



MINISTRY OF ENERGY AND MINERAL RESOURCES
DIRECTORATE GENERAL OF NEW RENEWABLE ENERGY AND ENERGY CONSERVATION



OPTIMIZING RENEWABLE & FOSSIL ENERGY TOWARDS ENERGY TRANSITION IN INDONESIA

Dadan Kusdiana

Director General of New, Renewable Energy and Energy Conservation

Presented at:

Indonesia Petroleum Association Convention and Exhibition 2023 (IPA Convex 2023)

July 25, 2023

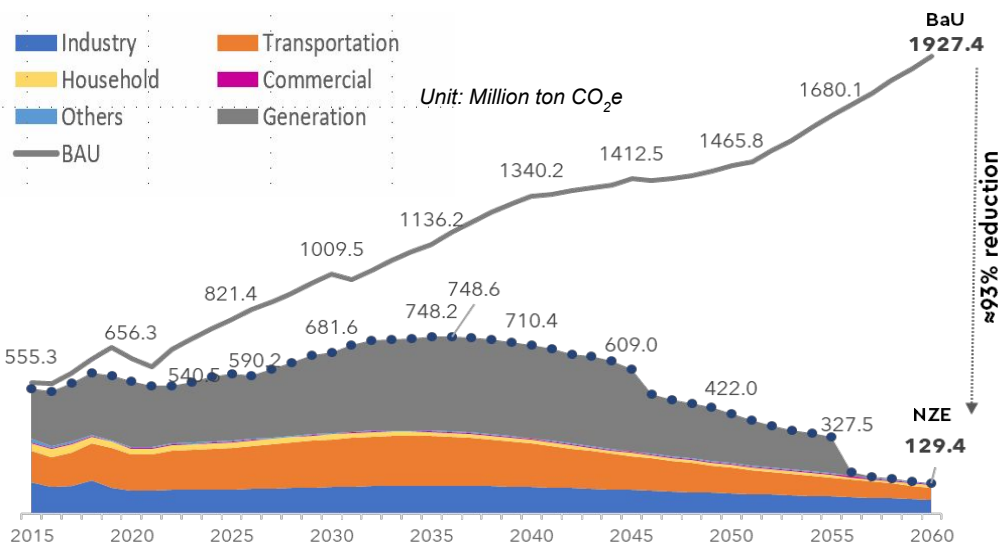
INDONESIA'S ENERGY SECTOR ROADMAP TOWARDS NET ZERO

EMISSION 2060

COP 26, 2 NOVEMBER

2021 Indonesia will be able to contribute faster to the global Net-Zero Emissions.

- The MEMR along with other stakeholders created the Energy Sector Roadmap towards Indonesia NZE 2060.



NZE Strategies

- 1 Electrification** (EV, induction stove, electrifying agriculture, etc)
- 2 NRE Development** (offgrid, ongrid, biofuel)
- 3 CFPP Moratorium & early retirement** of existing CFPPs
- 4 New energy sources** (hydrogen and ammonia)
- 5 CCS/CCUS**
- 6 Energy efficiency application**

Energy Sector Roadmap for NZE 2060 or sooner

Supply:

NRE Development based on RUPTL 2021-2030, cofiring on CFPP

Demand:

Induction stove, gas network, DME, B35 mandatory, EV.

2021-2025

2026-2030

Supply:

Green Hydrogen utilization begin in 2031 for transportation sector, BESS in 2034

Demand:

Induction stove, gas network, B40 mandatory, EV, energy management, & hydrogen for transportation sector

2031-203

2036-2040

Supply:

NRE Development based on RUPTL 2021-2030, pump storage starts by 2025

Demand:

Induction stove, gas network, B40 mandatory, EV, energy management.

Supply:

Nuclear PP starting 2039, massive Solar PV development, along with onshore and offshore wind PP.

Demand:

Induction stove, gas network, B40 mandatory, EV, and CCS for cement and steel industry

Supply:

Green Hydrogen utilization begin to substitute natural gas, NRE dominate the energy mix

Demand:

Induction stove, gas network, B40 mandatory, EV, & hydrogen for industry.

2041-2050

2051-2060

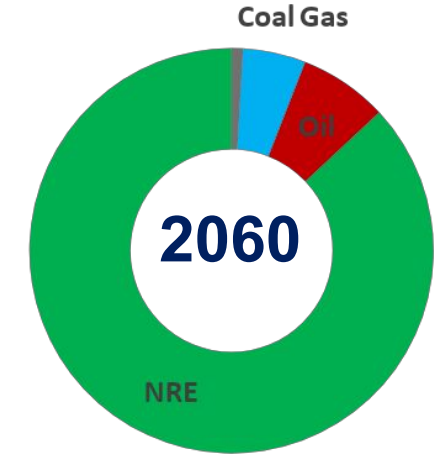
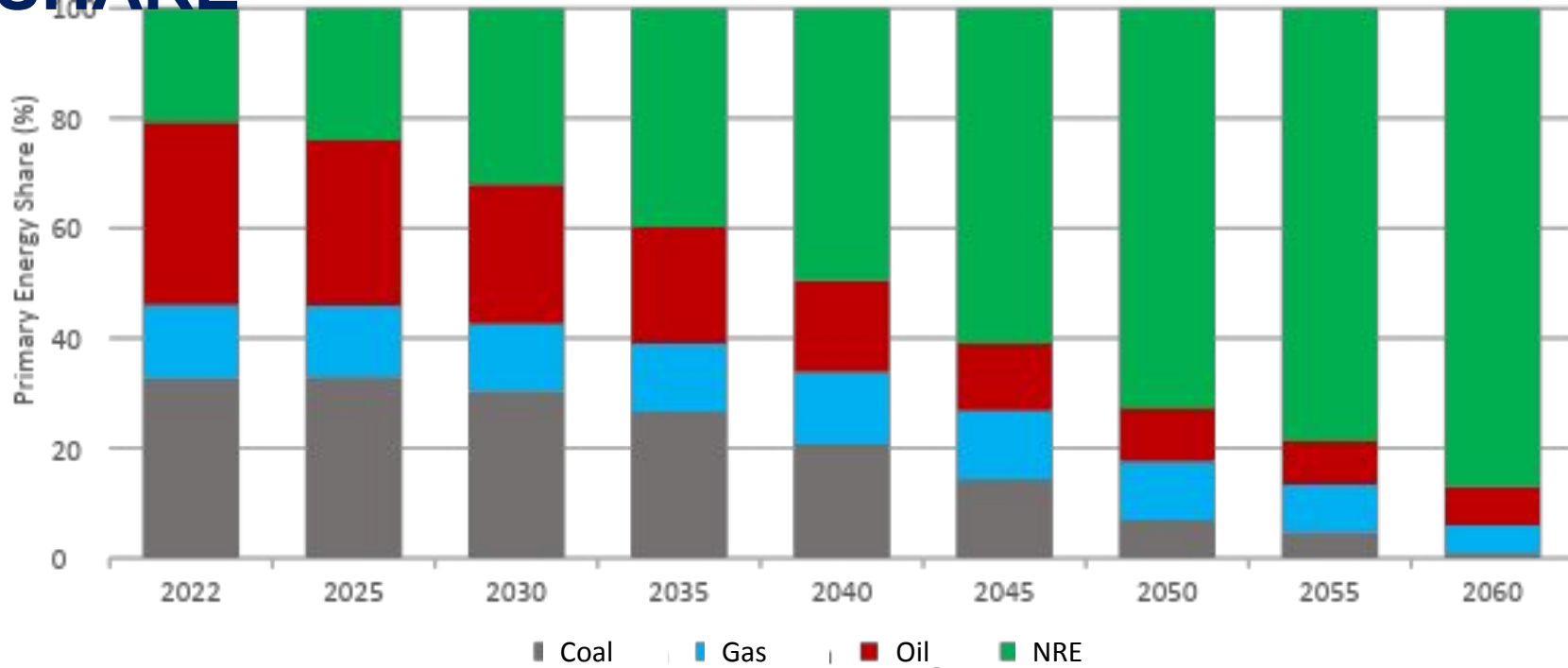
Supply:

