

RENEWABLE ENERGY OUTLOOK THAILAND

Based on Renewables Readiness Assessment
and REmap analysis

Thailand's Ministry of Energy and International Renewable Energy Agency (IRENA)

EE460: Thai Economy

Semester 1/2018

Faculty of Economics, Thammasat University

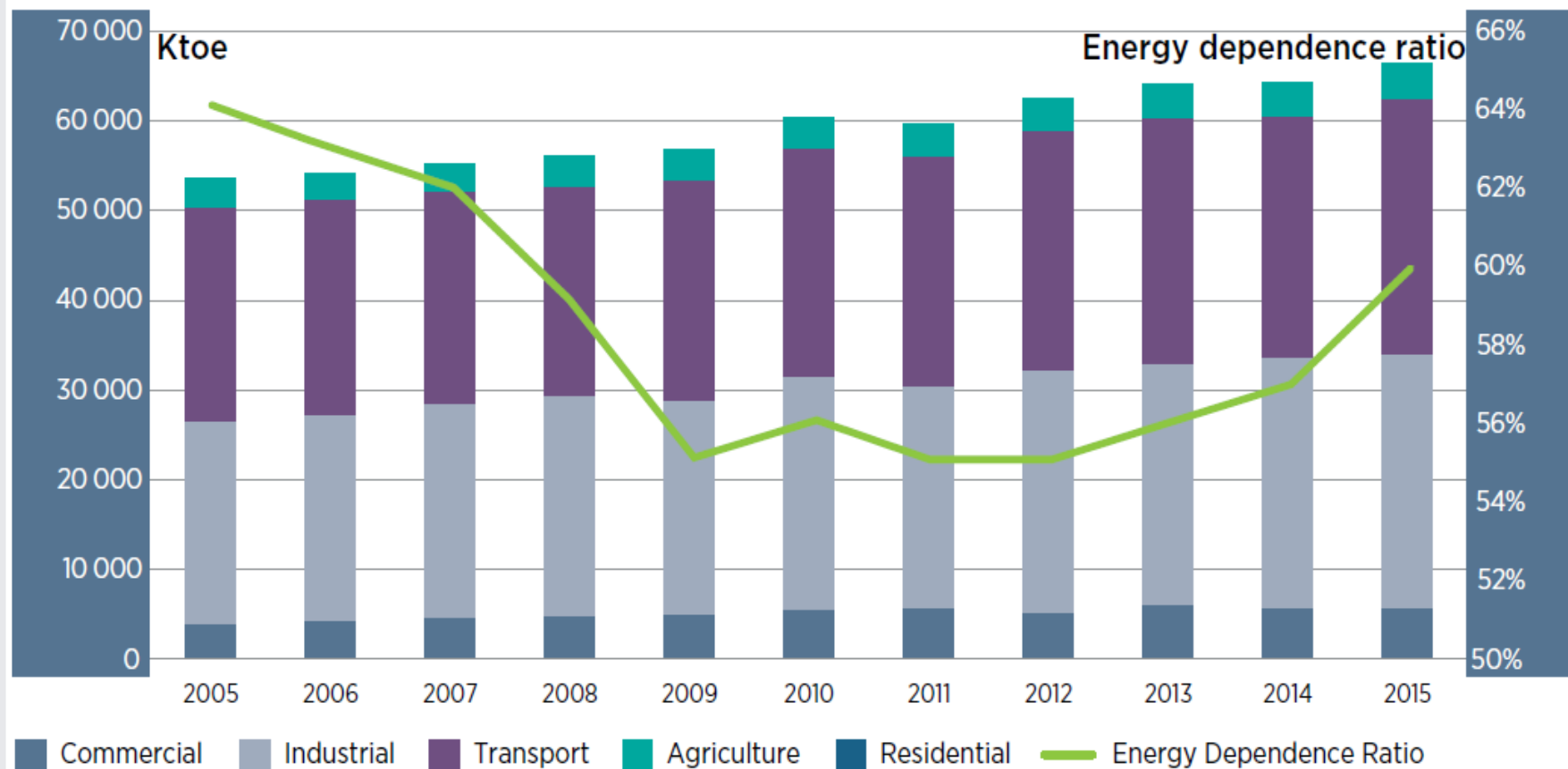
1. Overall energy system

Energy consumption and production

- For the past decade, Thailand's **Total Final Energy Consumption (TFEC)** has been **steadily increasing**, as illustrated in Figure 2. The **industrial and transport sectors** consumed largely **three-quarters of the total**.
- The secondary axis in the figure shows the **energy dependence ratio**, with more than **one-half of TFEC** met by **imported energy sources**.
- Expenditure on **energy imports** reached a peak of **12% of Thailand's GDP** in 2008, attributable to the **oil price surge**.
- While it had nearly **halved from the peak in 2015**, the country's energy **dependence ratio**, on the other hand, **went up in response** to the **lower oil prices** (EPPO, 2016a).
- This might **not be regarded as an alarming signal** if it were put into historical perspective.

