APAC Energy Sector trend and statistics

Nomura Research Institute Singapore

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Report summary

Background & Objective

- ✓ Global energy-related trends such as decarbonization are progressing rapidly in the Asia-Pacific region. On the other hand, the situation in the area is not uniform, and the degree of influence and progress is different for each country.
- ✓ NRI Singapore's energy team will publish a regular energy report for the purpose of assisting the market players to understand the market situation better.
- ✓ In this 1st report, we will introduce basic statistics on the energy and electric power fields, as well as a comparison of trends such as deregulation.

Contents of report

1. Basic Statistics in APAC energy sector
   - Primary energy
   - Electricity
2. Key trend and related indicators
   - De-carbonization
   - De-centralization
   - De-regulation
3. Each country statistics

Summary of indicators

In the subsequent slides, we will provide the following list of indicators on primary energy and specifically electricity

Segment	Sub-Segment	Indicators
Basic Statistics	Primary Energy	Balance of Primary Energy: Production Composition (%)
		Self-Sufficiency (%)
		Energy Final Consumption by end-use (%)
	Electricity	Electricity Domestic Demand & Supply (TWh)
		Electricity Generation Mix (%)
		Electricity Final Consumption by end-use (%)
		Electrification rate
		Electricity tariff
Electricity Trend	De-carbonization	Balance of RE
		Target for RE
	De-centralisation	FIT and other policy
		FiT and renewable energy auctions
		Next generation automobiles (EVs)
	De-regulation	Electricity liberalization
		Penetration of smart meters

Agenda

1. Basic Statistics in APAC energy sector

- Primary Energy
- Electricity

2. Key trend and related indicators

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Shortlisted countries

Abbreviation	Country
BD	Bangladesh
IN	India
ID	Indonesia
MY	Malaysia
PH	Philippines
SG	Singapore
TH	Thailand
VN	Vietnam

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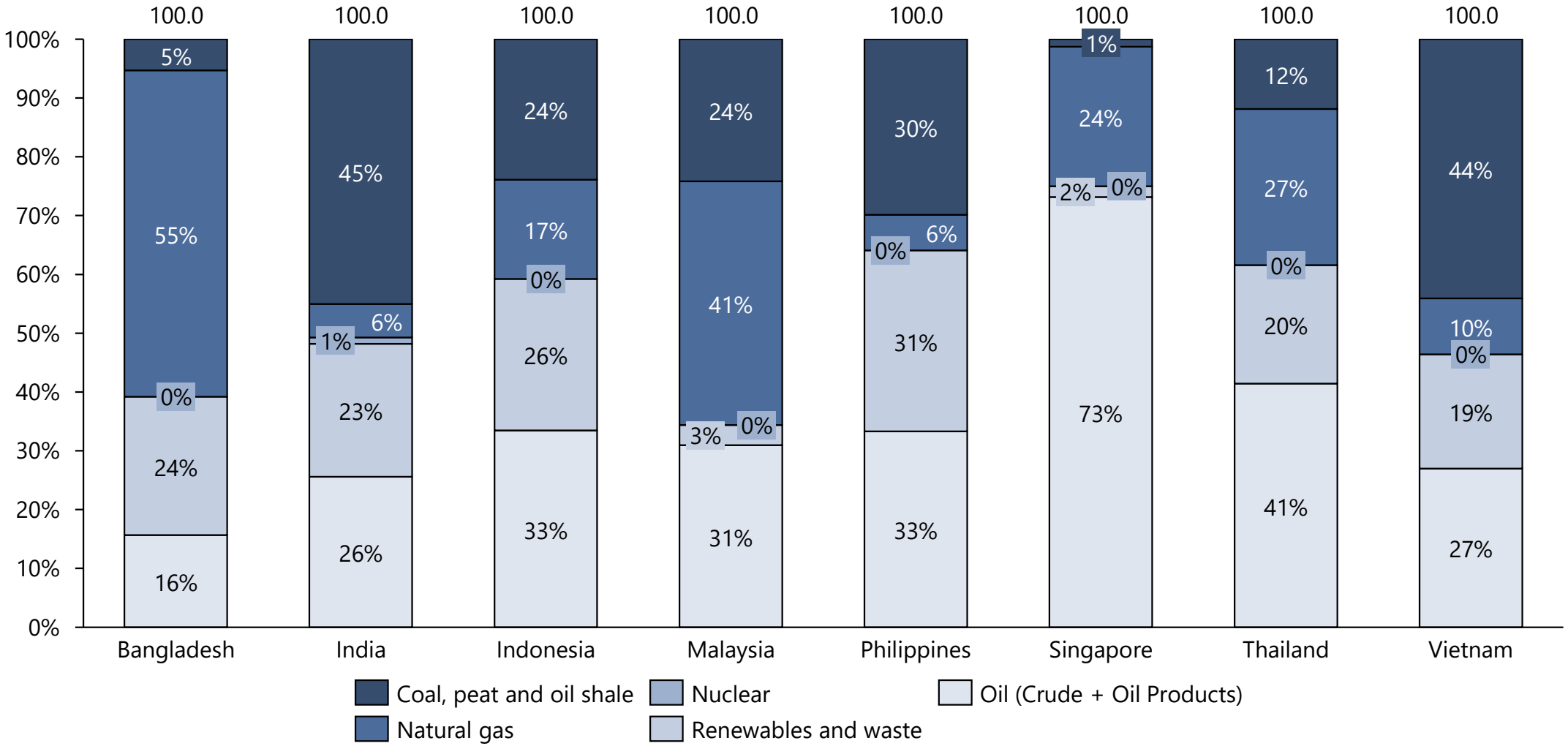
Total Energy-related indicators: Balance of Primary Energy Supply

Looking at the breakdown of primary energy supply for 8 of our shortlisted countries, they are still heavily dependent on oil products

Balance of 2018 Total Primary Energy Supply by Fuel in selected countries (%)



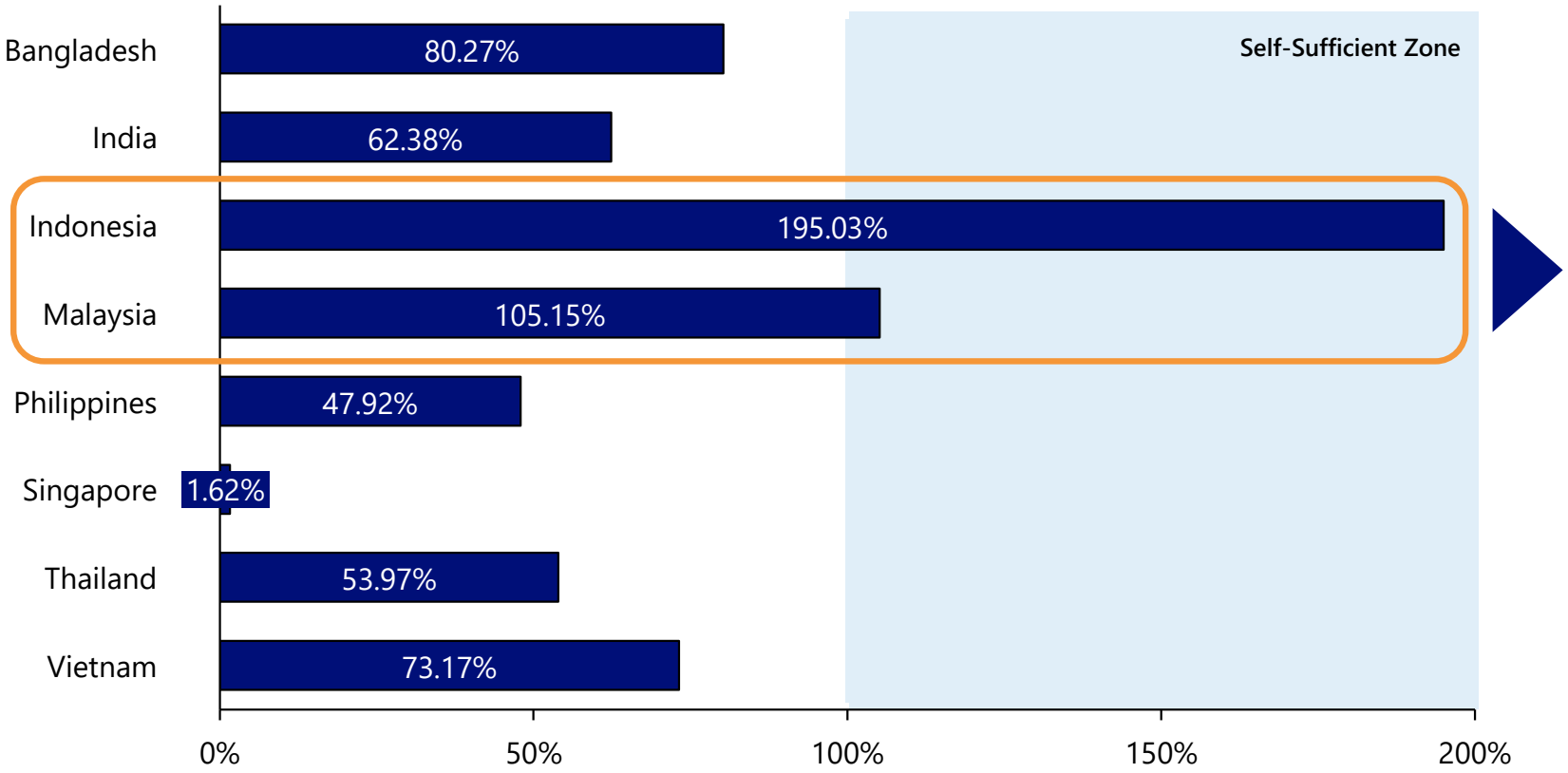
Note(s): Renewable Definition = Hydro + Geothermal + Solar PV + Solar Thermal + Wind + Tide
Source: IEA, NRI Analysis

Total Energy-related indicators: Self-Sufficiency (%)

Looking at the breakdown of self-sufficiency for 8 of our shortlisted countries, Indonesia and Malaysia are self-sufficient compared to the other countries

2018 Self-Sufficiency in selected countries (%)

- Self-sufficiency is defined as the ability of a country or region to fulfil its own energy needs
- Self-sufficiency is calculated as the domestic production over the total primary energy supply (domestic production + imports – exports +adjustments such as stock changes)



Out of the 8 countries, only **Indonesia and Malaysia are self-sufficient** in terms of their energy production as their self-sufficiency % is more than 100%.

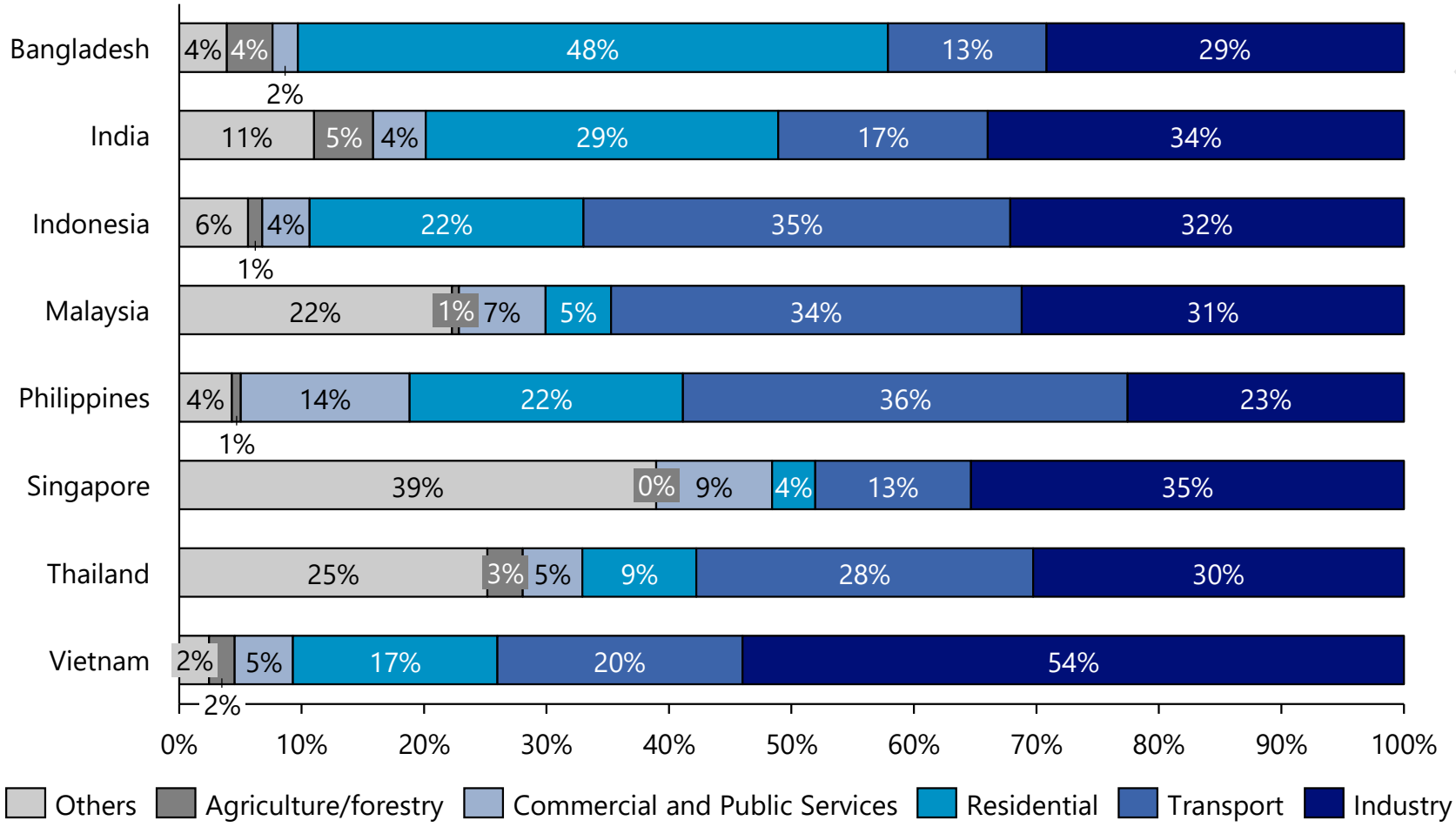
This means **they do not depend on other countries** on their total energy requirements.

Source: ASEAN Energy, IEA, NRI Analysis

Total Energy-related indicators: Energy Final Consumption by end-use (%)

Looking at the breakdown of final consumption, prioritisation of future energy-related initiatives can be carefully planted

2018 Final Energy Consumption breakdown by end-use in selected countries (%)



Insights

1. **Common large users of energy.** The major users of energy are from industry, transport and residential areas. This means there is **an opportunity** in these users to decrease their energy usage **by providing more efficient energy solutions.**

2. **Energy user segmentation allows prioritisation of energy solutions.** Using the chart on the left, specific prioritisation of energy-saving or energy-efficiency efforts **can be carefully allocated.**

Source: IEA, NRI Analysis

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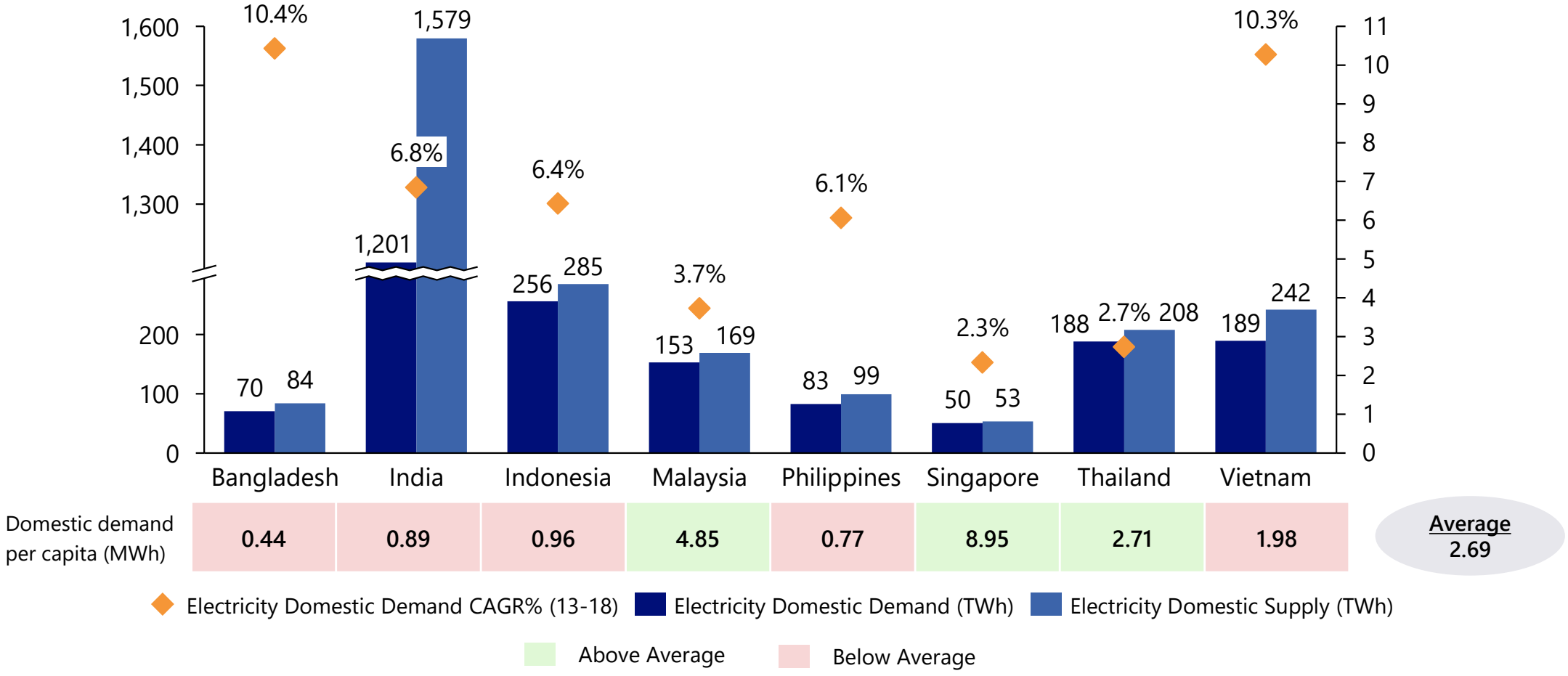
Electricity-related indicators: Electricity Domestic Demand & Supply (TWh)

All selected countries have relatively balanced demand and supply in electricity.

2018 Electricity Domestic Demand and Supply in selected country (TWh)

- Definition: (1) Domestic Demand = Domestic Consumption. (2) Domestic Supply = Domestic Production + Imports – Exports
- Insights: All 8 countries have more sufficient electricity as domestic supply is more than their domestic demand. However, India has excessive oversupply of electricity, and thus India could utilise this excessive electricity more effectively.

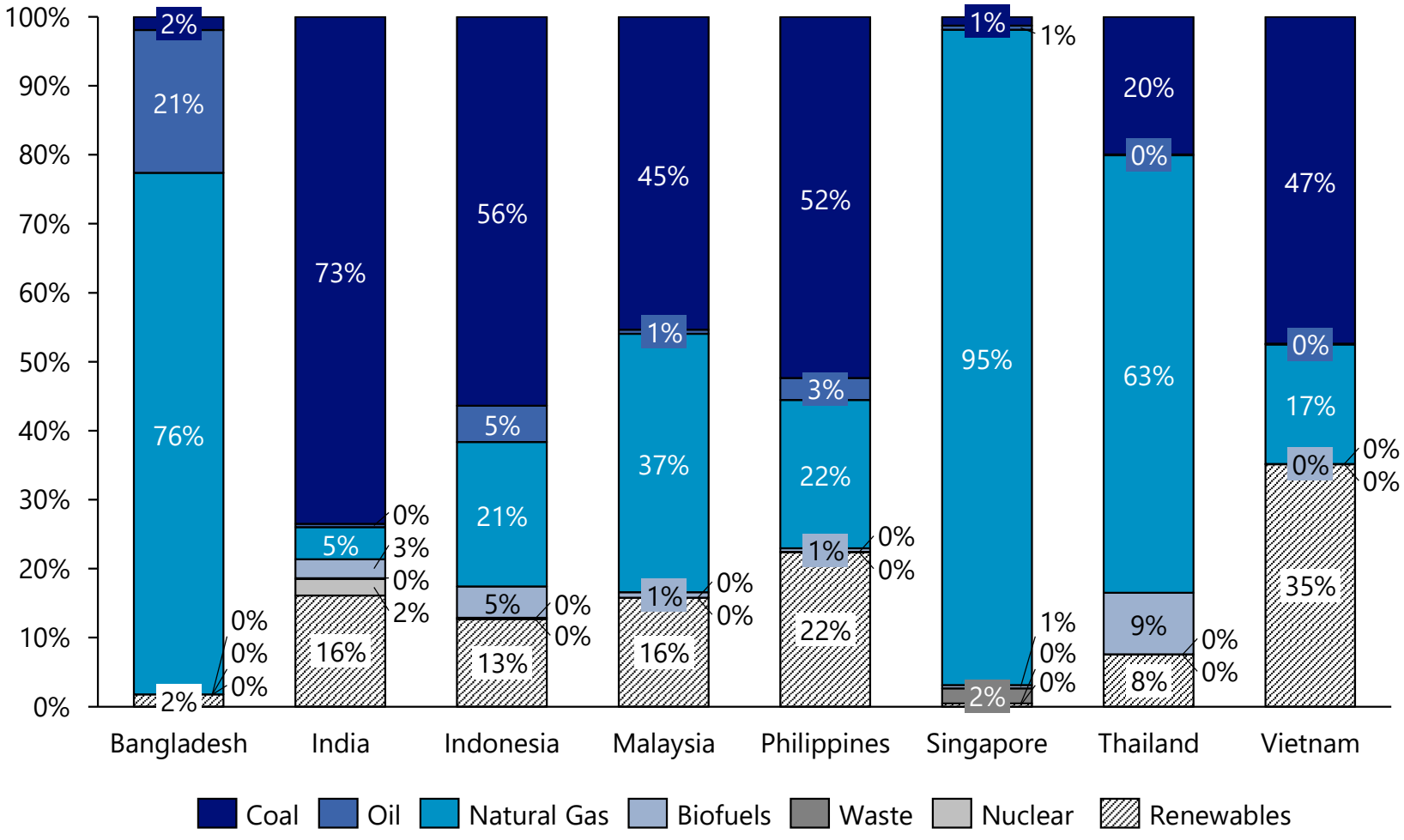


Source: IEA, NRI Analysis, World Bank

Electricity-related indicators: Electricity Generation Mix (%)

Looking at the electricity composition as shown below, it shows that most countries either depend on coal or natural gas as their fuel to generate electricity

2018 Electricity Generation Mix in selected countries (%)



Insights

1. **High dependency on coal and natural gas to produce electricity.** For countries such as India, Indonesia, Malaysia, Philippines, they are heavy on coal as their fuel for electricity. Singapore and Bangladesh are using more natural gas.