All electricity are generated by NRE PP. Remaining GHG emission level: 129 million tons CO₂.

Demand:

Induction stove, gas network, EV, and CCS for industry

NET ZERO EMISSION 2060: ROADMAP OF PRIMARY ENERGY SHARE



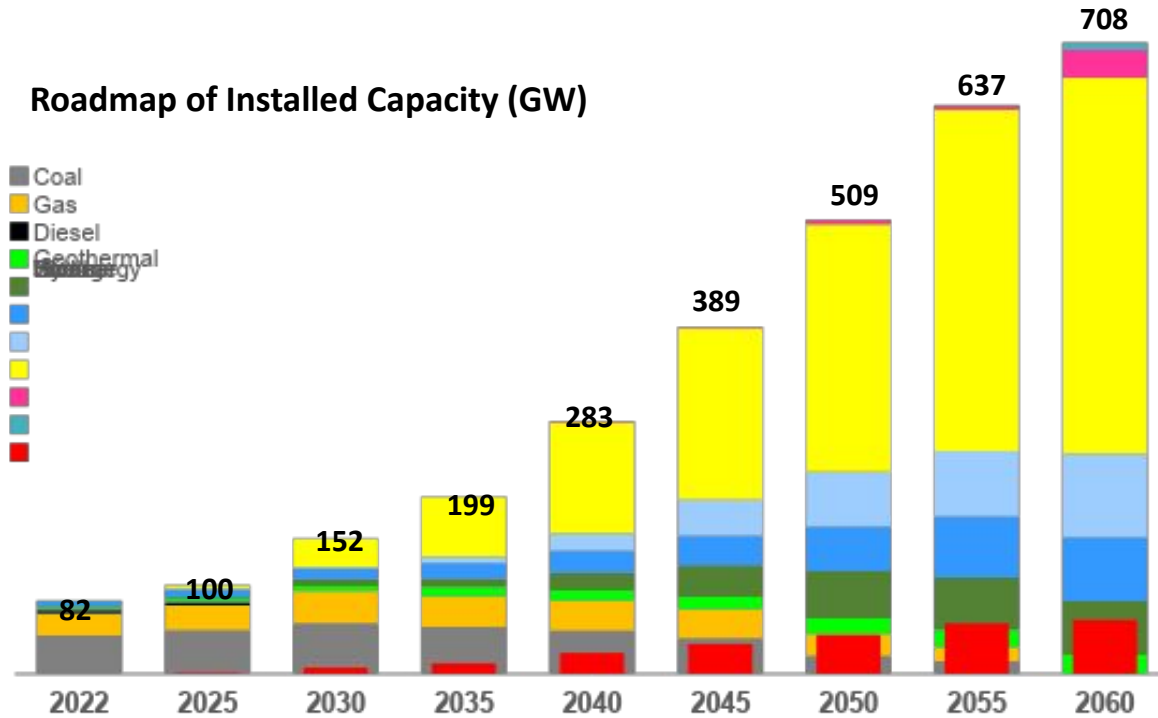
- Primary energy growth increases 4 times from 2022.
- The NRE Primary Energy Mix grows by 1.74%/year and reaches 702 MTOE in 2060.
- Coal and natural gas are still used for energy needs in the industrial sector while petroleum is used in the transportation sector for Internal Combustion Engine (ICE) vehicles which are still operating .

Energy Source	2022		2025		2030		2035		2040		2045		2050		2055		2060	
	MTOE	%	MTOE	%	MTOE	%	MTOE	%	MTOE	%	MTOE	%	MTOE	%	MTOE	%	MTOE	%
Coal	71	32.7	81	32.9	97	30.4	107	26.6	100	20.7	82	14.3	46	6.9	35	4.7	7	0.9
Gas	29	13.4	32	13.0	39	12.2	50	12.4	63	13.1	71	12.4	70	10.6	64	8.6	41	5.1
Oil	72	33.2	74	30.1	81	25.4	85	21.1	80	16.6	70	12.2	64	9.7	59	7.9	57	7.1
NRE	45	20.7	59	24.0	102	32.0	160	39.8	239	49.6	349	61.0	483	72.9	585	78.7	702	87.0
Total	217		246		319		402		482		572		663		743		807	

