik Tenaga Panas Bumi (Geothermal Power Plant)
PLTS	: Pembangkit Listrik Tenaga Surya (Solar Power Plant)
PLTSa	: Pembangkit Listrik Tenaga Sampah (Waste Power Plant)
POME	: Palm Oil Mill Effluent
PP	: Power Plant
PPA	: Power Purchase Agreement
PV	: Photovoltaic

GLOSSARY

RE	: Renewable Energy
RUEN	: Rencana Umum Energi Nasional (General Plan on National Energy)
RUED	: Rencana Umum Energi Daerah (Regional Energy Plan)
RUKD	: Rencana Umum Ketenagalistrikan Daerah (General Plan for Regional Electricity)
RUPTL	: Rencana Usaha Penyediaan Tenaga Listrik (Electricity Business Plan)
RoR	: Rate of Return
SE	: Star Energy
SE Asia	: Southeast Asia
SOL	: Sarulla Operation Limited
TCO^2	: Total of Carbon Dioxide
TPES	: Total Primary Energy Supply
USD	: United States Dollar
UU	: Undang – Undang (Republic Indonesia Law)

CHAPTER 1

RENEWABLE ENERGY REGULATIONS

1.1 INTERNATIONAL REGULATIONS ON RENEWABLE ENERGY

- (7.1) By 2030, ensure universal access to affordable, reliable and modern energy services.
- (7.2) By 2030, increase substantially the share of renewable energy in the global energy mix.
- (7.3) By 2030, double the global rate of improvement in energy efficiency.
- (7.a) By 2030, enhance international cooperation to facilitate access to clean energy research and technology, including renewable energy, energy efficiency and advanced and cleaner fossil-fuel technology, and promote investment in energy infrastructure and clean energy technology.
- (7.b) By 2030, expand infrastructure and upgrade technology for supplying modern and sustainable energy services for all in developing countries, in particular least developed countries, small island developing states and landlocked developing countries, in accordance with their respective programs of support.

Source: United Nations, 2019

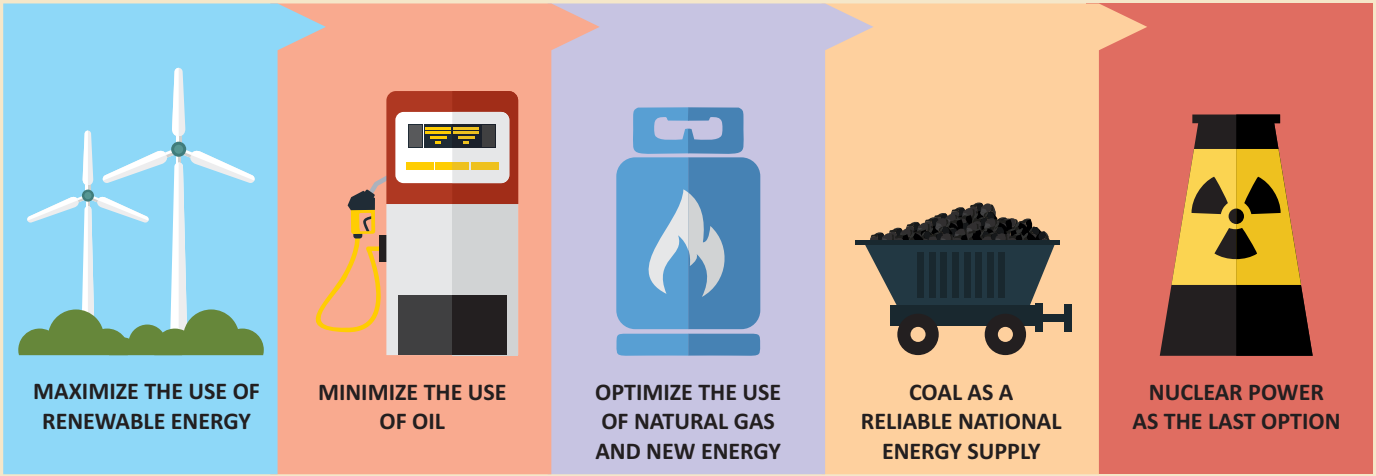
1.2 INDONESIA'S GOVERNMENT REGULATIONS ON RENEWABLE ENERGY

LAW No. 30/2007
ON ENERGY

- Article 20, (2) The provision of energy by government and/or regional government is prioritized in underdeveloped regions, remote areas and village regions by using the local energy sources, especially renewable energy.

- Article 21, (2) The utilization of new energy and renewable energy must be increased by the government and regional government.

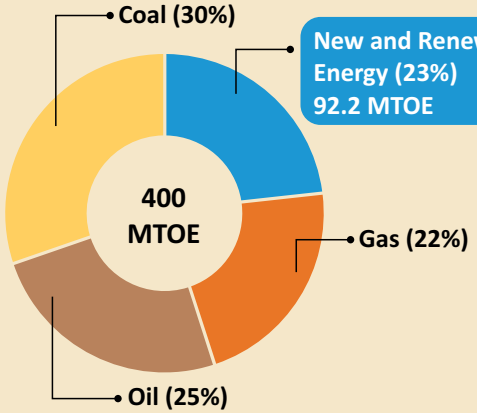
GOVERNMENT REGULATION NO. 79/2014
ON NATIONAL ENERGY POLICY (KEN)



PRESIDENTIAL REGULATION NO. 22/2017

GENERAL PLAN ON NATIONAL ENERGY (RUEN)

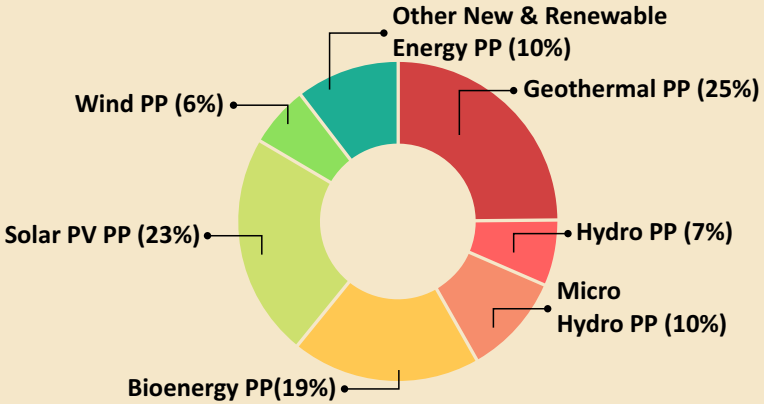
2025 New and Renewable Energy Supply Target according to General Planning for National Energy (RUEN)



- National Power Plant Capacity: 135 GW
- RE Power Plant Capacity: 45 GW

(75.05%) 69.2 MTOE

ELECTRICITY SECTOR



(24.95%) 23 MTOE

NON-ELECTRICITY SECTOR

- Biofuel
  13.69 Million kiloliters
- Biomass
  8.4 Million tons
- Biogas
  489.8 Million m^3
- CBM
  46 MMSCFD

1.2 INDONESIA'S GOVERNMENT REGULATIONS ON RENEWABLE ENERGY

YEAR	TITLE	LEGAL REFERENCES	STATUS
2019	Income Tax Facility For Investments In Certain Business Lines and/ or In Certain Regions	Government Regulation No. 78/2019	In Force
	Rooftop PV Utilization by PT PLN Consumer	MEMR Regulation No. 16/2019	In Force
	Rooftop PV Utilization by PT PLN Consumer	MEMR Regulation No. 13/2019	Amended
	Electric Power Generation Capacity for Own Use Based on Operation Permits	MEMR Regulation No. 12/2019	In Force
	Electricity Supply Business Plan (RUPTL) 2019-2028	MEMR Decree No. 39 K/20/MEM/2019	In Force
2018	Collection and Disbursement of Oil Palm Estate Fund	Presidential Regulation No. 66/2018	In Force
	Acceleration of Waste-to-electrical Energy Installations Based on Environmentally Friendly Technologies	Presidential Regulation No. 35/2018	In Force
	Utilization of Renewable Energy Sources for Electricity Supply	MEMR Regulation No. 53/2018	In Force
	Rooftop PV Utilization by PT PLN Consumer	MEMR Regulation No. 49/2018	Amended

1.2 INDONESIA'S GOVERNMENT REGULATIONS ON RENEWABLE ENERGY

YEAR	TITLE	LEGAL REFERENCES	STATUS
2018	Provision and Utilization of Biodiesel in the Financing Framework of the Indonesian Oil Palm Estate Fund	MEMR Regulation No. 45/2018	In Force
	Provision and Utilization of Biodiesel in the Financing Framework of the Indonesian Oil Palm Estate Fund	MEMR Regulation No. 41/2018	Amended
2017	Geothermal for Indirect Utilization	Government Regulation No. 7/2017	In Force
	Utilization of Renewable Energy Sources for Electricity Supply	MEMR Regulation No. 50/2017	Amended
	Utilization of Renewable Energy Sources for Electricity Supply	MEMR Regulation No. 43/2017	Superseded
	Utilization of Renewable Energy Sources for Electricity Supply	MEMR Regulation No. 12/2017	Superseded
	The Guidelines for the Use of Domestic Products for the Development of Electrical Infrastructure	MoI Regulation No. 5/2017	In Force
	Provisions and Procedures for Assessing Local Content Requirement for Solar Power Plant	MoI Regulation No. 4/2017	In Force

1.2 INDONESIA'S GOVERNMENT REGULATIONS ON RENEWABLE ENERGY

YEAR	TITLE	LEGAL REFERENCES	STATUS
2016	Income Tax Facilities for Capital Investment in Certain Business Fields and/or Certain Regions	Government Regulation No. 9/2016	Superseded
	Collection and Disbursement of Oil Palm Estate Fund	Presidential Regulation No. 24/2016	Amended
	Purchase of Electric Power from Biomass and Biogas Power Plants by PLN	MEMR Regulation No. 21/2016	Superseded
	Power Purchase from Solar Photovoltaic Plants	MEMR Regulation No. 19/2016	Superseded
2015	Income Tax Facilities for Capital Investment in Certain Business Fields and/or Certain Regions	Government Regulation No. 18/2015	Superseded
	Collection and Disbursement of Oil Palm Estate Fund	Presidential Regulation No. 61/2015	Amended
	Purchase of Electric Power from Municipal Waste Power Plants by PLN	MEMR Regulation No. 44/2015	In Force
	Purchase of Electricity by PT PLN from Hydro Power Plants with a Capacity of Up To 10 MW	MEMR Regulation No. 19/2015	Superseded
	Biofuel Supply, Utilization and Trading	MEMR Regulation No. 12/2015	In Force

1.2 INDONESIA'S GOVERNMENT REGULATIONS ON RENEWABLE ENERGY

YEAR	TITLE	LEGAL REFERENCES	STATUS
2014	Geothermal Law	Law No. 21/2014	In Force
	National Energy Policy	Government Regulation No. 79/2014	In Force
	Geothermal Business Activities	Government Regulation No. 75/2014	Superseded
	Purchase of Electric Power from Biomass and Biogas Power Plants by PLN	MEMR Regulation No. 27/2014	Superseded
	Biofuel Supply, Utilization and Trading	MEMR Regulation No. 20/2014	Amended
	Power Purchase from Geothermal Power Plant	MEMR Regulation No. 17/2014	In Force
2013	Biofuel Supply, Utilization and Trading	MEMR Regulation No. 25/2013	Amended
	Power Purchase from Solar Photovoltaic Plants	MEMR Regulation No. 17/2013	Superseded
2012	Purchase of Electricity and Benchmark Price from Geothermal Power Plant	MEMR Regulation No. 22/2012	Superseded
	Electricity Price from Small and Medium Scale Renewable Energy or Excess Power	MEMR Regulation No. 4/2012	Superseded
	Geothermal Fund	MoF Regulation No. 3/PMK.011/2012	In Force

1.2 INDONESIA'S GOVERNMENT REGULATIONS ON RENEWABLE ENERGY

YEAR	TITLE	LEGAL REFERENCES	STATUS
2012	The Guidelines for the Use of Domestic Products for the Development of Electrical Infrastructure	MoI Regulation No. 54/2012	Amended
2011	Purchase of Electricity and Benchmark Price from Geothermal Power Plant	MEMR Regulation No. 2/2011	Superseded
	Tax Exemption on Goods for Geothermal Exploration	MoF Regulation No. 22/PMK.011/2011	In Force
2010	Geothermal Business Activities	Government Regulation No. 70/2010	Superseded
	Tax and Custom Facilities for Renewable Energy Utilization	MoF Regulation No. 21/PMK.011/2010	In Force
2009	Electricity Law	Law No. 30/2009	In Force
	Electricity Price from Small and Medium Scale Renewable Energy or Excess Power	MEMR Regulation No. 31/2009	Superseded
	Non-Building Tangible Assets for Tax Depreciation Purposes	MoF No. 96/PMK.03/2009	In Force
2008	Biofuel Supply, Utilization and Trading	MEMR Regulation No. 32/2008	Amended

1.2 INDONESIA'S GOVERNMENT REGULATIONS ON RENEWABLE ENERGY

YEAR	TITLE	LEGAL REFERENCES	STATUS
2007	Energy Law	Law No. 30/2007	In Force
	Geothermal Business Activities	Government Regulation No. 59/2007	Superseded
	Credits for Food and Energy Security	MoF Regulation No. 79/PMK.05/2007	In Force
2006	National Energy Policy	Presidential Regulation No. 5/2006	Superseded
	Medium-Scale Power Generation using Renewable Energy	MEMR Regulation No. 2/2006	In Force
	Development Credits for Biofuels and Plantation Revitalisation	MoF Regulation No. 117/PMK.06/2006	In Force
2003	Geothermal Law	Law No. 27/2003	Superseded

CHAPTER 2

THE CURRENT SITUATION OF RENEWABLE ENERGY IN INDONESIA

2.1 RENEWABLE ENERGY PRODUCTION AND CAPACITY

INDONESIAN ENERGY INDICATORS IN 2019

POPULATION
265.02 Million

GDP
USD 1.15 Trillion
2010 USD

TPES
1,466 MBOE

TPES/Capita
5.53 BOE/capita

TPES GDP
0.33 BOE/000 2010 USD

Final Energy Consumption
868.58 MBOE

Energy Consumption/Capita
3.28 BOE/capita

CO_2 emission
543 MT of CO_2

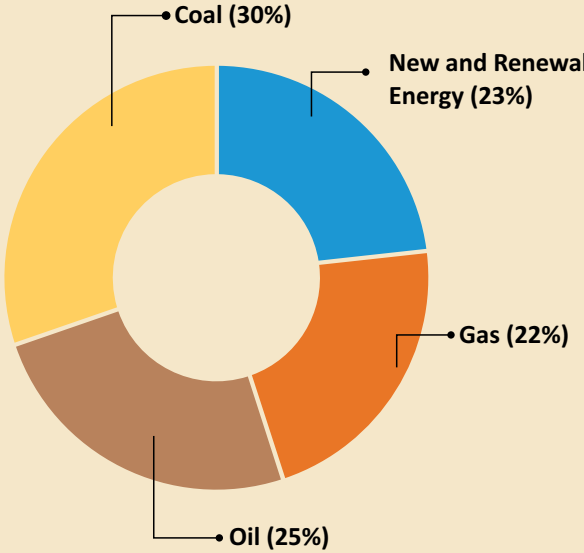
CO_2/TPES
0.37 TCO_2/BOE

CO_2/Capita
2.05 TCO_2/capita

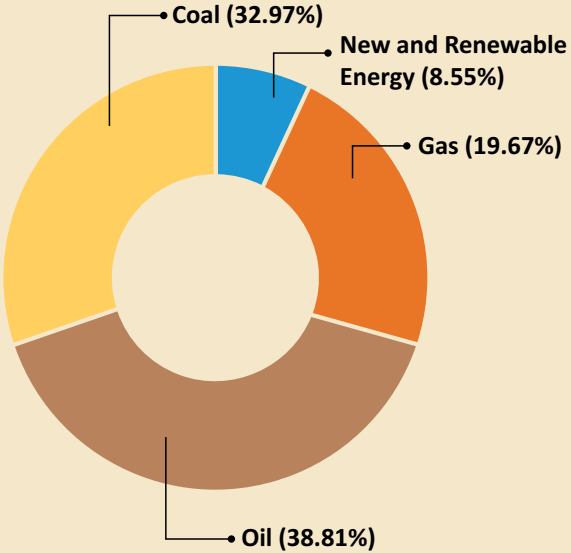
Source: BP Statistical Review of World Energy, BP, 2019; HEES Indonesia, MEMR 2019; World Bank, 2019