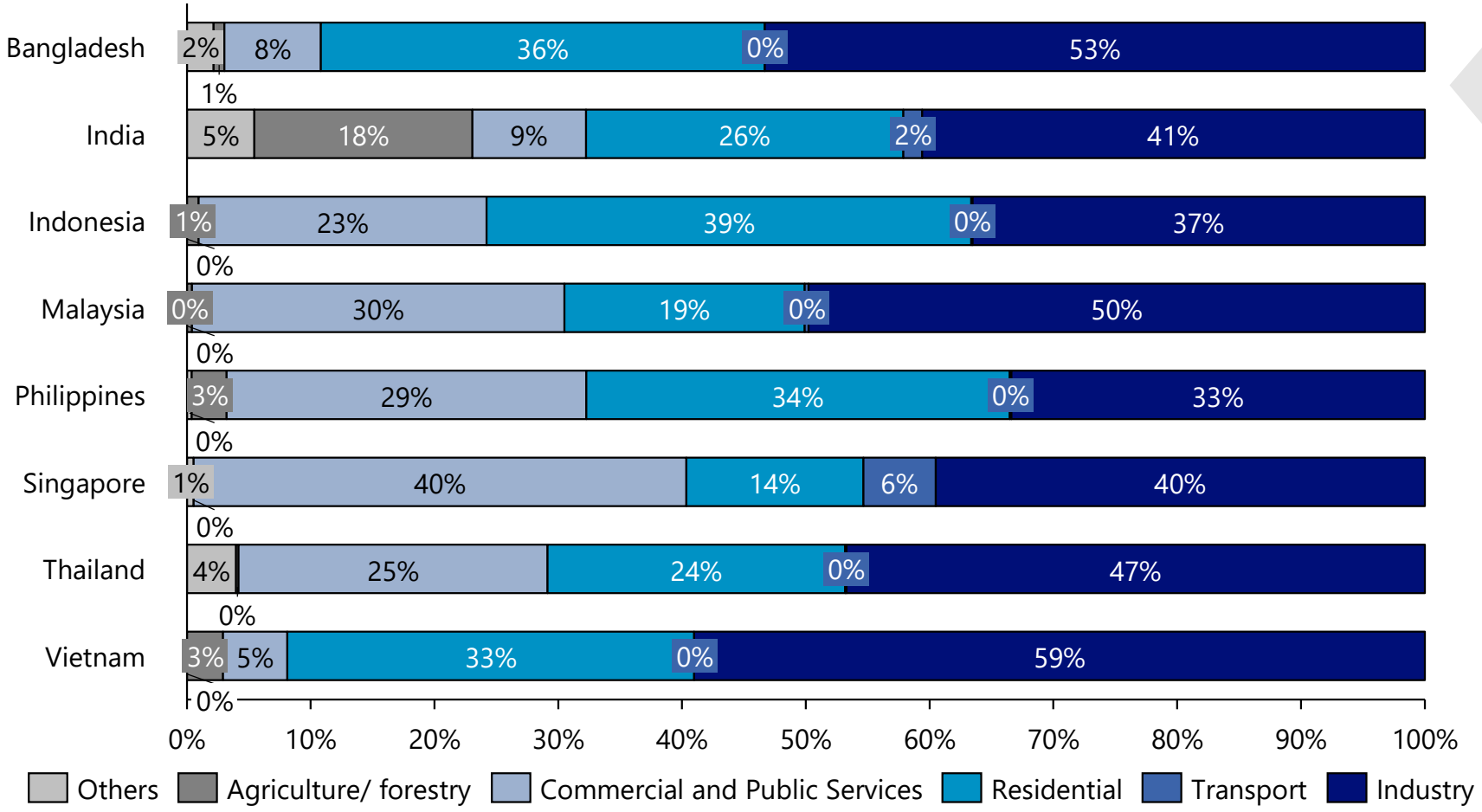
2. **Small adoption of renewables as fuel for electricity.** The leader of these selected countries for renewables is Vietnam as they appear to be one of the most balanced country with a decent composition of renewables.

Note(s): Renewable Definition = Hydro + Geothermal + Solar PV + Solar Thermal + Wind + Tide
Source: IEA, NRI Analysis, World Bank

Electricity-related indicators: Electricity Final Consumption by end-use (%)

Users of Electricity vary from country to country depend on the industry structure.

2018 Electricity Consumption by end-use in selected countries (%)



Insights

1. **The major users of energy are from industry and residential areas.**
2. **More usage on commercial and public services for electrical energy compared to the total primary energy.** There is a significant difference for usage on commercial and public services using primary energy or specifically electrical energy

Source: IEA, NRI Analysis, World Bank

Electric power-related indicators: Electrification rate

Looking at the electricity access rates shown below, most South Asian and Southeast Asian nations have basic electricity access for their population

Electricity access of populations in selected countries

Country	Total Population in 2018 (millions)	Electricity access metrics (2018)	
		No access to electricity (%)	Population that has no access to electricity (millions)
Bangladesh	161.4	14.8%	24.0
Indonesia	267.7	1.5%	4.0
India	1,353.0	4.8%	64.5
Malaysia	31.5	0.0%	0.0
Philippines	106.7	5.1%	5.5
Singapore	5.6	0.0%	0.0
Thailand	69.4	0.0%	0.0
Vietnam	95.4	0.0%	0.0

Insights

1. **Majority have access to electricity.** As of 2015, only 107 million out of 630 million people in ASEAN, and 400 million out of 1.8 billion in South Asia do not have electricity. Those affected live mostly in remote areas and are far off from electricity grids.

2. **Most countries are on route to achieve 100% electricity coverage**. The United Nations Sustainable Development Goals (SDGs) calls for all member states to hit target goals by 2030. One of the goals is to allow universal access to electricity, which is being rolled out to all areas.

Source: World Bank Development Indicators, IEA, NRI Analysis

Looking at the electricity tariff table shown below, the Philippines' electricity price in the industrial sector is much higher compared to other countries.

Electricity Tariff in selected countries

Country	City	Industrial electricity tariff				Household electricity tariff		
		(USD/kWh)		(USD)		(USD/kWh)		(USD)
		Monthly fee	Per kWh	Average Monthly Bill (Light- Heavy Users)		Monthly fee	Per kWh	Average Monthly Bill
Bangladesh	Dhaka	0.19 - 1.00	0.05 - 0.17	2,957.40	295,680.60	0.31 - 0.63	0.04 - 0.13	21.35
Indonesia	Jakarta	-	0.07	1,881.60	188,160.00	-	0.1	37.45
India	New Delhi	2.45 - 3.60 / kVA	per kVA: 0.10	3,192.00	319,200.00	1.80 - 3.60 / kW	0.04 - 0.11	13.36
Malaysia	Kuala Lumpur	146	0.05 - 0.09	2,027.60	188,306.00	0.73	0.05 - 0.14	36.31
Philippines	Manila	-	0.21	5,644.80	564,480.00	-	0.1	37.45
Singapore	Singapore	6.77 / kW	0.10 - 0.17	4,576.60	457,660.00	-	0.19	80.09
Thailand	Bangkok	9.76	0.08 - 0.16	3,235.36	322,569.76	1.19	0.10 - 0.14	47.38
Vietnam	Hanoi	-	0.04 - 0.19	2,643.20	264,320.00	-	0.07 - 0.13	24.56

Source: JETRO、NRI Analysis

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    - De-carbonization
    - De-centralization
    - De-regulation
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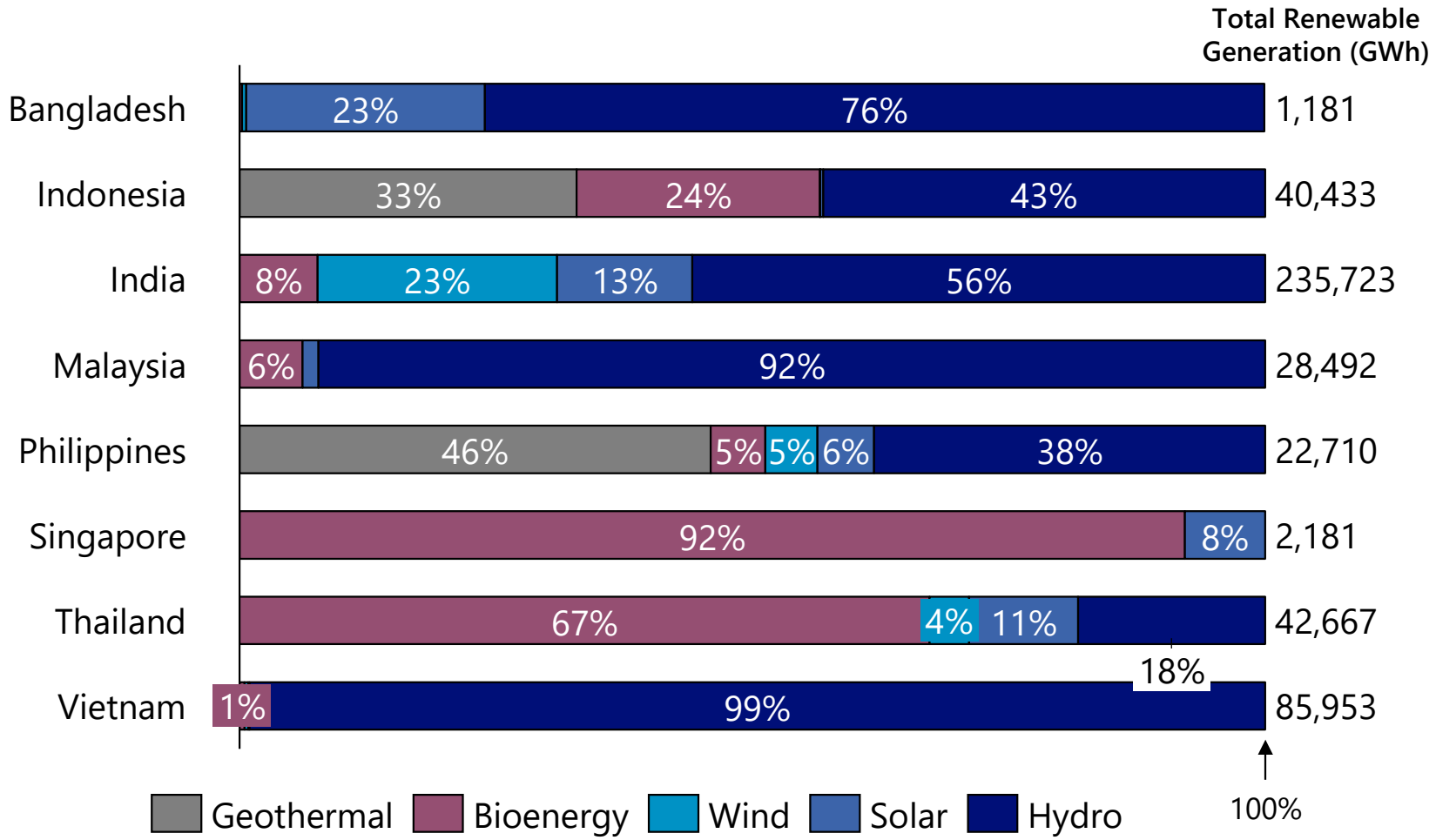
Looking at the balance of renewable energy generation as shown below, most countries have a preferred source for renewable energy

Renewable energy generation mix in selected countries



Insights

1. **High concentration in hydropower sources.** Most countries are still reliant on hydropower like Vietnam, Malaysia and Bangladesh. It is expected to remain the world's largest source of renewable electricity generation.

2. **Diversification into newer energy sources.** Many countries are moving towards a diversified energy mix, building up the ability to generate energy from wind, solar, geothermal, biomass sources etc. Existing Hydropower is an opportunity for pumped energy storage and floating solar power

Source: IRENA Renewable Energy Outlook, IEA, NRI Analysis

De-carbonization：Target for Renewable Energy

Most countries have renewable energy targets set for either the near / far future, and are making progress towards achieving them

Renewable energy targets in selected countries

Country	Current Progress	Targeted Goal
Bangladesh	Less than **1%** of electricity generation comes from renewable energy as of 2019	Aims to hit **10%** of renewable energy in electricity generation by 2020; no new goal set yet
Indonesia	**13%** of the total electricity produced comes from renewable energy as of 2018	Aims to hit **23%** of its total energy coming from renewables e.g. solar and wind by 2025
India	Currently at **86 GW** in 2020	Aims to hit **175** gigawatts (GW) of renewable capacity by 2022, and **450** GW by 2030
Malaysia	**2%** of the electricity generation mix is contributed by renewable energy as of 2018	Aims to hit **20%** renewable energy in its generation mix by 2025
Philippines	**21%** of the energy mix comes from renewable energy as of 2019	Aims to hit **35%** of renewable energy share in 2030
Singapore	Currently at **350 megawatt-peak (MWp)** in 2020	Aims to hit **2 gigawatt-peak (GWp)** of solar energy by 2030
Thailand	**10%** of electricity generation comes from renewable sources as of 2018	Aims to hit **30%** of renewable energy for electricity production by 2036
Vietnam	**9%** of generation capacity comes from renewable sources as of 2019	Aims to hit **10.7%** renewable energy generation by 2030

Source: News Articles, Government Websites

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De-centralisation：FiT and other policy

Most countries have Feed in Tariffs (FIT), and FIT vary depending on the type of projects or the location of deployment

Feed in Tariffs in selected countries

Country	Does country have FIT?	Explanation	Average FIT (USD $cent/kWh)
Bangladesh	No	Draft policy document is completed and waiting to be implemented	N/A
Indonesia	Yes	Different rates for various renewables, depending on the location of the power generation	14.1 - 25.0
India	Yes	Feed-in tariff rate of ₹15/kWh for the first 15 years starting in 2010 and ₹5/kWh for the next 15 years	21.0
Malaysia	Yes	Different rates for various renewables	18.8
Philippines	Yes	The FiT for all solar installations will be 9.68 PHP (US$0.23) per kWh, regardless of the size of the system or technology used	23.0
Singapore	No	Singapore believes that subsidies such as FIT distorts the energy markets and increases costs for consumers, thus they do not implement it. The country has instead taken proactive steps to introduce regulatory enhancements and R&D to facilitate the entry of renewable energy.	N/A
Thailand	Yes	Different rates for various renewables	16.8
Vietnam	Yes	FiT were based on three technology types: ground-mounted projects, floating solar energy projects and rooftop solar energy projects	7.7

Source: News Articles, Government Websites

De-centralisation ：FiT and renewable energy auctions

Most countries have Feed in Tariffs (FIT), with prices varying based on type of project. Renewable energy auctions are also held to further develop capabilities.

Feed in Tariffs / Renewable Energy Auctions in selected countries

Country	Does country have FiT?	Average FIT (USD $cent/kWh)	Renewable energy auctions held
Bangladesh	No	N/A	Auction in August 2019 for 45-55 MW grid-tied PV array in Rangunia at winning price of BDT USD 74.96/MWh. In Sep 2020, The Bangladesh Power Development Board (BPDB) has released a notice inviting bids to develop 100 MW of grid-connected wind power projects at two sites in the country.
Indonesia	Yes	14.5 - 25.0	In December 2020, Indonesia's state-owned public utility, PLN has invited bids for solar and bioenergy projects.
India	Yes	11.9	Auction in Jan 2021 held by Maharashtra State Power Generation Co. Ltd., which registered a price of INR 2.51/kWh (USD 33/MWh) in a 250 MW grid-connected solar project at the Dondaicha Solar Park in Maharashtra.
Malaysia	Yes	17.7 – 13.0	Through the fourth tender of the LSS program for large scale PV in Mar 2021, the Malaysian authorities have pre-selected 30 solar projects with a combined capacity of 823 MW. The lowest bid came in at MYR176.8/MWh ($42.9/MWh) and the highest at MYR248.1/MWh ($59.5/MWh).
Philippines	Yes	19.43	Auction in February 2018, awarded 150 MW of onshore wind at price of PHP 3,500/MWh (USD 67.5/MWh). The Philippines is setting the launch of its first green energy auction in mid-2021 which is hoped to allocate 2 GW of renewable energy generation capacity.
Singapore	No	N/A	In March 2021, HDB Launched Sixth SolarNova Tender with 70MW capacity and Smart Electrical Sub-meters to Optimise Energy Use. HDB has been launching SolarNova every year since 2015, and last 5 tenders had following capacities: 40MW, 40MW, 50MW, 70MW, 60MW.
Thailand	Yes	20	Auction in October 2017, awarding a total capacity of 300 MW of renewable energy. Auction in Jun 2019 by EGAT, awarding for a 55.5MW floating PV project at the Sirindhorn Dam.
Vietnam	Yes	8.4	Auction mechanism is planned from the past few years, and new draft decision on the future Solar Auction Program is submitted in January 2021.

Source: News Articles, Government Websites

De-centralisation : Next-generation automobiles

Adoption of EVs is still in progress in ASEAN as a whole because of weak government support

Electrical vehicle progress in selected countries

Country	Current Progress	Example / Explanation
Bangladesh	Developing	Around 1 million EVs in 2019, in district towns and rural areas. Mainly Battery Electric Vehicles (BEVs), also known as Easy Bike (Two and three wheeled vehicles).
Indonesia	Developing	Comprehensive EV policy, aiming for electric vehicles to make up 20% of total domestic vehicle sales by 2025 – 2.1 million e-motorcycles and 400,000 e-cars to be on the road.
India	Developing	In 2019, 285,000 buyers of electric and hybrid vehicles benefitted from subsidies under the FAME-India program according to the Ministry of Heavy Industries and Public Enterprises (MHIPE). The country aims to be a 100% electric vehicle nation by 2030.
Malaysia	Developing	Comprehensive EV policy to grow EV sales. In 2019, total sales for hybrid & electric vehicles in the country accounted for 2.2 percent of ~610,000 units sold by automakers.
Philippines	Developing	Slowly developing EV infrastructure, with government aiming to replace regular tricycle with 100,000 e-tricycles in the long term.
Singapore	Developing	The government is pushing for the rollout of EVs. Currently there are 1,125 cars on the road as of January 2020, which make up fewer than 0.2% of the current car population.
Thailand	Developing	Comprehensive EV policy, plans to increase # of plug-in hybrid electric vehicles (PHEV) and battery electric vehicles (BEV) to 1.2 million units and 690 charging stations by 2036.
Vietnam	Developing	Vinfast leading efforts to develop EV market in the country, selling 50,000 e-bikes in 2019, building research institutes and other initiatives like developing electric buses.

Source: News Articles, Frost & Sullivan

De-centralisation : Next-generation automobiles

To Accelrate the adoption of EV, Government incentives and Safety Standards need to be established.

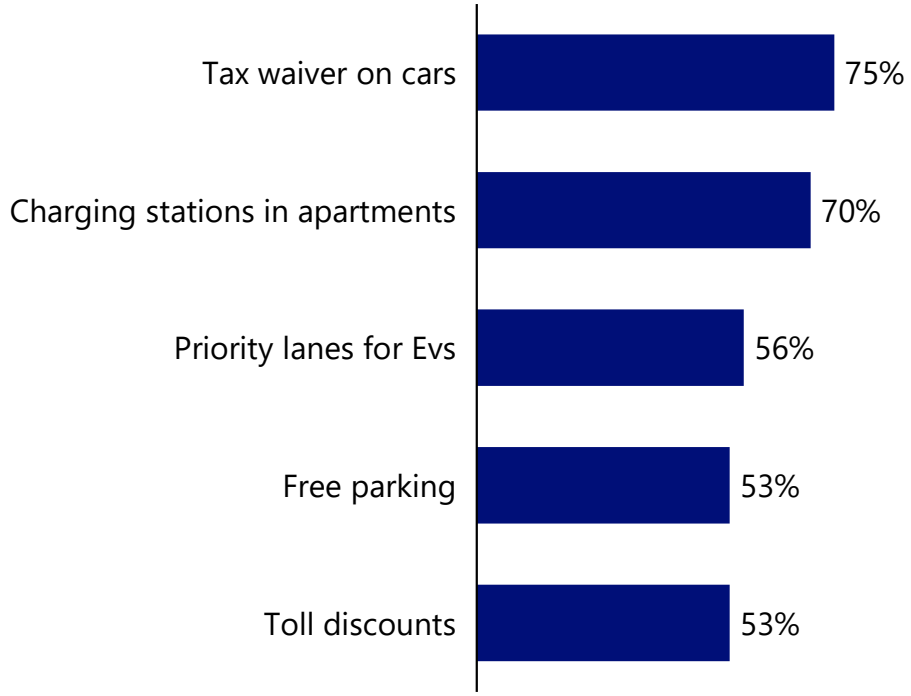
Electrical vehicle consumer profile in selected countries

Top 3 motivating factors for EV use / purchase	Bangladesh	Indonesia
	Government incentives	Better safety standards
	Lower operating costs of EVs	Charging flexibility & convenience
	Convenience for short commutes	Environmental awareness

India	Malaysia	Philippines
Government incentives	Better safety standards	Better safety standards
Charging flexibility & convenience	Charging flexibility & convenience	Charging flexibility & convenience
Lower operating costs of EVs	Lower operating costs of EVs	Battery range equal to full tank

Singapore	Thailand	Vietnam
Better safety standards	Better safety standards	Better safety standards
Government incentives	Charging flexibility & convenience	Charging flexibility & convenience
Charging flexibility & convenience	Lower operating costs of EVs	Environmental awareness

Incentives influencing switch from conventional vehicles to electric vehicles



Future of mobility is moving into electric and greener sources, but strong collaboration is required between public and private parties to overcome infrastructure hurdles

Source: News Articles, Frost & Sullivan

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De-regulation : Electricity liberalization

In all selected countries, the generation market has been liberalized. Singapore has liberalized the energy market, as well as retail in the electricity market.

Electricity liberalization overview

✓ : Liberalized

Country	Generation market		Wholesale market		Retail liberalization status		
	Liberalization	FDI Regulation	Energy market	Adjustment market	Large-scale retail	Small-scale retail	Full liberalization
Bangladesh	✓	✓					
India	✓	✓	✓				
Indonesia	✓	✓					
Malaysia	✓	✓					
Philippines	✓	✓			✓		
Singapore	✓	✓	✓		✓	✓	✓
Thailand	✓	✓					
Vietnam	✓	✓					

Source: News Articles, JEPIC

De-regulation : Penetration of smart meters

The penetration rate in Singapore is about 20%. On the other hand, Bangladesh is the sole country that has not yet introduced smart meters.