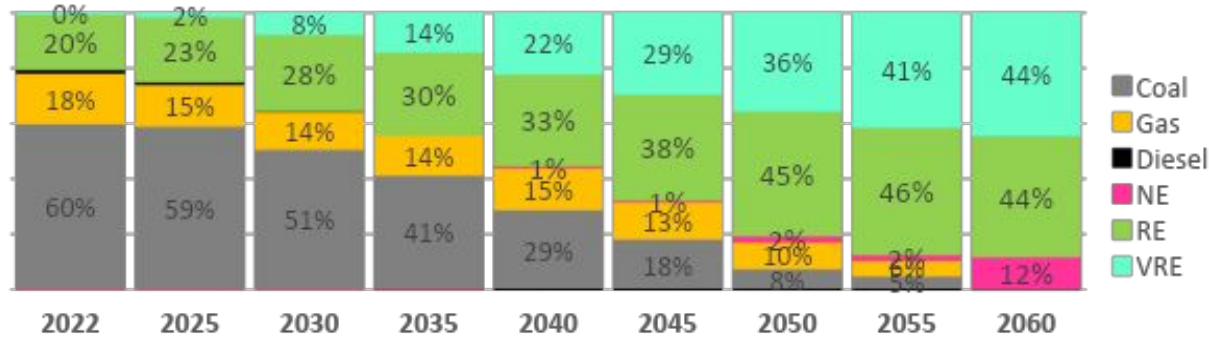
NET ZERO EMISSION 2060: ROADMAP OF POWER SECTOR

NZE Power Plant Development Roadmap Including Fossil Energy

Roadmap of Installed Capacity (GW)



Roadmap of Energy Share (% TWh)

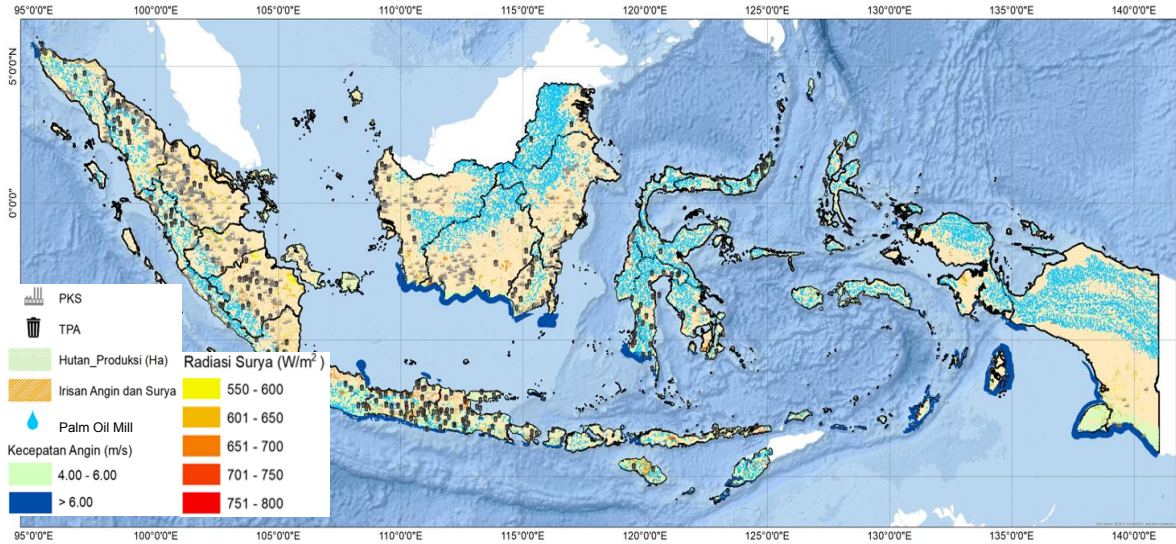


- The projected electricity demand reach **1,942 TWh** and electricity consumption per capita equal to **5,862 kWh/capita**.
- Total investment: **1,108 billion USD** or **28.5 billion USD p.a.** up to 2060.
- National power generation will be mainly sourced by VRE while optimizing other RE resources to help maintaining system stability.
- Pump storage enters the system in 2025, Battery Energy Storage System (BESS) to be massively utilized in 2031.
- NRE PP Installed Capacity in 2060: **708 GW** (Solar 421 GW, Wind 94 GW, Hydro 72 GW, Bioenergy 60 GW, Nuclear 31 GW, Geothermal 22 GW, Ocean Energy 8 GW). Supported with **60,2 GW Storage**: Pumped Storage 4.2 GW, BESS 56 GW.
- Indonesia's unique circumstances: **archipelagic country** while RE resources are widespread all over the country, **a modern and integrated super grid is required**, to establish resilient and robust transmission infrastructure in Indonesia.
- Additional Coal Fired Power Plant only for the projects that are already have a contract or under construction. Coal Fired Power Plant from IPP would be retired by the end of PPA. Steam-Gas Power Plant (PLTGU) would be retired on 30 years operation.
- Coal, oil, and gas will still be utilized during the transition to maintain national energy security. Moreover, clean fossil technology, such as Clean coal technology including gasification as well as CCS/CCUS will also be regarded for future energy sector development.

NRE POTENTIAL TO SUPPORT ENERGY TRANSITION

National NRE Potential and Utilization

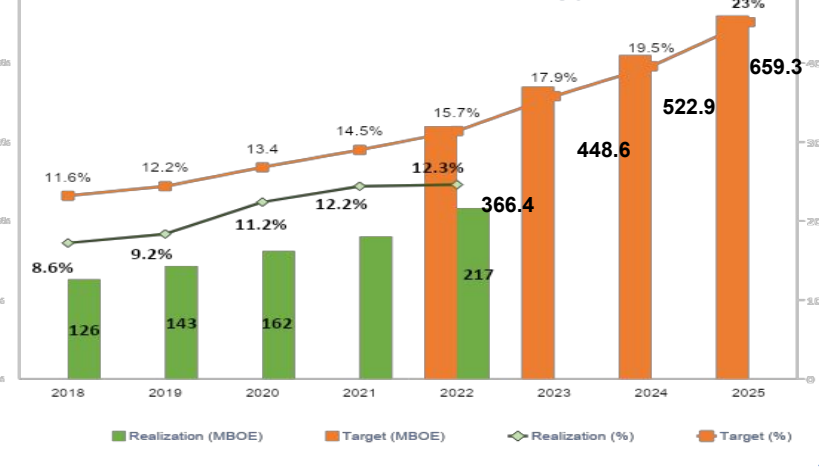
Indonesia's NRE resources are **abundant, diverse and spread** throughout the country. Currently, **only 0.3% of the total potential has been utilized**.