1. Overall energy system (cont'd)

Figure 2. Thailand's energy consumption by sector, 2005-2015



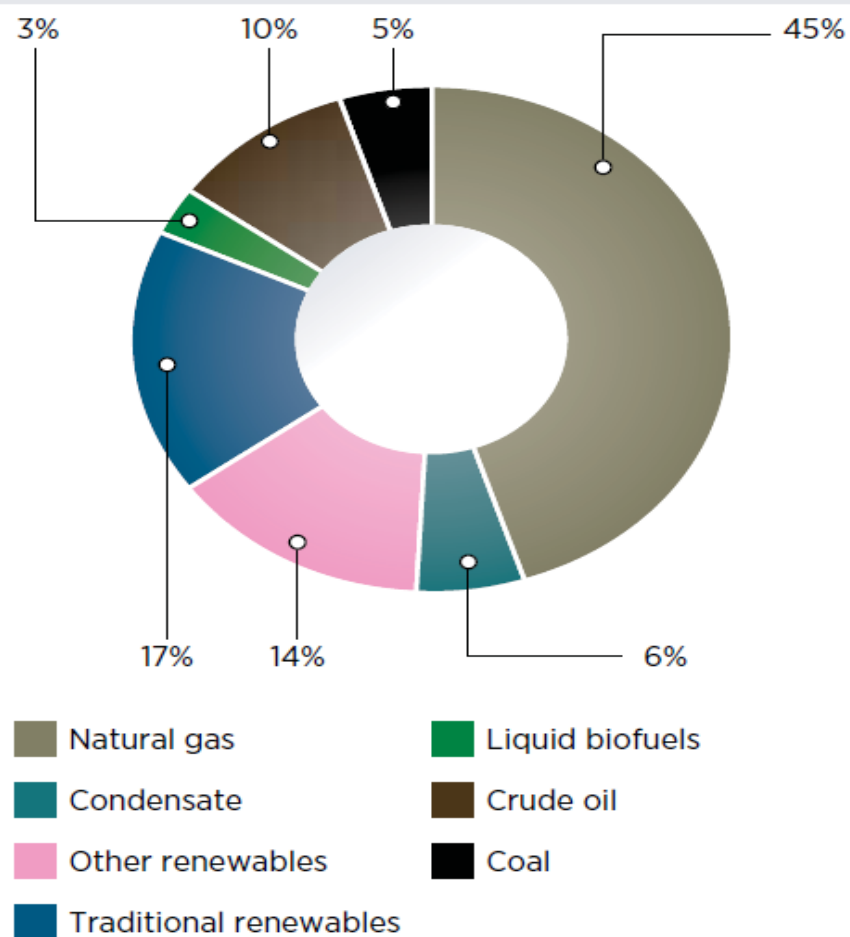
Note: ktoe = thousand tonnes of oil equivalent
Based on data from EPPO and DEDE, Ministry of Energy of Thailand

1. Overall energy system (cont'd)

- Over the past four decades, Thailand has been **relying on imported fuels** to meet more than **half of its energy demand**, having reached a record high of **90% dependence in the 1970s** before the **discovery and extraction** of **indigenous oil and natural gas resources**.
- Thailand has its own fossil energy resources such as crude oil, natural gas and coal, but the **oil and gas are not adequate** for domestic consumption and are expected to **deplete in a decade if current production rates** were to remain same as they are.
- If only the proven reserves are counted, Thailand would have about **4-5 years left for either oil or natural gas**, according to data from the MoE, while merely **2.3 years for oil and 5.5 years for gas according to BP**.
- Put it into perspective, the world average for oil or natural gas is about 50 years or so (EPPO, 2016a; BP, 2016).

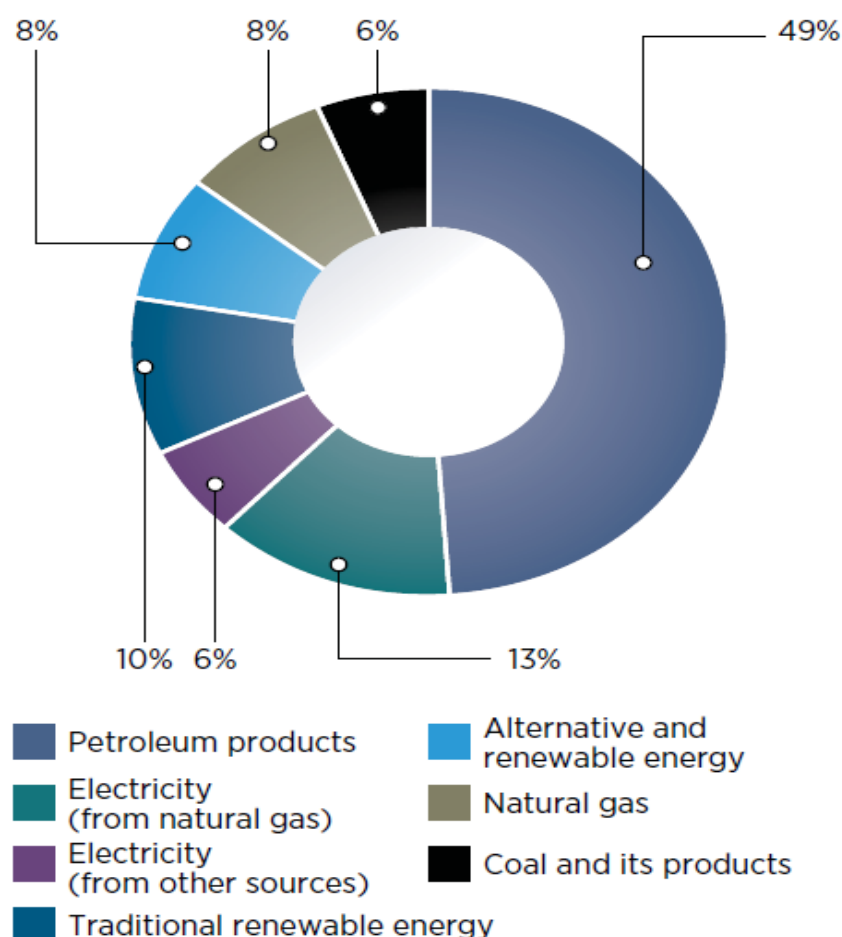
1. Overall energy system (cont'd)