Penetration of smart meters

Country	Introduction	Penetration	Pilot Project Status		Overview
BD	-	-	-	-	-
IN	✓	1%	✓	NDMC Smart Meter Project	50,000 conventional electricity meters in New Delhi replaced in 2019
ID	✓	2%	✓	PLN Bali Eco Smart Grid Smart Meter Pilot	PLN Bali deployed 1,000 2-way smart meters based on LoRa WAN in Kuta
MY	✓	3%	✓	TNB Pilot Project (Malacca and Putrajaya)	1,000 meters deployed successfully in Malacca & Putrajaya
PH	✓	1%	✓	Meralco's Luzon Pilot Project	40,000 smart meters installed in Luzon in a pilot test phase
SG	✓	20%	✓	Completed	Smart meters to be rolled out nation-wide by 2024 - 2025
TH	✓	2%	✓	Pattaya Smart Pilot Project	12,00 homes had smart meters installed in Pattaya City, Chonburi Province
VN	✓	2%	✓	EVN Smart Grid Project 2017	10,200 customers have had their metres replaced in Ho Chi Minh

Source: News Articles

De-regulation : Penetration of smart meters

In terms of the usage level, Malaysia, the Philippines, and Singapore are at the intermediate level, whereas other countries are at the basic level.

Smart meters' usage level assessment

Country	Smart Meter Data Usage	Overview
BD	–	–
IN	Basic	Data mostly used to only measure consumption and allow the households to monitor electricity usage
ID	Basic	Indonesian consumers are now able to conveniently access their electricity balance and payment deadlines
MY	Intermediate	TNB uses the energy consumption data to forecast and adjust energy production. Customers are also able to adjust their consumption through data collected.
PH	Intermediate	Meralco's 80,000 smart meters has allowed them to collect data to predict component failure, reducing power failure and increasing reliability. Customers are also given the opportunity to receive alerts when consumption is high, allowing them to monitor their consumption easily
SG	Intermediate	In 2019, a customized half-year household energy efficiency report was generated for ~1,000 Singaporean households in Jurong based on their energy usage data collected from their advanced meters
VN	Basic	Data is currently mainly used for measurement, data collection and outage management

Source: News Articles

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    - India
    - Indonesia
    - Malaysia
    - Philippines
    - Singapore
    - Thailand
    - Vietnam

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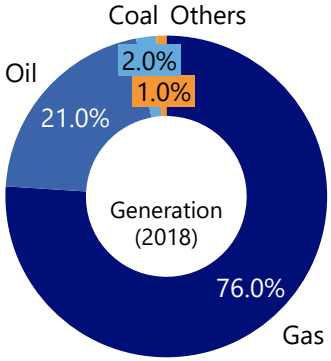
    - Philippines
    - Singapore
    - Thailand
    - Vietnam

Power Business Structure: Bangladesh

Regulatory body	Ministry of Power, Energy & Mineral Resources (MPEMR) is a regulatory agency Bangladesh Energy Regulatory Commission (BERC) is a regulatory body

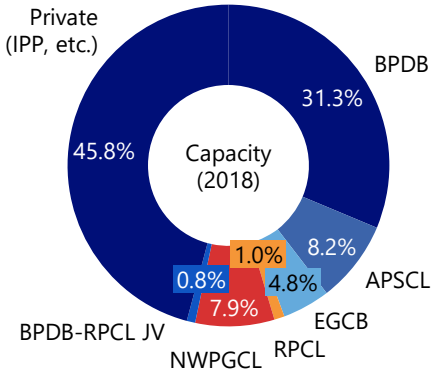
Generation

Main is Gas-fired power



State-owned company and IPP split 50-50

- IPP system established in 1992



Transmission

Operated by subsidiary of BPDB (Bangladesh Power Development Board), PGCB (Power Grid Company of Bangladesh)

- Separated Generation / Transmission / Distribution, and started privatization since 1996

Distribution

Public and private operators occupy by region

- BPDB：DSO in Dhaka and urban areas except the western part
- DPDC：DSO in Dhaka and surrounding region (except for Mirpur and Gulshan)
- DESCO：DSO in Mirpur and Gulshan near Dhaka
- REB：Manage the activities of the Rural Electrification Union (PBS), a power community by local civilians
- WZPDCL：DSO in Khulna

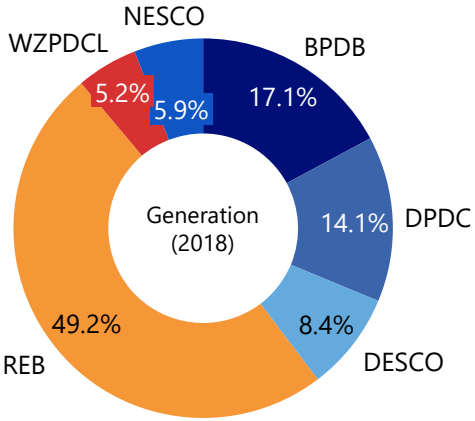
Trading market

Doesn't exist

Retail

DSO operates as retail company

- In rural areas, PBS (72) controlled by REB distributes and retails electricity.
- The electrification rate is 93% (2019)

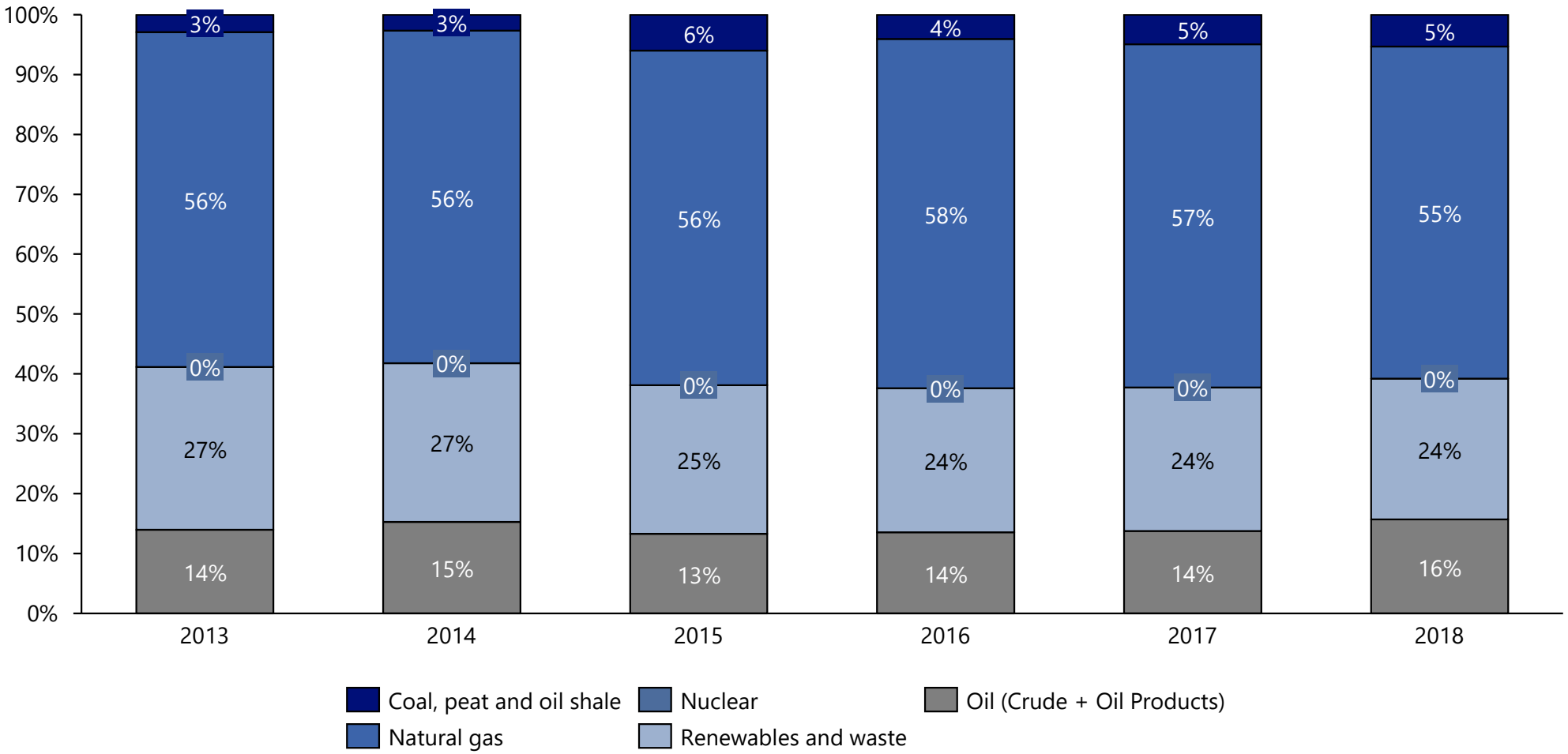


Notes）WZPDCL is subsidiary of BPDB

Source: NRI Analysis

Primary Energy-related indicators: Primary Energy Supply

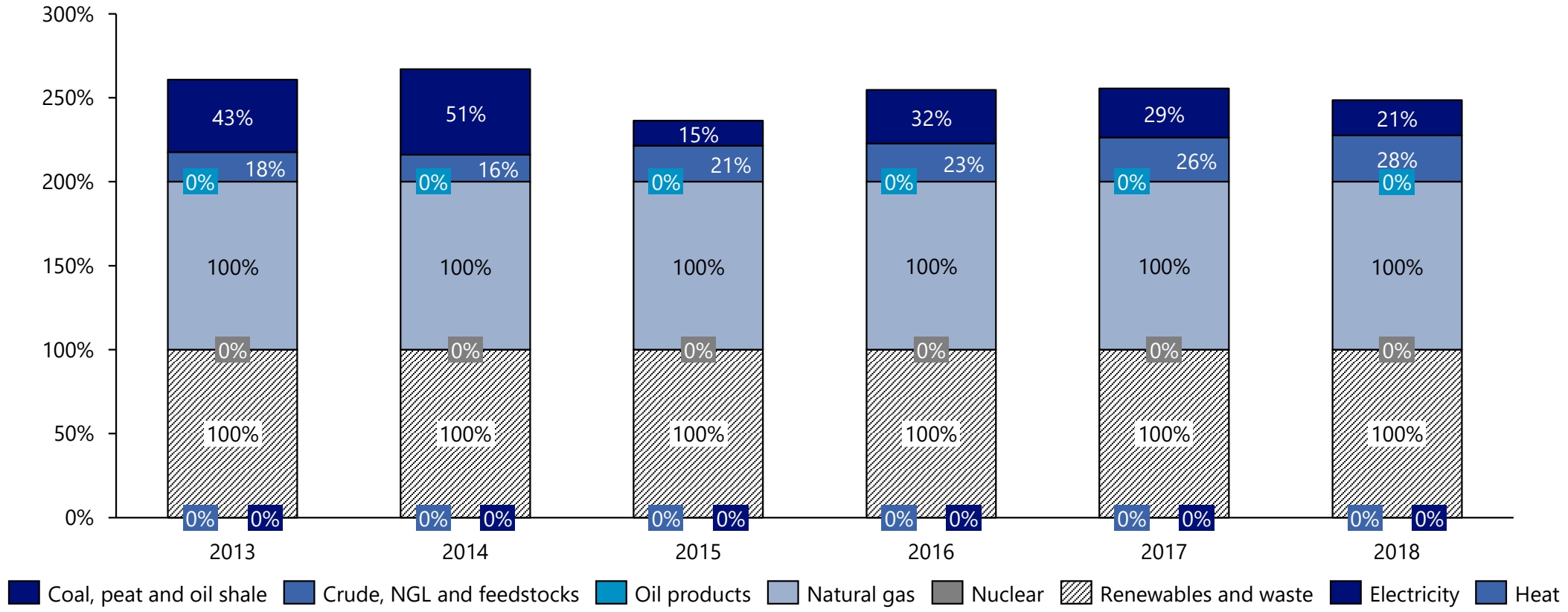
Primary Energy Supply by Fuel from 2013 to 2018



Source: IEA, NRI Analysis

Primary Energy-related indicators: Self-Sufficiency

Self-Sufficiency by Fuel from 2013 to 2018



Definition
(1) Domestic Production
(2) Domestic Supply = (1) Domestic Production + Imports – Exports + Adjustments such as stock changes
(3) Primary Energy Balance = (1) Domestic Production / (2) Domestic Supply

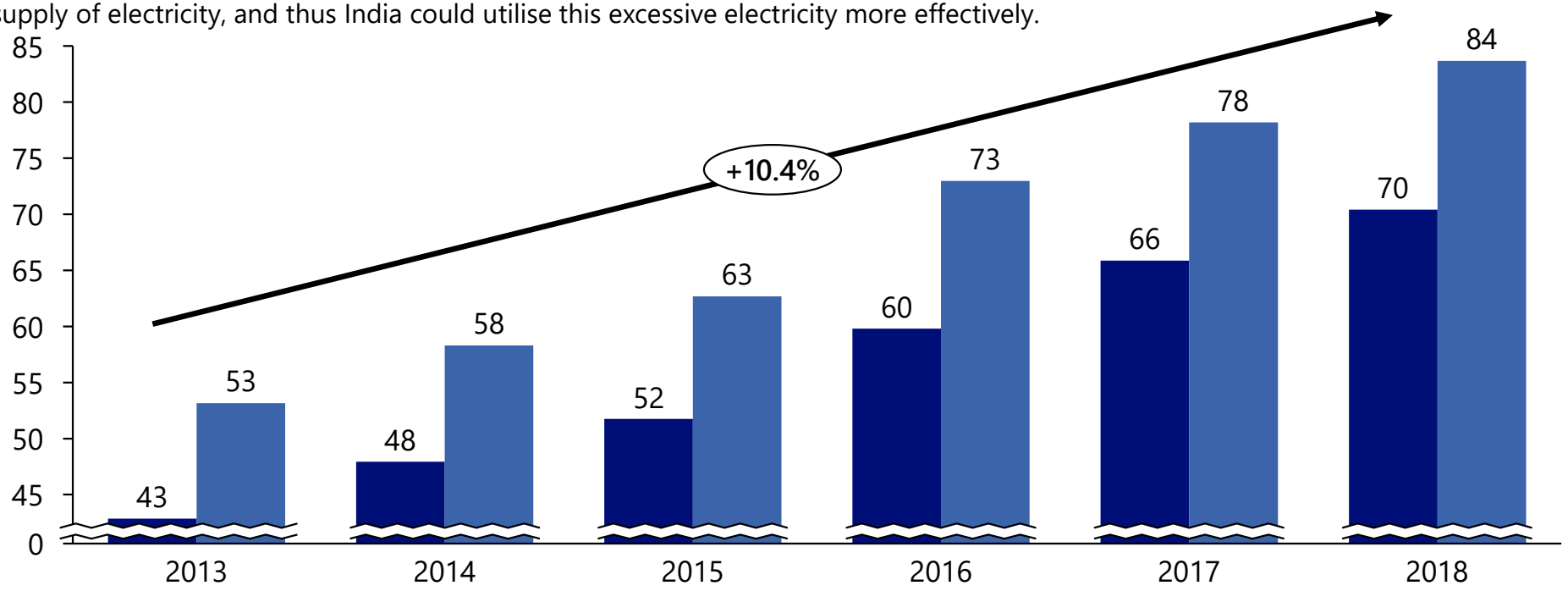
Note(s): Please take note that the graph does not show proportion but the self-sufficiency rate per fuel

Source: IEA, NRI Analysis

Electricity-related indicators: Demand and Supply Trend

Electricity Demand and Supply from 2013 to 2018

- Definition: (1) Domestic Demand = Domestic Consumption. (2) Domestic Supply = Domestic Production + Imports – Exports
- Insights: All 8 countries have more sufficient electricity as domestic supply is more than their domestic demand. However, India has excessive oversupply of electricity, and thus India could utilise this excessive electricity more effectively.



	2013	2014	2015	2016	2017	2018	Average
Domestic demand per capita (MWh)	0.28	0.31	0.33	0.38	0.41	0.44	0.36

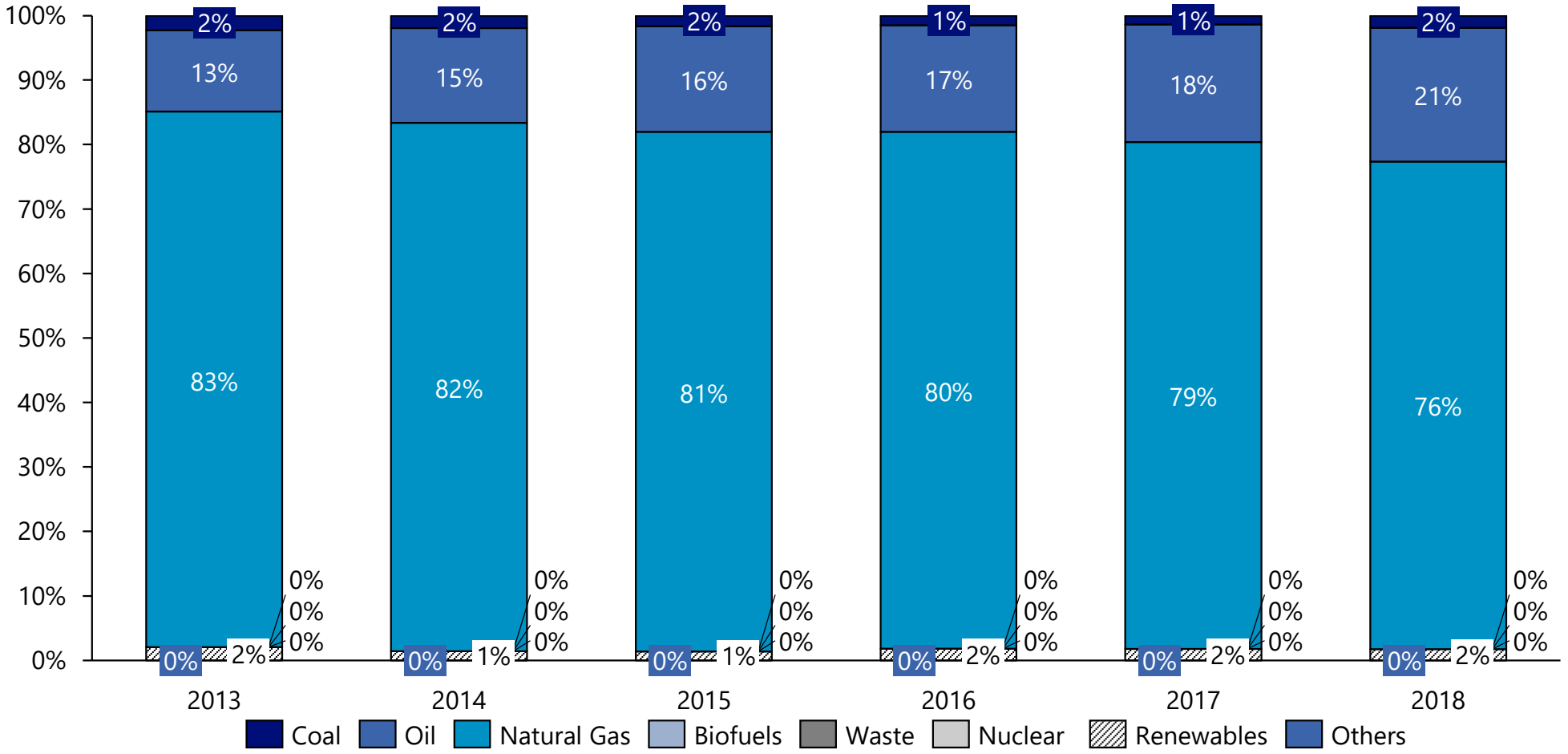
Electricity Domestic Demand (TWh) | Electricity Domestic Supply (TWh)

Above Average | Below Average

Source: IEA, NRI Analysis

Electricity-related indicators: Electricity Generation Composition (%)

Electricity Generation Composition Ratio (%) from 2013 to 2018



Source: IEA, NRI Analysis

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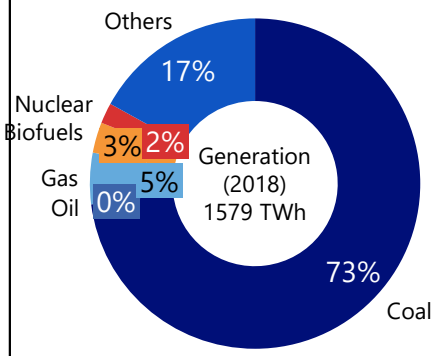
    - Vietnam

Power Business Structure: India

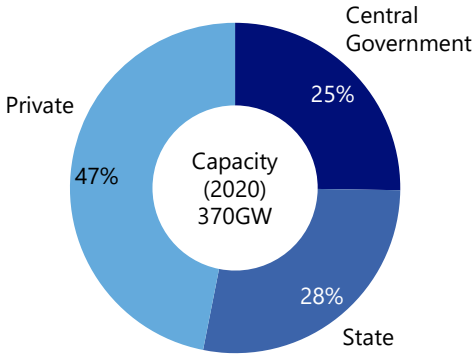
Regulatory body	Central Electricity Regulatory Commission (CERC) and State Electricity Regulatory Commissions (SERC)

Generation

>70% of generation is coal



Private companies has 47% share (generation base)



Transmission

The national TSO PGCIL handles nationwide transmission, while TSO and power companies manages within each state

- TSO are different at national, state, and private levels.
- PGCIL is responsible for half of India's total generation.
- At the state level, TSO and vertically integrated State Electricity Bureaus (SEBs) carry out transmission operations.

Distribution

Few states have privatized distribution companies

- Under the "Electricity Act, 2003", the distribution sector has been liberalized since 2003.
- The deficit of distribution companies has become a major problem, and the total deficit of distribution companies nationwide in fiscal 2009 was nearly 1 billion yen.

Retail

Distribution company implements retail business

- There are at least 100 distribution and retail companies nationwide.