	POTENTIALS (GW)	UTILIZATION (MW)
SOLAR all over Indonesia's areas, particularly in East Nusa Tenggara, West Kalimantan and Riau which has higher radiation	3,294	323
HYDRO all over Indonesia's areas, particularly in North Kalimantan, NAD, North Sumatra and Papua	95	6,738
BIOENERGY all over Indonesia in the form of main products, forestry/plantation land waste, waste in industry. Potential types include biofuels, biomass and biogas.	57	3,118
WIND (>6 m/s) particularly located in East Nusa Tenggara, South Kalimantan, West Java, NAD & Papua.	155	154
GEOTHERMAL in ring of fire areas, including Sumatra, Java, Bali, Nusa Tenggara, Sulawesi, & Maluku.	23	2,373
OCEAN all over Indonesia's areas, particularly in Maluku, East Nusa Tenggara, West Nusa Tenggara and Bali	63	0
COAL GAS.		30
TOTAL	3,687	12,737

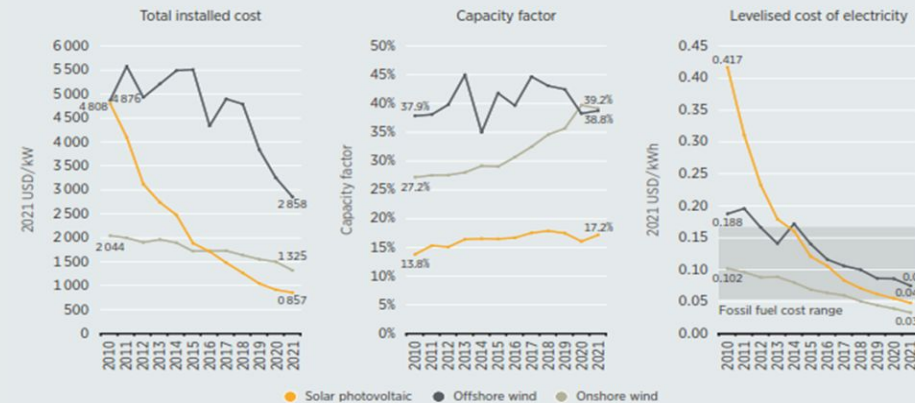
Note: (1) June 2023, total numbers are rounded up (2) Including "LTSHE"; Nuclear pot.: Uranium 89,483 tons - Thorium 143,234 tons

Realization of Renewable Energy Mix



NRE Development Opportunity □ COST

The cost of NRE is decreasing over the last decade



- The investment costs for new NRE power plants, especially Solar PV and Wind Turbine (including integration costs) are cheaper and could compete with existing 800MW coal-fired power plants.
- The O&M costs of NRE power plants are relatively low. Reducing taxes and fees for the use of natural resources can be an alternative incentive for more competitive NRE electricity prices.

UTILIZATION OF BIOMASS AND BIOFUEL

Implementation Of Biomass Cofiring

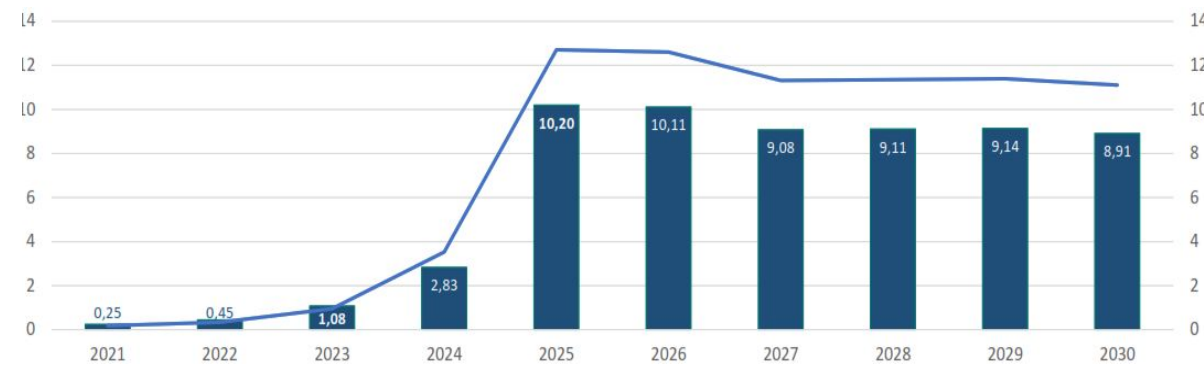
Biomass cofiring – mixing biomass with coal in existing CFPPs.
Objective: increase NRE mix while reducing coal consumption.

TARGET 2023: 52 CFPP -- Current Realization: 36 CFPP

THEORETICAL POTENTIAL OF BIOMASS FUEL FOR COFIRING

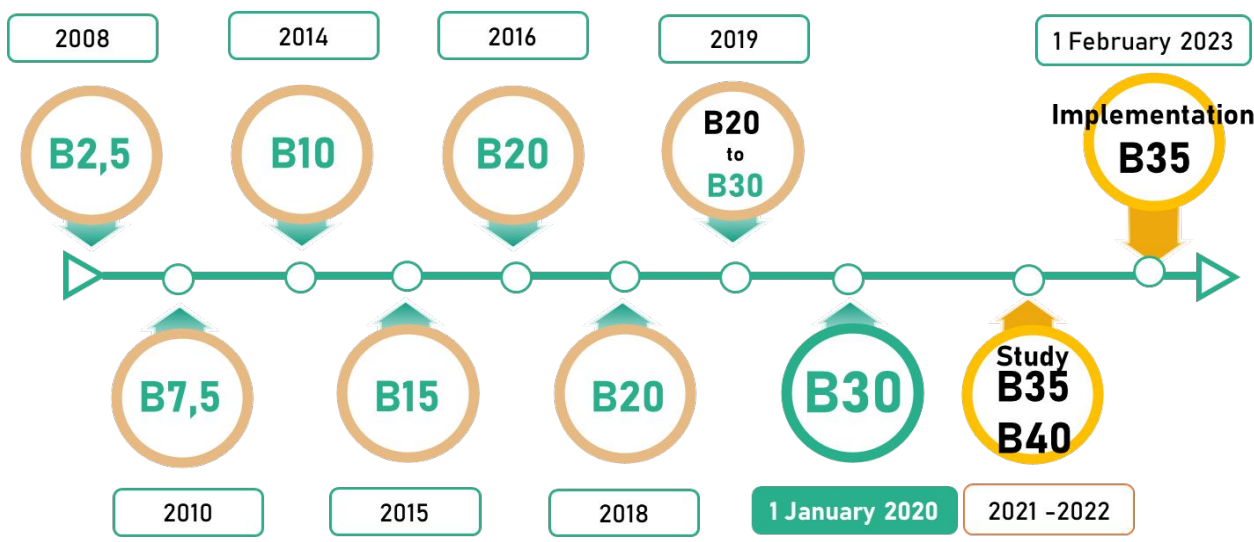
- Coconut Shell / Shell 425,978 ton
- Palm shells 12,850,976 ton
- Sawdust 2,427,638 ton
- Rice Husk 10,047,142 ton
- Wood chip 789,008 ton
- EFB 47,120,246 ton
- Energy Forests Existing Potency: 49,578 Ha ≈ 991,560 ton
Development Potency: 27,223,454 Ha ≈ 544,469,073 ton
- Municipal Waste | 68,500,000 ton MSW ≈ 42,013,333 ton SRF