INDONESIA ENERGY MIX 2018

2025 New and Renewable Energy Supply Target according to General Planning for National Energy (RUEN)



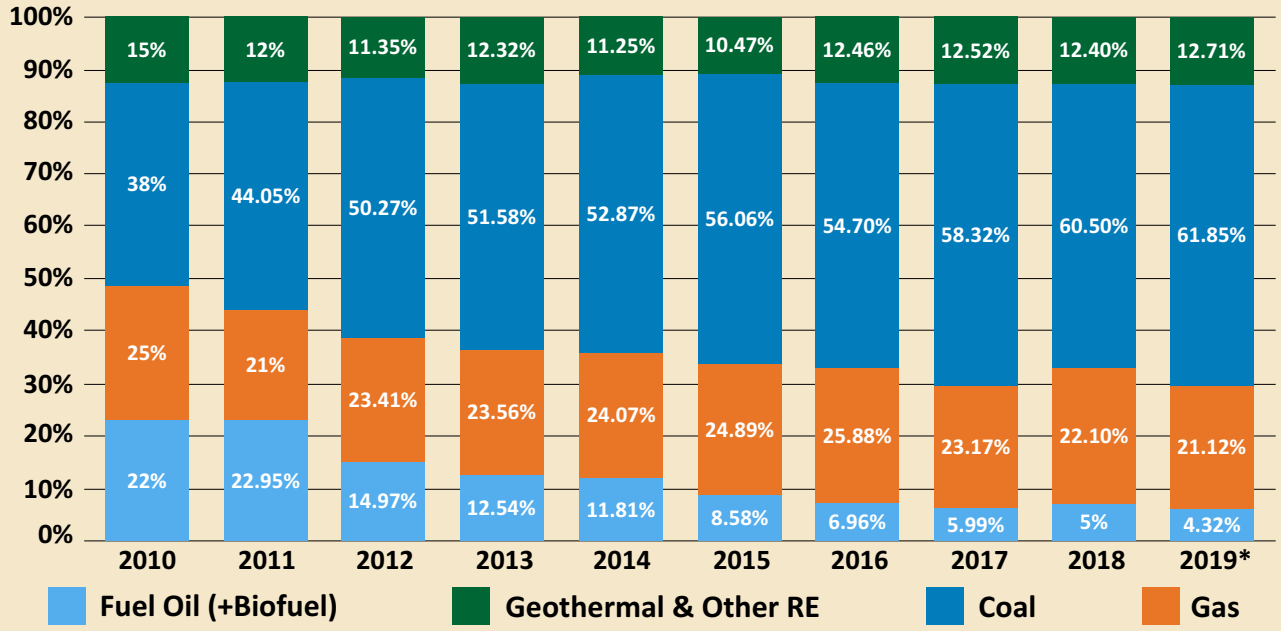
2018 National Energy Mix Realization



Source: HEES Indonesia, MEMR, 2019; RUEN, MEMR, 2017

RENEWABLE ENERGY CONTRIBUTION IN POWER GENERATION SECTOR

INDONESIA POWER GENERATION ENERGY MIX 2010 - 2019*

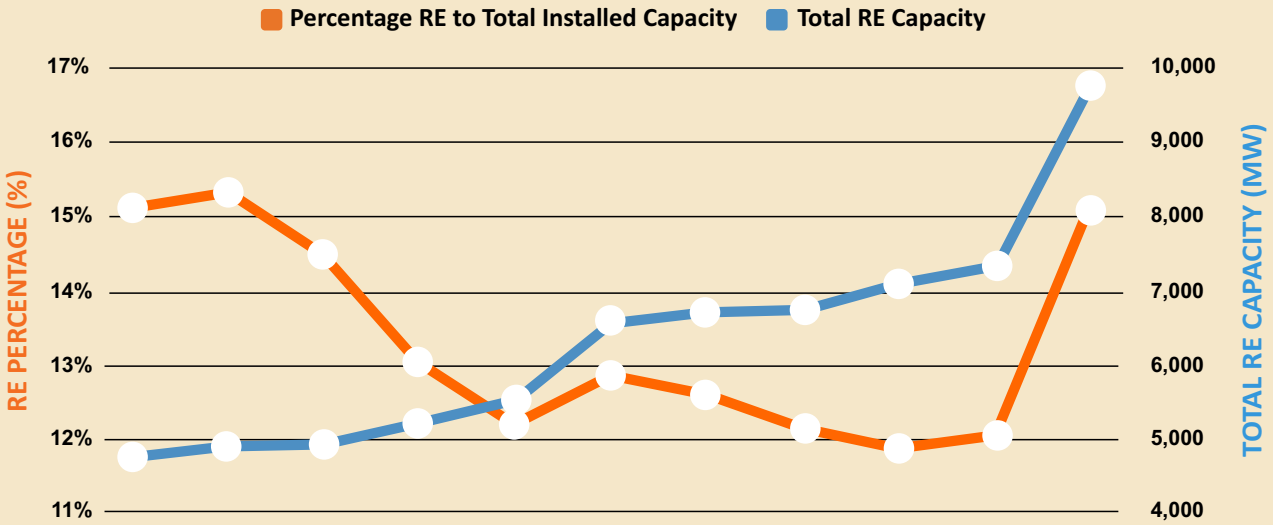


* Data as of first semester of 2019

Source: Energi Berkeadilan Semester-I, MEMR, 2019; HEES Indonesia, MEMR, 2019

2.1 RENEWABLE ENERGY PRODUCTION AND CAPACITY

RENEWABLE ENERGY POWER PLANT INSTALLED CAPACITY



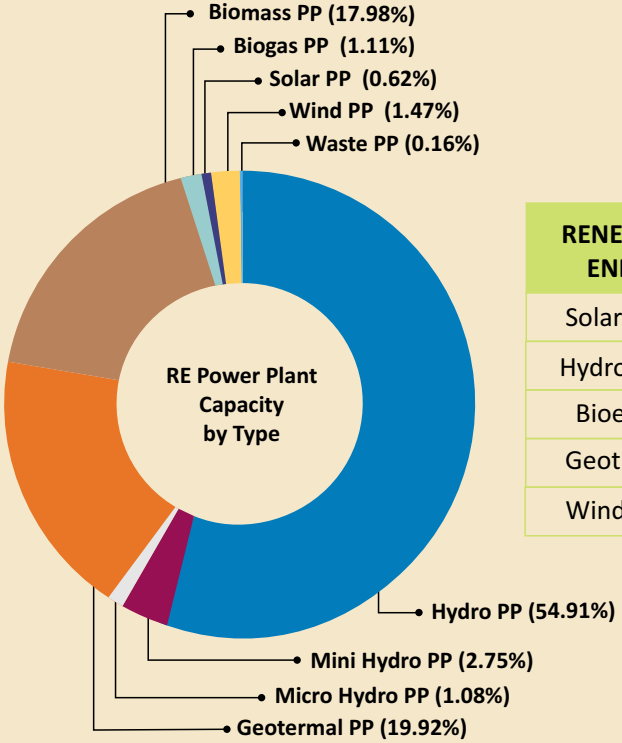
	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Percentage RE to Total Installed Capacity	15.10%	15.31%	14.49%	13.02%	12.19%	12.84%	12.59%	12.15%	11.87%	12.23%	15.06%
Total RE Capacity	4,749.78	4,891.73	4,923.44	5,198.51	5,513.43	6,544.76	6,679.03	6,745.33	7,079.03	7,379.2	9,780.54

- The total of Renewable Energy (RE) power plant capacity increased by 32% between 2017-2018.
- In 2018, there was a significant increase of RE share in the national energy mix from 12.23% in 2017 to 15.06% in 2018. This increase was due to the additional off-grid biomass power plant data which was published by the government in 2018.

Source: HEES Indonesia, MEMR, 2019

2.1 RENEWABLE ENERGY PRODUCTION AND CAPACITY

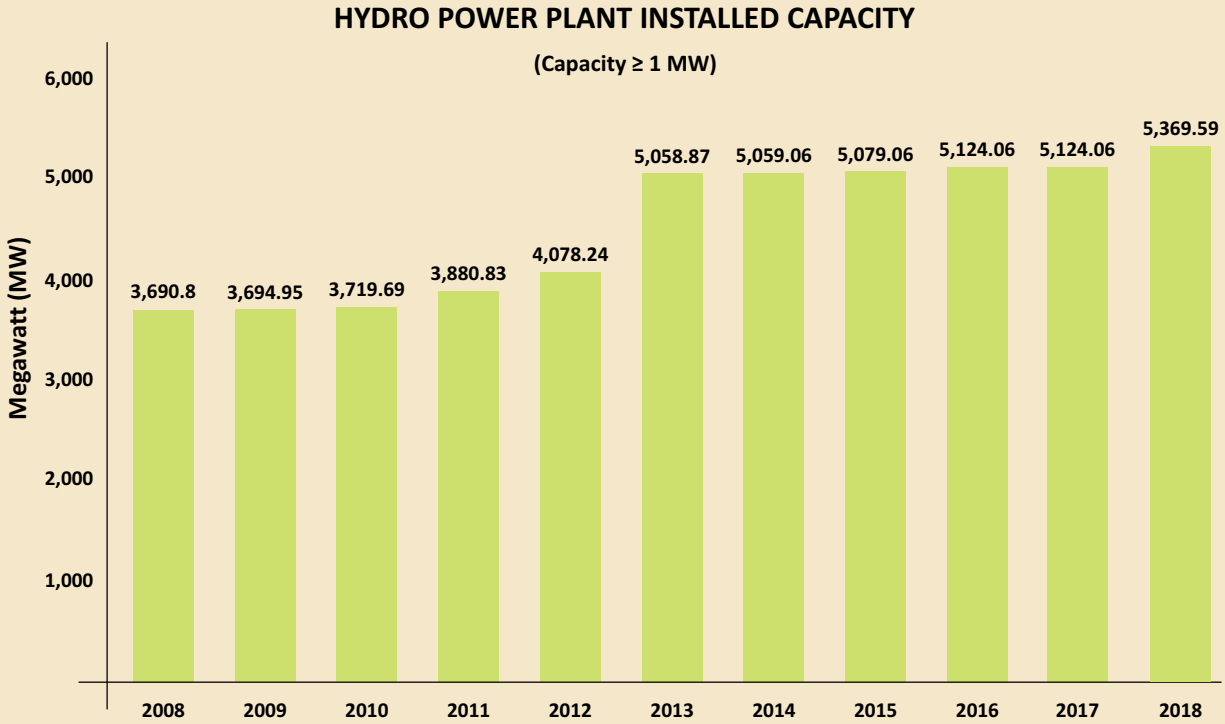
INDONESIA'S RENEWABLE ENERGY IN NUMBERS 2018



RENEWABLE ENERGY	TOTAL RESOURCES (MW)	INSTALLED CAPACITY (MW)	PERCENTAGE OF UTILIZED RESOURCE
Solar Power	207,898	60.20	0.03%
Hydro Power	75,670	5,742.15	7.59%
Bioenergy	49,810	1,867.15	3.75%
Geothermal	25,386	1,948.30	7.67%
Wind Power	9,290	143.51	1.54%

Source: HEES Indonesia, MEMR, 2019

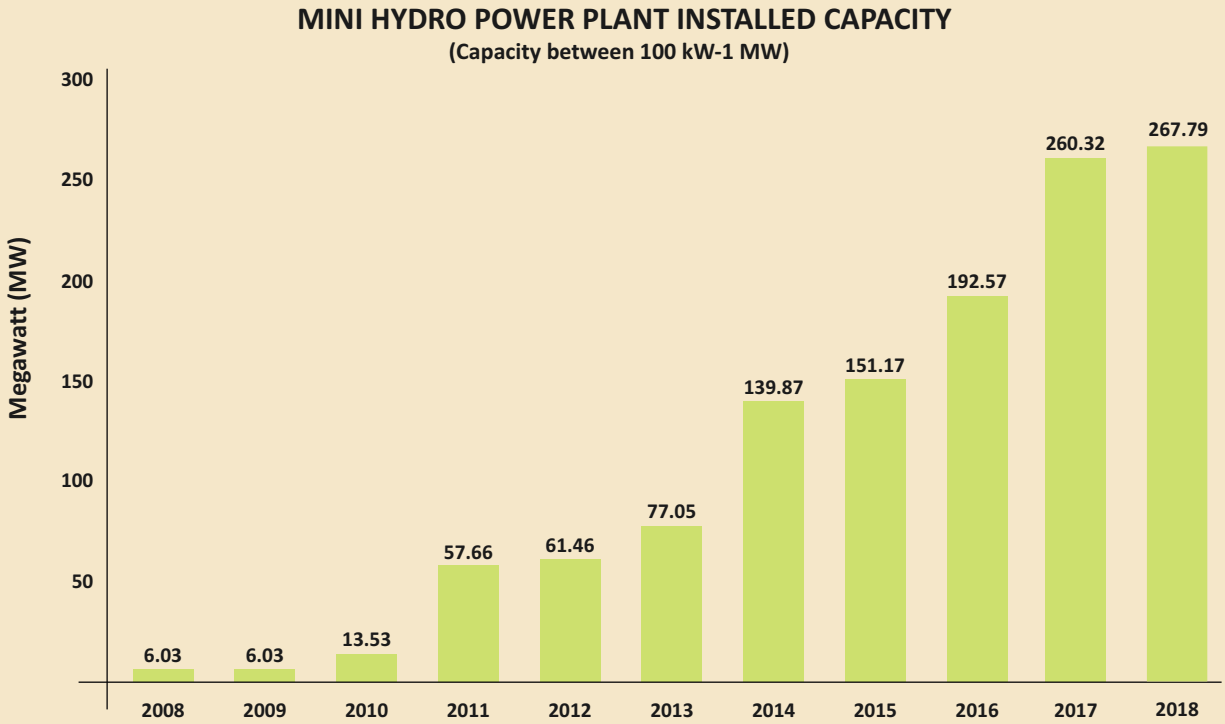
2.1 RENEWABLE ENERGY PRODUCTION AND CAPACITY



Source: HEES Indonesia, MEMR, 2019

The significant increase of hydro power plant installed capacity between 2012 and 2013 was the result of new private power plant operations in North Sumatra and South Sulawesi.