Trading market

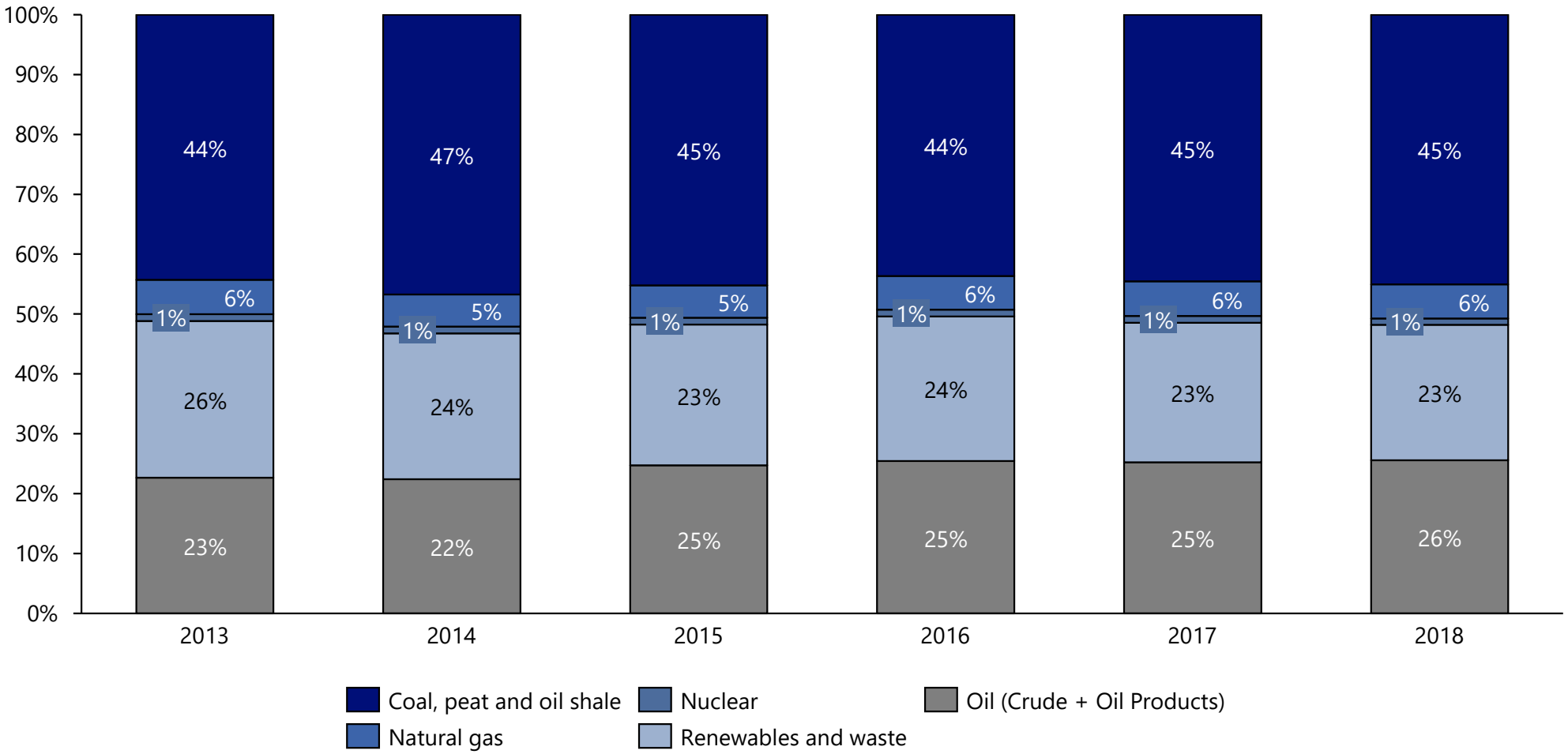
Despite the presence of Indian Energy Exchange, it accounts for only about 3% of total power generation

- PPA contracts dominate, accounting for 89% of total power generation.

Source: NRI Analysis

Primary Energy-related indicators: Primary Energy Supply

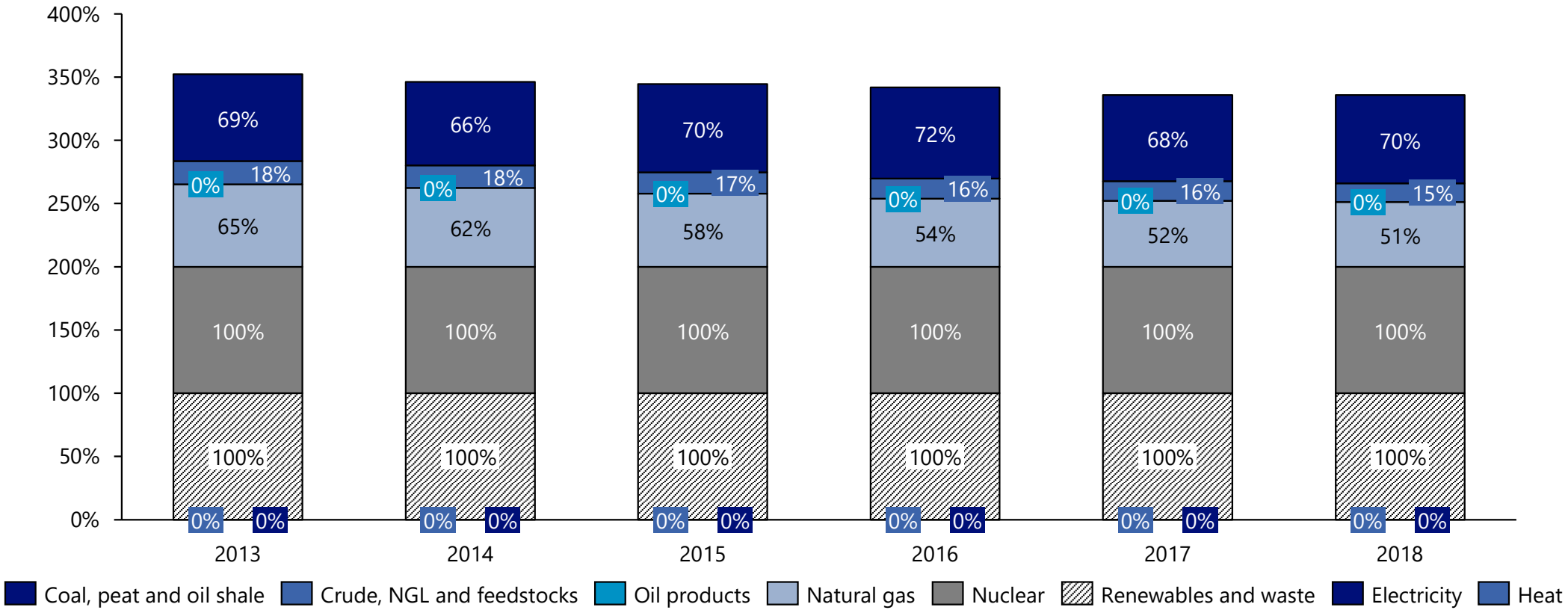
Primary Energy Supply by Fuel from 2013 to 2018



Source: IEA, NRI Analysis

Primary Energy-related indicators: Self-Sufficiency

Self-Sufficiency by Fuel from 2010 to 2018



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Note(s): Please take note that the graph does not show proportion but the self-sufficiency rate per fuel

Source: IEA, NRI Analysis

Electricity-related indicators: Demand and Supply Trend

Electricity Demand and Supply from 2013 to 2018

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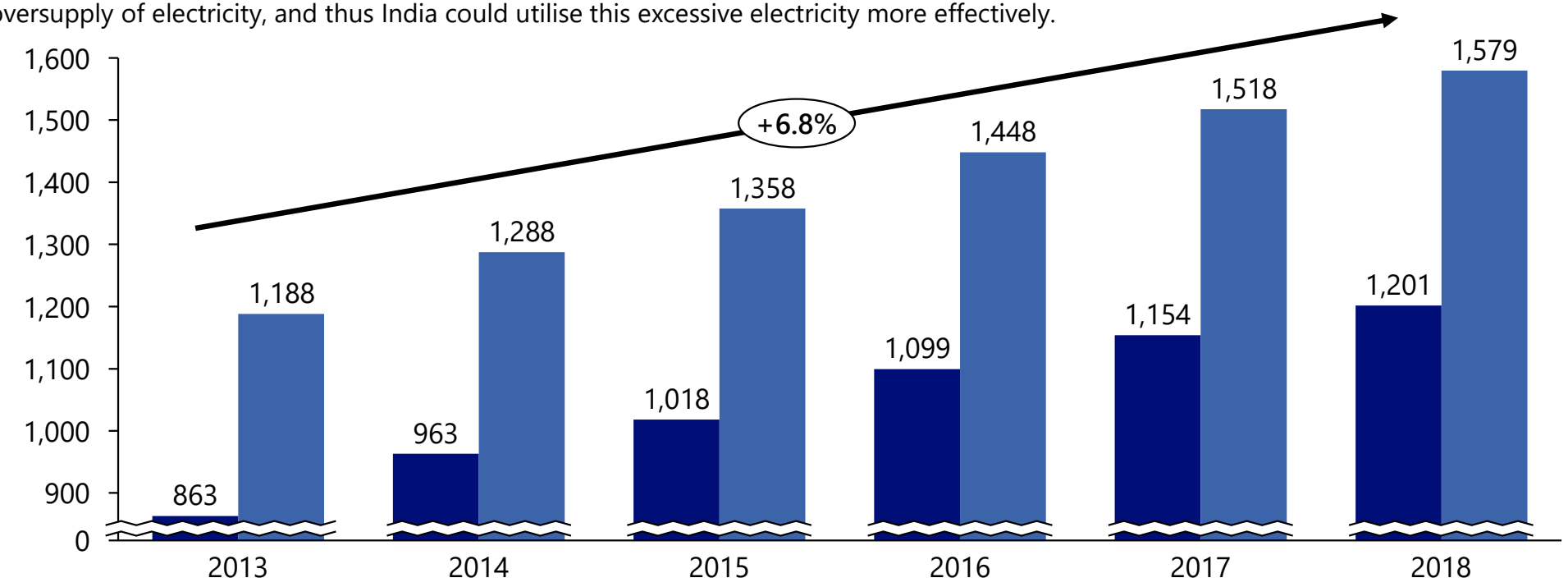


	2013	2014	2015	2016	2017	2018	Average
Domestic demand per capita (MWh)	0.67	0.74	0.78	0.83	0.86	0.89	0.80

Electricity Domestic Demand (TWh) | Electricity Domestic Supply (TWh)

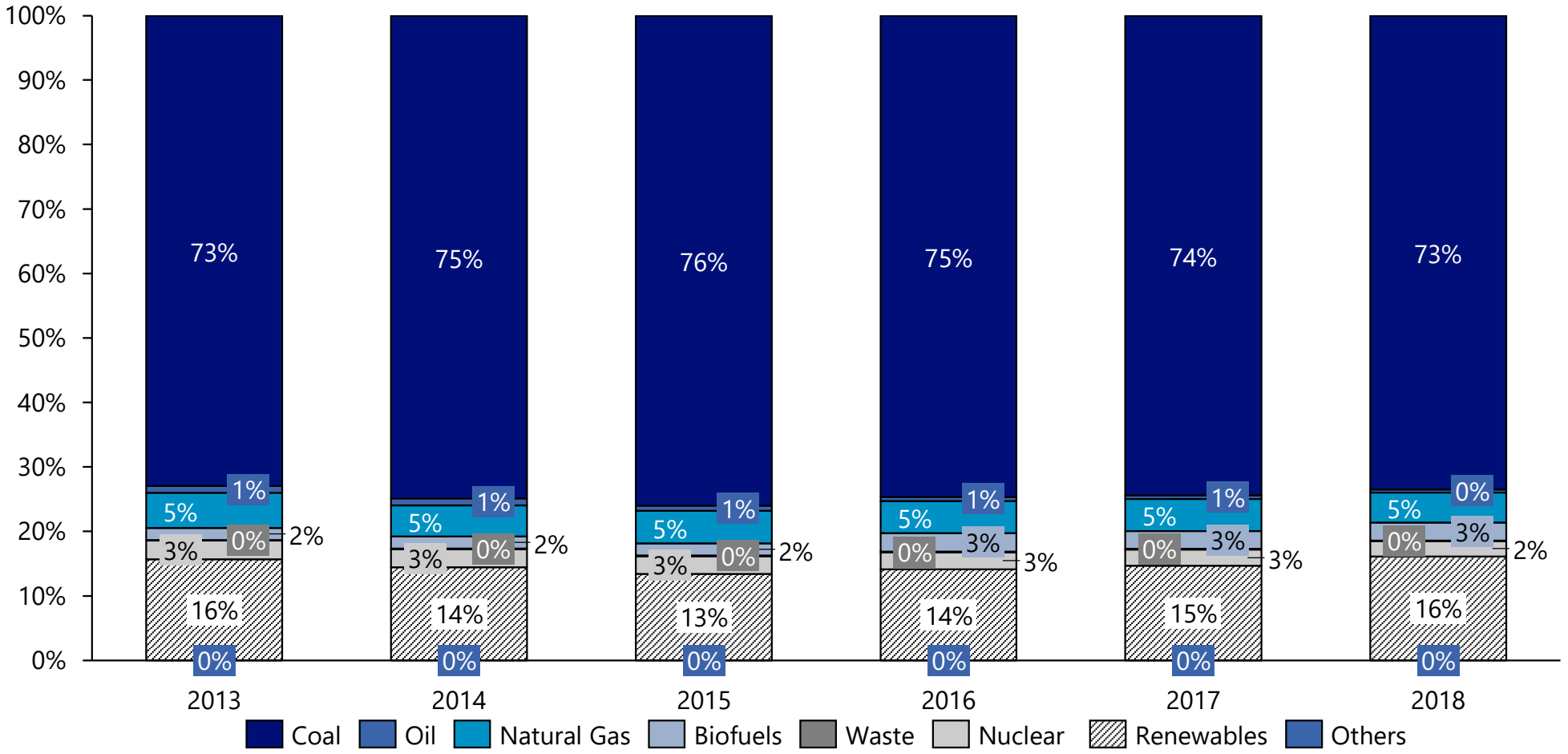
Above Average | Below Average

Source: IEA, NRI Analysis

Country Analysis: India

Electricity-related indicators: Electricity Generation Composition (%)

Electricity Generation Composition Ratio (%) from 2013 to 2018



Source: IEA, NRI Analysis

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Power Business Structure: Indonesia

Regulatory Body

Energi dan Sumber Daya Mineral (ESDM; Ministry of Energy and Mineral Resources)

- Overview: An organization that determines Indonesia's energy policy and supervises and regulates electricity, gas, oil, mining and other business activities.
- Organization: Under the minister in charge, it is divided into: (1) oil and gas (2) electricity and energy utilization (3) mining and geothermal. Under the Department of Electricity, there are the Department of Electricity Program Supervision and the Department of Business Administration.
- Role and Responsibility: Policy decision, policy enforcement, decision of standard, technical guidance / evaluation, etc.

Generation

High share of thermal power, low adoption of renewable energy. IPP fills the shortage of PLN supply.

- Generation as of 2016:
  （※Other than IPP, includes PLN-PLN's regional subsidiaries）

Hydro	3.6GW（7.0%）
Steam	19.5GW（38.4%）
Gas	3.2GW（6.3%）
Combined	9.2GW（18.2%）
Geothermal	0.6GW（1.2%）
Diesel	3.2GW（9.8%）
IPP	11.4GW（22.5%）

Transmission

PLN owns and operates

- In the competitive areas (Java, Bali, Sumatra), generation, transmission, and distribution are separated as business units, while in non-competitive areas, the vertical integration is maintained.

Distribution

PLN owns and operates

- Standard voltage: 150kV－20kV－220/380V
- In the competitive areas (Java, Bali, Sumatra), generation, transmission, and distribution are separated as business units, while in non-competitive areas, the vertical integration is maintained.

Retail

PLN occupies

- In the competitive area, each power distribution business unit conducts retail business.
- In non-competitive areas, 9 regional branches and 2 regional subsidiaries operate as vertically integrated

Trading market

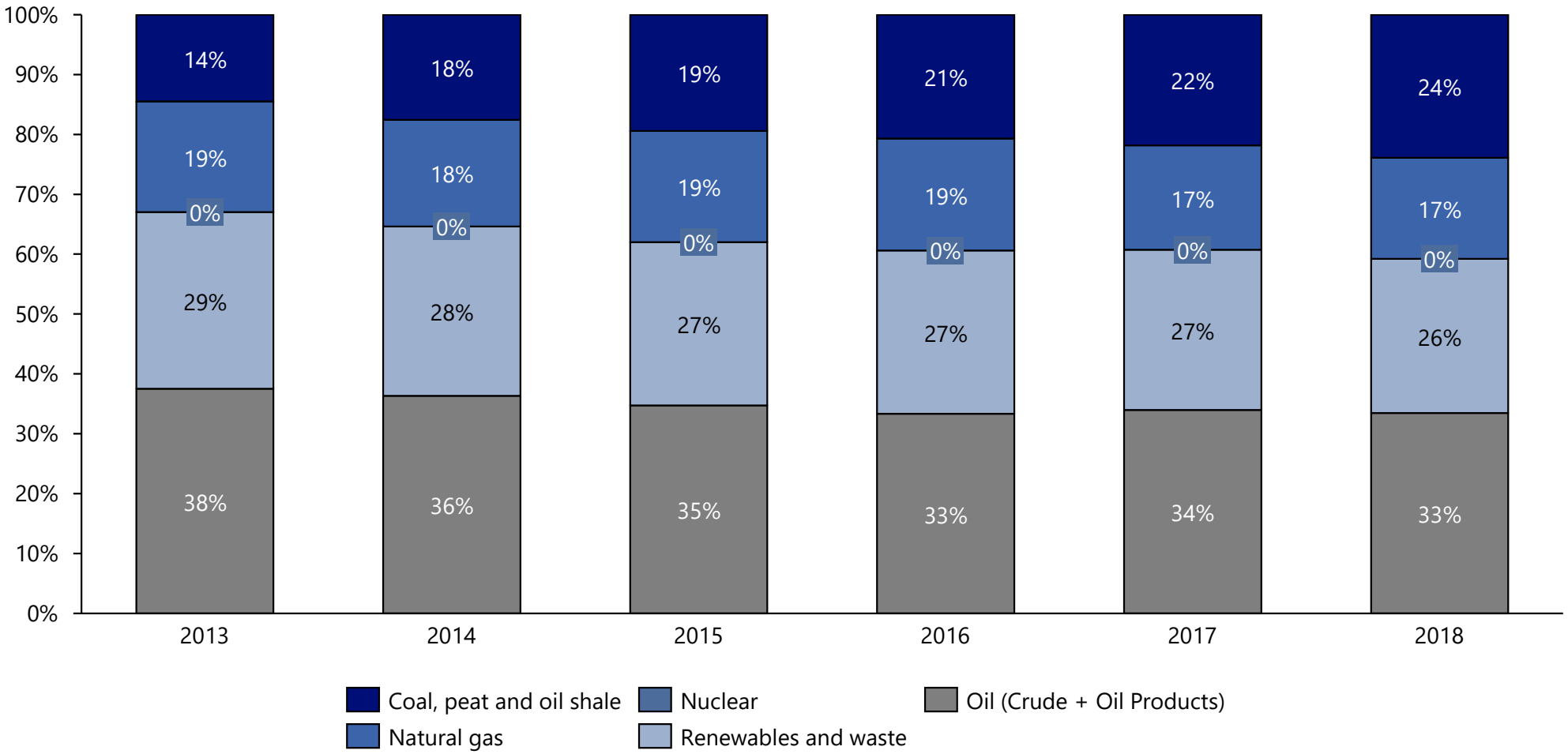
Does not exist

- All IPP power generation is taken off to PLN.

Source: NRI Analysis

Primary Energy-related indicators: Primary Energy Supply

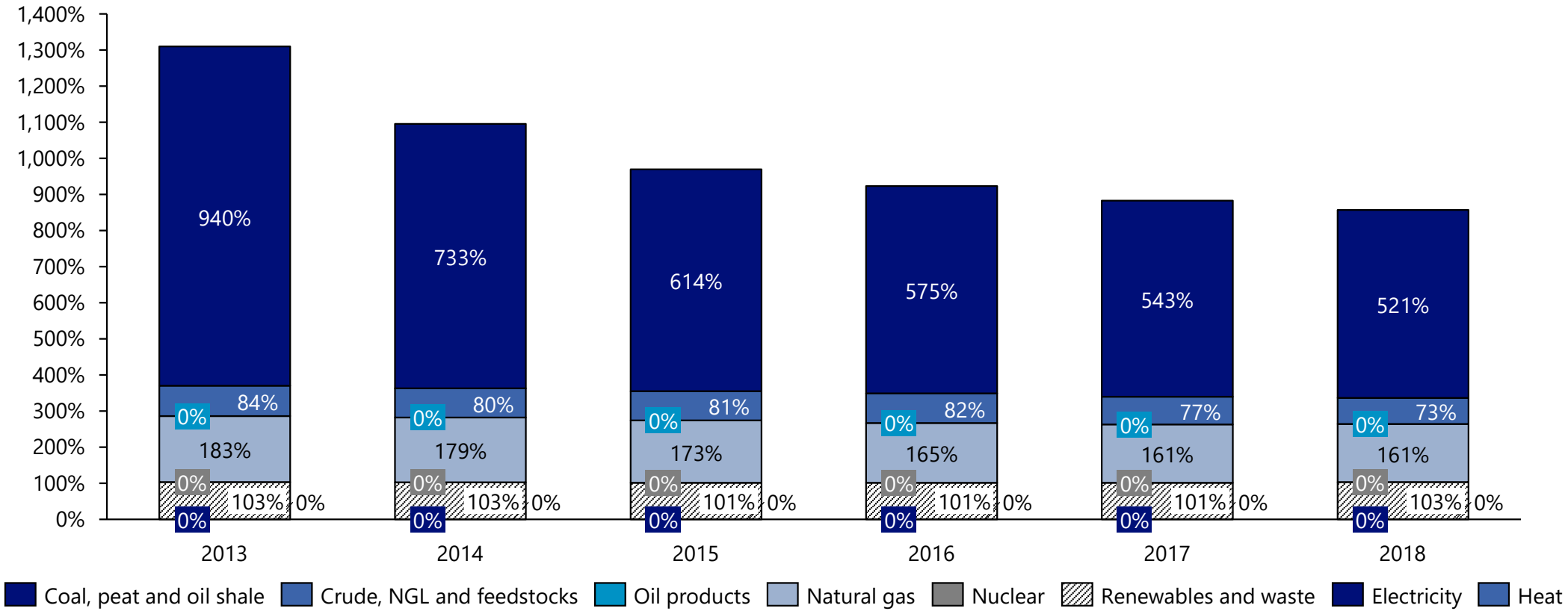
Primary Energy Supply by Fuel from 2013 to 2018



Source: IEA, NRI Analysis

Primary Energy-related indicators: Self-Sufficiency

Self-Sufficiency by Fuel from 2013 to 2018



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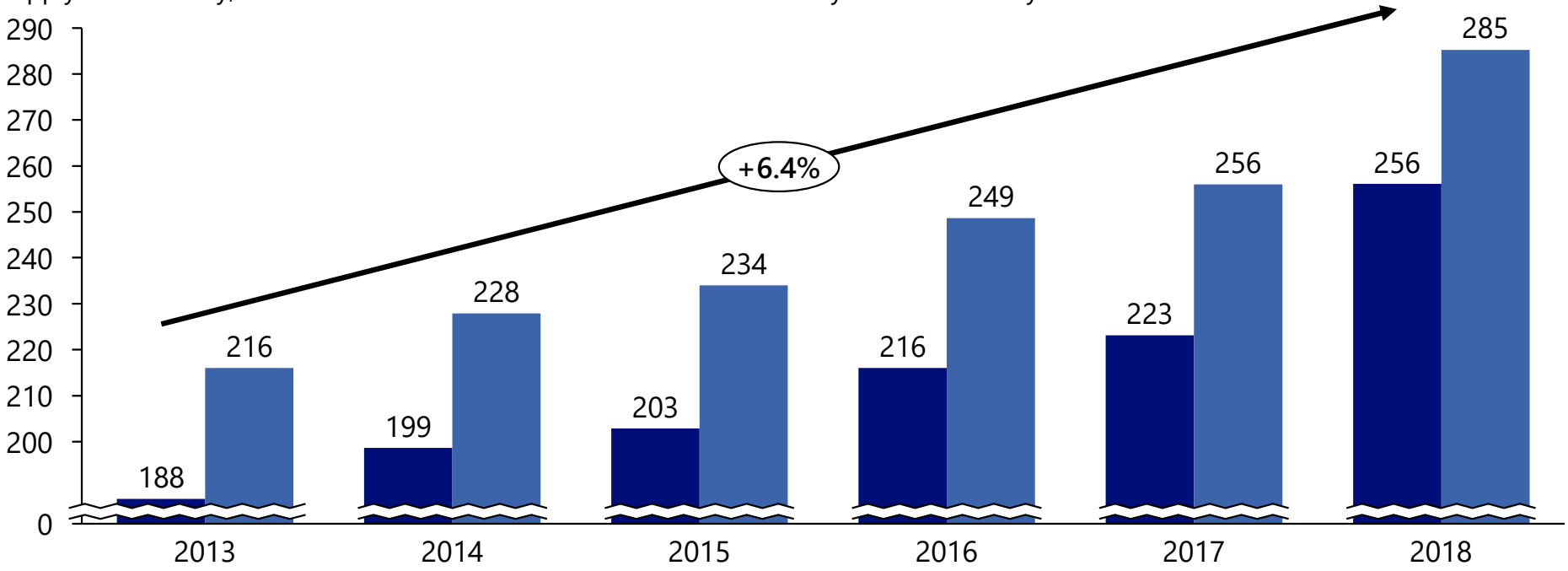
Note(s): Please take note that the graph does not show proportion but the self-sufficiency rate per fuel

Source: IEA, NRI Analysis

Electricity-related indicators: Demand and Supply Trend

Electricity Demand and Supply from 2013 to 2018

- Definition: (1) Domestic Demand = Domestic Consumption. (2) Domestic Supply = Domestic Production + Imports – Exports
- Insights: All 8 countries have more sufficient electricity as domestic supply is more than their domestic demand. However, India has excessive oversupply of electricity, and thus India could utilise this excessive electricity more effectively.