Roadmap of Biomass Cofiring

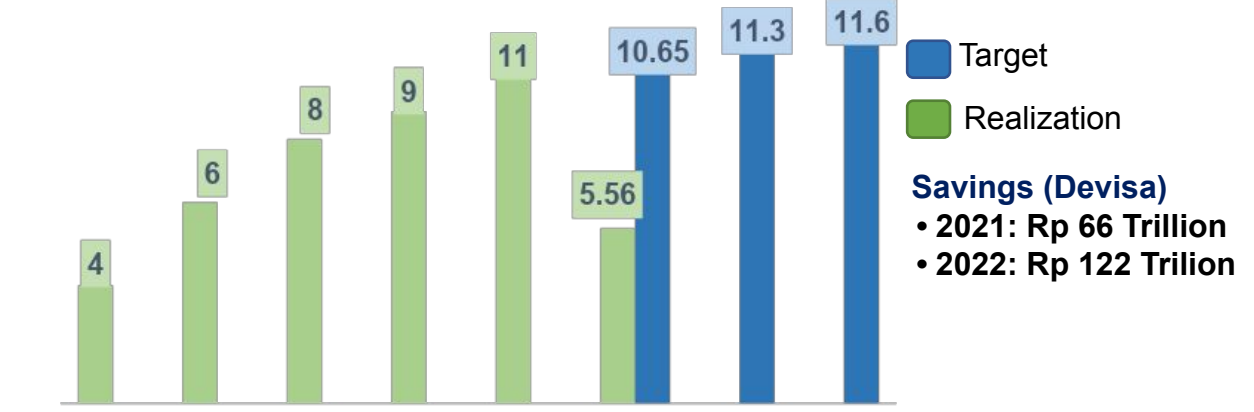


	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
CFPP (Location)	25	36	42	52	52	52	52	52	52	52
TWh	0.18	0.59	0.95	3.12	11.71	11.60	11.31	11.35	11.39	11.10
Biomass (mio Ton)	0.25	0.57	1.08	2.83	10.20	10.11	9.08	9.11	9.14	8.91

Mandatory Biofuel Implementation



Target & Achievement of Biodiesel (Million kL)

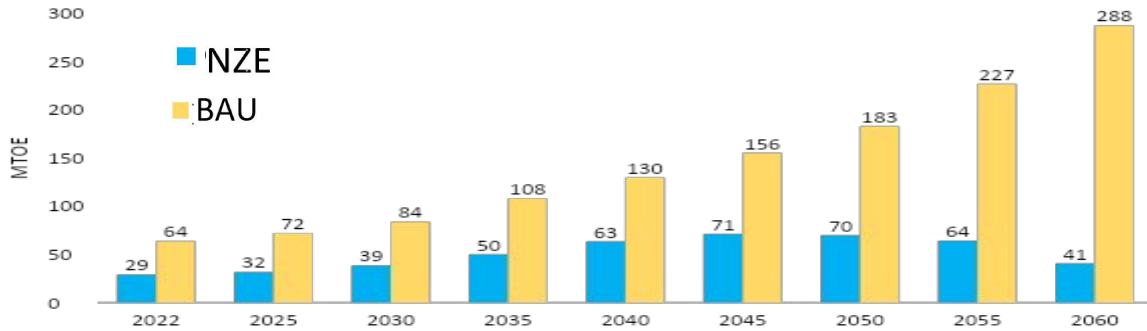


NOTE: Road test of B40 with the fuel formula namely FAME 40% and FAME30% + HVO10%: Vehicle road tests, storage stability tests and filter resistance tests have been completed. Currently, the preparation of the final report on the implementation of the B40 road test is being carried out

GAS AS A BRIDGE FOR THE ENERGY TRANSITION

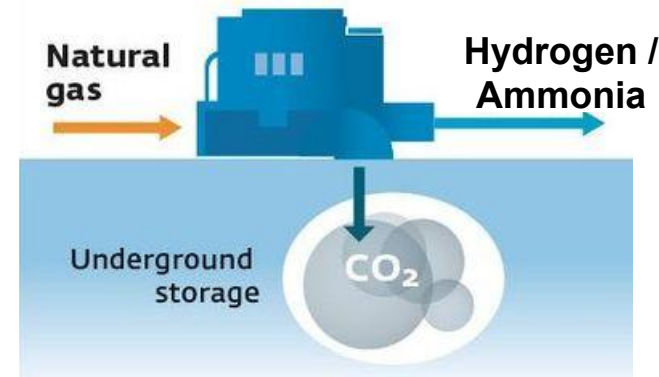
Role of Gas in NZE Scenario

Primary Energy from Gas in NZE & BAU Scenario (MTOE)



- Gas utilization is needed to support **gas demand in industry, public transport, and household (city gas)**
- LPG and Natural Gas are still needed for **cooking** (through domestically produce LPG)

Development of Blue Hydrogen / Ammonia



- Natural Gas as **feedstock** for blue hydrogen / ammonia
- Produces **non-carbon fuel to substitute conventional fuel or co-firing to reduce emissions**