Figure 3. Thailand's total primary energy production (from indigenous resources), 2015



Source: EPPO, 2016b

Figure 4. Thailand's energy consumption by fuel type, 2015



Source: EPPO, 2016b

1. Overall energy system (cont'd)

- Figure 3 shows that **natural gas, condensate and crude oil** accounted for **61% of total energy production** from indigenous energy resources in 2015.
- On the consumption side, **oil-derived energy products** and natural gas accounted for **around 70% of Thailand's TFEC**, as presented in Figure 4.
- This means that **imported energy or domestic lignite coal consumption would increase** if the other forms of energy were scaled up to fill the gap from the depletion of indigenous oil and gas resources.
- If so, this might **lock Thailand into a carbon-intensive energy system in future**, unless carbon capture and storage can present a viable technological option, which does not appear as if it will be the case.

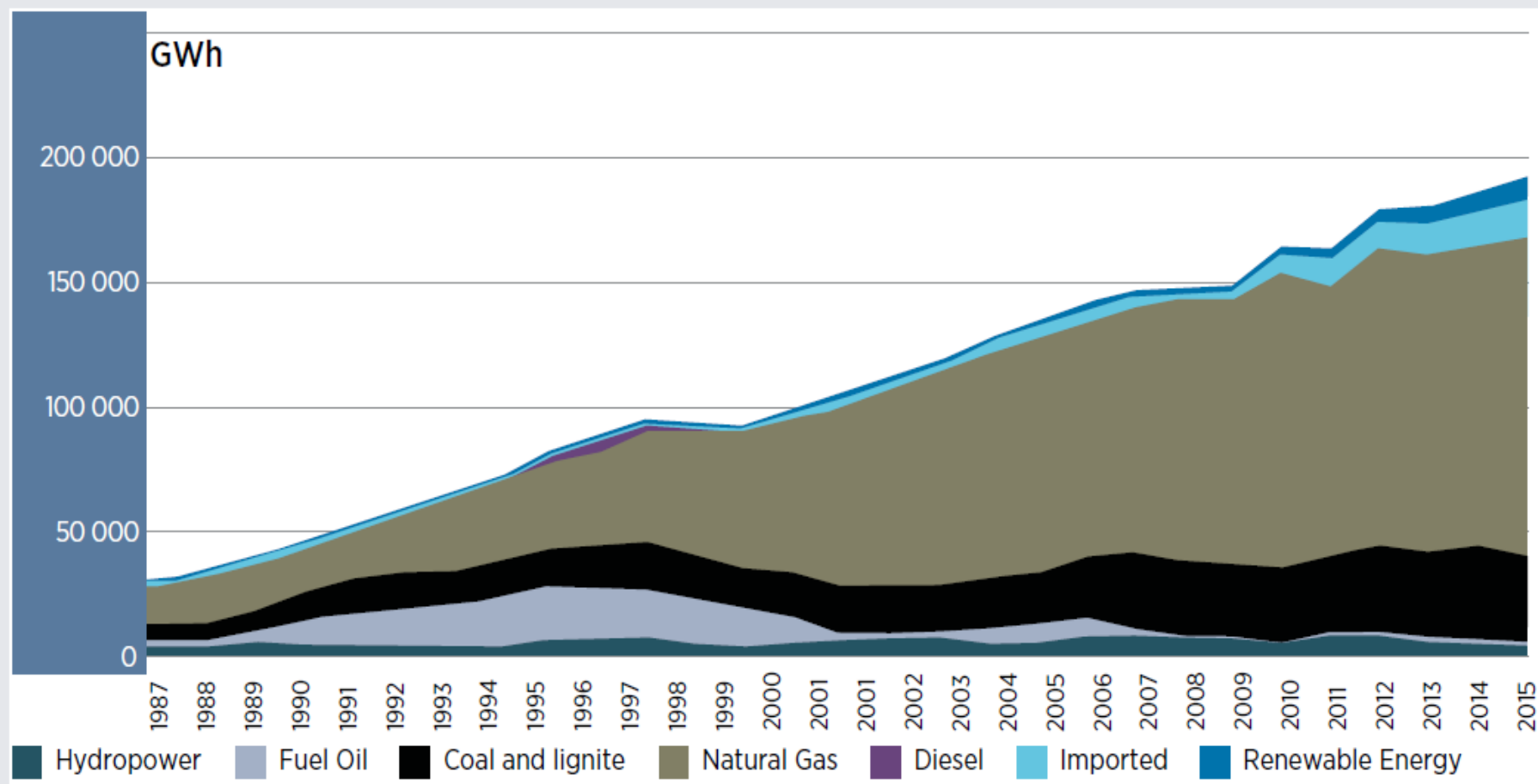
1. Overall energy system (cont'd)