	2013	2014	2015	2016	2017	2018	Average
Domestic demand per capita (MWh)	0.74	0.78	0.79	0.83	0.84	0.96	0.82

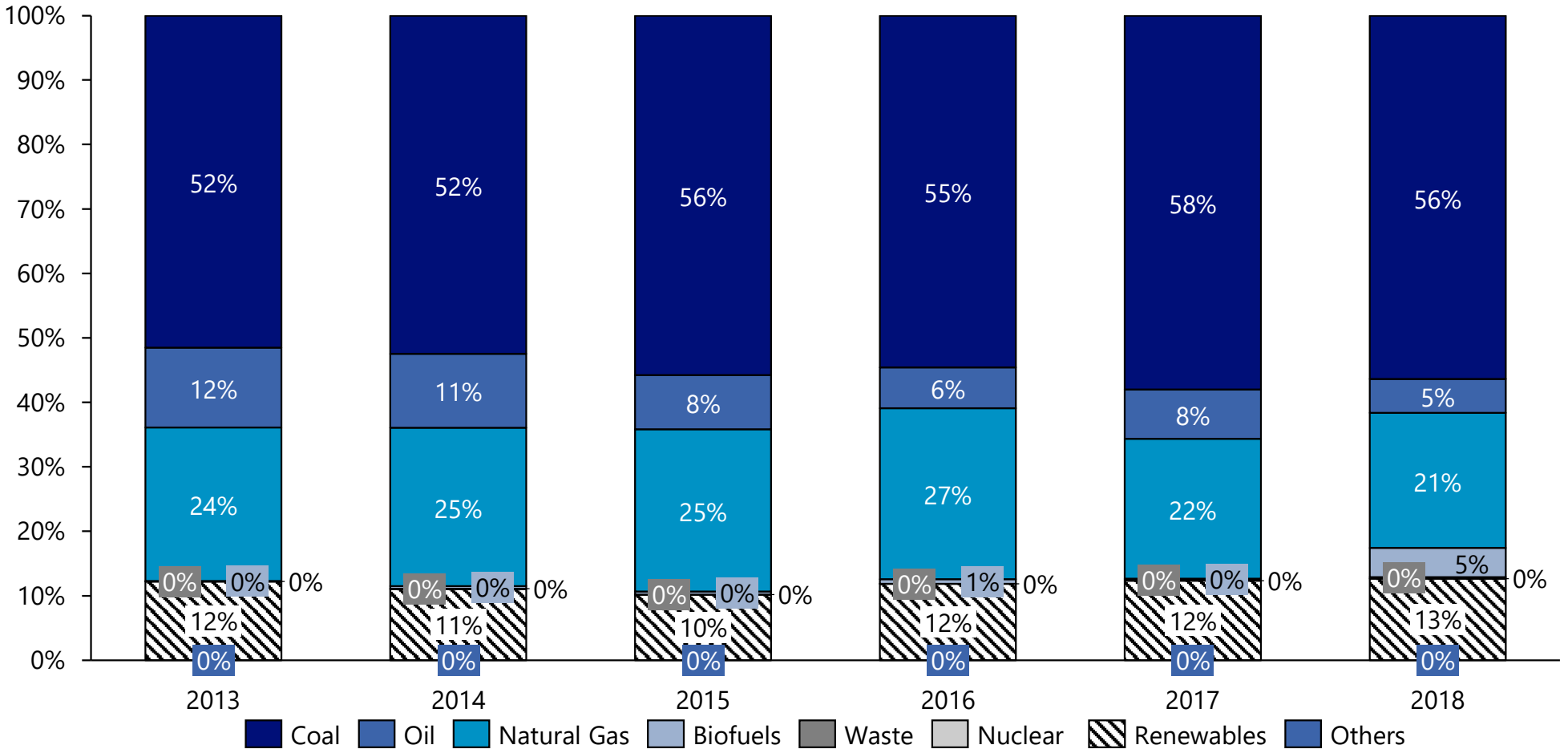
Electricity Domestic Demand (TWh) | Electricity Domestic Supply (TWh)

Above Average | Below Average

Source: IEA, NRI Analysis

Electricity-related indicators: Electricity Generation Composition (%)

Electricity Generation Composition Ratio (%) from 2013 to 2018



Source: IEA, NRI Analysis

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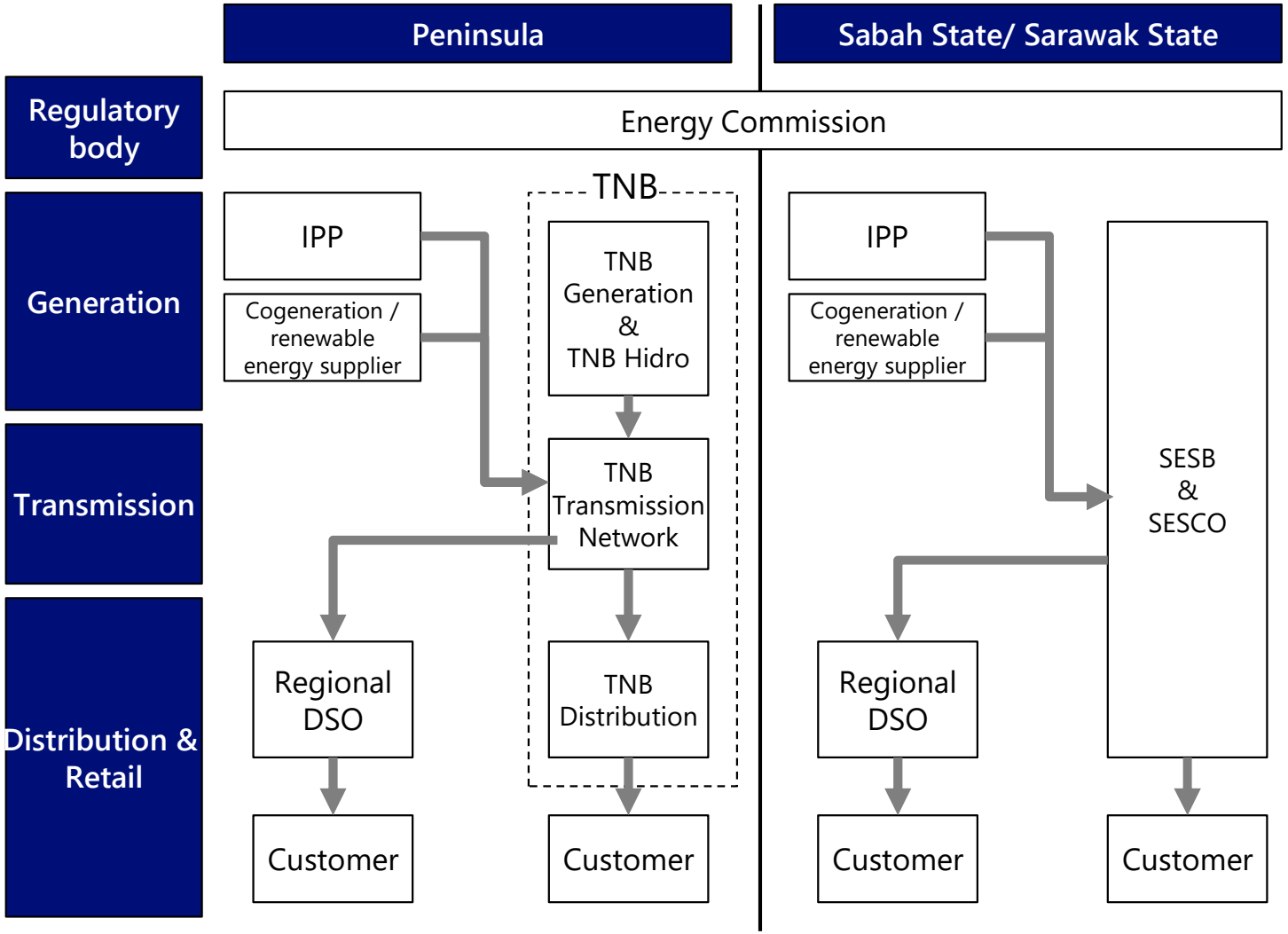
Power Business Structure: Malaysia

Power Market Structure



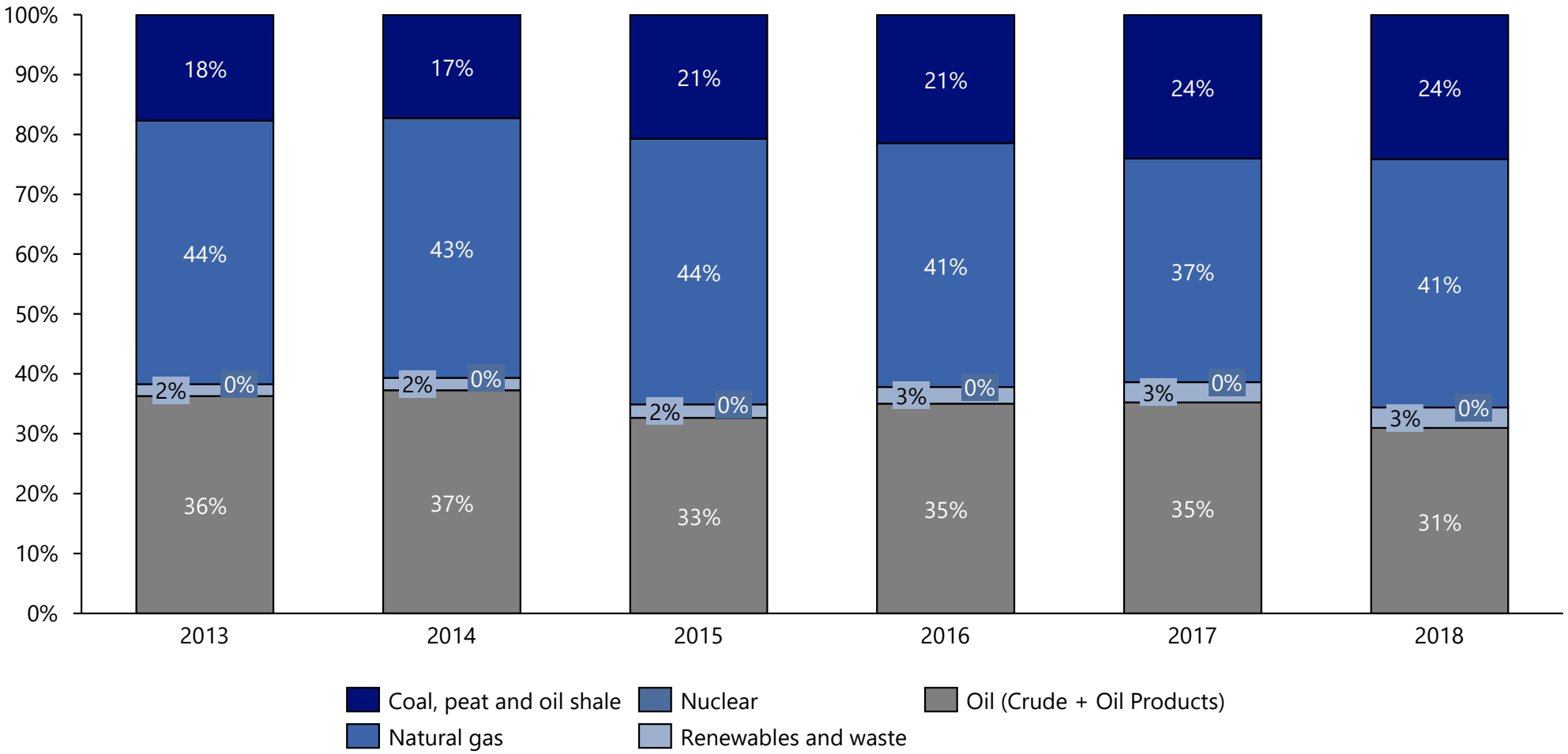
Status of deregulation

Separation of Generation and Transmission	✓ Both Peninsula and East Malaysia are vertically integrated. ✓ For transmission, TNB occupies peninsula, SESB occupies Sabah, and SESCO occupies Sarawak.
Retail Liberalization	✓ In principle, it is an exclusive market where TSO does distribution and retail. ✓ However, dozens of companies are licensed for distribution and retail in limited areas such as industrial parks and resorts.
Trading market	✓ Doesn't exist

Source: NRI Analysis

Primary Energy-related indicators: Primary Energy Supply

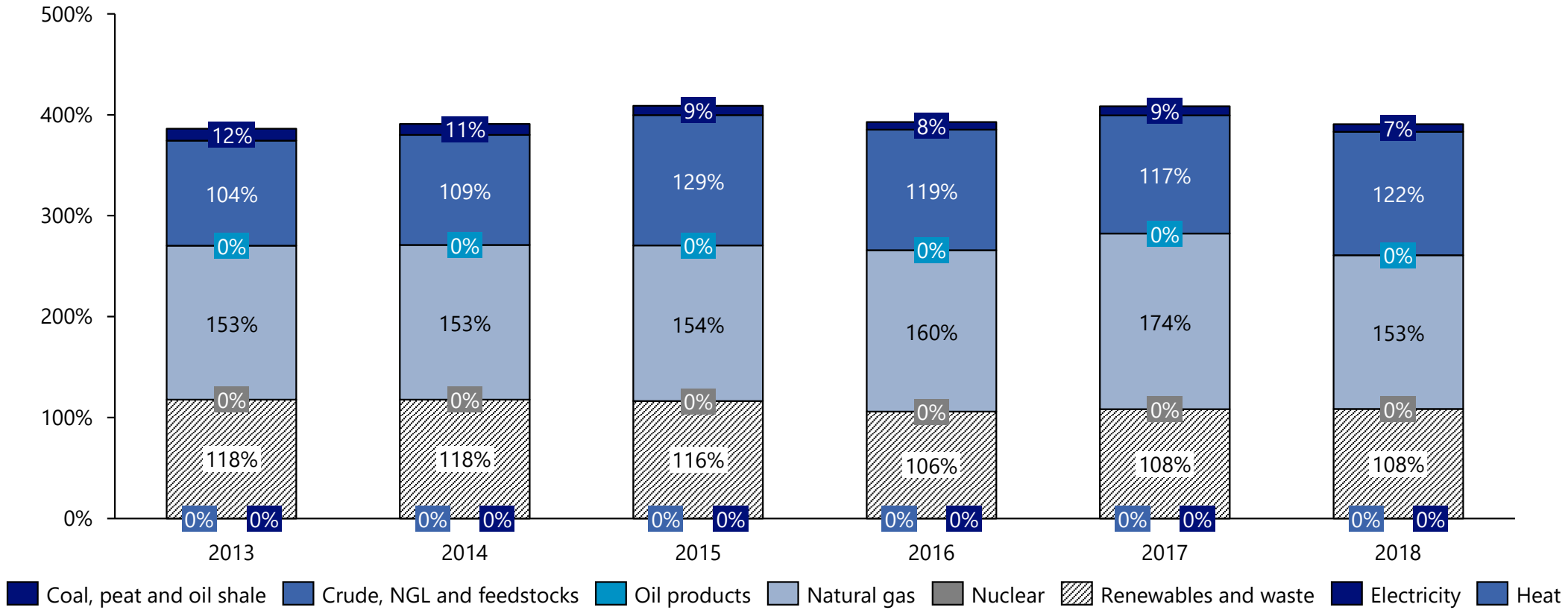
Primary Energy Supply by Fuel from 2013 to 2018



Source: IEA, NRI Analysis

Primary Energy-related indicators: Self-Sufficiency

Self-Sufficiency by Fuel from 2013 to 2018



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Source: IEA, NRI Analysis

Electricity-related indicators: Demand and Supply Trend

Electricity Demand and Supply from 2013 to 2018

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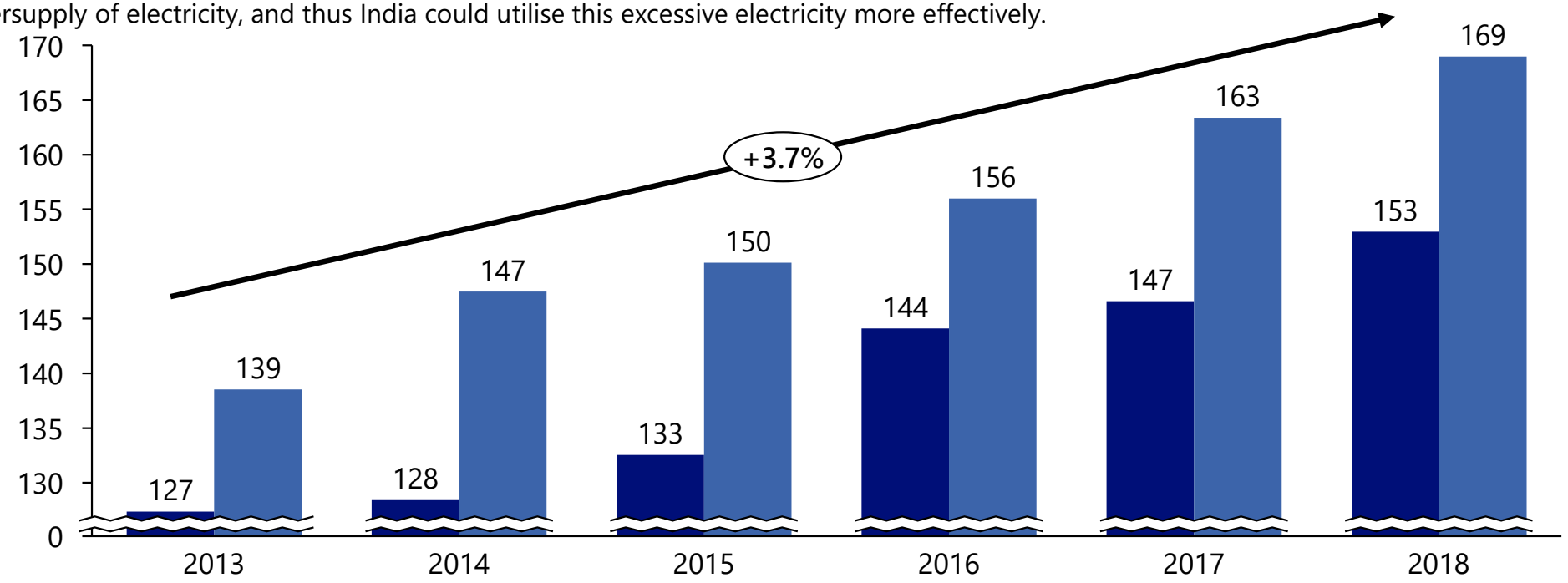


	2013	2014	2015	2016	2017	2018	Average
Domestic demand per capita (MWh)	4.32	4.30	4.38	4.70	4.71	4.85	4.54