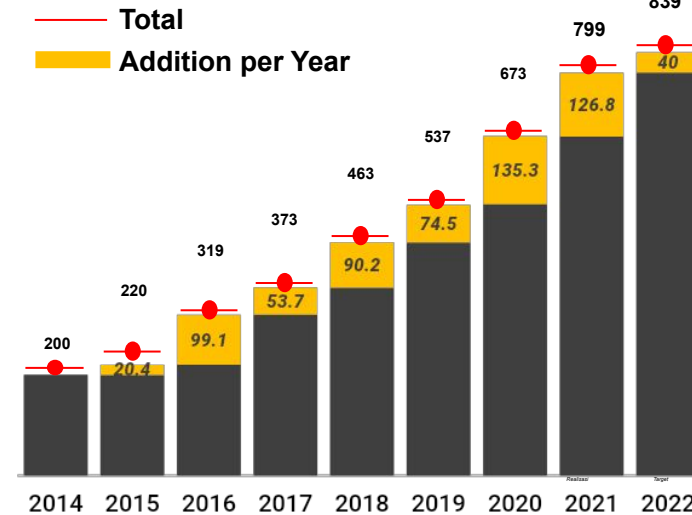
“Conversion to Gas” as a part of Diesel Conversion Program (Dedieselization)

5,200 units Spread over **2,130 Locations** (mostly remote)

1	Diesel Conversion to NRE	499 MW	Conversion to NRE Plants: Solar PV + BESS + Hybrid (Diesel)
2	Diesel Conversion to Gas	304 MW	PLTD converted into gasification plants
3	Diesel Conversion to Grid	1070 MW	PLTD converted into isolated interconnection to the grid.

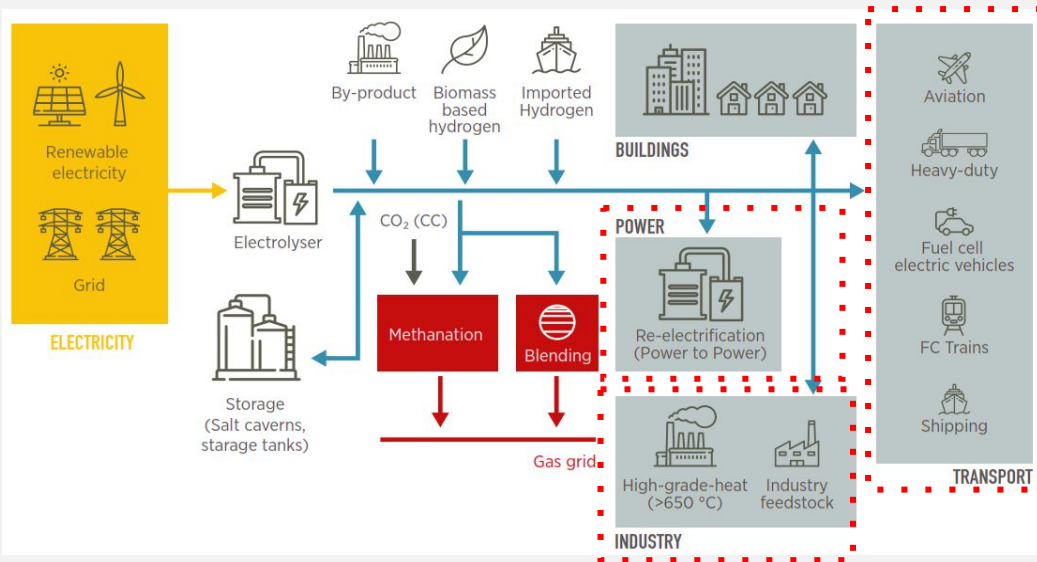
City Gas Network

Unit: Thousand Households



RENEWABLE SOURCES FOR THE FUTURE OF GAS

HYDROGEN UTILIZATION POTENTIAL

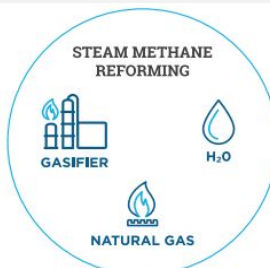
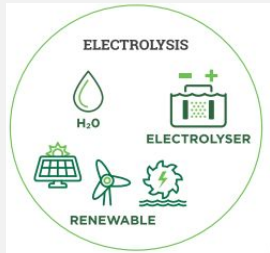


Green Hydrogen

Indonesia's potential for renewable energy of **3,686 GW** has the potential to be used to produce **green hydrogen**.

Blue Hydrogen

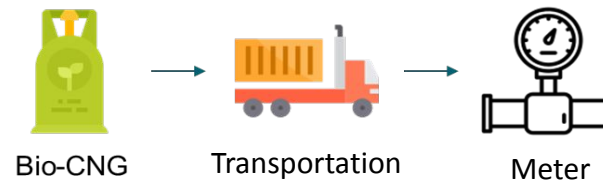
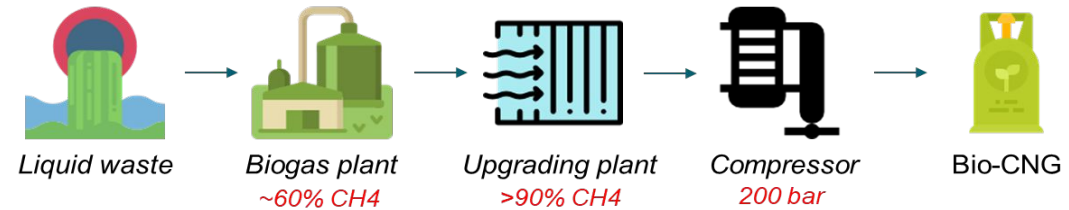
Indonesia's proven natural gas reserves of **41.62 TCF** have the potential to be used to produce **blue hydrogen**.



ADVANCING BIOGAS: COMPRESSED BIOMETHANE GAS (CBG / BIO CNG)