Electric power system

- Thailand has a **well-established electric power grid** infrastructure providing **nearly universal access to electricity**, thanks to the **two-decade long Thailand Accelerated Rural Electrification programme**.
- **Power production** has been **steadily increasing to meet growing demand**, as illustrated in Figure 5.
- This was, in part, attributable to the **abundant supply of domestic natural gas** following its exploration and discovery in the 1970s.
- With the **depletion of natural gas reserves**, Thailand has stepped up its effort in **diversifying the power mix** by increasing the share of **renewable energy sources**, in particular **solar photovoltaic (PV)** and **wind power** generation capacity.

1. Overall energy system (cont'd)

Figure 5. Thailand's Power Supply, 1987-2015



Note: GWh = gigawatt-hour

Based on data from the Electricity Generating Authority of Thailand (EGAT), Provincial Electricity Authority (PEA) and Metropolitan Electricity Authority (MEA), compiled by Energy Policy and Planning Office (EPPO)

1. Overall energy system (cont'd)

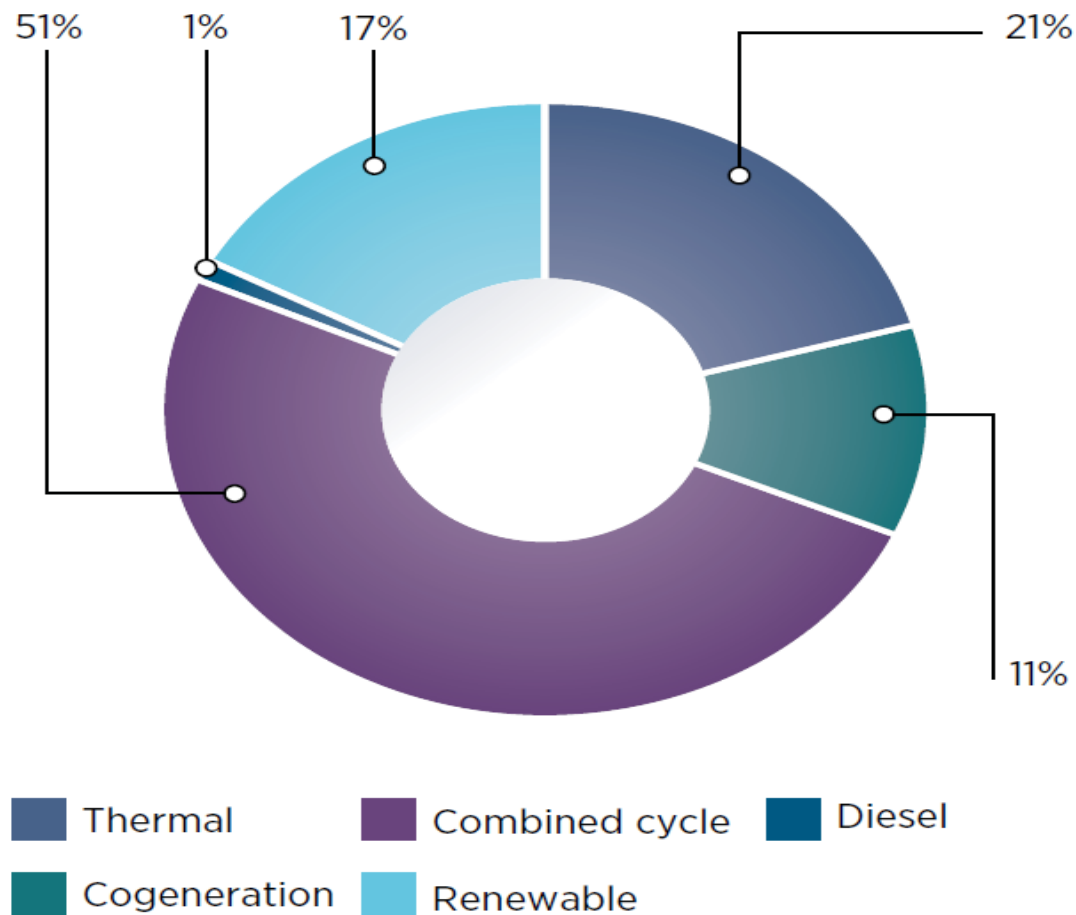
- Thailand's electrical infrastructure consists of **three systems**, which are
 - a) **the generating system**, including **EGAT**, independent power producers (**IPPs**), small power producers (**SPPs**) and very small power producers (**VSPPs**)
 - b) the **transmission system** (**EGAT**)
 - c) the **distribution system** (**PEA** and **MEA**)
- In addition, the annual power exchange with and purchase from **neighbouring countries** through **interconnected grids** contribute about **7%** of the total electricity consumption (IEA, 2016).