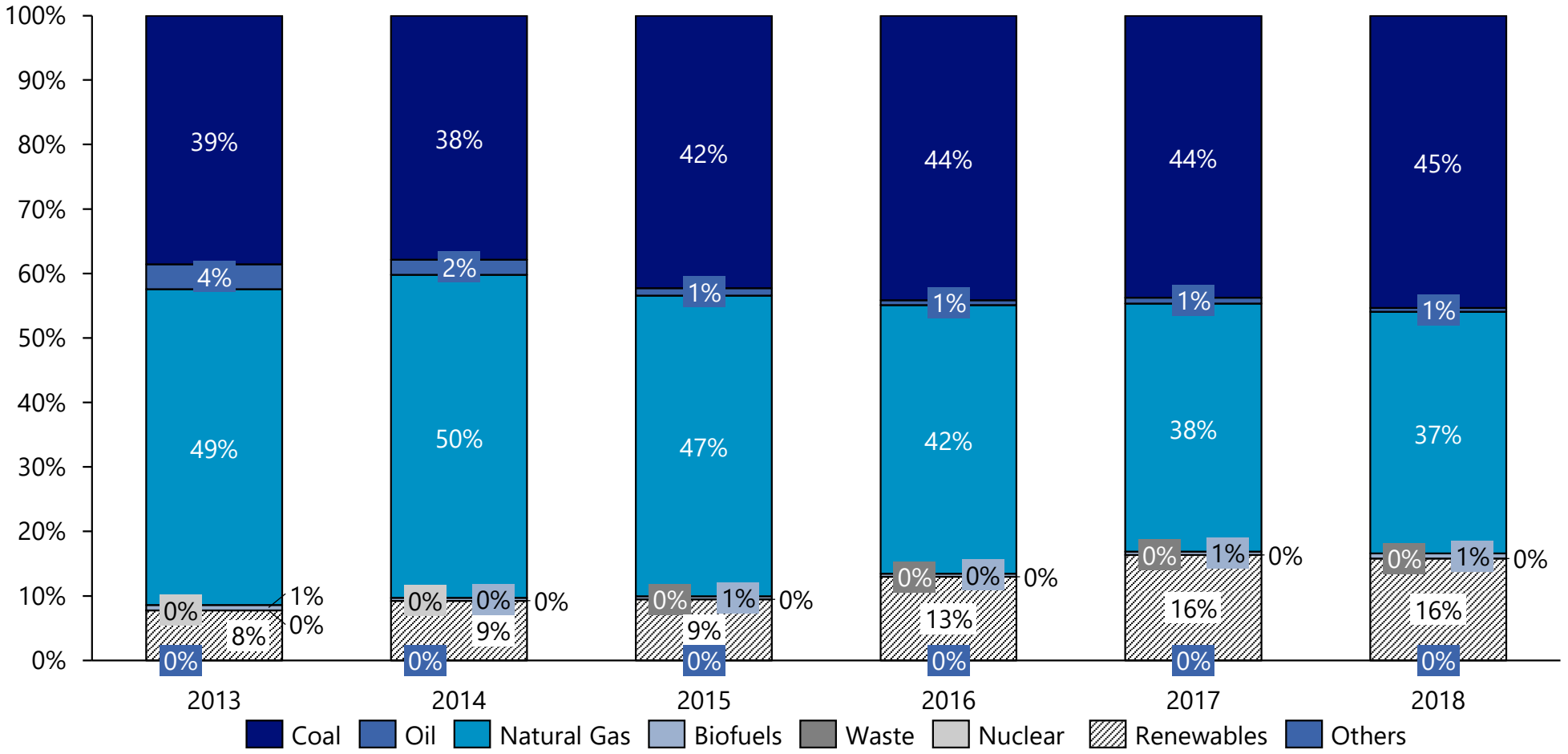
Electricity Domestic Demand (TWh) | Electricity Domestic Supply (TWh)

Above Average | Below Average

Source: IEA, NRI Analysis

Electricity-related indicators: Electricity Generation Composition (%)

Electricity Generation Composition Ratio (%) from 2013 to 2018



Source: IEA, NRI Analysis

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Power Business Structure: Philippines

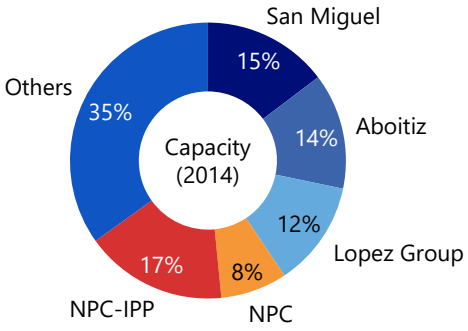
Regulatory body	ERC (Energy Regulatory Commission)

Generation

Mainly Coal and Gas

Three conglomerate IPPs occupy a high share

- Power companies are divided into two patterns
- IPP: Introduced IPP system from 1993. Three conglomerate, San Miguel Energy, First Gen, Aboitiz Power occupy a high share
- Power generation corporation NPC: Owns the majority of power generation assets since its establishment in 1936. Divided and privatized under the EPIRA Act in 2001. Responsible for operating existing power plants until privatization (plus small-scale power generation in off-grid areas called missionary areas)



Transmission

NGCP, invested by State Grid Corporation of China, implements transmission business

- TRANSCO: Supervision and guidance on asset ownership and business operation. Established transmission division of NPC as a separate company in 2003.
- NGCP: In charge of transmission. Transferred transmission business from TRANSCO in 2009. Main shareholders: State Grid Corporation of China (40%), 2 local companies (30% each)

Distribution

Meralco and VECO, private DSO, are major players

- Receives electricity from the primary substation managed by NGCP at 69 to 138 kV and supplies electricity to consumers

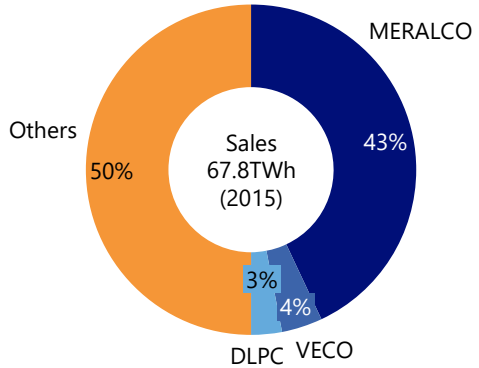
Retailer classification	#
Private Power Distribution Units (PDU) (MERALCO, VECO, etc.)	25
Public enterprises by local governments (LGU-OI)	5
Electric Cooperative (EC)	121

Retail

There are retailers under Power Distribution Units (PDU) and other retailers

- Liberalized for contracted power of >750kW (Mar 2018). There are retailers (RES license holders) and PDU subsidiaries (for retail operations within PDU jurisdiction, called local RES).
- DSO are in charge of retailing in non-liberalized area

MERALCO accounts for 43% of electricity sales (2015)



Trading market

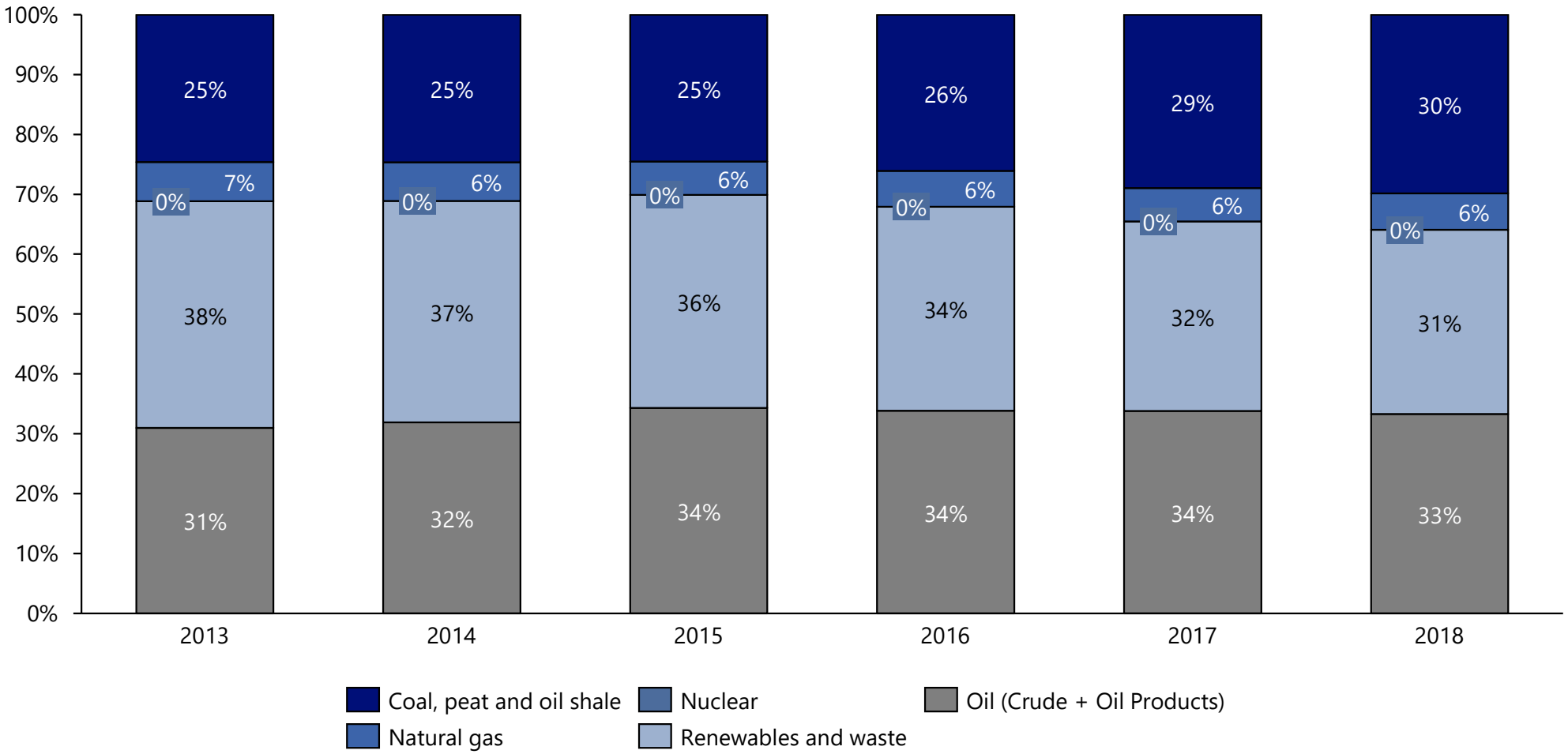
WESM (Wholesale Electricity Spot Market)

- One of the highlights of EPIRA. Established in 2006 with the support of ADB and JICA (from the Luzon grid, followed by operation in the Visayas grid in 2010. As of October 2018, the Mindanao area is under preparation).
- Luzon accounts for 80% of the transaction volume, and MERALCO is the largest buyer

Source: NRI Analysis

Primary Energy-related indicators: Primary Energy Supply

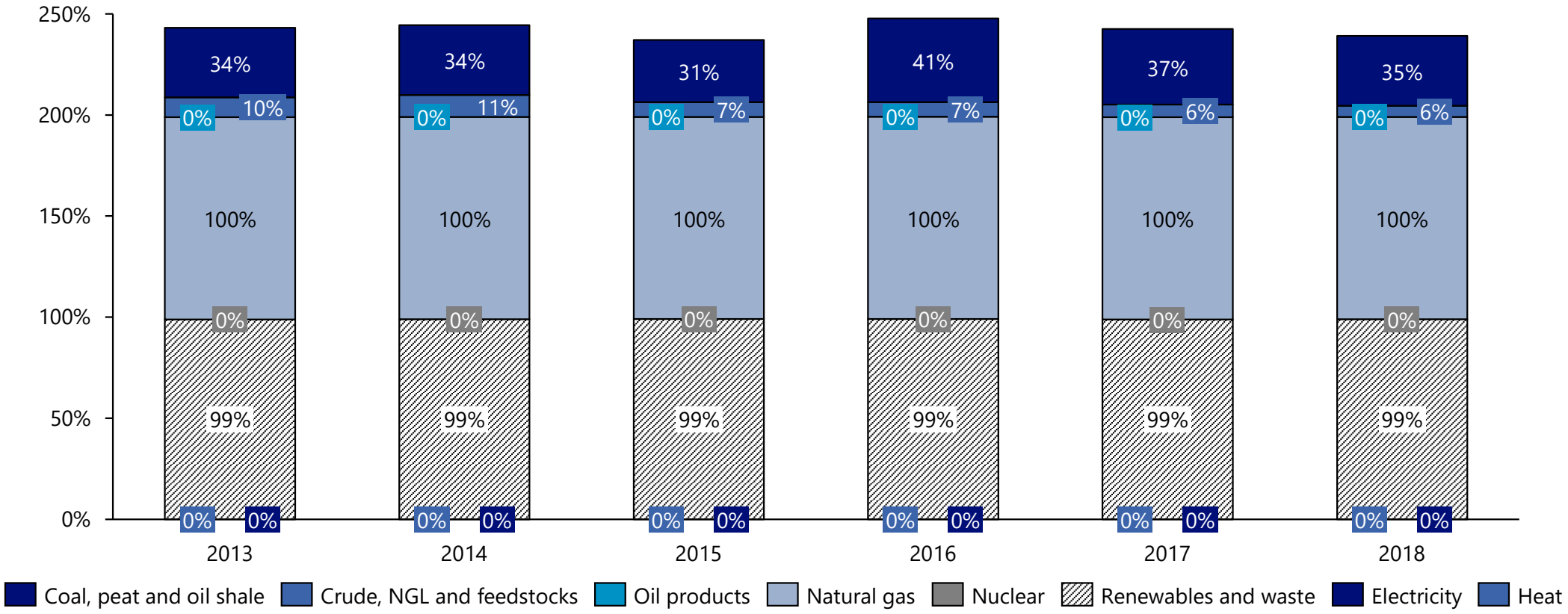
Primary Energy Supply by Fuel from 2013 to 2018



Source: IEA, NRI Analysis

Primary Energy-related indicators: Self-Sufficiency

Self-Sufficiency by Fuel from 2013 to 2018



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Source: IEA, NRI Analysis

Electricity-related indicators: Demand and Supply Trend

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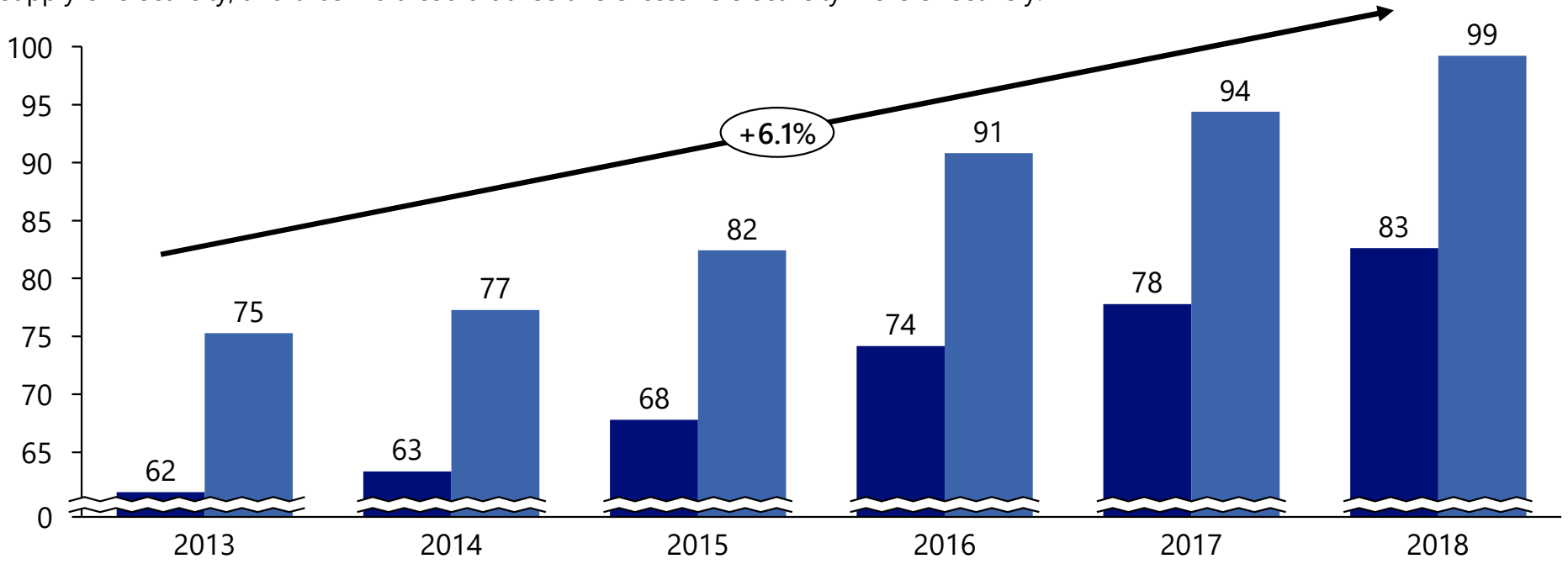


	2013	2014	2015	2016	2017	2018	Average
Domestic demand per capita (MWh)	0.62	0.63	0.66	0.72	0.74	0.77	0.69

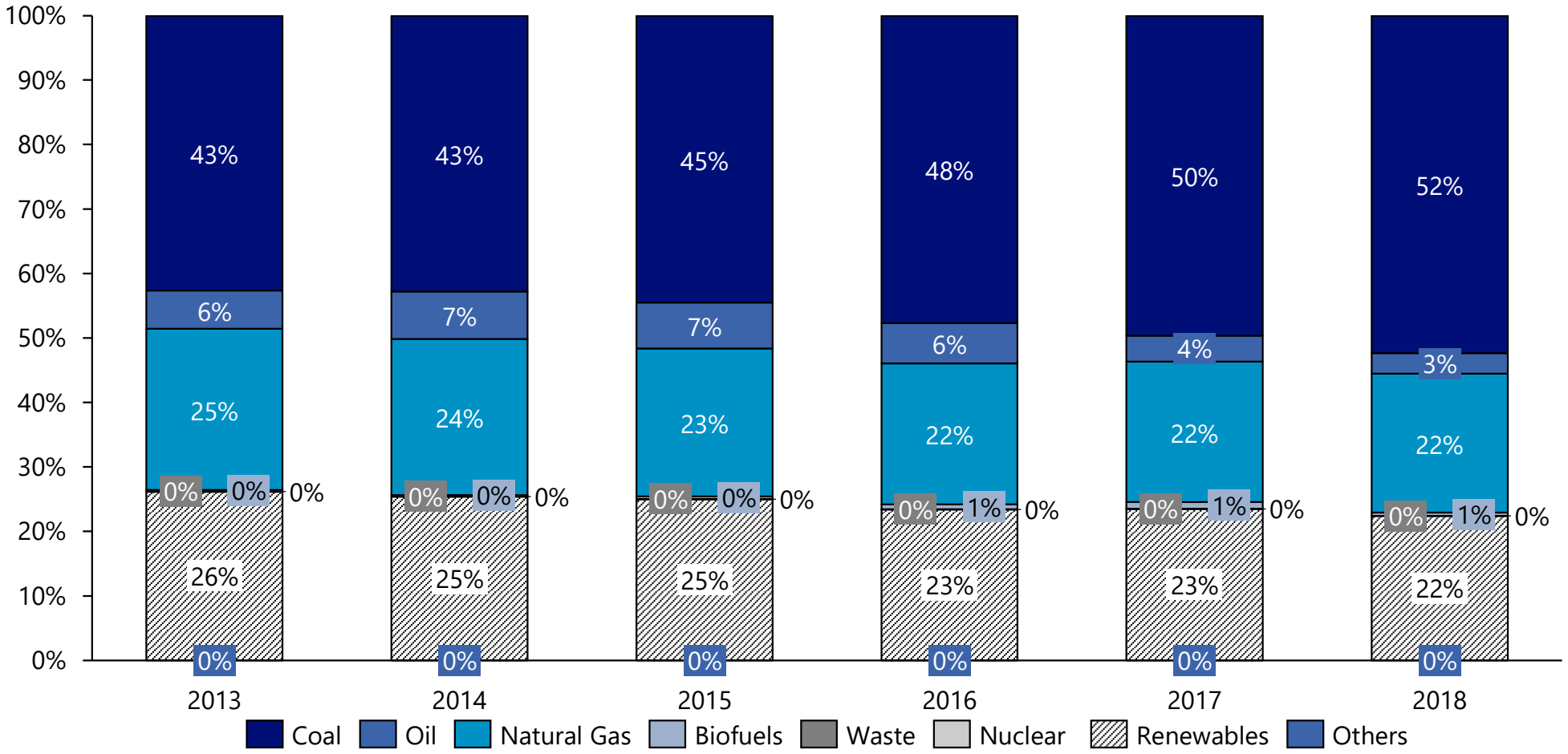
Electricity Domestic Demand (TWh) Electricity Domestic Supply (TWh)

Above Average Below Average

Source: IEA, NRI Analysis

Electricity-related indicators: Electricity Generation Composition (%)

Electricity Generation Composition Ratio (%) from 2013 to 2018



Source: IEA, NRI Analysis

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Power Business Structure: Singapore

Regulatory body

Energy Market Authority (EMA)

- Overview: Established in 2001 with the liberalization of the energy industry to regulate the electricity and gas markets and ensure the stability of the electricity system.
- Organization: Legal organization under the Ministry of Trade and Industry (A legal entity established under an individual law that regulates the relationship between the statutory body and the ministry. Staff are not public servants.)
- Role and Responsibility: Implement electricity, city gas and district heat supply regulations

Generation

95% is Natural Gas

- Generation base (total 53TWh) (2018):
  Gas 95%
  Coal 1%
  Oil 1%
  Others 3%
- Small land area and poor renewable energy potential. Most of primary energy depends on imports

Power companies have a 95% capacity share

- 5% from home generation
- Licenced for 15 companies
- Main Players:
  Senoco Energy 3.3GW
  YTL Power Seraya 3.1GW
  Tuas Power Generation 2.6GW
  Keppel Merlimau Cogen 1.3GW
  SembCope Cogen 1.2GW
  PacificLight Poer 0.8GW

Transmission / Distribution

SP PowerGrid operates facilities owned by SP PowerAssets

- Grid operators are PSOs (a division of EMA)
- Standard voltage: 400kV－6.6kV
- SP PowerAssets owns transmission and distribution equipment, including a 29,000km underground line
- SP PowerGrid operates facilities owned by SP PowerAssets and PowerGas

Trading market

NEMS (National Electricity Market of Singapore) consists of a spot market and a reserve electricity market

- Operated by The Energy Market Company Pte Ltd.
- Market participants can choose to procure from (1) the spot market, (2) procure through bilateral contracts, or (3) procure at regulated prices through SP Services.
- There are a total of 76 market participants (based on EMA licenses): 15 power generation companies, 30 retailers, 3 wholesalers (adjustable load service: DR), and 28 wholesalers (power generation).