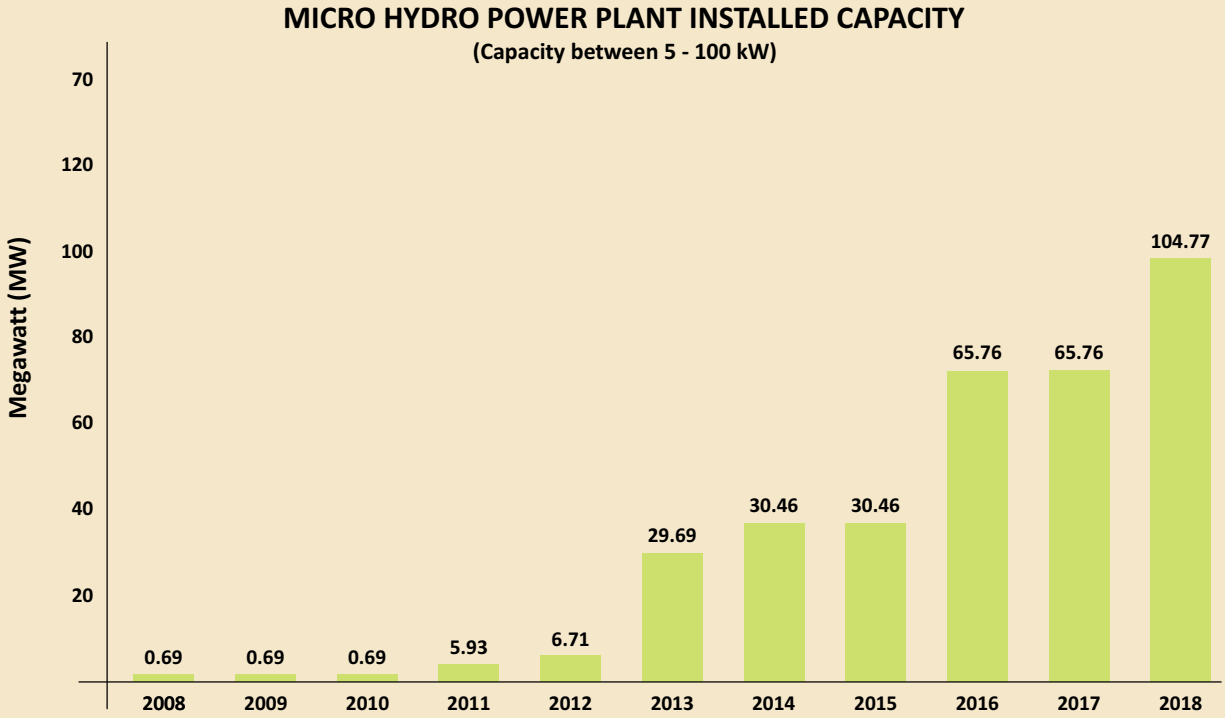
2.1 RENEWABLE ENERGY PRODUCTION AND CAPACITY



Source: HEES Indonesia, MEMR, 2019

The significant increase of mini hydro power plant installed capacity in 2011 was the result of additional mini hydro power plant policy on the National Energy Policy (KEN) in 2007.

2.1 RENEWABLE ENERGY PRODUCTION AND CAPACITY



Source: HEES Indonesia, MEMR, 2019

In 2018, the remarkable growth of micro hydro was supported by the significant additional capacity in Sumatera, such as in Silangkitang Tambiski, North Sumatera (53 kW).

2.1 RENEWABLE ENERGY PRODUCTION AND CAPACITY

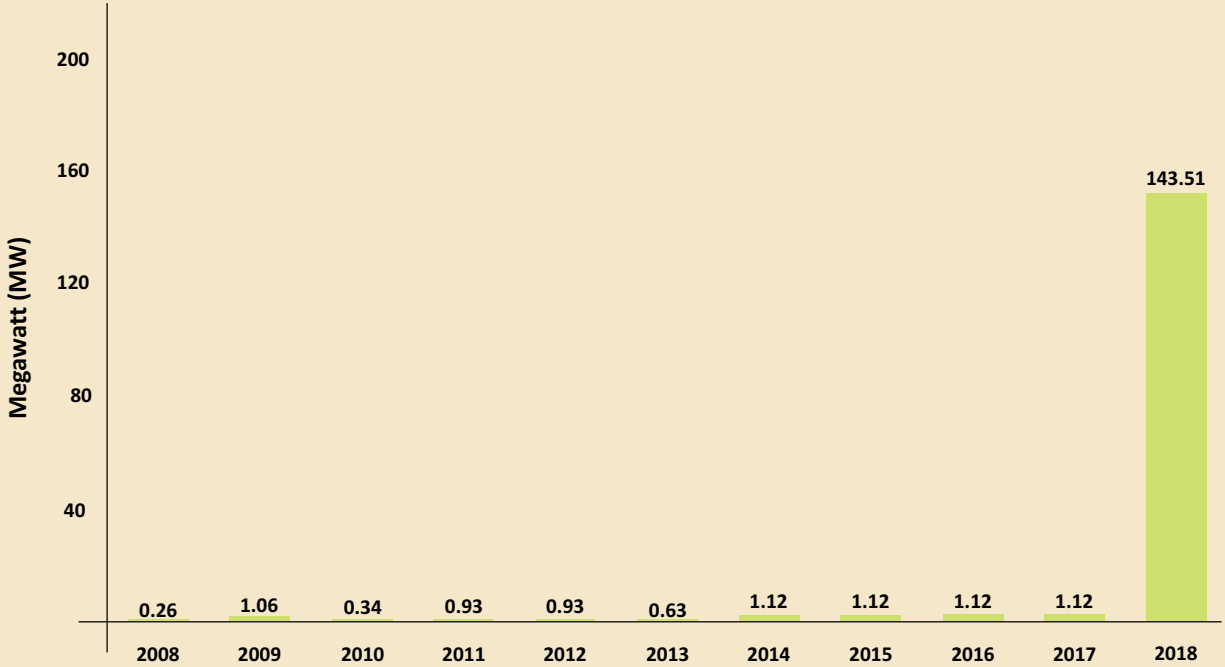
GEOTHERMAL POWER PLANT INSTALLED CAPACITY

Source: HEES Indonesia, MEMR, 2019

Since the implementation of Government Regulation No. 70/2010 and MEMR Regulation No. 22/2012, there was an increasing trend of geothermal power plant installed capacity. The 2018 additional capacity came from PLTP Sarulla (110 MW) and PLTP Karaha (30 MW).

2.1 RENEWABLE ENERGY PRODUCTION AND CAPACITY

WIND POWER PLANT INSTALLED CAPACITY

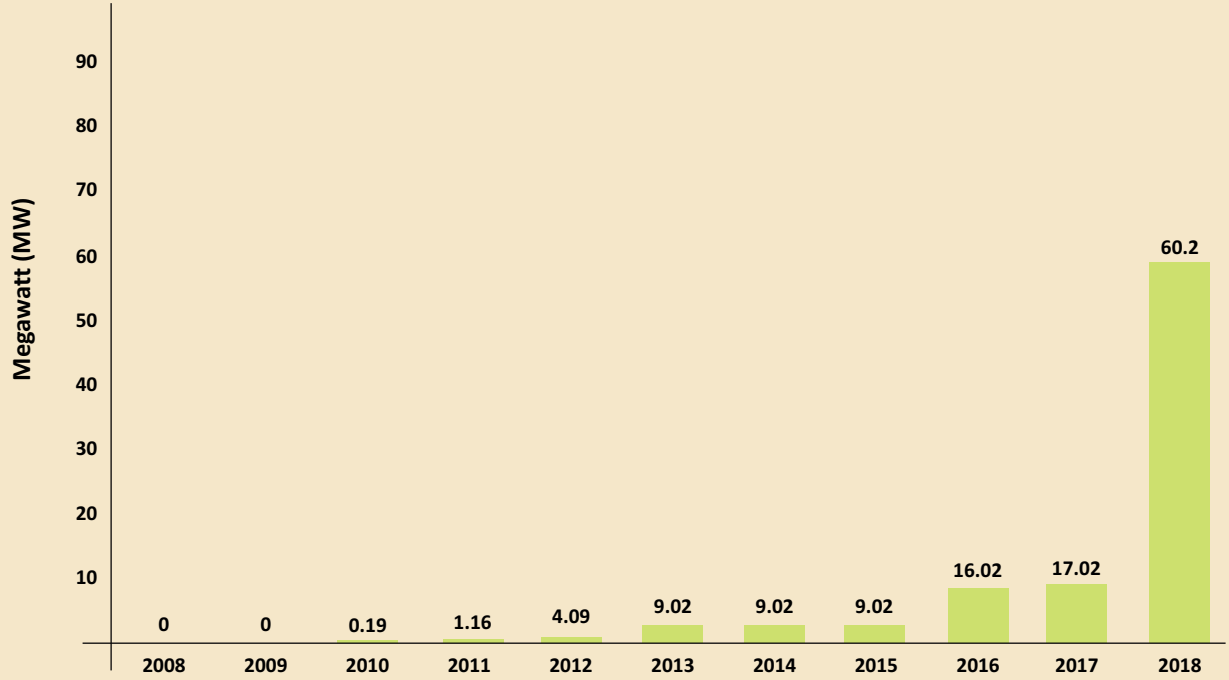


Source: HEES Indonesia, MEMR, 2019

In 2018, the first large-scale wind power plants were inaugurated in Sidrap and Jeneponto, South Sulawesi. PLTB Sidrap is the biggest wind power plant in Southeast Asia.

2.1 RENEWABLE ENERGY PRODUCTION AND CAPACITY

SOLAR POWER PLANT INSTALLED CAPACITY

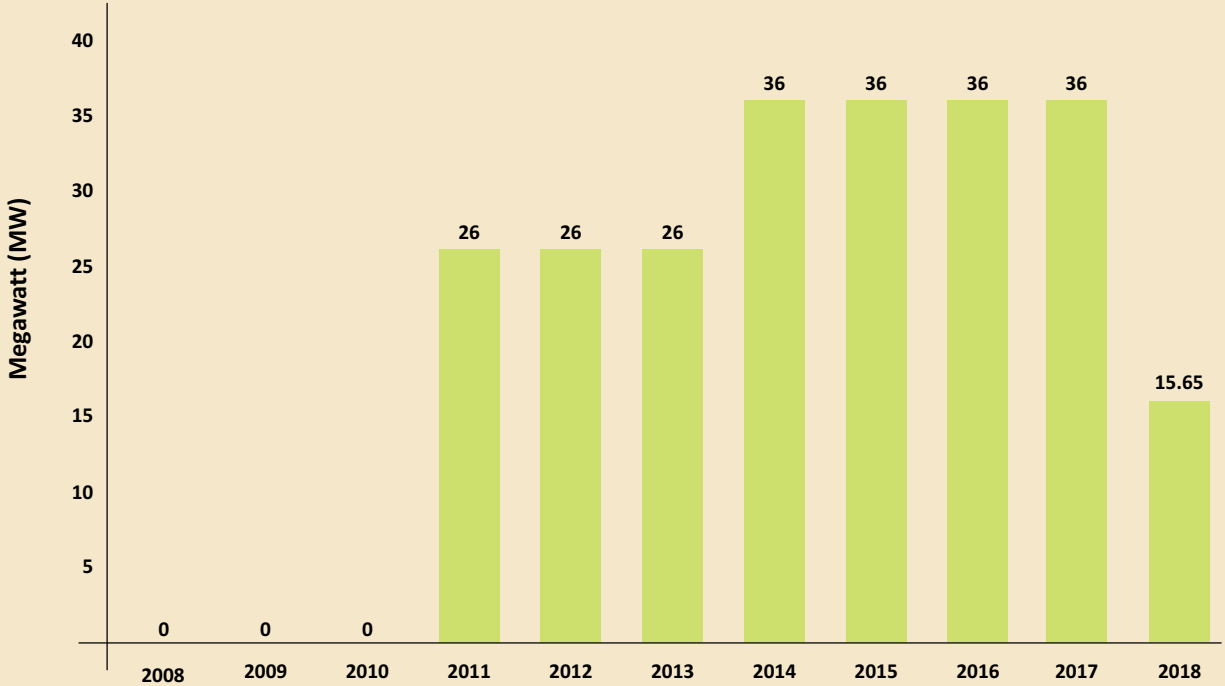


Source: HEES Indonesia, MEMR, 2019

The significant increase of solar power in 2018 mostly came from the additional off-grid solar power capacity, including the LTSHE program from the government. Moreover, the issuance of MEMR Regulation No. 19/2016 on solar feed-in-tariff in Indonesia supported the development of solar power since 2016.

2.1 RENEWABLE ENERGY PRODUCTION AND CAPACITY

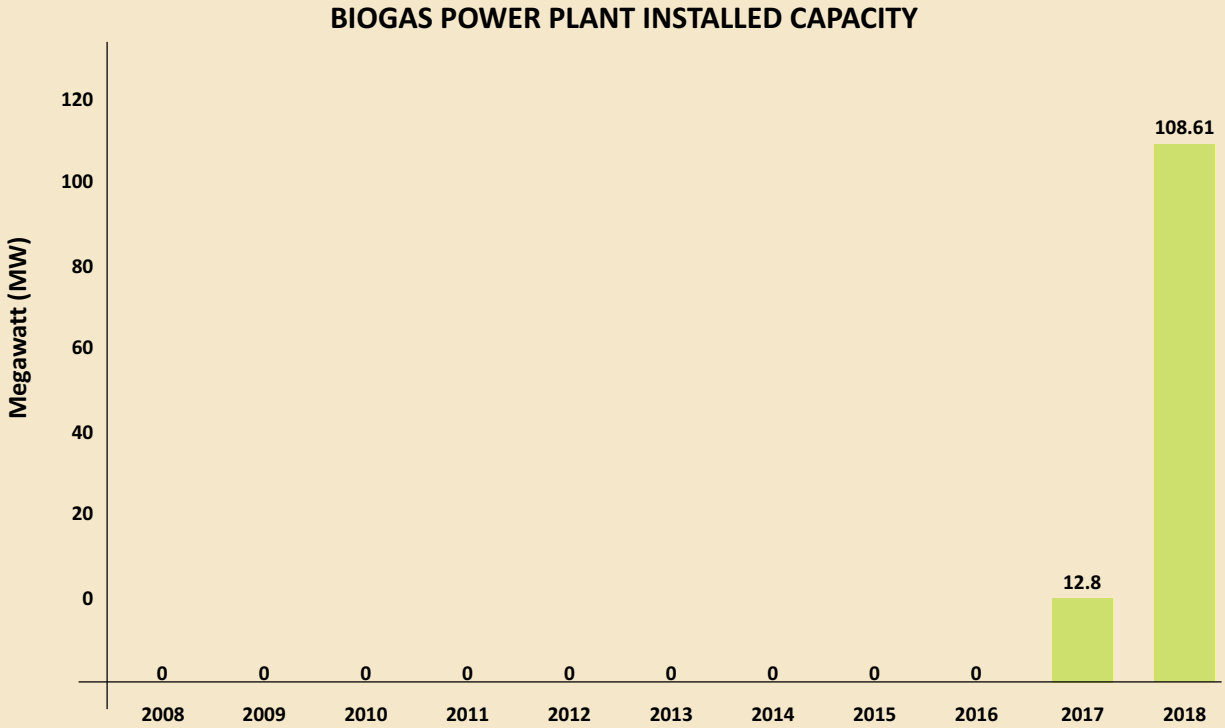
WASTE POWER PLANT INSTALLED CAPACITY



Source: HEES Indonesia, MEMR, 2019

The increase of waste power plant installed capacity from 2013 to 2014 was the response to the enactment of MEMR regulation No. 27/2014. However, the trend dropped in 2018 due to the MEMR Regulation No. 50/2017, which stipulates the waste power plant electricity price at a maximum of 100% of regional electricity supply cost (BPP). The government then anticipated it by imposing Presidential Regulation No. 35/2018.