1. Overall energy system (cont'd)

- As of September 2016, the electricity generating capacity of Thailand's system reached nearly **42 gigawatts (GW)**, of which, by technology, **combined-cycle and condensation thermal power plants** counted for about **70%** of the total, while **renewables** accounted for **17%**, as illustrated in Figure 6.
- As regards the ownership of generation assets, **EGAT owns and controls** the **largest share of the nation's total**, while the other half is owned by IPPs, SPPs and VSPPs.

1. Overall energy system (cont'd)

Figure 6. Thailand's power generation capacity by technology, 2017



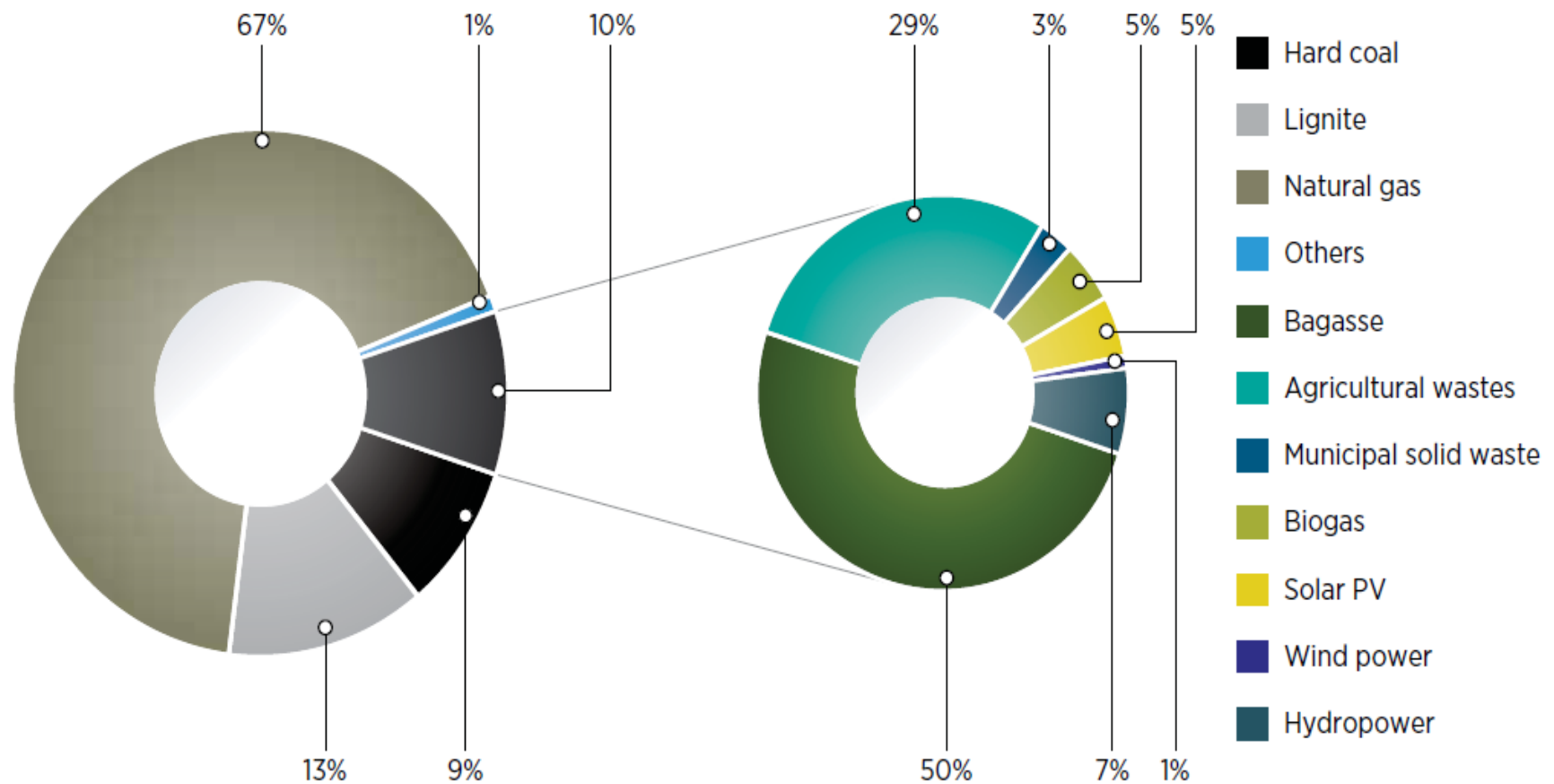
Based on data from EGAT

1. Overall energy system (cont'd)

- As to the electricity generated, Figure 7 below shows that **natural gas** and **hard coal** and **lignite** accounted for nearly **90%**, while **renewable electricity** contributed only **10%** of the total.
- It is evident that **fossil fuels**, particularly natural gas, followed by hard coal and lignite, **still remain the dominant fuel** for power generation, while biomass based energy sources account for the major share within the renewable energy generation portfolio.

1. Overall energy system (cont'd)

Figure 7. Thailand's electricity generation by fuel, 2016



Based on data from EGAT

1. Overall energy system (cont'd)

- Aside from domestic generation, Thailand signed a **memorandum of understanding (MoU)** on the purchase of electricity from **Lao PDR** in **September 2016**.
- The agreement allows for the purchase of up to **9,000 MW**, including **1,878 MW** from **lignite** and the rest from **hydropower**.
- Hydropower from the **Lao PDR** is insignificantly affected by seasonal variations in hydrological circulation due mainly to the **large capacity** of **its reservoirs** and **high surface water run-off**.
- In addition, Thailand has also been **increasing its electricity imports from other countries**, such as **Myanmar** and **Malaysia**.
- Electricity imports from neighbouring countries would be expected to increase over the next two decades, but will be **capped at 15%** due to **security concerns**.

1. Overall energy system (cont'd)

- In addition to its role as grid operator, EGAT also operates its own electricity generation facilities, and purchases electricity from domestic IPPs, SPPs and neighbouring countries, while only VSPPs can sell electricity directly to PEA and MEA.
- In VSPPs' case, MEA has already connected 54 projects with a purchasing capacity of 67 MW while PEA has connected 839 projects with 3,498 MW (ERC, 2016).
- For electricity consumption by economic sector, **the industrial sector (76,914 GWh or 42.4%), the commercial sector (61,446 GWh or 33.9%)** and the **residential sector (41,443 GWh or 22.8%)** are the key consumers, as shown in Figure 8.

2. Key energy legislation and institutions

- Key energy legislation In 1992, **three important pieces** of energy legislation were enacted, namely