Retail

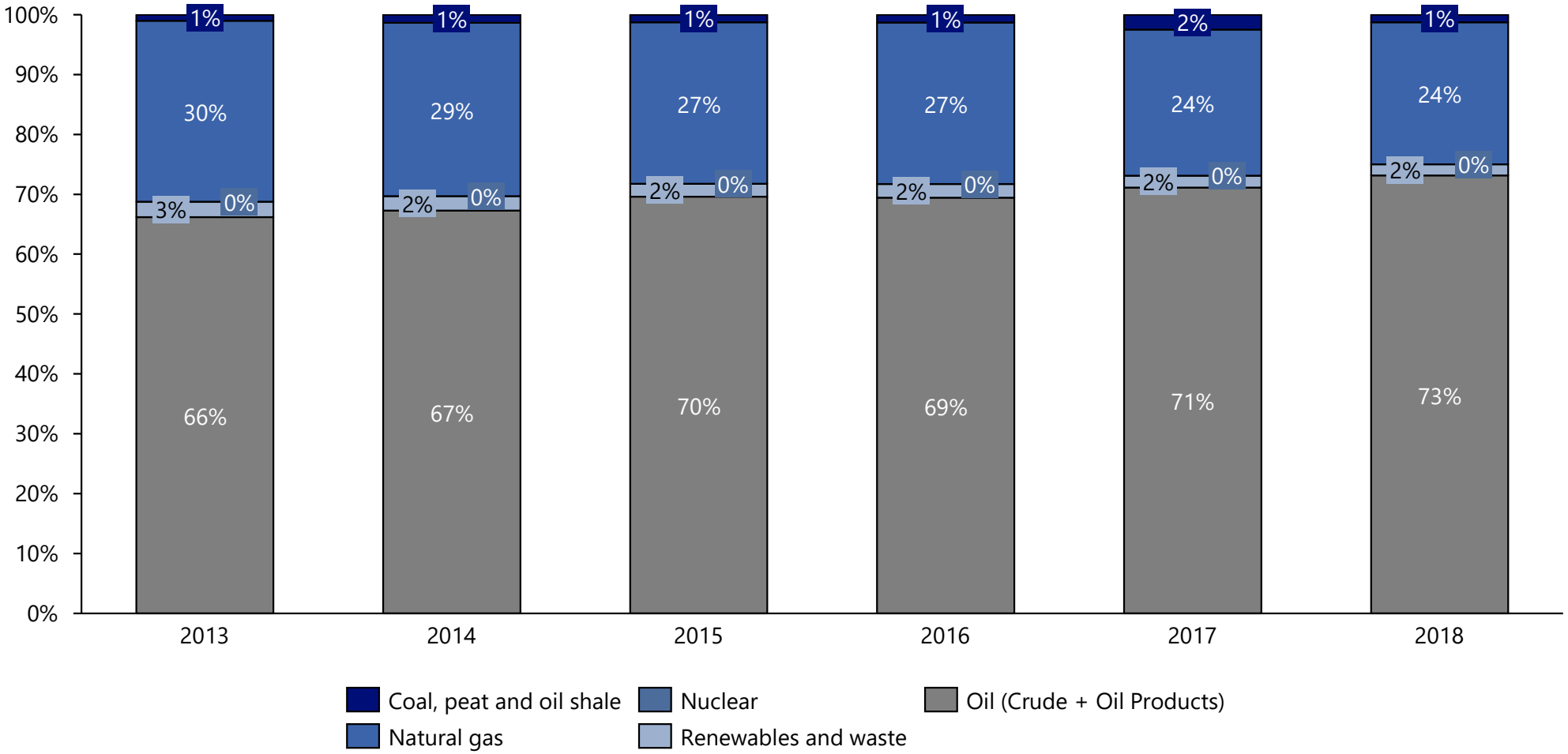
Competition among 30 companies

- Licenced to 30 companies
- 90% share by six big players
- Retail market was gradually liberalized.
  >10MWh/mo (2000)
  >8MWh/mo (2004)
  >4MWh/mo (2014)
  >2MWh/mo (2015)
  Full liberalization (Nov 2018)
- SP Group, which has been supplying power to non-liberalized customers, continues to supply power at regulated rates. Consumers can still choose SP Group.
- Main Players (share in 2017)
  SP Services 35.5%
  Keppel Electric 13.8%
  Tuas Power Supply 13.6%
  Seraya Energy 12.2%
  Senoko Energy Supply 11.6%
  SembCorp Power 10.9%
  PacificLight Energy 6.1%

Source: NRI Analysis

Primary Energy-related indicators: Primary Energy Supply

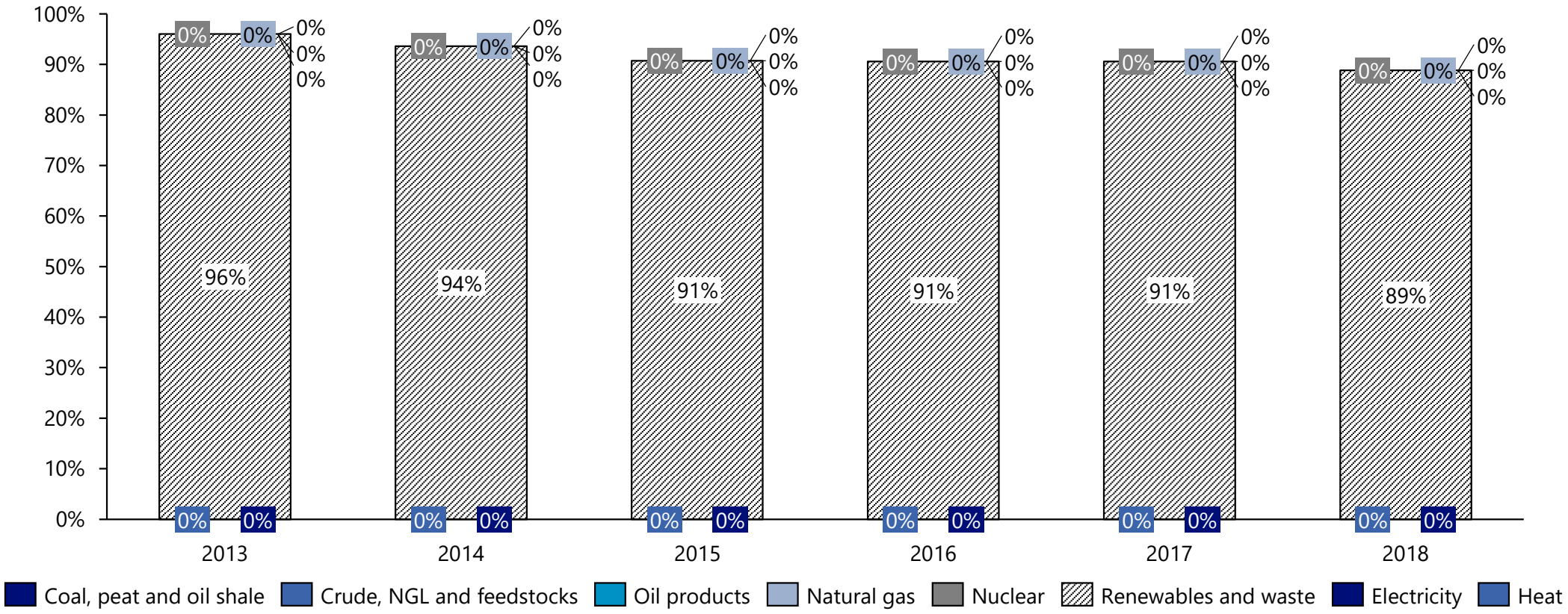
Primary Energy Supply by Fuel from 2013 to 2018



Source: IEA, NRI Analysis

Primary Energy-related indicators: Self-Sufficiency

Self-Sufficiency by Fuel from 2013 to 2018



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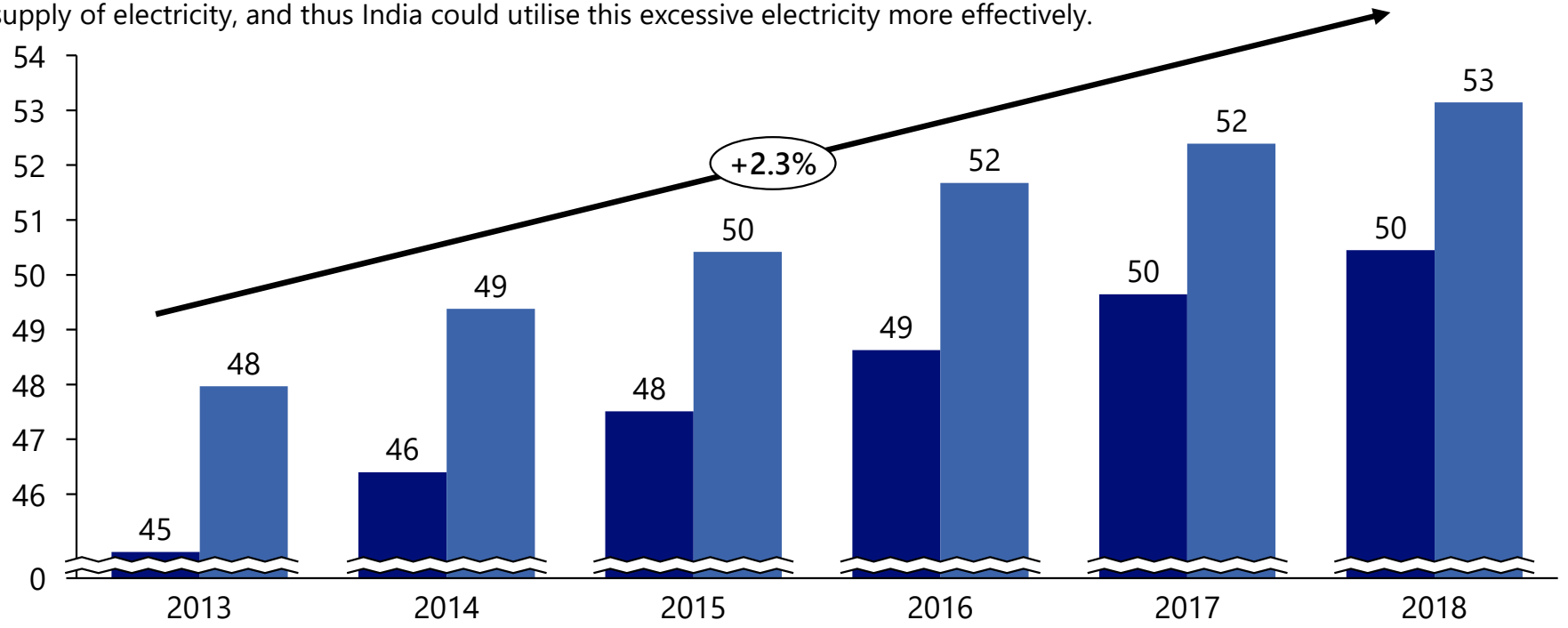


	2013	2014	2015	2016	2017	2018	Average
Domestic demand per capita (MWh)	8.33	8.48	8.58	8.67	8.85	8.95	8.64

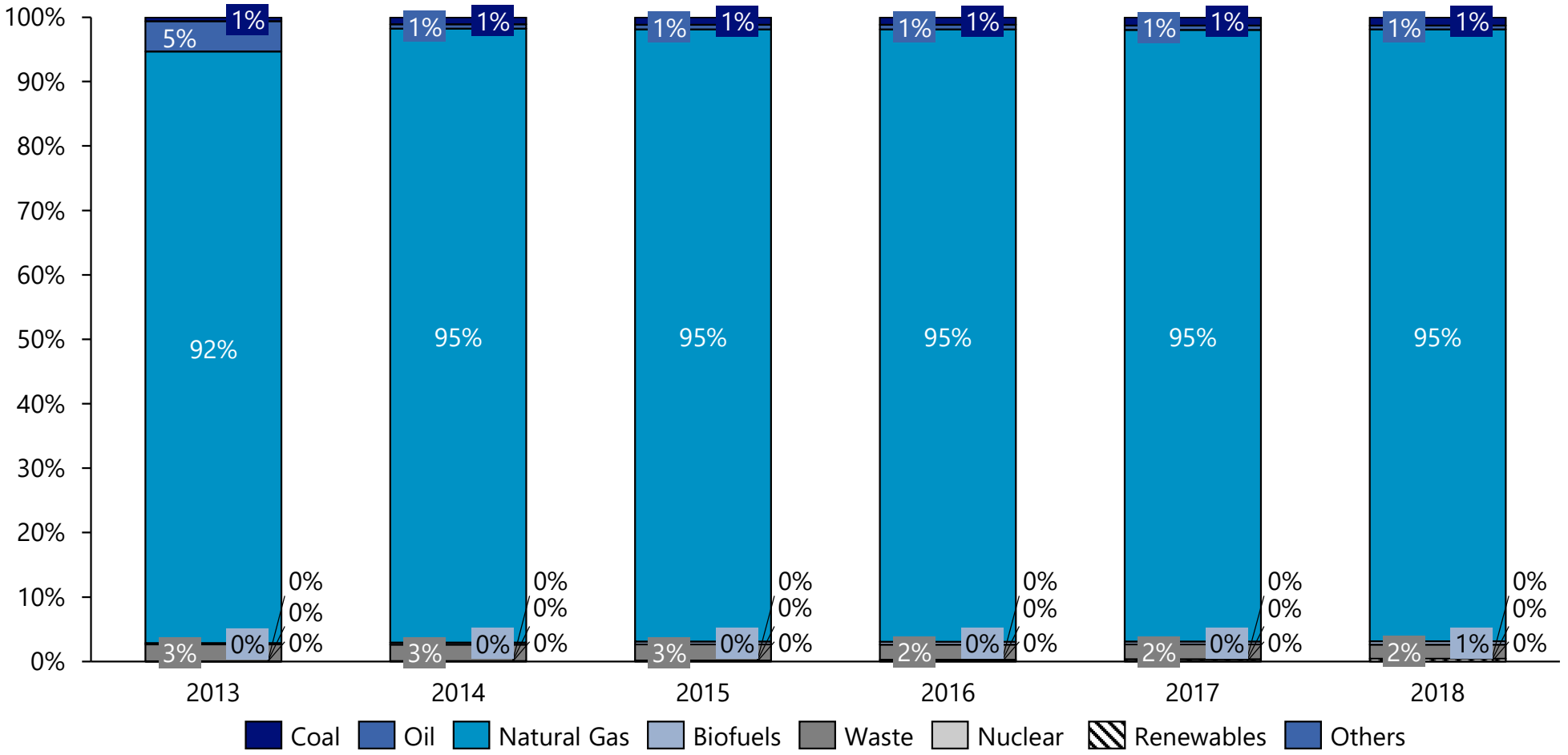
Electricity Domestic Demand (TWh) | Electricity Domestic Supply (TWh)

Above Average | Below Average

Source: IEA, NRI Analysis

Electricity-related indicators: Electricity Generation Composition (%)

Electricity Generation Composition Ratio (%) from 2013 to 2018



Source: IEA, NRI Analysis

Agenda

1. Basic Statistics in APAC energy sector
2. Key trend and related indicators
3. **Each Country Statistics**
    - Bangladesh
    - India
    - Indonesia
    - Malaysia
    - Philippines
    - Singapore
    - **Thailand**
    - Vietnam

Power Business Structure: Thailand

Regulatory body

Ministry of Energy (MOEN)
- In charge of EGAT, MEA, PEA.

National Energy Policy Office (NEPO)
- Responsible for power generation planning, investment promotion, transmission and distribution planning, investment promotion, wholesale price regulation, etc.

Generation

Natural Gas is 63% of total generation
- Generation (2018): Natural Gas (63%), Coal: (20%), Renewables (8%)
- Higher natural gas due to expansion of imports from Myanmar
- The same applies to coal with increase in import from Laos

50% share each from EGAT and IPP•SPP. Majority of IPP is subsidiary of EGAT
- Generation based share by company: EGAT (49%), IPP/SPP (51%), PEA, DEDE (0.1%)
- IPP/SPP has a high market share, but statistically four EGAT subsidiaries are also included in the IPP

Transmission

Exclusively owned and operated by EGAT
- Backbone system: 500, 230kV
- Electricity generated by IPP and SPP operators is wholesaled to EGAT and transmitted using EGAT's transmission facilities

Distribution

Exclusively owned and operated by MEA•PEA
- MEA distributes to the metropolitan area and PEA distributes to rural areas.
- MEA: High voltage: 24, 12kV, low voltage: 380, 220V
- PEA：High voltage: 33, 22, 19kV, low voltage: 400, 230V

Trading market

EGAT occupies transmission, MEA•PEA occupies retail and there's no market trading
- We cannot confirm the existence of the power exchange at this time

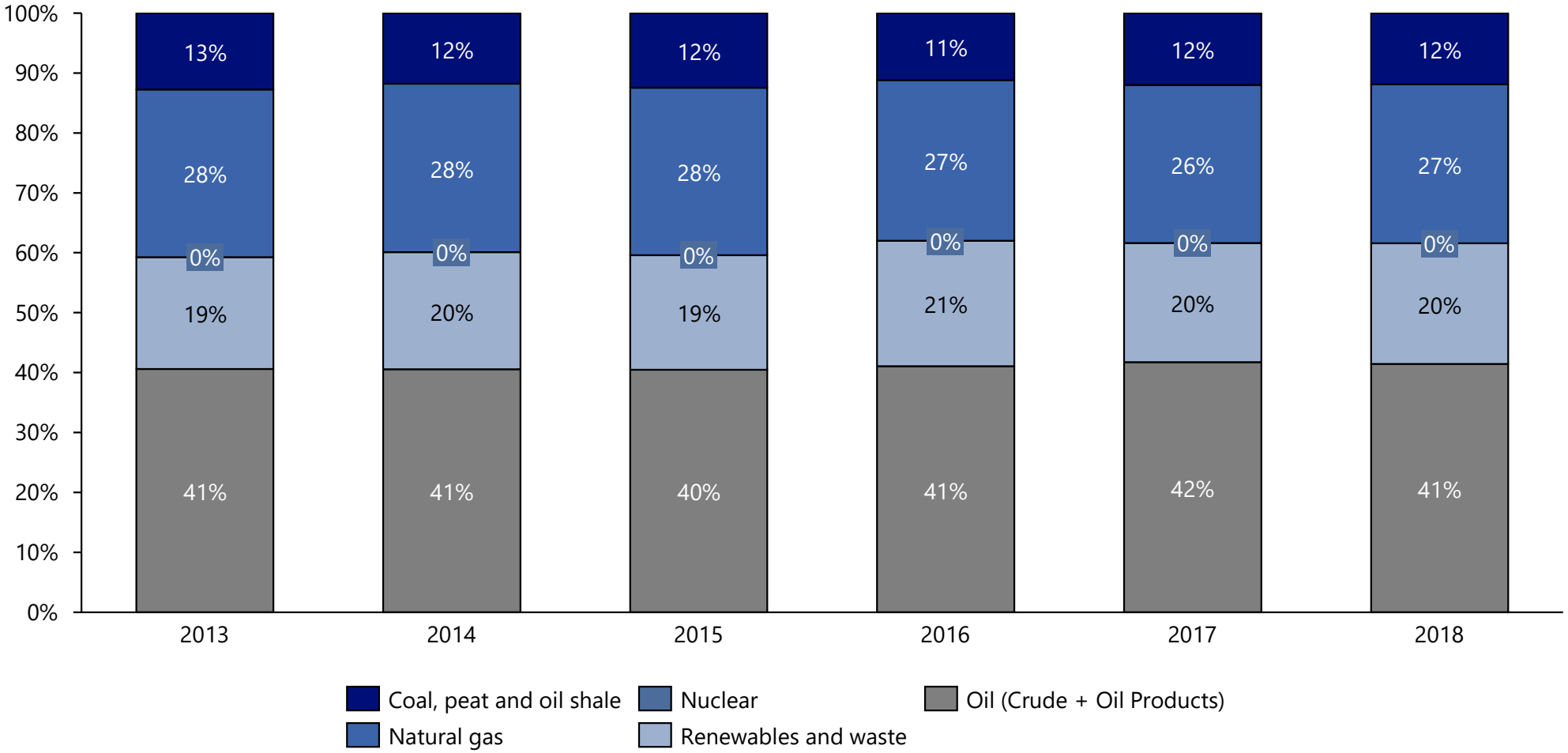
Retail

Exclusively retailed by MEA•PEA
- MEA retails to the metropolitan area and PEA to rural areas.
- In the past, liberalization of retail supply was considered along with privatization of EGAT (later failed) but withdrew due to the 2000-2001 California power crisis.
- EGAT purchases electricity from IPPs / SPPs etc. as an off-taker and wholesales (sells) to power distribution companies and large customers

Source: NRI Analysis

Primary Energy-related indicators: Primary Energy Supply

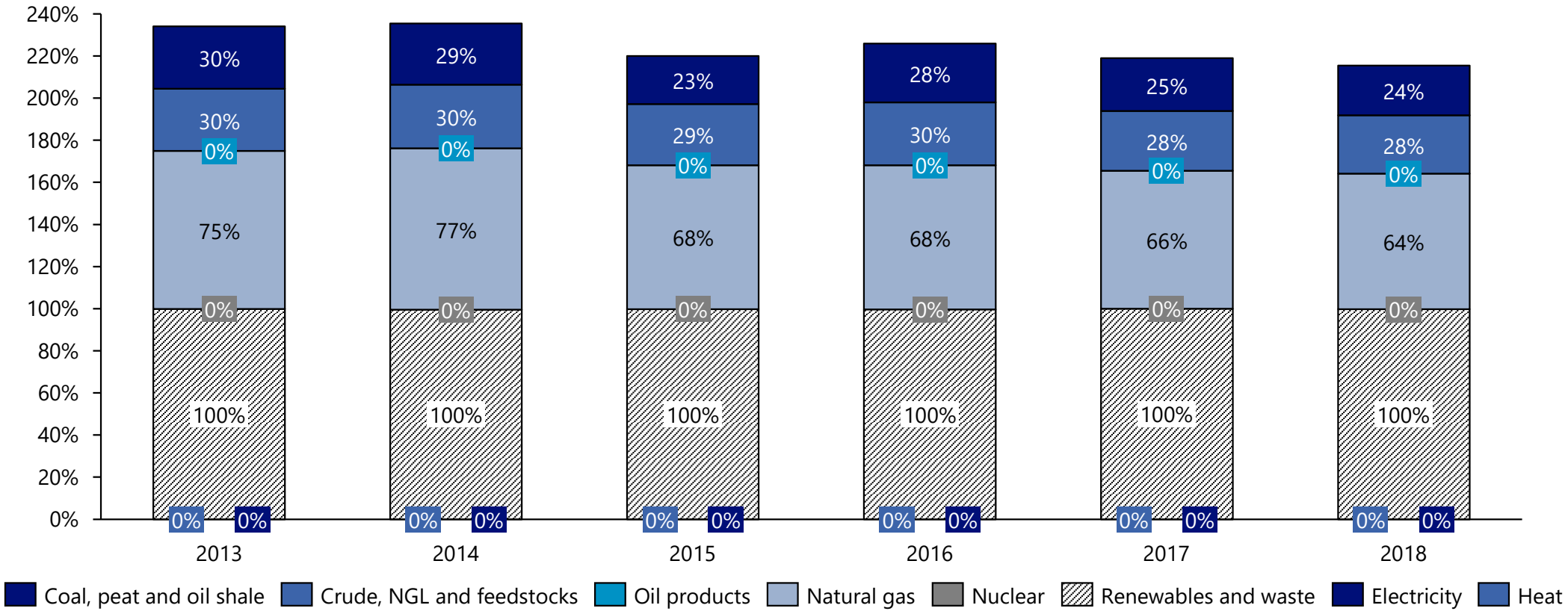
Primary Energy Supply by Fuel from 2013 to 2018



Source: IEA, NRI Analysis

Primary Energy-related indicators: Self-Sufficiency

Self-Sufficiency by Fuel from 2013 to 2018



Definition
(1) Domestic Production
(2) Domestic Supply = (1) Domestic Production + Imports – Exports + Adjustments such as stock changes
(3) Primary Energy Balance = (1) Domestic Production / (2) Domestic Supply