2.1 RENEWABLE ENERGY PRODUCTION AND CAPACITY

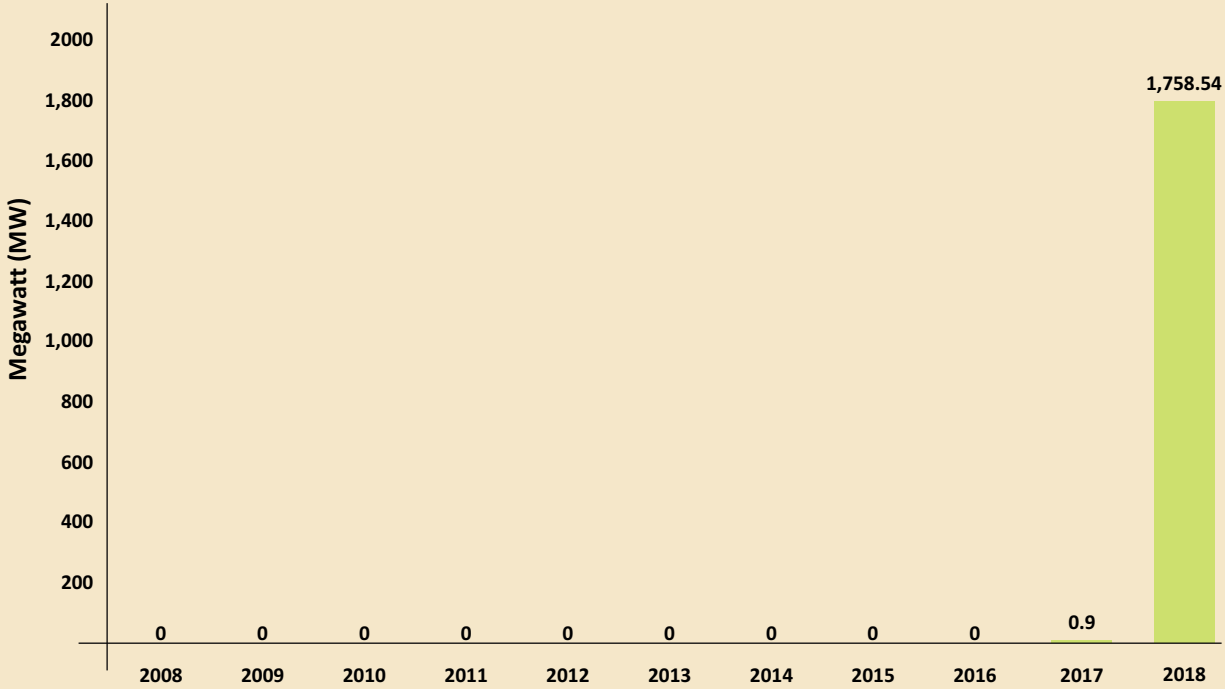


Source: HEES Indonesia, MEMR, 2019

The first Indonesia's commercial biogas power plant operated using Palm Oil Mill Effluent (POME) as the fuel was installed in Jangkang, East Belitung in 2017. Then, followed by other biogas power plants operation in Sumatera region, where it has abundant supply of palm oil.

2.1 RENEWABLE ENERGY PRODUCTION AND CAPACITY

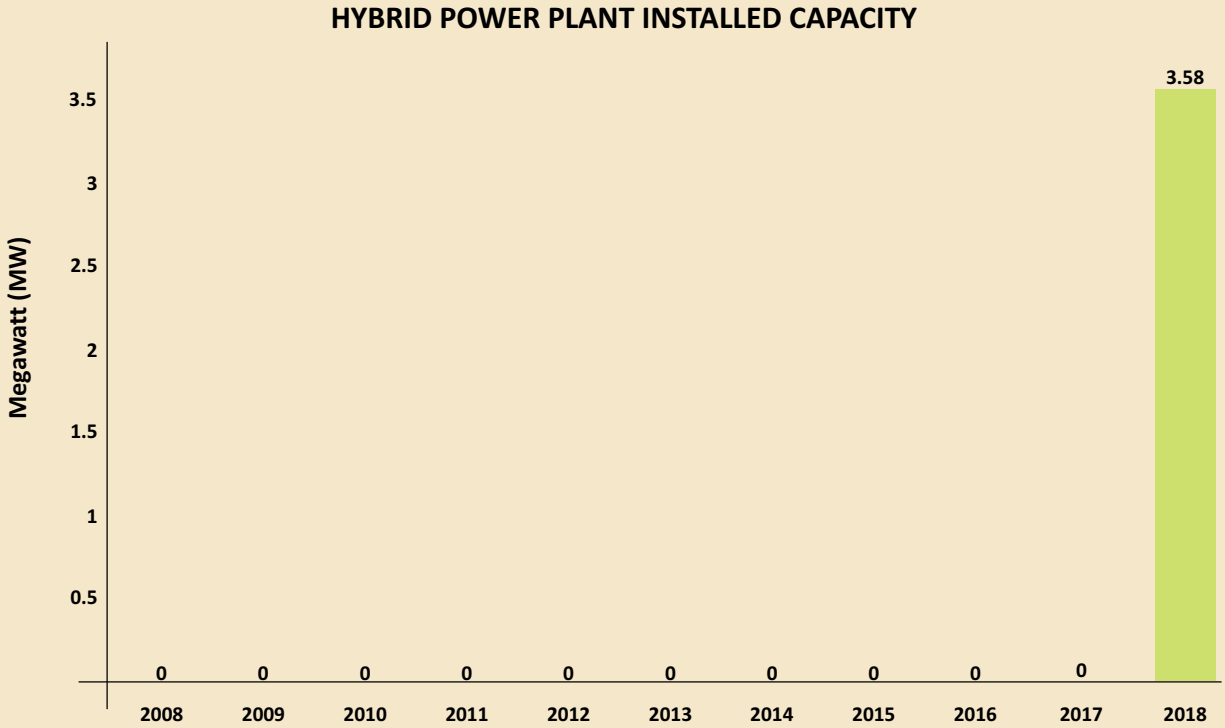
BIOMASS POWER PLANT INSTALLED CAPACITY



Source: HEES Indonesia, MEMR, 2019

The first utilization of biomass material for a commercial power plant in Indonesia can be traced back in 2017 by the first operation of a commercial biomass power plant in Kepulauan Riau. In 2018, the significant increase was caused by additional off grid data by MEMR and new biomass power plants installation such as in Siantan, West Kalimantan (15 MW).

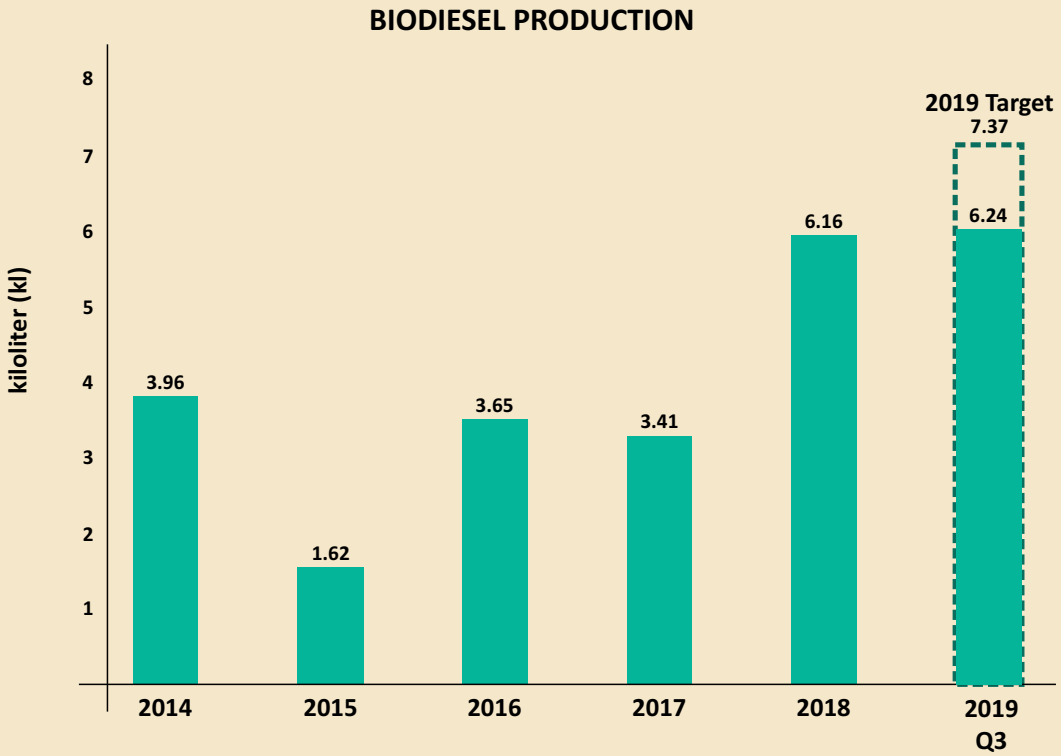
2.1 RENEWABLE ENERGY PRODUCTION AND CAPACITY



Source: HEES Indonesia, MEMR, 2019

Hybrid power plant is a combination of different technologies to produce power from various sources. In 2018, 1.23 MW hybrid power plants which integrate three power generation systems (microhydro-genset-solar PV & battery) were installed in 3 villages in Kabupaten Berau, Kalimantan Timur.

2.1 RENEWABLE ENERGY PRODUCTION AND CAPACITY

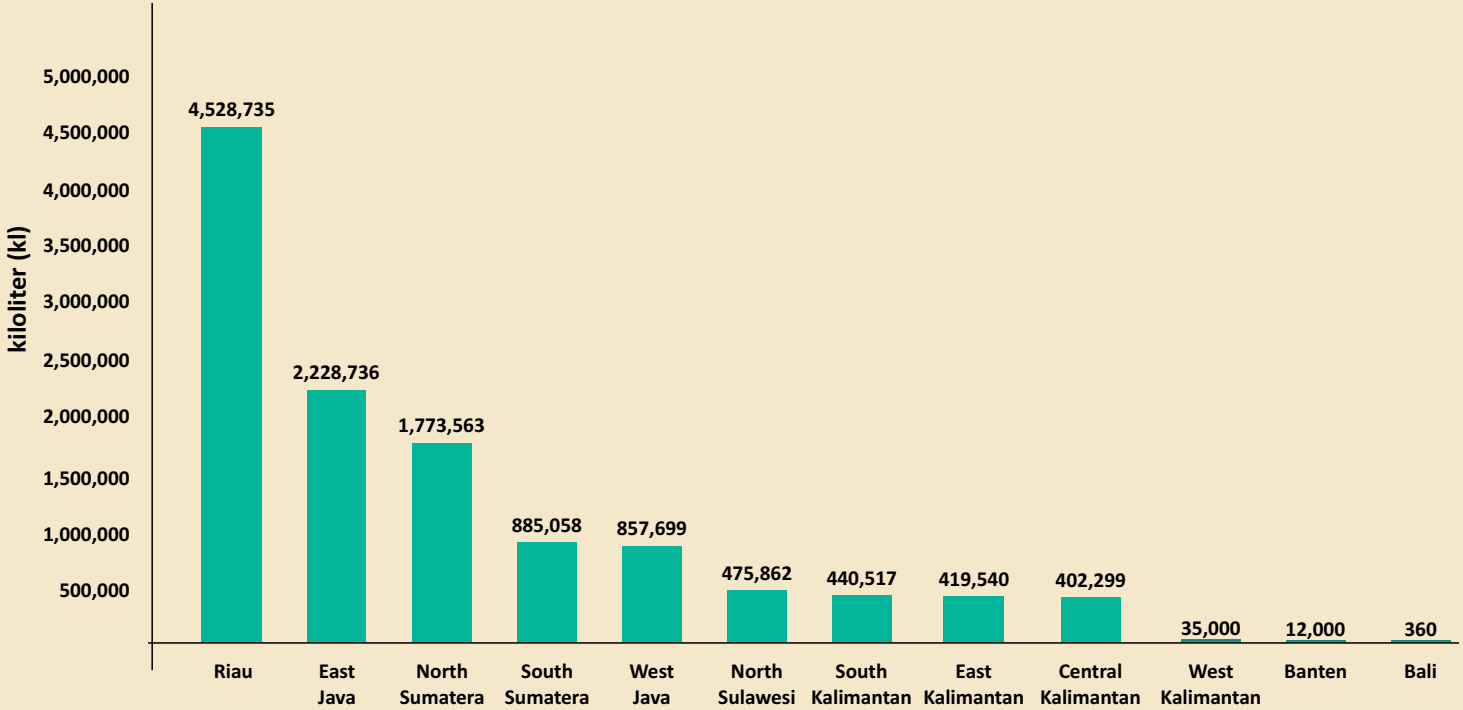


Source: Energi Berkeadilan TW-III, MEMR, 2019

Biodiesel utilization started to grow significantly after the government issued Presidential Regulation No. 66/2018 on "Collection and Utilization of the Palm Oil Plantation Fund" and MEMR Regulation No. 41/2018 on "Provision and Utilization of Biodiesel in the Financing Framework of the Indonesian Oil Palm Estate Fund". Through B20 program, the government successfully increased biodiesel consumption in Q4 of 2018 .