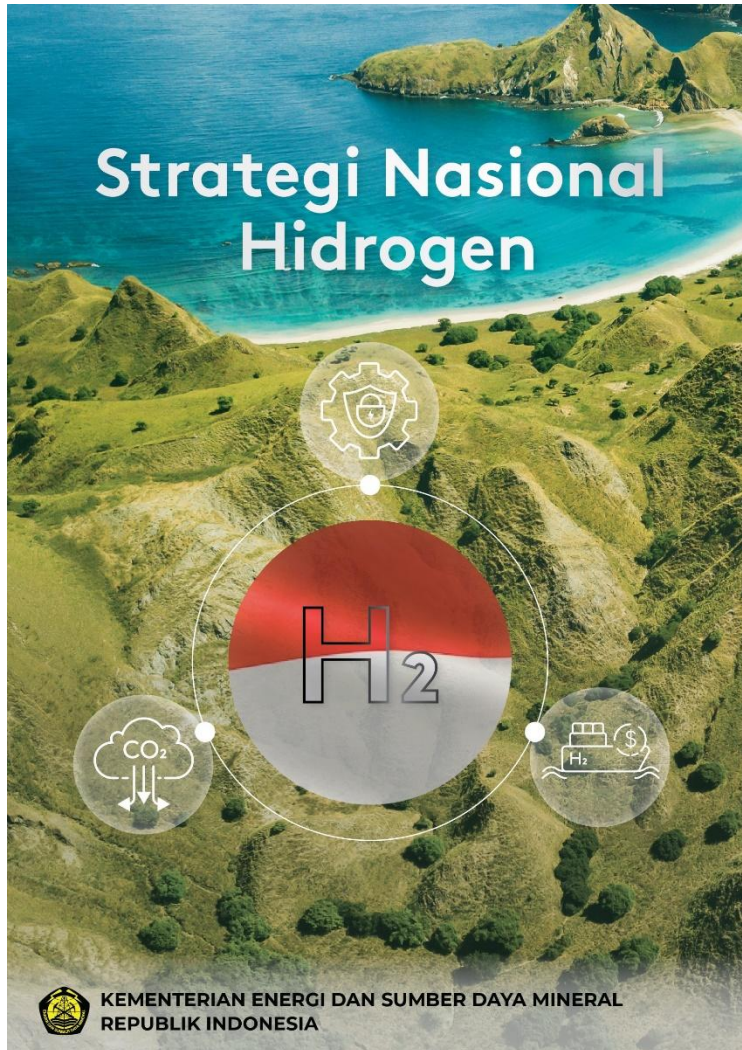
Compressed Biomethane Gas (CBG) is the result of purification of Biogas (Pure Methane), where the impurity gas compounds are removed to produce > 95% Pure Methane Gas.

Bio-CNG Production Flow and Utilization



- CBG has a calorific value and other properties like Compressed Natural Gas so that it can be used as **automotive fuel, power plants, as well as for industrial and commercial purposes.**
- DGNREEC partnered with GGGI, Bappeda Central Kalimantan and East Kalimantan have conducted a **Market Assessment study for CBG/Bio-CNG**. The most viable business model at the moment is the use of CBG for palm plantation internal consumption (conversion of a diesel engine to a dual fuel CBG-diesel engine, both in power plants and in trucks/buses).

THE NATIONAL HYDROGEN STRATEGY



Contents

Current utilization of hydrogen in Indonesia, the **direction and objectives**, **strategic action plans**, and **monitoring framework** for hydrogen development in Indonesia.

Objectives

To establish a **hydrogen economy** that contributes to energy transition and **plays an essential role in the decarbonization** of the global energy system

THREE STRATEGIC PILLARS OF HYDROGEN UTILIZATION

Reducing dependency on fuel imports to strengthen national energy security and sovereignty.

- Accelerate renewable energy implementation
- Plan for reliable and efficient use of hydrogen
- Support universal energy access

Developing domestic market to boost Indonesia decarbonization efforts.

- Create comprehensive regulatory environment
- Develop an industrial hydrogen hub
- Support hydrogen refuelling infrastructure

Becoming a player in the global hydrogen market as well as its derivatives products.

- Develop a low carbon product export hub
- Develop low carbon fuels for export commodity
- Develop bilateral agreements

Thank you

www.esdm.go.id



Kementerian Energi dan
Sumber Daya Mineral



@kesdm



@KementerianESDM



KementerianESDM



Address

Jl. Pegangsaan Timur No.1,
Cikini, Menteng Jakarta

GOVERNMENT PROGRESS TO ACHIEVE SDGs

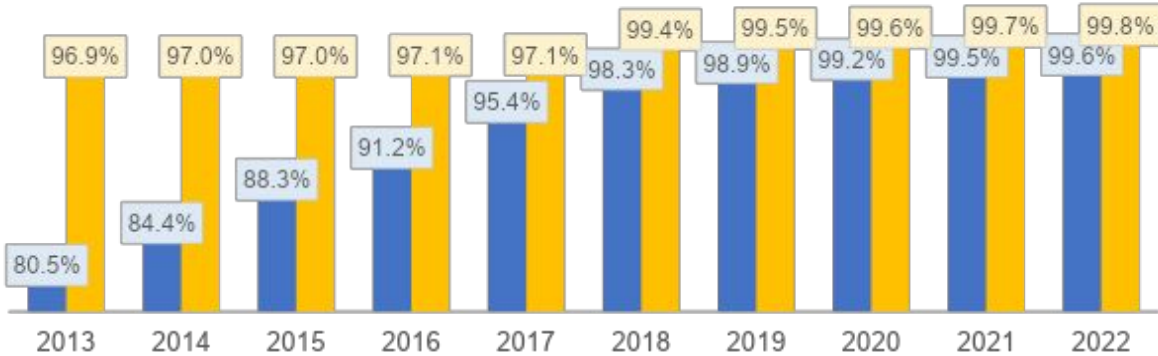


Clean and Affordable Energy

- Ensuring access to affordable energy
- Increased share of renewable energy
- Improved energy efficiency