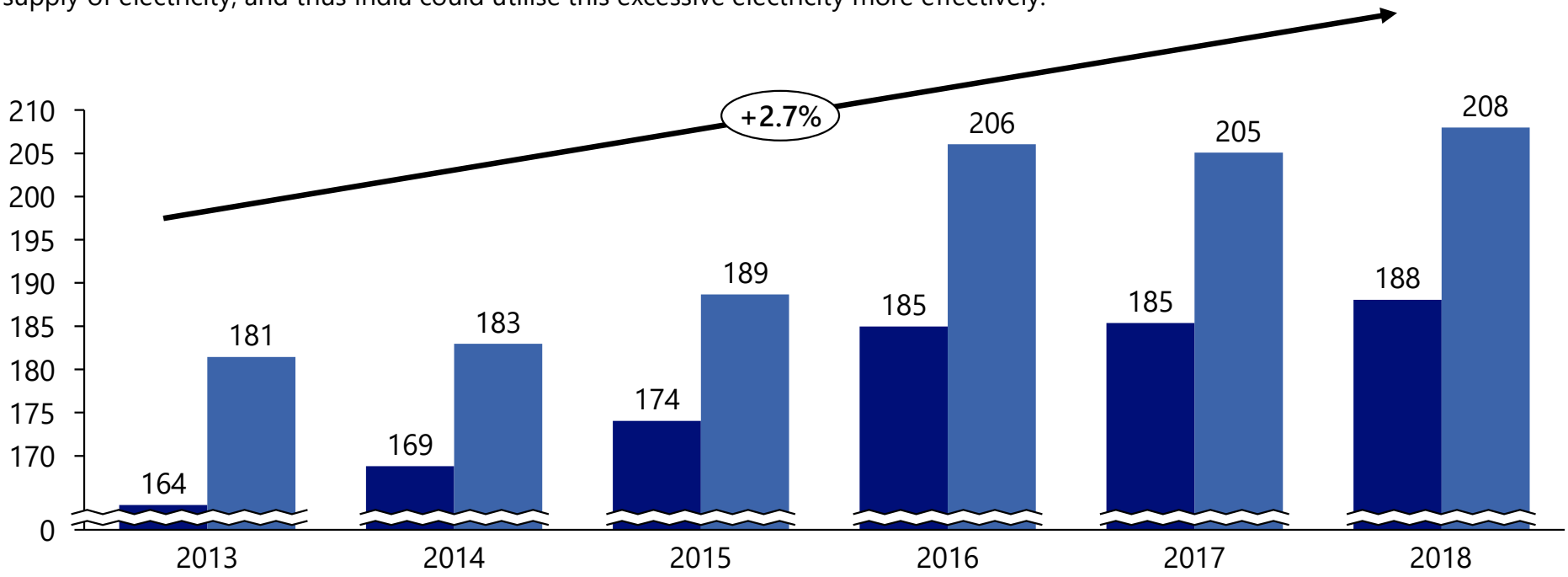
Note(s): Please take note that the graph does not show proportion but the self-sufficiency rate per fuel

Source: IEA, NRI Analysis

Electricity-related indicators: Demand and Supply Trend

Electricity Demand and Supply from 2013 to 2018

- Definition: (1) Domestic Demand = Domestic Consumption. (2) Domestic Supply = Domestic Production + Imports – Exports
- Insights: All 8 countries have more sufficient electricity as domestic supply is more than their domestic demand. However, India has excessive oversupply of electricity, and thus India could utilise this excessive electricity more effectively.



Source: IEA, NRI Analysis

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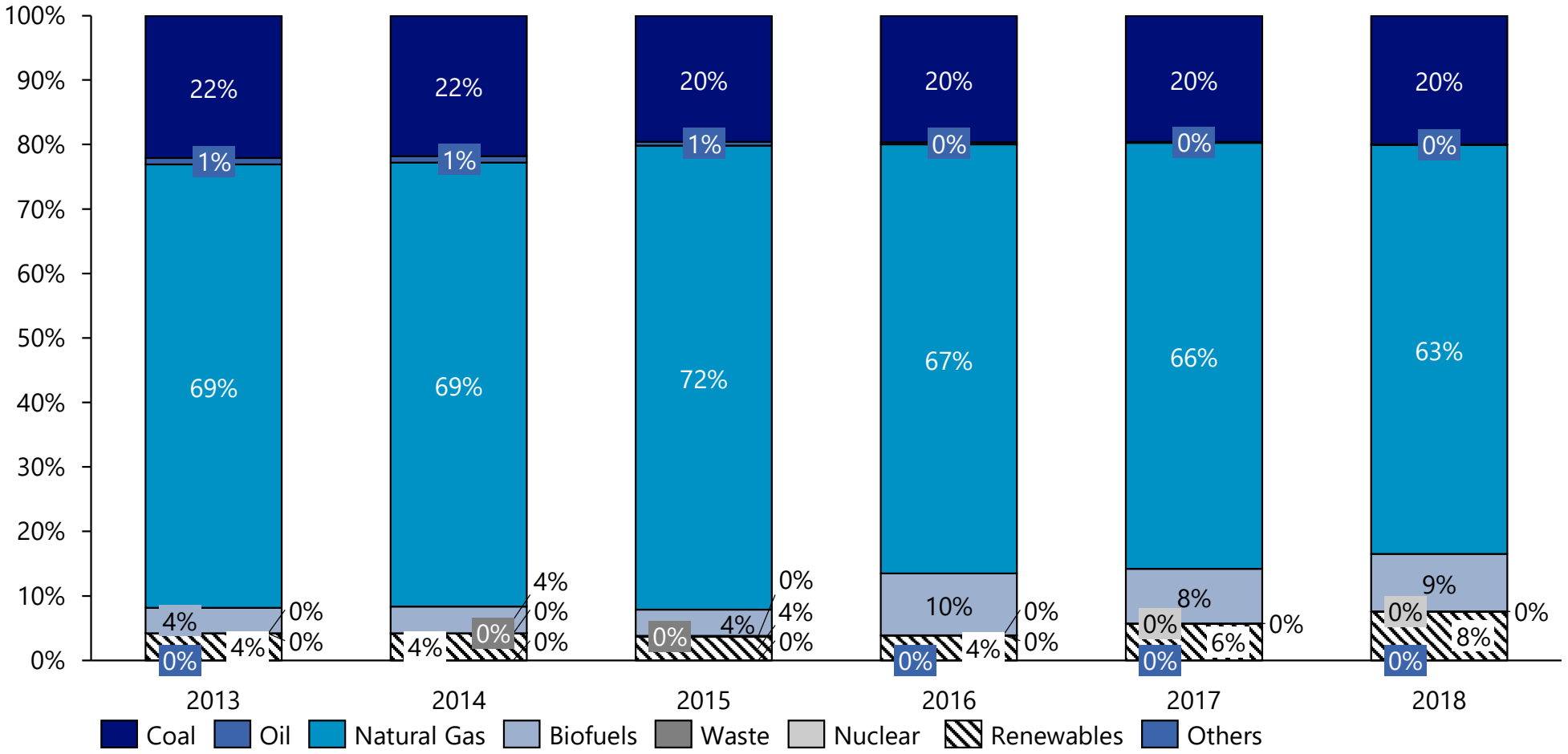
Electricity Generation Composition Ratio (%) from 2013 to 2018



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Power Business Structure: Vietnam

Regulatory body

Electricity Regulatory Authority (ERAV)

- Established under Ministry of Industry and Trade (MOIT) in 2005. It regulates electricity markets and prices. It's an independent committee unaffected by politics.
- MOIT also owns EVN, so there's conflict of interest with ERAV supervision.

Generation

Mainly conventional power supply. Renewable energy was introduced from 2015.

- Full-scale introduction of renewable energy starts in 2015
- Main generation in 2018: Renewables (35%), Natural Gas (17%)

EVN subsidiaries has majority of share (61%, 2016). IPP/BOT share is 39%.

- EVN subsidiaries are divided into three companies towards privatization (Genco 1-3)
- There are two state-owned IPP operators: Petrovietnam (PVN) and VINACOMIN. (There are few other local IPP)
- Foreign IPP is called BOT

Transmission

Occupied by EVN NPT

- A 500kV transmission line running north-south was completed in 1994, linking north-south grids.
- EVN NPT is a state-owned transmission company that reports directly to EVN. Four TSO were merged and established in 2008 (North (PTC1), Mid-North (PTC2), Mid-South (PTC3), South (PTC4)).

Distribution

Occupied by EVN related company. There is also regions where there is a Commune distribution company below.

- There are five DSO (PC) under EVN. Regional monopoly operation. Implemented by each company's independent profit system.
- In some cases, Commune operators perform facility design, construction, operation, and maintenance at the village level.

Trading market

Doesn't exist

- EVN takes off all IPP power generation
- The wholesale / retail electricity market is scheduled to be introduced but is still in the demonstration stage

Retail

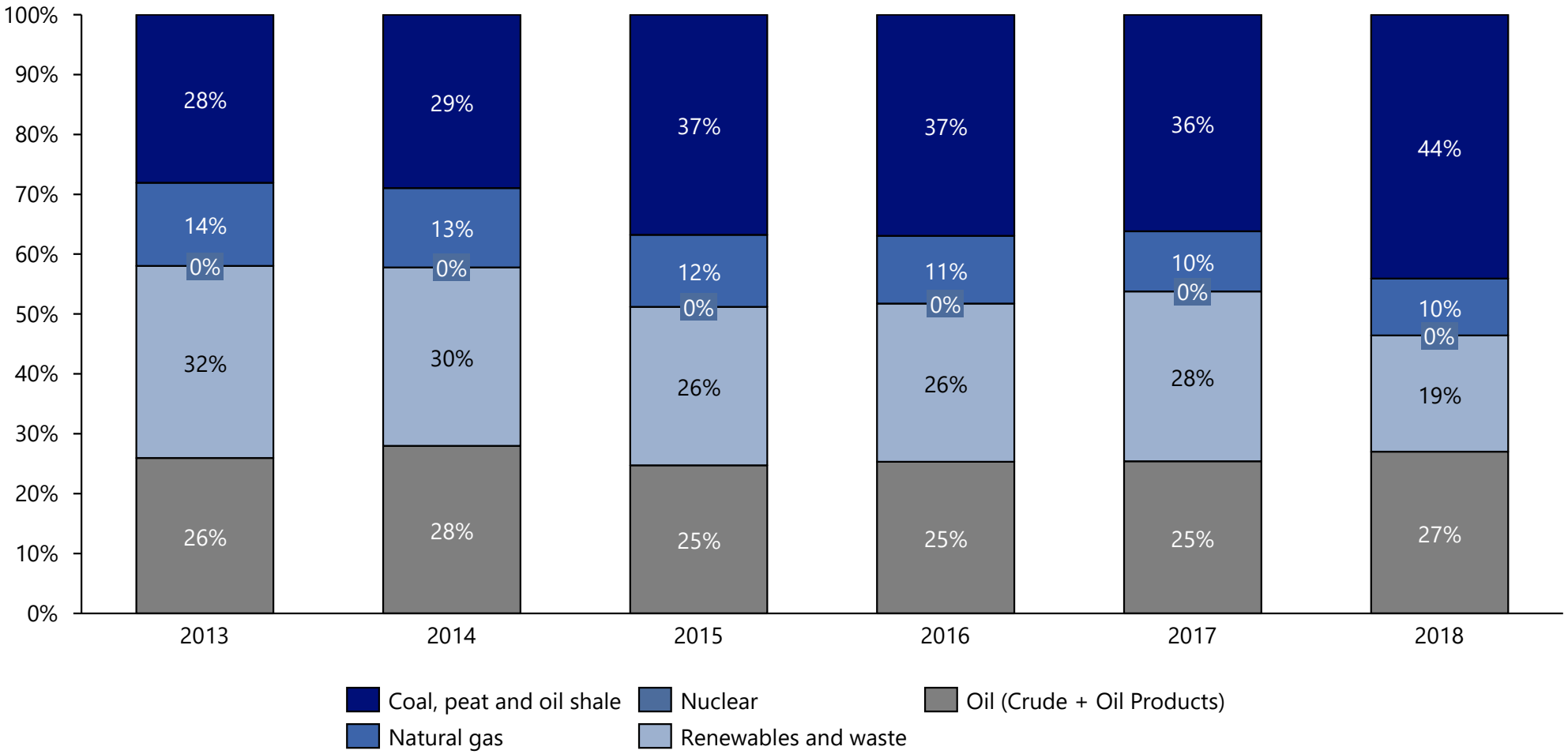
Price regulation eased

- Basically implemented by five distribution companies under EVN.
- Also operated by a Commune operator (electrification association, local government) that receives power from a PC
- In the past, the nationwide unified retail price set by EVN was used, but since 2010, each distribution company can negotiate the price if it is below the predetermined cap.

Source: NRI Analysis

Primary Energy-related indicators: Primary Energy Supply

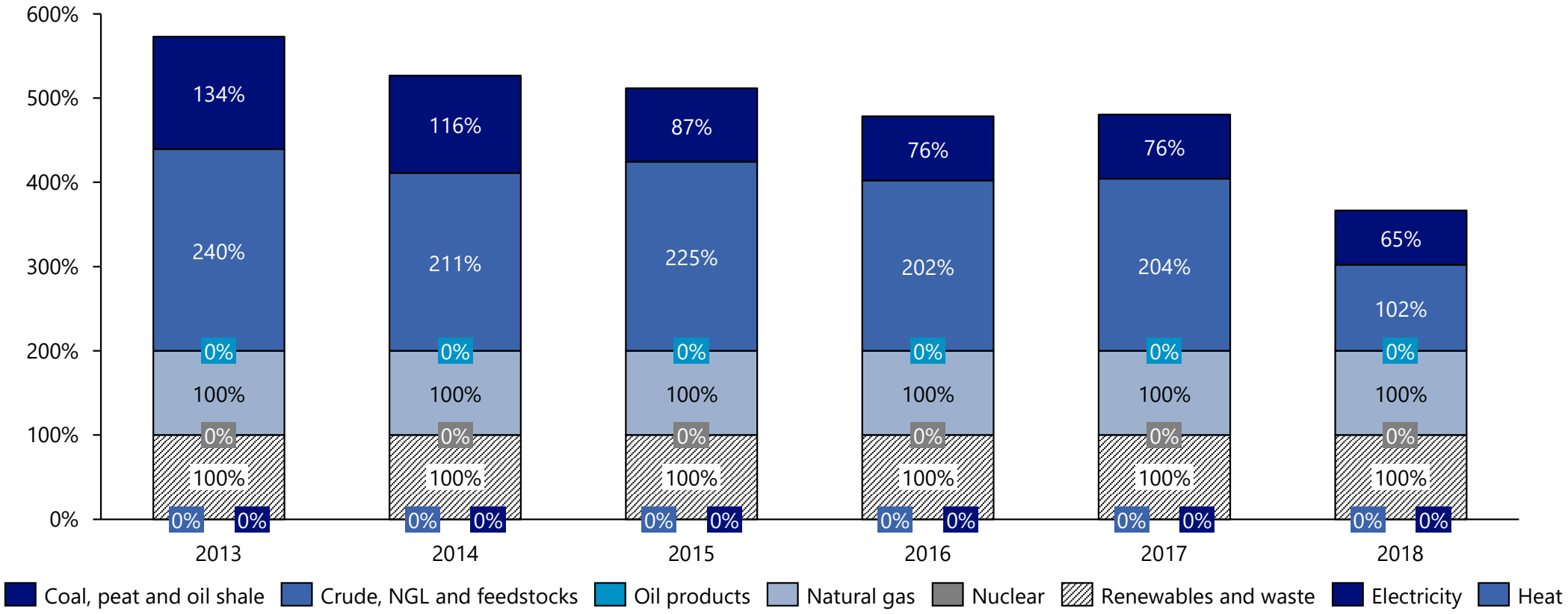
Primary Energy Supply by Fuel from 2013 to 2018



Source: IEA, NRI Analysis

Primary Energy-related indicators: Self-Sufficiency

Self-Sufficiency by Fuel from 2013 to 2018



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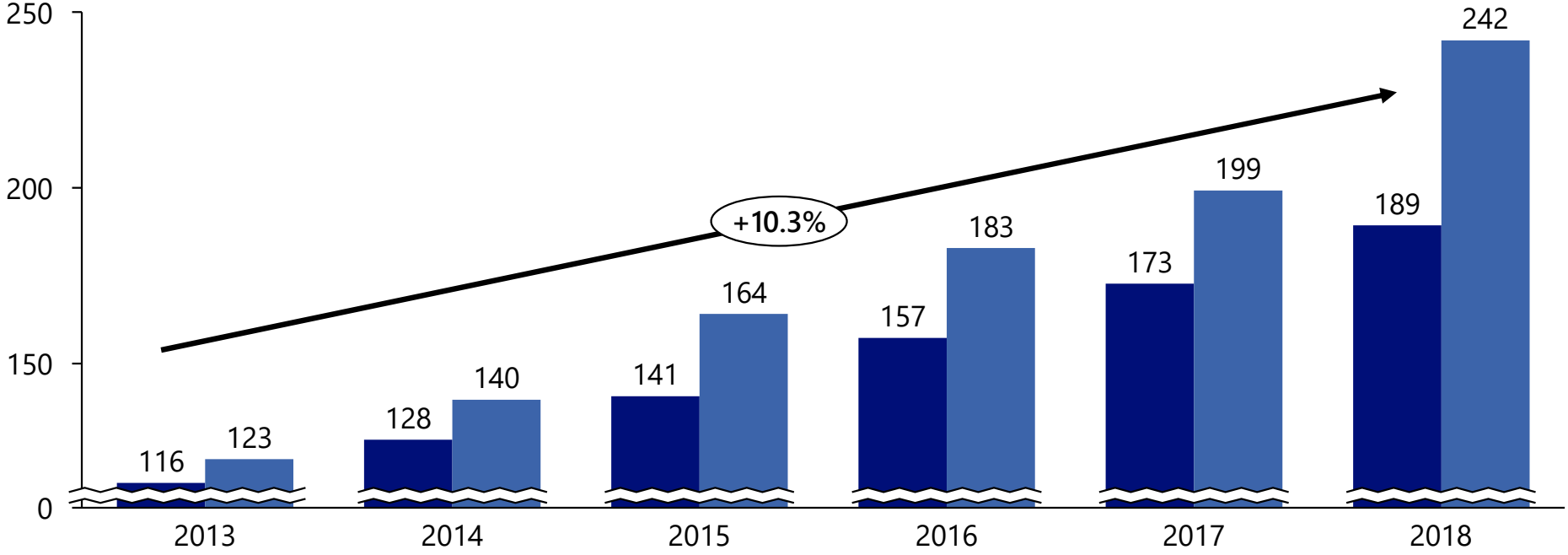

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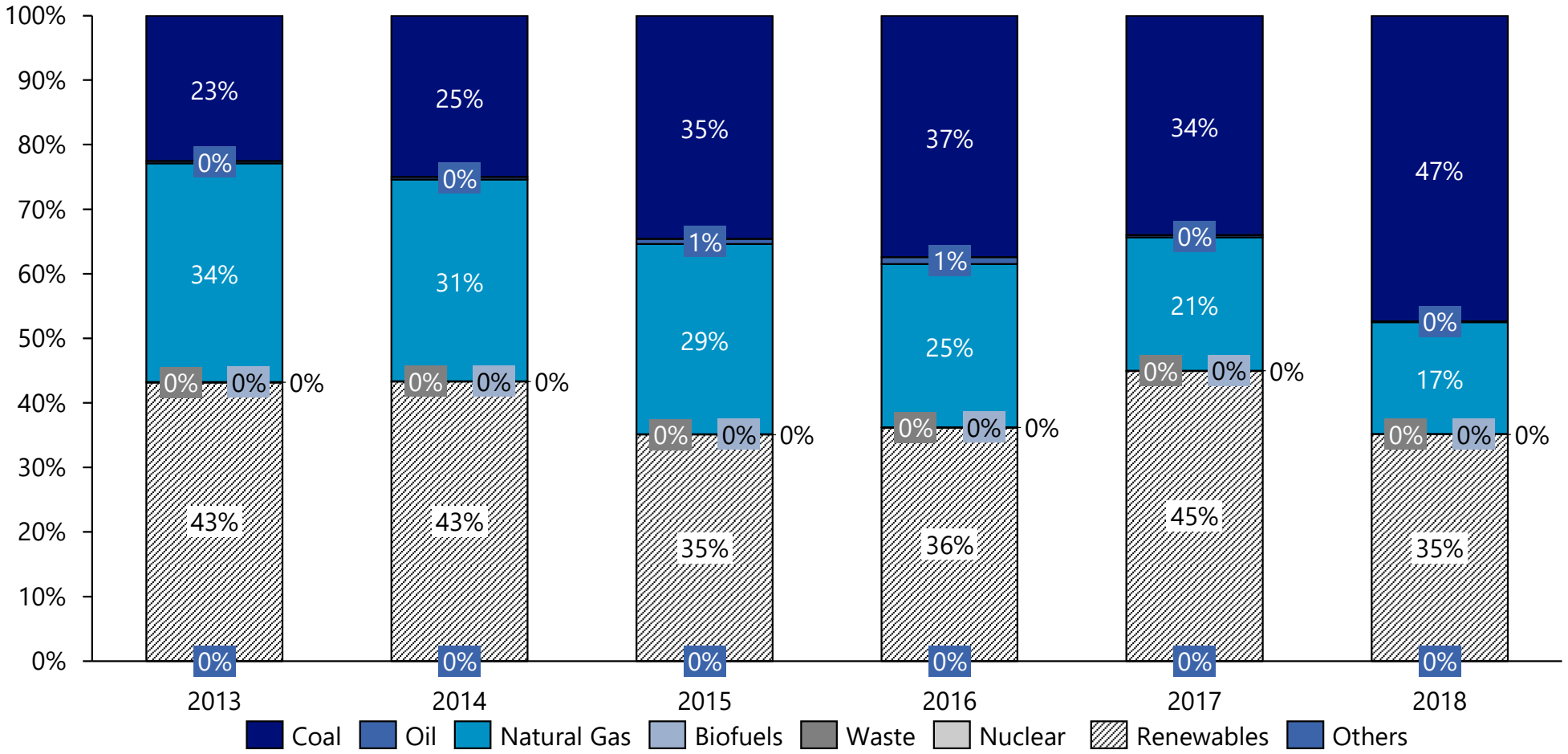

Source: IEA, NRI Analysis

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❖ Contact

NRI Singapore Energy group

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❖ Coming soon

- Our energy team will publish the energy related report quarterly.
- Next publishment will be disclosed on around October 2021.
- The topic will be “Carbon neutral trend in ASEAN region”

Share the Next Values!