2.1 RENEWABLE ENERGY PRODUCTION AND CAPACITY

BIODIESEL INDUSTRY CAPACITY IN 2018

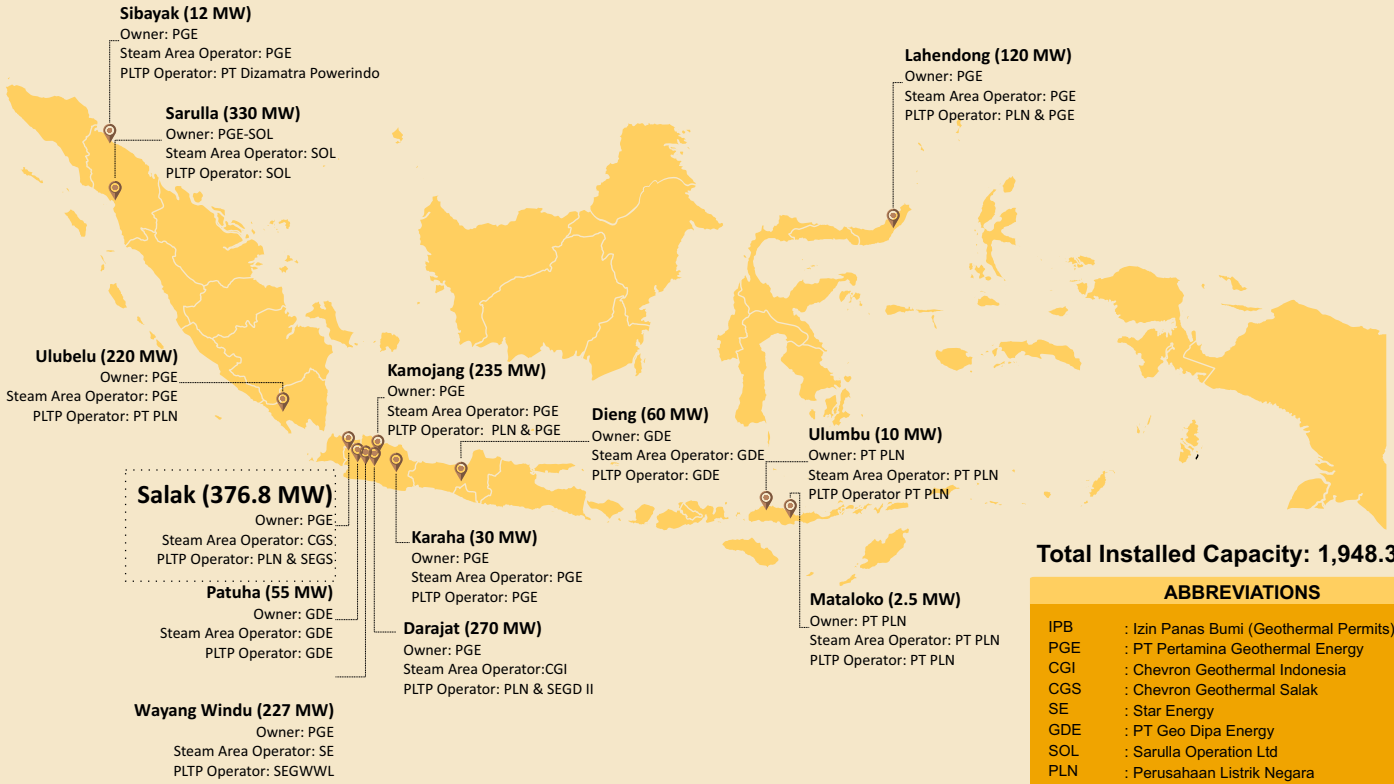


Source: HEES Indonesia, MEMR, 2019

Biodiesel industry is usually located close to the palm oil industry, since it is the main feedstock for biodiesel production. According to Ministry of Agriculture, there are about 14.23 million Ha of palm oil plantations, in which 19% of them are in Riau.

2.1 RENEWABLE ENERGY PRODUCTION AND CAPACITY

GEOTHERMAL POWER PLANT CAPACITY (2018)



Source: HEES Indonesia, MEMR, 2019

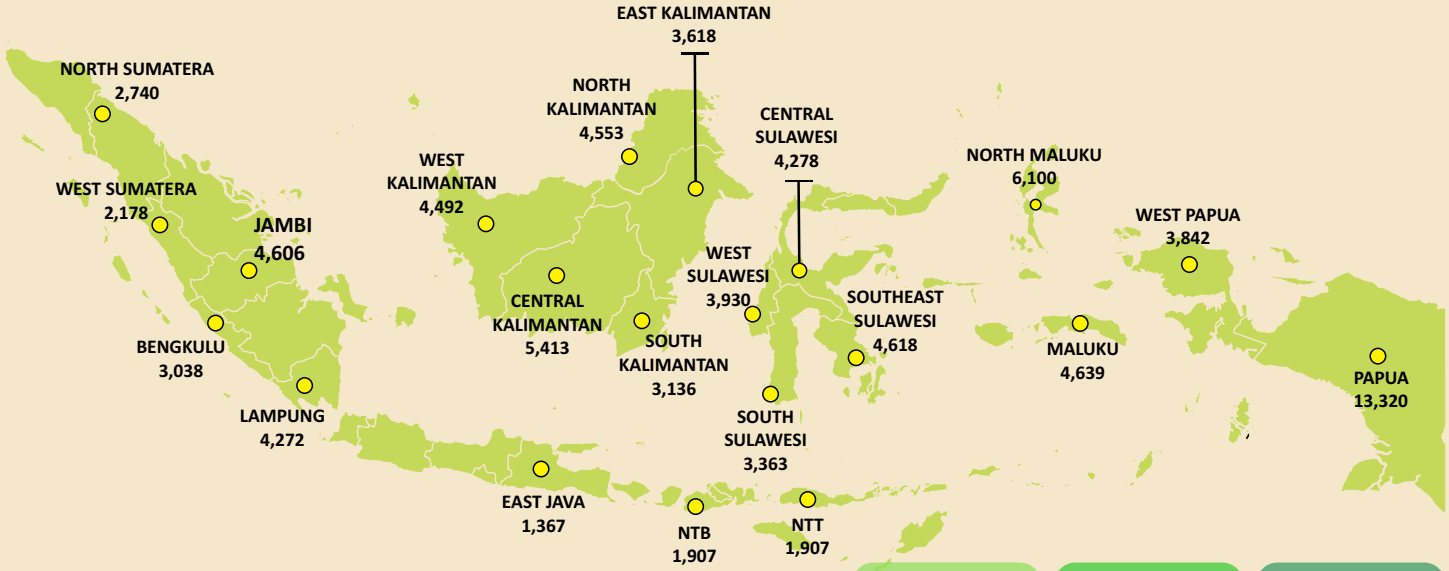
Total Installed Capacity: 1,948.3 MW

ABBREVIATIONS

IPB	: Izin Panas Bumi (Geothermal Permits)
PGE	: PT Pertamina Geothermal Energy
CGI	: Chevron Geothermal Indonesia
CGS	: Chevron Geothermal Salak
SE	: Star Energy
GDE	: PT Geo Dipa Energy
SOL	: Sarulla Operation Ltd
PLN	: Perusahaan Listrik Negara
SEGS	: Star Energy Geothermal Salak Ltd.
SEGD II	: Star Energy Geothermal Darajat II Ltd.
SEGWWL	: Star Energy Geothermal Wayang Windu Ltd.

2.1 RENEWABLE ENERGY PRODUCTION AND CAPACITY

LOCATION AND QUANTITY OF INSTALLED FREE SOLAR POWER ENERGY SAVING LAMPS "LAMPU TENAGA SURYA HEMAT ENERGI (LTSHE)" IN 2019



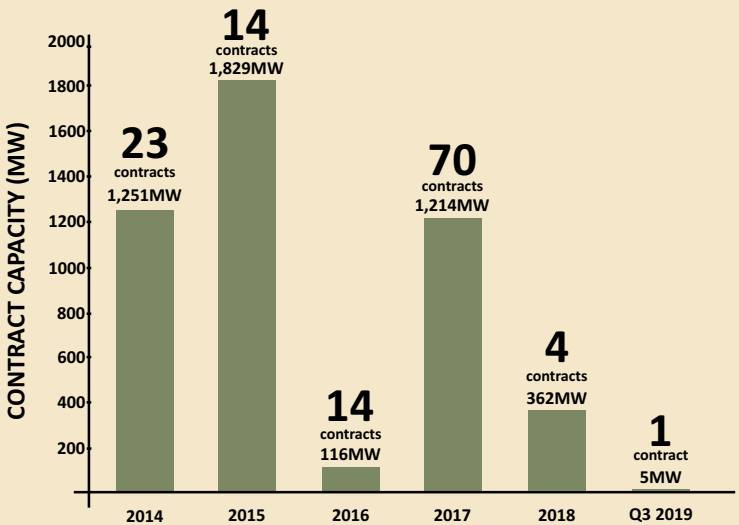
79,556	172,996	72,265
units in 5 provinces	units in 16 provinces	units in 22 provinces
2017	2018	Q3 2019

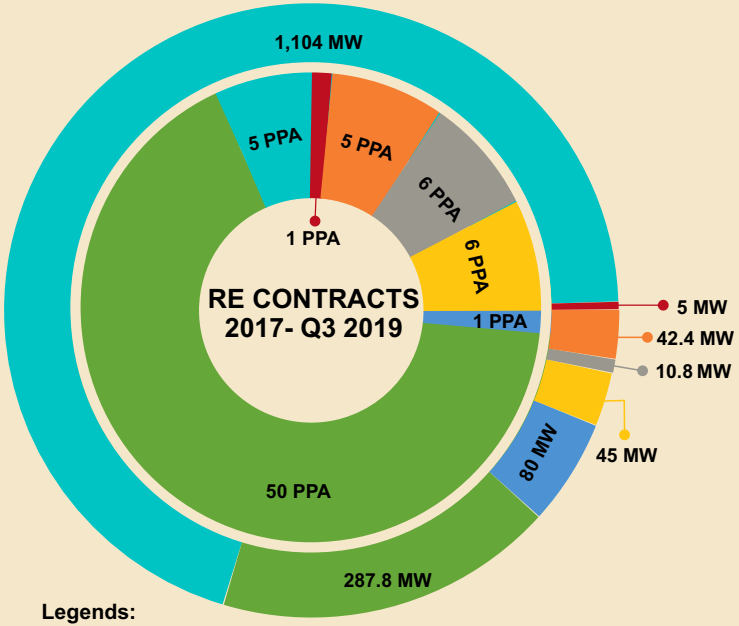
Source: Energi Berkeadilan TW-III, MEMR, 2019

2.1 RENEWABLE ENERGY PRODUCTION AND CAPACITY

RENEWABLE ENERGY CONTRACTS

NUMBER OF RE CONTRACTS SIGNED





Legends:

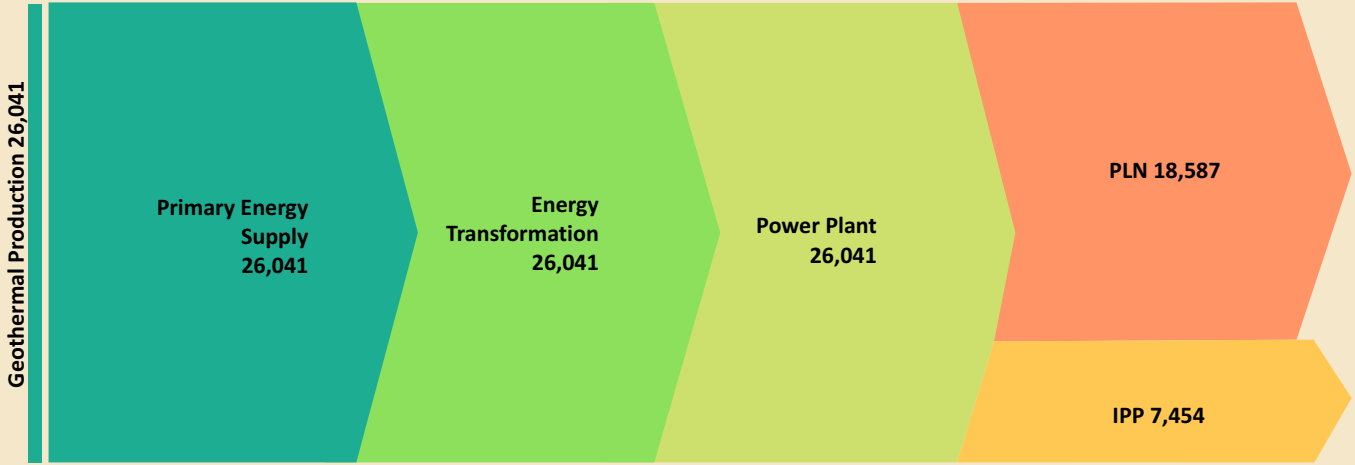
Outer circle : Capacity Shares
Inner circle : Number of Contract

- : Hydro (>1MW)
- : Mini Hydro (<1MW)
- : Solar
- : Geothermal
- : Biogas
- : Biomass
- : Waste to Energy

Source: Energi Berkeadilan TW-III, MEMR, 2019

2.2 RENEWABLE ENERGY BALANCE BY TYPE

GEOTHERMAL SANKEY DIAGRAM* 2018 (THOUSAND BOE)

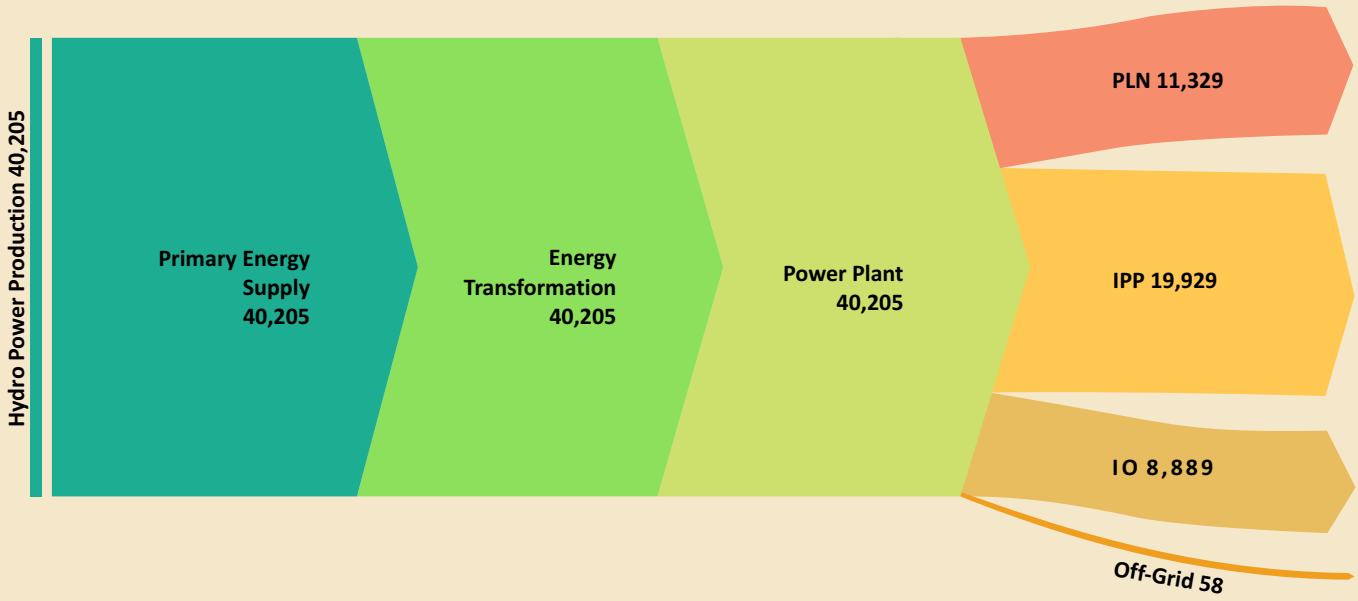


Source: HEES Indonesia, MEMR, 2019

*Sankey Diagram represents the flows of energy and their quantities in each process from the primary energy supply to the final consumption.