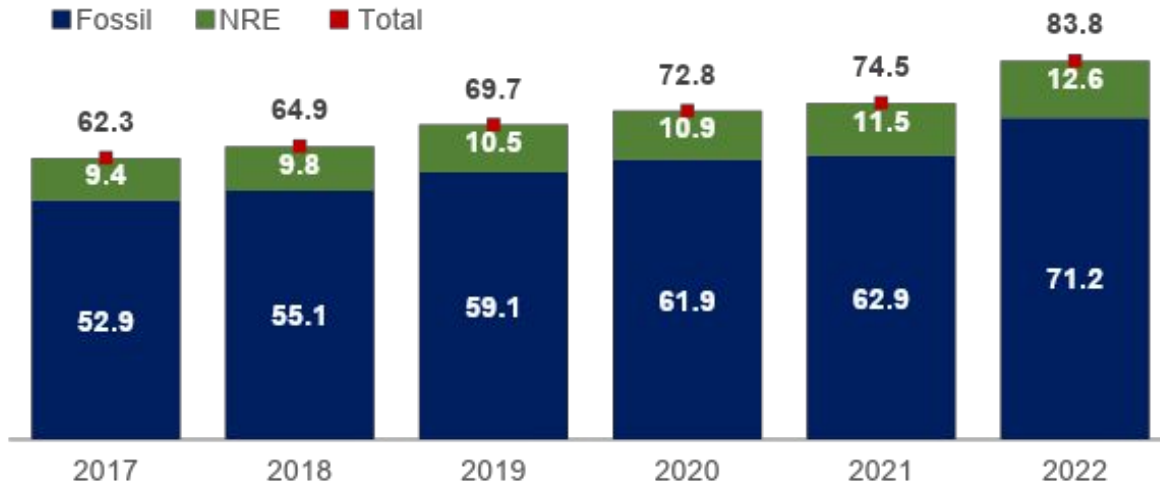
Access to Electricity

■ Electrification Ratio ■ Village Electrification Ratio



Power Plant Installed Capacity 2022 | GW

■ Fossil ■ NRE ■ Total

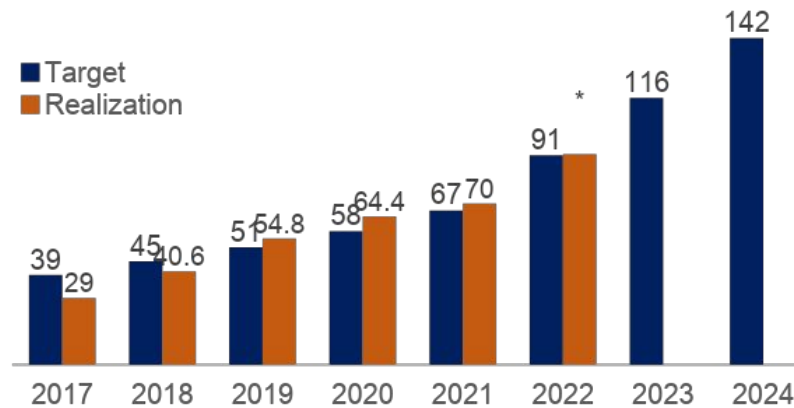


Climate Change and Disaster Mitigation

- Strengthen resilience and adaptation capacity to climate-related hazards and natural disasters
- Integrate climate change anticipation measures into policies, strategies & planning

Enhanced NDC 2030

No	Sector	2010 GHG Emission (Million Ton CO ₂ e)	GHG Emission by 2030			Reduction	
			BaU	CM1	CM2	CM1	CM2
1.	Energy	453.2	1,669	1,311	1,223	358	446
2.	Waste	88	296	256	253	40	45.3
3.	IPPU	36	70	63	61	7	9
4.	Agriculture	111	120	110	108	10	12
5.	FOLU	647	714	217	-15	500	729
TOTAL		1,334	2,869	1,953	1,632	915	1,240



- By 2022, the energy sector will be able to reduce GHG emissions by 91.5 million tonnes of CO₂e.
- Energy efficiency contributed for 22% of the realization or equal to 20.5 million tonnes of CO₂e

THE ROLE OF FOSSIL ENERGY IN THE ENERGY TRANSITION

Oil and Gas

Coal and Minerals

**Role
s**

1. Oil is currently the main energy in the transportation sector.
2. Natural gas is used as the transition before 100% NRE is established for power generation, and to overcome the intermittent nature of NRE.
3. Meeting domestic needs in various sectors

1. Fulfilling domestic needs, i.e., fuel in power plants, fuel in industry and fuel in households before there is a cleaner alternative energy.
2. Minerals, such as nickel and cobalt, are the main source of materials for battery manufacturing.

**Issue
s**

1. Increased the production to 1 million BOPD oil and 12 BSCFD gas in 2030.
2. Emits carbon dioxide.

1. GHG emissions contributors which require thorough management to follow sustainable mining rules.
2. The readiness of Cell battery industry.

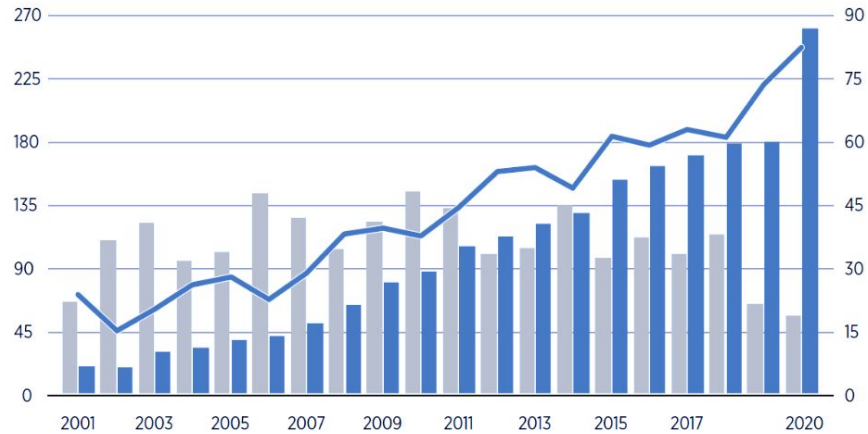
Strategies

1. Improving reserves through :
 - Optimization of existing field production.
 - Transformation of Resources to Production
 - Accelerating Chemical EOR implementation
 - Massive exploration for big discoveries
2. Developing natural gas-fired power plant.
3. Implementing CCS/CCUS.

1. Reducing the use of coal as a source of generating electricity or utilizing CCS/CCUS in CFPPs.
2. The use of coal in households through the development of Dimethyl Ether (DME).
3. Increasing the added value of minerals through processing and refining for domestic metal mineral mining commodities.
4. Integrated battery industry development

INCORPORATING NREEC IN OIL AND GAS INDUSTRY

NRE Portion in Annual Capacity Addition (Global)



In the last decade, the addition of NRE PP capacity globally has become more dominant than the addition of fossil generators



GLOBAL OIL & GAS COMPANY TO RENEWABLE ENERGY

 Acquisition Acquisition Acquisition ~\$5,800 Mn	 	 Acquisition Acquisition ~\$900 Mn	
 Acquisition Partner ~\$1,760 Mn	 	 Partner Dev ~\$5 Mn	
 Acquisition Partner ~\$2,400 Mn	 	 Acquisition Partner N/A	

Source : Company Annual Reports and Websites, BNEF, PEI Analysis

NRE Electricity Powering Oil and Gas Production (Own Use)

Renewable energy use and energy conservation practices can be implemented in the oil and Gas Industry, such as:

- **Solar PV** for remote monitoring & telecommunication system
- **Solar PV** for Pumping System
- **Solar PV** for Water Treatment
- **NRE** use for electricity in production line, i.e. Solar Energy, Wind Energy
- Waste to energy
- Use of **Electric Vehicles** in production sites
- Energy Management
- Use of **Energy Efficient Technology**