 - the National Energy Policy Council Act, B.E. 2535 (1992), amended by the National Energy Policy Council Act (No. 2), B.E. 2550 (2007)
 - the National Energy Policy Council Act (No. 3), B.E. 2551 (2008), the Energy Development and Promotion Act, B.E. 2535 (1992)
 - the Energy Conservation Promotion Act, B.E. 2535 (1992), amended by the Energy Conservation Promotion Act (No. 2), B.E. 2550 (2007).
- These acts defined today's **legislative framework for Thailand's energy sector**, providing the legal foundation for national energy sector management, development of energy production, transport and distribution, and also energy efficiency improvements.

2. Key energy legislation and institutions (cont'd)

- The key elements of the above-mentioned legislation are described in Table 1

Table 1. Key elements of important energy legislation

Legislation	Key elements
National Energy Policy Council Act, B.E. 2535 (1992), amended by the National Energy Policy Council Act (No. 2), B.E. 2550 (2007) and the National Energy Policy Council Act (No. 3), B.E. 2551 (2008)	- Determined the mandates, powers, duties and operational mechanism, and institutional structure of, and under, the National Energy Policy Council – the highest governmental entity in oversight of energy sector management reporting to the Cabinet in Thailand. - Defined the scope of energy, renewable energy, non-renewable energy, and fuel, to be used as reference in, for instance, the Energy Industry Act, B.E. 2550 (2007).
Energy Development and Promotion Act, B.E. 2535 (1992)	- Replaced the National Energy Act B.E. 2496 (1953), as amended, while specified the implications for the enforcement of other decrees, regulators or orders issued under the previous act. - Changed the title of “National Energy Administration” to the “Department of Energy Development and Promotion” of the then Ministry of Science, Technology and Energy (the present Ministry of Science and Technology). - Defined in detail the department’s authorities, duties and operational mechanism and principles that should be followed.

2. Key energy legislation and institutions (cont'd)

- The key elements of the above-mentioned legislation are described in Table 1

Energy Conservation Promotion Act, B.E. 2535 (1992), amended by the Energy Conservation Promotion Act (No. 2), B.E. 2550 (2007)

- Focused on key energy end-use sectors, including industrial and buildings sectors, with respect to energy conservation and efficiency improvement.
- Referred to as guidance for policy, strategy and programme development as far as energy conservation is concerned, with the aim of promoting application of high-efficiency measures in end-use sectors.
- Defined the authorities and duties of relevant governmental entities, and determined (institutionally and financially) the supportive schemes and programmes for promoting and supporting energy efficiency improvements in end-use sectors.
- Defined the penalties for non- and under-compliance with the act, or fraudulent behaviours.