2.2 RENEWABLE ENERGY BALANCE BY TYPE

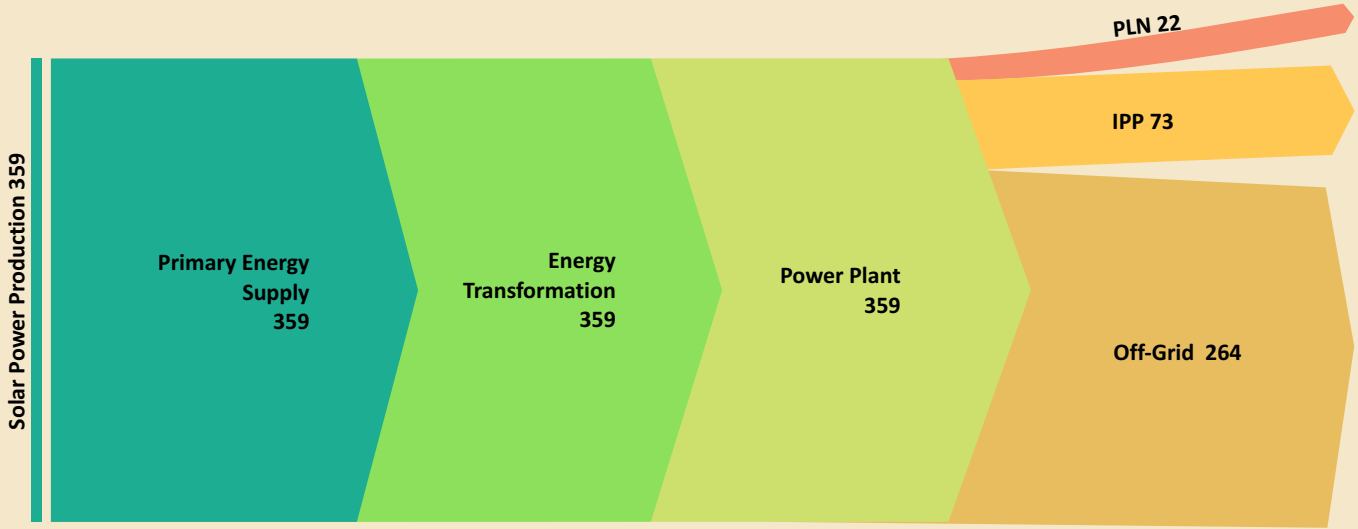
HYDRO POWER SANKEY DIAGRAM 2018 (THOUSAND BOE)



Source: HEES Indonesia, MEMR, 2019

2.2 RENEWABLE ENERGY BALANCE BY TYPE

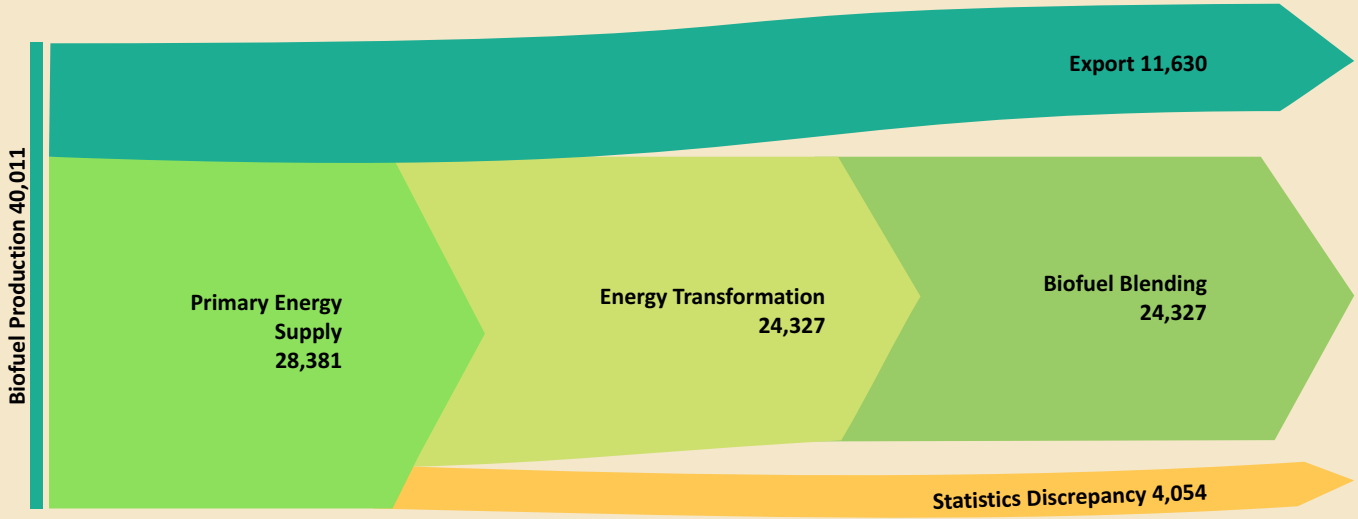
SOLAR & SOLAR PV SANKEY DIAGRAM 2018 (THOUSAND BOE)



Source: HEES Indonesia, MEMR, 2019

2.2 RENEWABLE ENERGY BALANCE BY TYPE

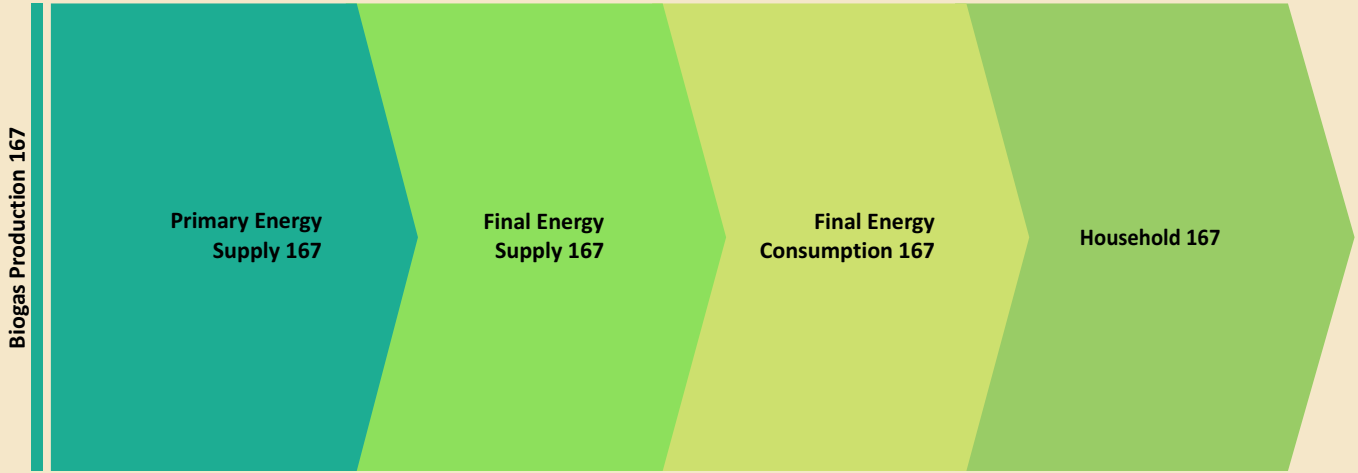
BIOFUEL SANKEY DIAGRAM 2018 (THOUSAND BOE)



Source: HEES Indonesia, MEMR, 2019

2.2 RENEWABLE ENERGY BALANCE BY TYPE

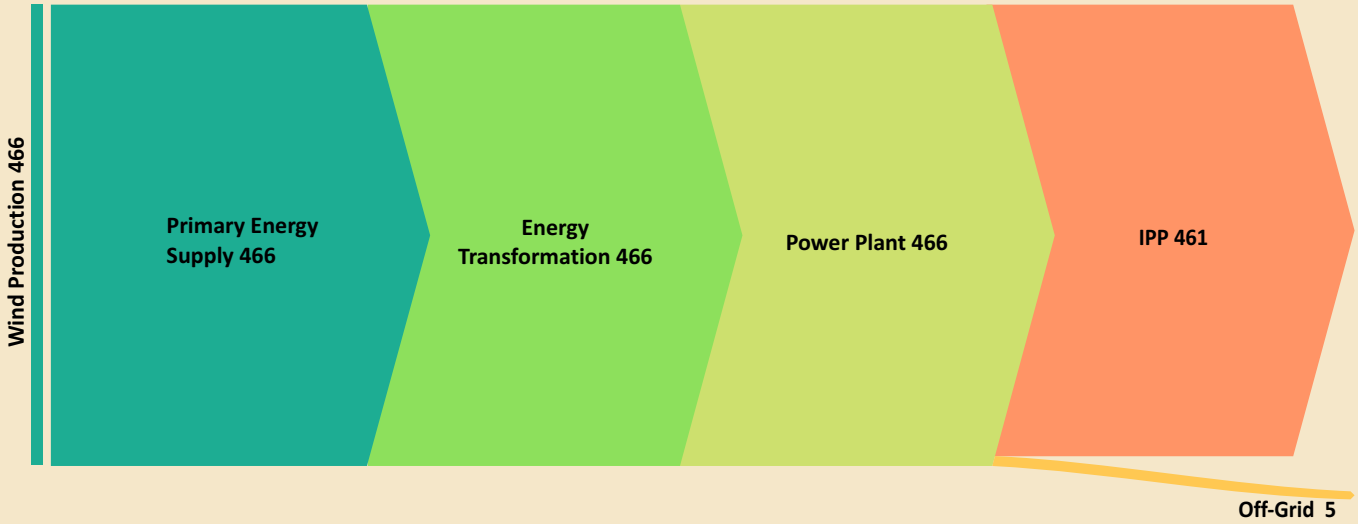
BIOGAS SANKEY DIAGRAM 2018 (THOUSAND BOE)



Source: HEES Indonesia, MEMR, 2019

2.2 RENEWABLE ENERGY BALANCE BY TYPE

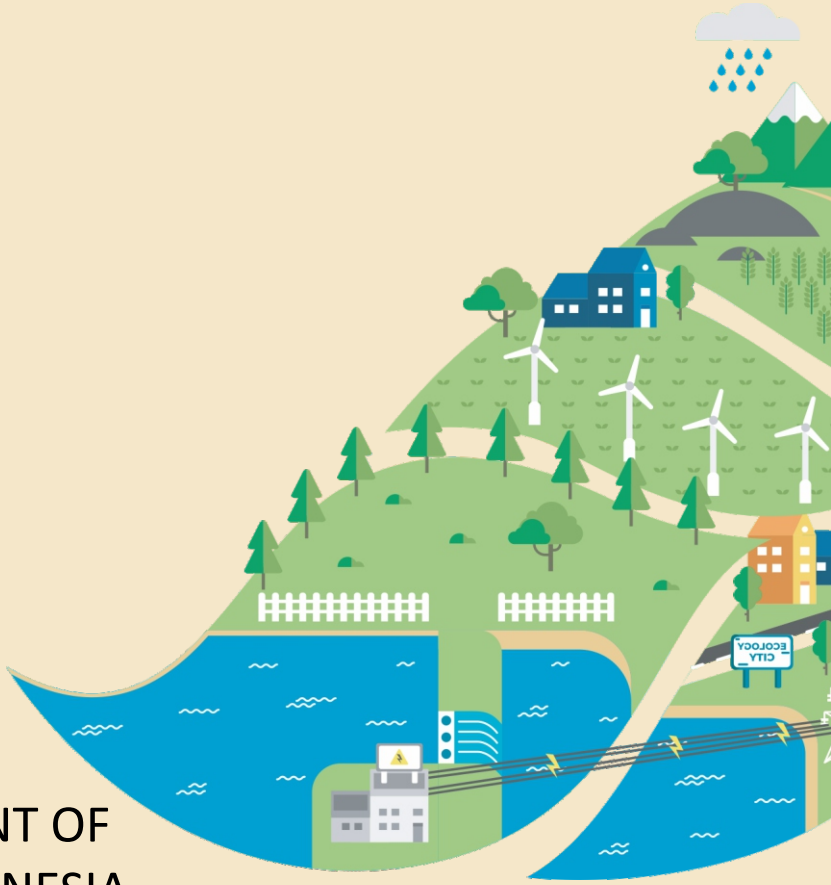
WIND POWER SANKEY DIAGRAM 2018 (THOUSAND BOE)



Source: HEES Indonesia, MEMR, 2019

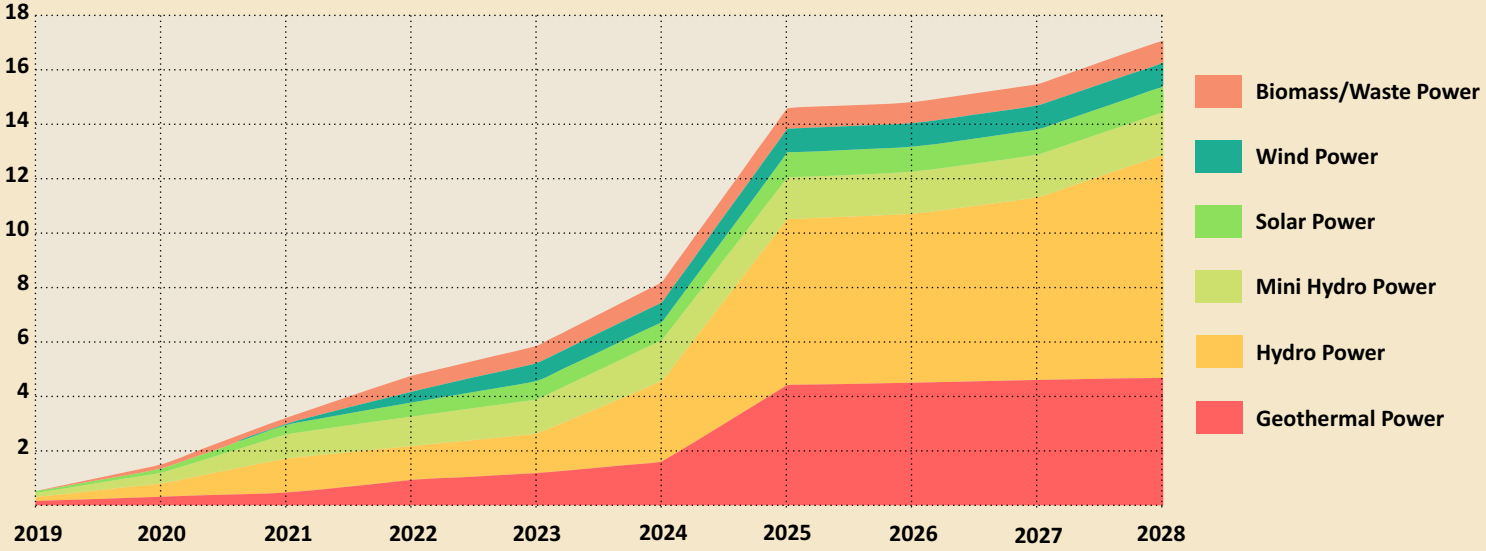
CHAPTER 3

THE POTENTIAL DEVELOPMENT OF RENEWABLE ENERGY IN INDONESIA



3.1 CLASSIFICATION BASED ON RENEWABLE ENERGY TYPES

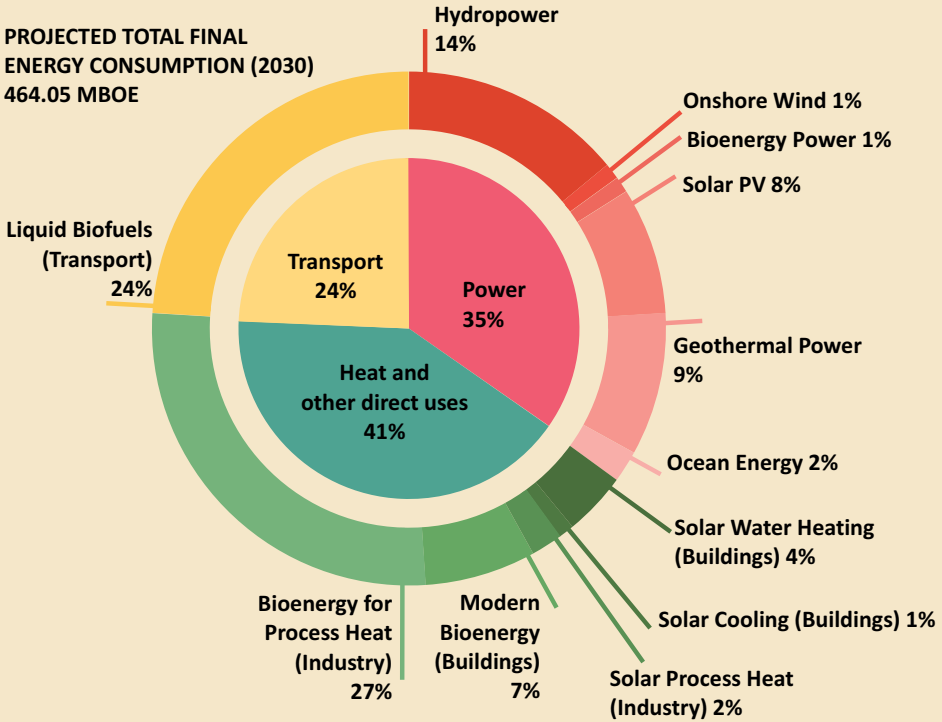
ADDITIONAL RENEWABLE ENERGY POWER PLANT CAPACITY (GW) FROM 2019 TO 2028



Up to 2028, the additional RE capacity projection will mostly be dominated by hydro power plants accounting for 8 GW, followed by geothermal power plants and mini hydro power plants.

Source: RUPTL, PT PLN (Persero), 2019

BREAKDOWN OF RENEWABLE ENERGY IN TOTAL FINAL ENERGY CONSUMPTION (2030)

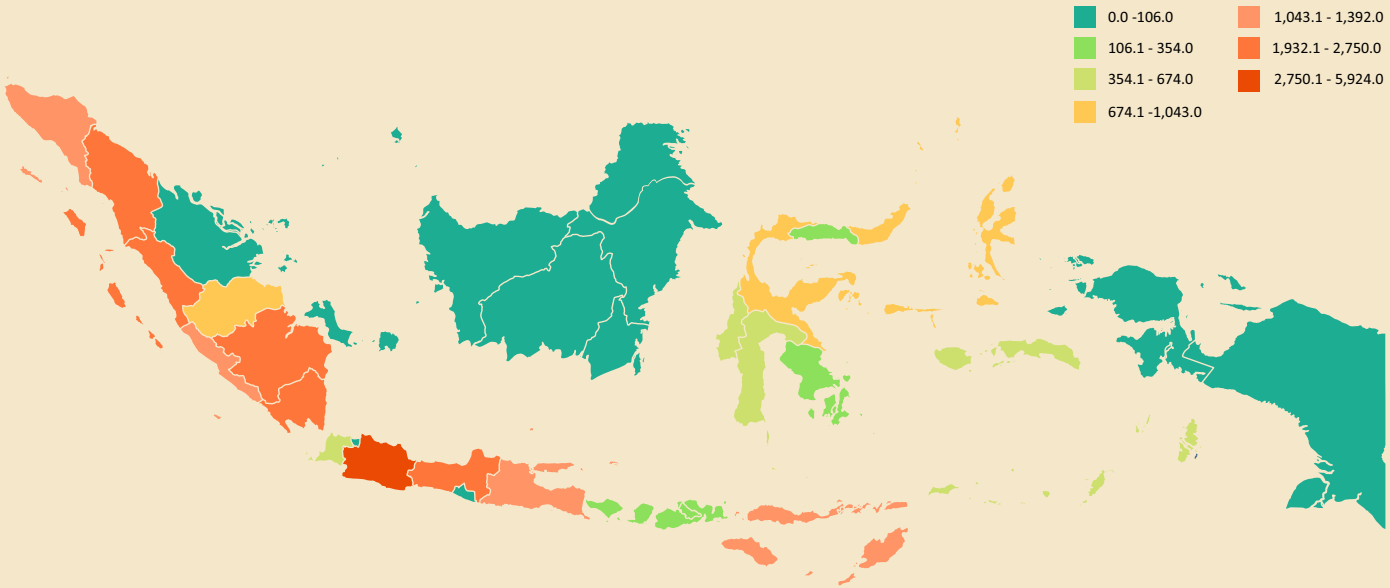


Source: IRENA, 2017

- Bioenergy will dominate the RE usage in the transport, heat and other direct uses.
- While hydro, geothermal and solar energy dominate the RE usage in the power sector.

3.2 CLASSIFICATION BASED ON GEOGRAPHICAL AREAS

GEOTHERMAL RESOURCES (MW)

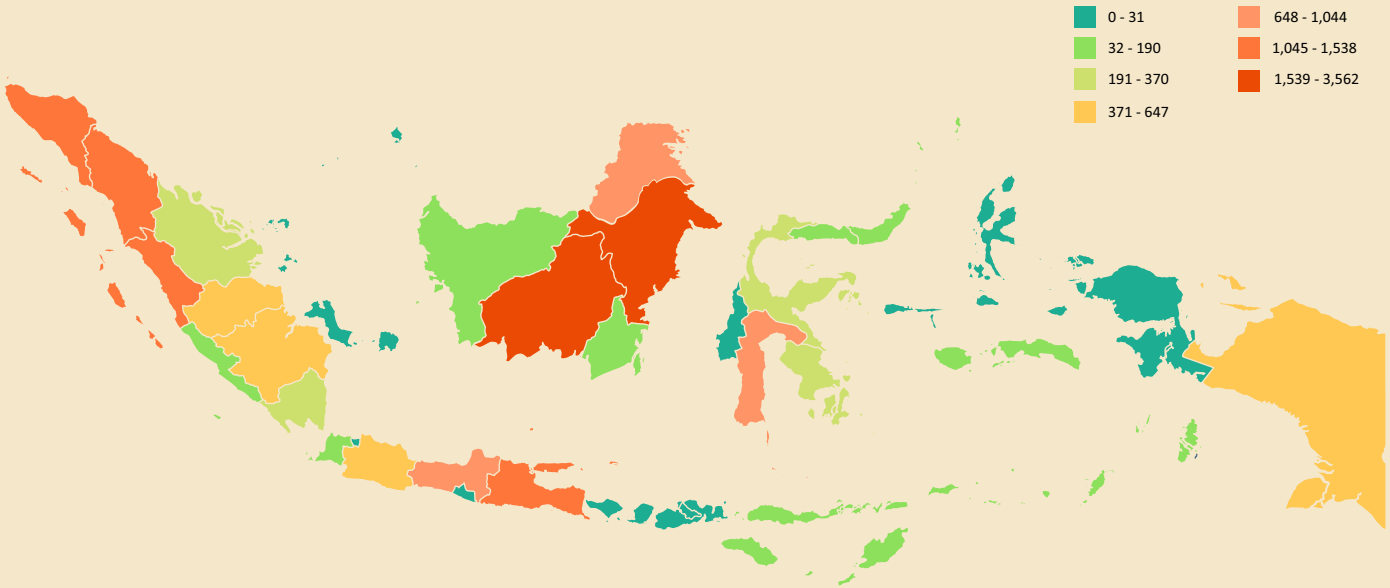


The highest geothermal resources are spread along the volcanic track in Sunda Trench, that lies from the western of Sumatra to the southern of Java and continue to the southern part of East Nusa Tenggara. In the northern part, the meeting point between Eurasia plate, Pacific Plate and Philippines Plate produces the volcanically active zone which provides a high geothermal potential. The geothermal power plants have been developed in West Java, Central Java, Nusa Tenggara, West Sumatera and Lampung while other potentials in different areas are yet to be developed.

Source: Statistik EBTKE, DGNREEC, 2016

3.2 CLASSIFICATION BASED ON GEOGRAPHICAL AREAS

MINI AND MICRO HYDRO RESOURCES (MW)

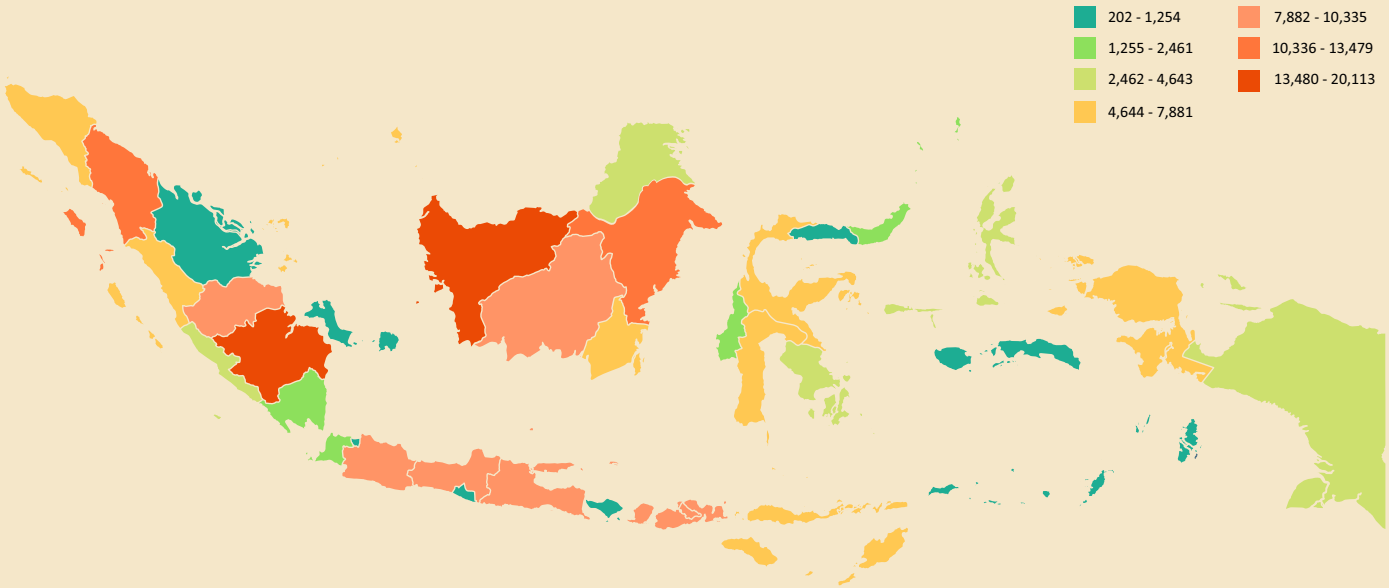


Islands of Sumatera, Java, Kalimantan, Sulawesi and Papua have significant potential of both mini and micro hydro power resources. Mini and micro hydro power plants have been commonly used in remote areas, especially for off-grid electrification.

Source: Statistik EBTKE, DGNREEC, 2016

3.2 CLASSIFICATION BASED ON GEOGRAPHICAL AREAS

SOLAR POWER RESOURCES (MW)

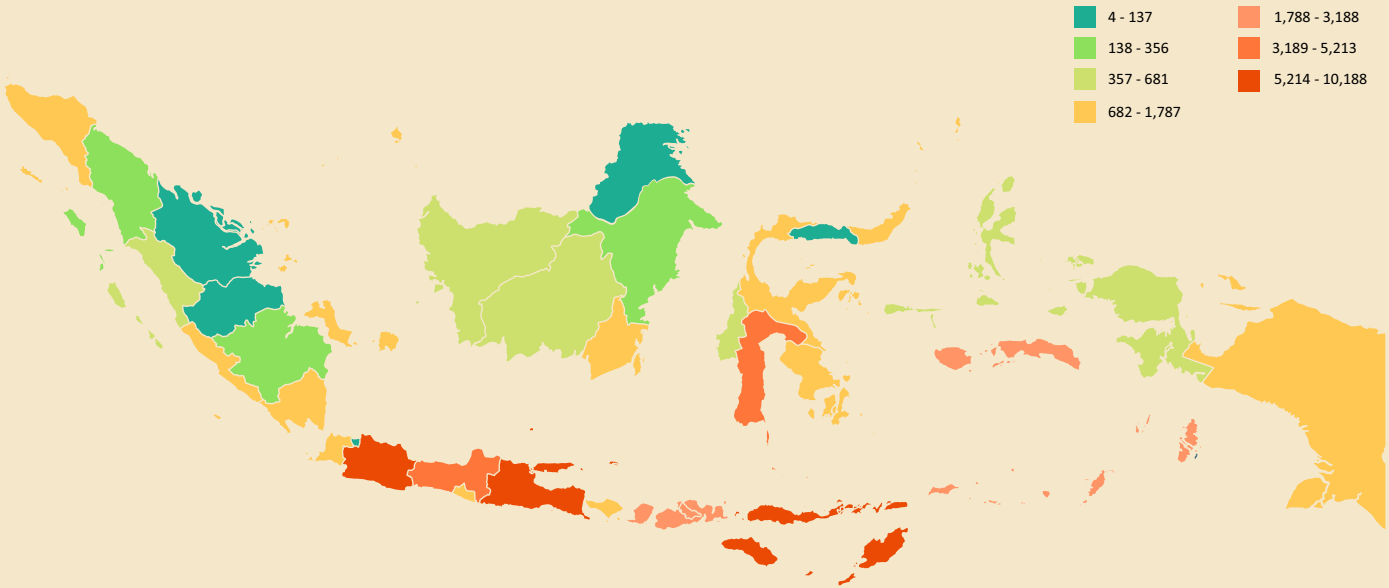


Indonesia is located in the equator zone where solar intensity is high. Thus, the solar potential is distributed in almost all provinces. Small scale solar power has been operated dispersedly in some areas of Indonesia from Sumatera to Papua but its potential has not been fully exploited.

Source: Statistik EBTKE, DGNREEC, 2016

3.2 CLASSIFICATION BASED ON GEOGRAPHICAL AREAS

WIND POWER RESOURCES (MW)



The highest wind power potential in Indonesia is widely distributed from Java to Nusa Tenggara, continued to Maluku, Papua and some parts of Sulawesi. The first and largest (75 MW) commercial wind power plant has been operating in South Sulawesi since 2018. The potential in other regions are yet to be developed.