Energy Industry Act, B.E. 2550 (2007)

- Established a new regulatory framework, with independent performance of energy policy making, regulation, formulation and implementation, for the electric power and natural gas sectors.
- The key objectives were to encourage engagement of the private sector and the general public through active participation and increased competition, promote the efficient and environmentally responsible use of energy resources, and also promote the use of renewable energy sources.
- Established the Energy Regulatory Commission and defined its authorities and duties and the specifics of certain operations, such as setting tariffs, energy network system supervision and power development funding.
- Provided comprehensive guidance for energy industry policy making and defined the powers of the Minister.

2. Key energy legislation and institutions (cont'd)

- As presented in Table 1, the acts provide the legal foundation for establishing the main energy institutions administering the energy sector in Thailand, including the National Energy Policy Council, the MoE, the Energy Regulatory Commission, EPPO, and DEDE (the former Department of Energy Development and Promotion).
- In addition, they also provide the legislative basis for energy policies, regulations and development plans.

2. Key energy legislation and institutions (cont'd)

Main institutions in the energy sector

- The **National Energy Policy Council (NEPC)**, chaired by the Prime Minister with the support of the Deputy Prime Minister designated by the Prime Minister as Vice-Chairman, is the ultimate authoritative body for the review and approval of proposals pertaining to national energy policy and regulation, energy sector management and development plans and strategies, with the objective of enhancing energy security and reducing dependency on imported energy while ensuring the affordability and sustainability of energy commodities. In addition to the Chairs, the council also has among its membership: cabinet ministers who are highly relevant to energy sector policy and management
- The minister attached to the Office of the Prime Minister
- The Secretary-General of the Council of State,
- The Secretary- General of the National Economic and Social Development Board
- The Director of the Bureau of the Budget
- The Director- General of the Energy Policy and Planning Office.

Each member has one vote in the decision-making process and a decision is made by a majority

2. Key energy legislation and institutions (cont'd)

- Benefiting from the high-level involvement of important cabinet ministries, the NEPC serves de facto as an **inter-ministerial co-ordination mechanism** for **policy making** as well as **implementation**.
- In the face of rising interaction of energy with other sectors on a range of issues – energy security, climate challenges, regional and local environments, rural development, job creation and the adoption of information and communication technologies for future grid infrastructure development – having a high-level effective co-ordination mechanism has become increasingly important for making important decisions on energy policy.
- These include **determining the price of energy products** and ensuring effective policy implementation, which contains five individual but interrelated plans.
- At the operational level, **EPPO as part of the MoE provides technical support to the NEPC**, in addition to any other committees or sub-committees that may be established if requested in addition to the NEPC.

2. Key energy legislation and institutions (cont'd)

- The Ministry of Energy (MoE) is the governmental authority responsible for **oversight of the overall operation of the energy sector**, including fossil fuels, electric power and rural energy supply, and also including managing the Thailand Oil Fund.
- It was also given a **mandate to propose energy policies and regulations**, formulate energy plans and strategies and supervise their implementation.
- The MoE is supported by its four operational departments covering energy policy and planning, managing mineral fuels, supervising energy business operations, and promoting alternative and energy efficiency, respectively.

2. Key energy legislation and institutions (cont'd)

- The **Energy Policy and Planning Office (EPPO)** acts as an operational body of the NEPC and is responsible for **formulating proposals on national energy policy and strategies addressing the existing and emerging challenges** in energy management, energy conservation, promotion of alternative energy sources and oil supply.
- It oversees the **implementation of various policies and plans** upon entry into force.

2. Key energy legislation and institutions (cont'd)

- The **Department of Alternative Energy Development and Efficiency (DEDE)** has an increasingly significant role to play in the context of the growing concerns over security of energy supply and the climate targets set in the Paris Agreement, and the falling costs of some renewable energy technologies over the past five years, such as solar PV modules and inverters, and on-shore wind power systems.
- In addition to **renewables**, **DEDE also promotes energy efficiency measures** as an instrument to reduce or minimise the growth in energy demand. The Permanent Energy Secretary oversees the operation of this department, while the Director-General is the commanding officer for, and thus responsible for the performance of, the department.
- **DEDE covers more than just renewables** in the notion defined as “**alternative**”.
- Having that said, while the meaning of “renewable energy” is clearly defined in both the National Energy Policy Council Act (1992) and the Energy Development and Promotion Act (1992), there is no such definition for “alternative” energy in any of the legislation.