Source: Statistik EBTKE, DGNREEC, 2016

3.2 CLASSIFICATION BASED ON GEOGRAPHICAL AREAS

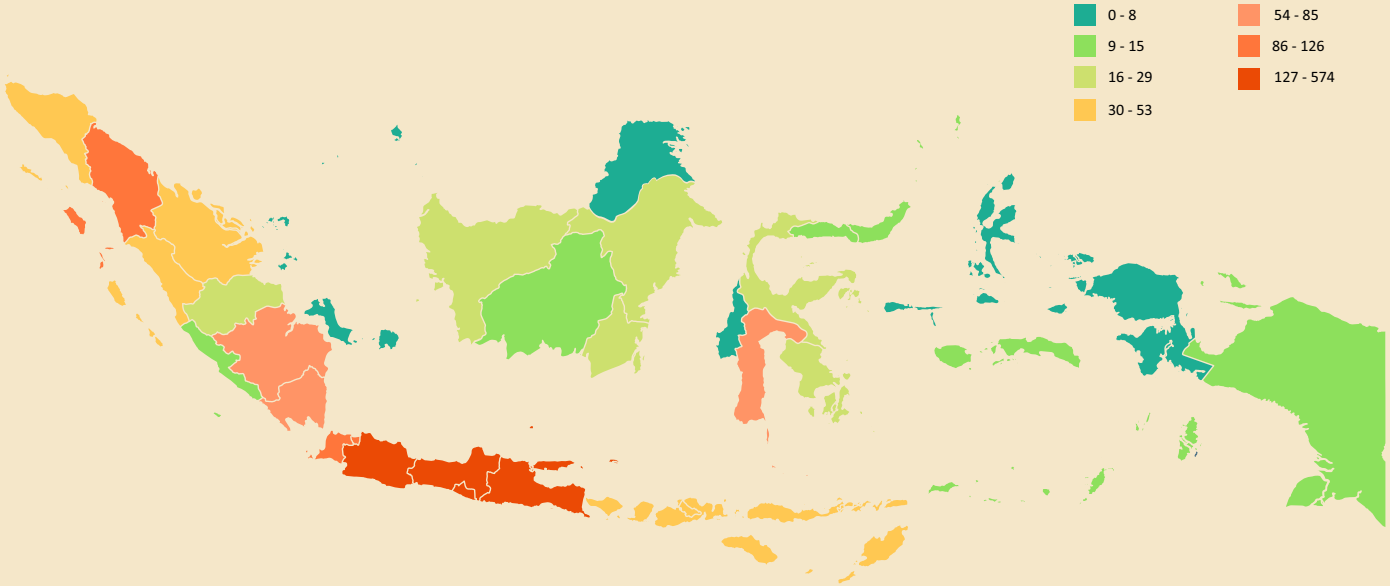
OCEAN ENERGY RESOURCES (MW)

West Nusa Tenggara, East Nusa Tenggara, Riau Islands, Lampung and West Papua Province are the locations with a promising ocean energy potential. Currently, there are no ocean energy power plant exists in Indonesia.

Source: Statistik EBTKE, DGNREEC, 2016

3.2 CLASSIFICATION BASED ON GEOGRAPHICAL AREAS

BIOGAS RESOURCES (MW)

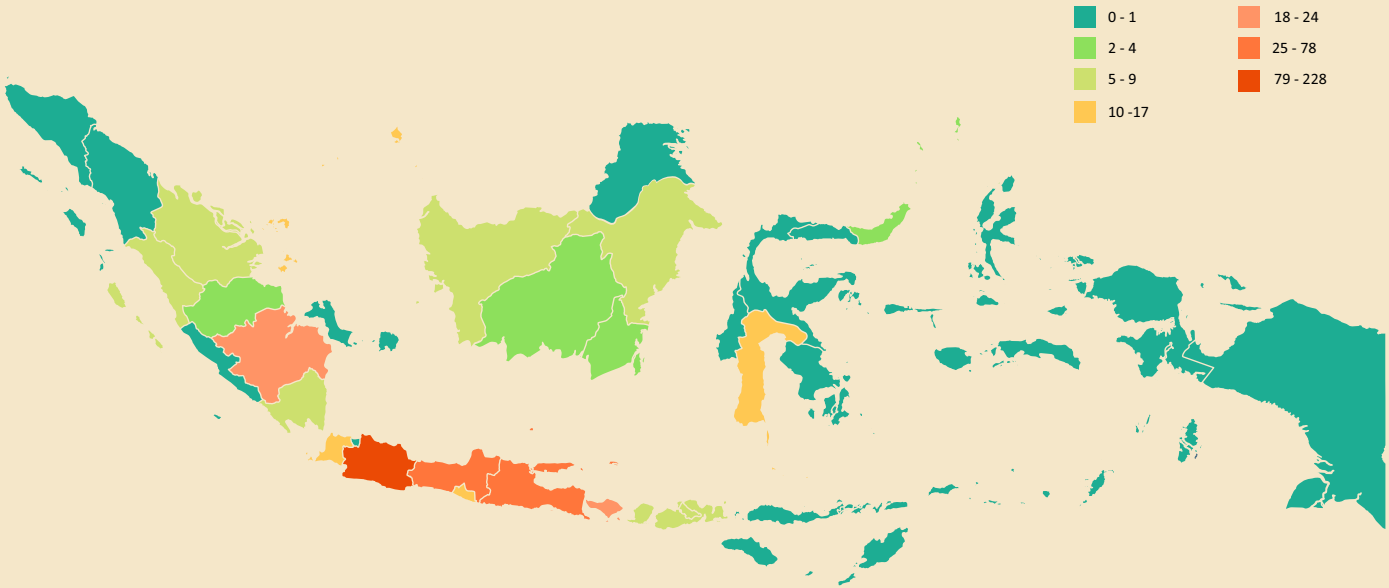


The biogas potential is related to the availability and sustainability of raw materials, such as agricultural waste, manure, municipal waste, plant material, sewage, green waste or food waste. Thus, the highest potential of biogas power plant is located in the area with high population. As of now, biogas for electricity generation has been utilized in several palm oil mills in Sumatera.

Source: Statistik EBTKE, DGNREEC, 2016

3.2 CLASSIFICATION BASED ON GEOGRAPHICAL AREAS

WASTE TO ENERGY RESOURCES (MW)

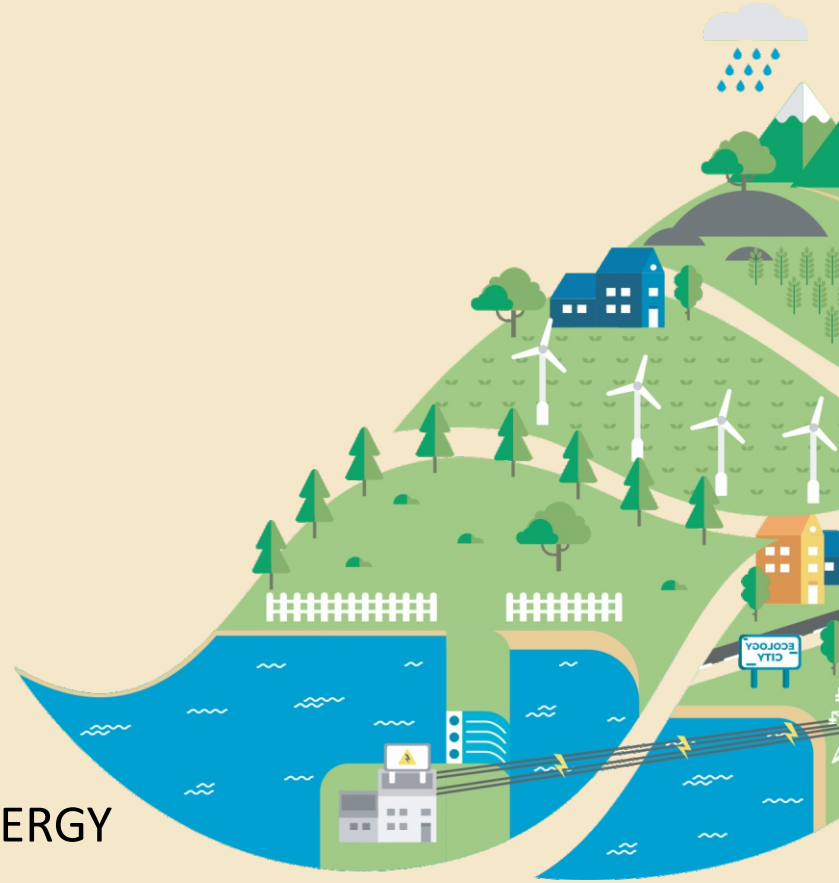


The waste to energy resource is related to the amount of waste. Thus, the highest potential of waste to energy is often located in the high densely-populated area. Currently, the waste to energy power plant remains in small scale and located in several urban areas, such as PLTSa Benowo in Surabaya.

Source: Statistik EBTKE, DGNREEC, 2016

CHAPTER 4

INDONESIA'S RENEWABLE ENERGY INSIGHTS



Stagnated RE contribution in Indonesia's energy mix is concerning

Indonesia's energy supply increased from 1,334 MBOE to 1,466 MBOE, marking a growth of 9.84%, from 2017 to 2018, respectively. Meanwhile, the final energy consumption grew at a higher rate at 11.27% during the same year, from 780 to 868 MBOE. The emission raised by 5.2%, from 516 MT to 543 MT CO_2e.

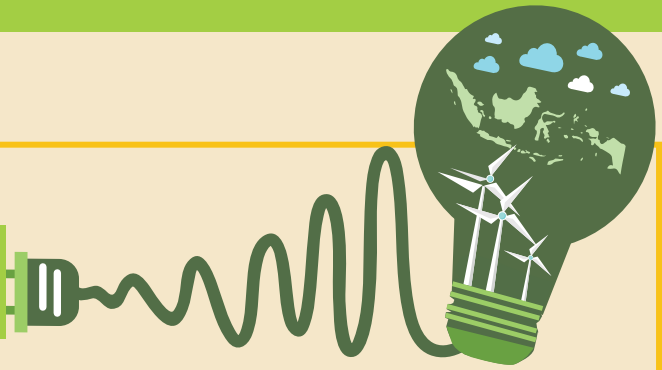
The renewable energy (RE) target in the energy mix remains the same, with 23% of the total energy mix in 2025, according to General Plan of National Energy (RUEN). In 2018, RE contribution grew slightly to 8.55%, compared to around 6% in 2017. This data indicates that a lot of work needs to be done to reach the 23% in the next five years.

GoI tries to boost solar rooftop installation by enacting a new MEMR Regulation

New regulations were enacted in 2018 and 2019, including a solar rooftop regulation and waste power plant electricity purchasing scheme. The solar rooftop regulation allows PLN's customers, both household and industrial customers, to install solar rooftop PV. The MEMR regulation No. 49/2018 covers the required license, installation requirements and excess power purchasing scheme. The excess power purchase is capped by 65% of the total monthly excess power. The MEMR regulation No. 13/2019 removes the requirement to obtain operating license (IO) for solar rooftop with capacity under 500 kV. Meanwhile, the MEMR regulation No. 16/2019 amends the MEMR regulation No. 49/2018. The new regulation removes the emergency charge and cut the capacity charge from 40 hours to 5 hours for industrial customers.

New purchasing price regulation to drive waste power plant installation

The new regulation on waste power plant, Presidential Regulation No. 35/2018, sets the electricity price for PLN at USD 13.35 cent/kWh and a bit adjustment for PLTSa with a capacity more than 20 MW. It also states the fundings for waste power plant development, requirements for electricity purchase by PLN and the required permits. Besides, the regulation arranges a coordination team to accelerate waste power plant development, to coordinate, to supervise and to provide assistance for the smooth development of waste power plant.

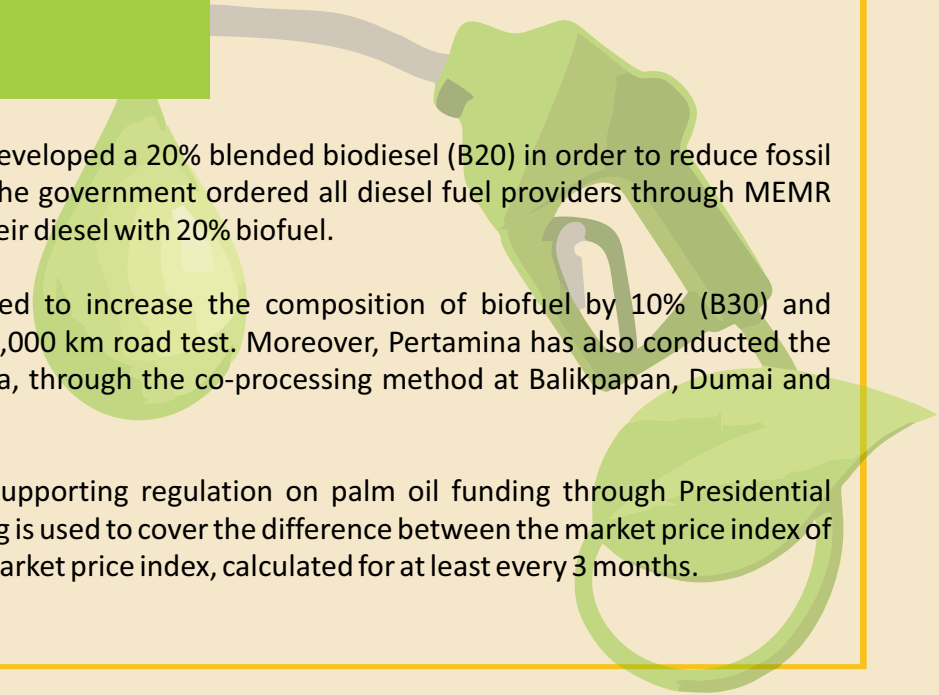


The biggest wind power plant in SE Asia could not help Indonesia to reach its target

In the electricity sector, the RE's contribution has stagnated around 12% for the last four years (2016-2019) in the generation mix. On the contrary, the portion of coal in the mix increased from 54.7% to 61.85% from 2016 to 2019. Total power plant installed capacity increased from 60.8 GW to 62.3 GW, from 2017 to 2018. Meanwhile, RE power plant installed capacity grew from 7.3 GW to 9.8 GW in the same year, accounting for 30% increase from 2017 to 2018.

A notable additional capacity of 1,6 GW was found in the off grid biomass power plant, according to the Handbook of Energy and Economic Statistics 2019 published by the Ministry of Energy and Mineral Resource. The increase of biomass power plant was pushed by the installation in the agriculture industry, such as palm oil industry. The growth of RE power plant capacity was also supported by the newly operated wind power plants in Jeneponto & Sidrap with a total capacity of 142 MW.

Greener fuel to set in motion



Meanwhile, the government also developed a 20% blended biodiesel (B20) in order to reduce fossil fuel imports. In September 2018, the government ordered all diesel fuel providers through MEMR Regulation No. 41/2018, to blend their diesel with 20% biofuel.

Recently, the government also tried to increase the composition of biofuel by 10% (B30) and successfully implemented it in a 50,000 km road test. Moreover, Pertamina has also conducted the first biorefinery testing in Indonesia, through the co-processing method at Balikpapan, Dumai and Plaju refineries.

The government also imposed a supporting regulation on palm oil funding through Presidential Regulation No. 66/2018. The funding is used to cover the difference between the market price index of diesel fuel types and the biodiesel market price index, calculated for at least every 3 months.

LACK OF SUBSTANTIAL AND INTEGRATED ACTION FROM RELATED STAKEHOLDERS IN FULFILLING RENEWABLE ENERGY TARGET

Availability	Indigenous characteristic of RE resource makes it difficult to be exploited and distributed to certain demand location;
Accessibility	Limited accessibility of renewable energy, in comparison with fossil energy;
Affordability	Uncompetitive cost of some renewable energy, compared to other alternatives, especially subsidized fossil energy; Cost of energy does not account the environmental cost;
Acceptability	Some RE developments face disapproval from local society and environmentalist, for example geothermal and hydro power;
Sustainability	Inadequate research and policy in assessing sustainable environment, social and economic impact of RE.

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