3. Energy policy and plan

- With greater volatility of energy commodity prices, the rising concern over energy security and the increasingly compelling cases made for renewables, the dynamics shaping the energy policy landscape have rapidly evolved in Thailand.
- The primary objectives of national energy policies are centred on **enhancing the country's energy security** by **diversifying the energy mix** and **strengthening the supply of depleting fossil fuels**, while **keeping energy prices at affordable rates** and minimising the adverse impacts of energy production and consumption on the environment and society.
- *Overall, Thailand's policy objectives for energy sector development have remained consistent, with a central focus on enhancing the security of energy supply in recognition of its critical importance to national economic and social development.*

3. Energy policy and plan (cont'd)

National Energy Policy 2008

- National Energy Policy 2008 was released in the context of the world **being in the middle of oil price volatility**.
- It therefore placed even greater stress on the importance of **energy security** and put forth a series of targets and actions to **reduce the country's dependence on imported fuels** by increasing the domestic supply of energy sources, and secure **long-term supply** from international energy commodity markets, as well as **improve energy efficiency**.
- The energy policy, along with the Renewable Energy Development Plan (REDP) (2008-22), aimed to **increase energy security** and the use of **alternative energy sources**, encourage **high-efficiency energy technologies**, and scale up green alternatives among communities.

3. Energy policy and plan (cont'd)

Thailand Integrated Energy Blueprint

- In 2015, the **five major energy plans** were **harmonised into one** integrated energy document known as the **Thailand Integrated Energy Blueprint (TIEB) 2015-36**.
- At present, the TIEB serves de facto as the national energy policy and energy sector development plan combined.
- This is because the official **National Energy Policy 2008 has yet to be updated or replaced** by a new policy document that may be developed in future.
- The long-term perspective and system approach taken in the TIEB could potentially change the way that energy policy is implemented in Thailand.
- It could yield the desired results, provided that an **effective mechanism for inter-ministerial co-ordination** and an implementation **monitoring system** are put in place.

3. Energy policy and plan (cont'd)

- The TIEB consists of the Power Development Plan (PDP), the Energy Efficiency Plan (EEP), the Alternative Energy Development Plan (AEDP), the Oil Plan, and the Gas Plan. The assumption on the annual average GDP growth rate over 2015-36 was 3.94%, as estimated in the National Economic and Social Development Plan, being slightly adjusted downward from the previously estimated 4.41% in the 2010-30 Power Development Plan.
- Table 2 below highlights the key targets set under each plan, with a breakdown for the power sector, heating, and transport.

3. Energy policy and plan (cont'd)

Table 2. Key targets in energy plans, 2015-2036

Energy plans	Overall target	Sector breakdown		
		Power sector	Heating	Transport
EEP	Energy intensity reduction of 30% by 2036 from the 2010 level	Expected saving of 90 865 GWh/7 813 ktoe accounting for 15% of the total savings	Expected saving of 13 673 ktoe, accounting for 26% of the total savings	Expected saving of 30 213 ktoe, accounting for 58% of the total savings
PDP	Fuel/generation capacity mix (2015-36): • Gas: 64% - 37% • Coal: 20% - 23% • Nuclear: 0% - 5% (2035) • Imported hydropower: 7% - 15% • Renewable energy: 8% - 20%		• Heat from co-generation with efficiency not lower than 45% should account for 10%	
AEDP	• Renewables (final energy consumption): 39 389 ktoe, or 30% of TFEC in 2036, i.e. 131 000 ktoe	• 19 684 MW (installed capacity): • Solar PV: 6 000 MW • Wind: 3 002 MW • Large hydro: 2 906 MW • Small hydro: 376 MW • Biomass: 5 570 MW • Biogas: 600 MW • WTE: 550 MW • Energy crops: 680 MW	• 25 088 ktoe (final energy consumption): • MSW: 495 ktoe • Biomass: 22 100 ktoe • Biogas: 1 283 ktoe • Solar heating: 1 200 ktoe • Others*: 10 ktoe	• Bioethanol: 11.3 million litres/day • Biodiesel: 14 million litres/day • Pyrolysis: 0.53 million litres/day • Compressed biogas: 4 800 tonnes/day • Others**: 10 ktoe

4. Overview of renewable energy development in Thailand

- Thailand has **long been promoting and supporting energy development**, especially in the **field of alternative energy and energy conservation**, driven primarily by the pursuit of enhanced energy security, stabilised economic prosperity and improved well-being.
- With the steadily **increased use of alternative energy sources** and **improved energy efficiency**, **imports of fossil fuels** would be expected to decline, and so would the long term risks of energy expenditure on energy importation.
- In addition, indigenous **clean energy development** could bring multiple co-benefits such as **environmental, social and economic advantages**, including job creation, in comparison to imported fossil fuels.

4. Overview of renewable energy development in Thailand

- Toward this end, indigenous **renewable energy resources**, including **solar, wind, various biomass-based energy sources** and **hydropower**, have been given priority with clear and ambitious targets and supportive policy schemes in place.
- By 2015 Thailand had developed a **decent share of renewables in primary energy production** and more so when traditional biomass for cooking is included, as shown in Figure 3.
- In 2015 alone, **modern renewable energy increased by 11.7% on a year-on-year basis** – as much as four times the annual growth rate of the total primary energy supply.
- Of the total amount of renewable energy consumption in 2015 (10,306 ktoe), about 64% was used for heating, 16% for electricity generation, and nearly 20% for biofuel production.

3. Energy policy and plan (cont'd)

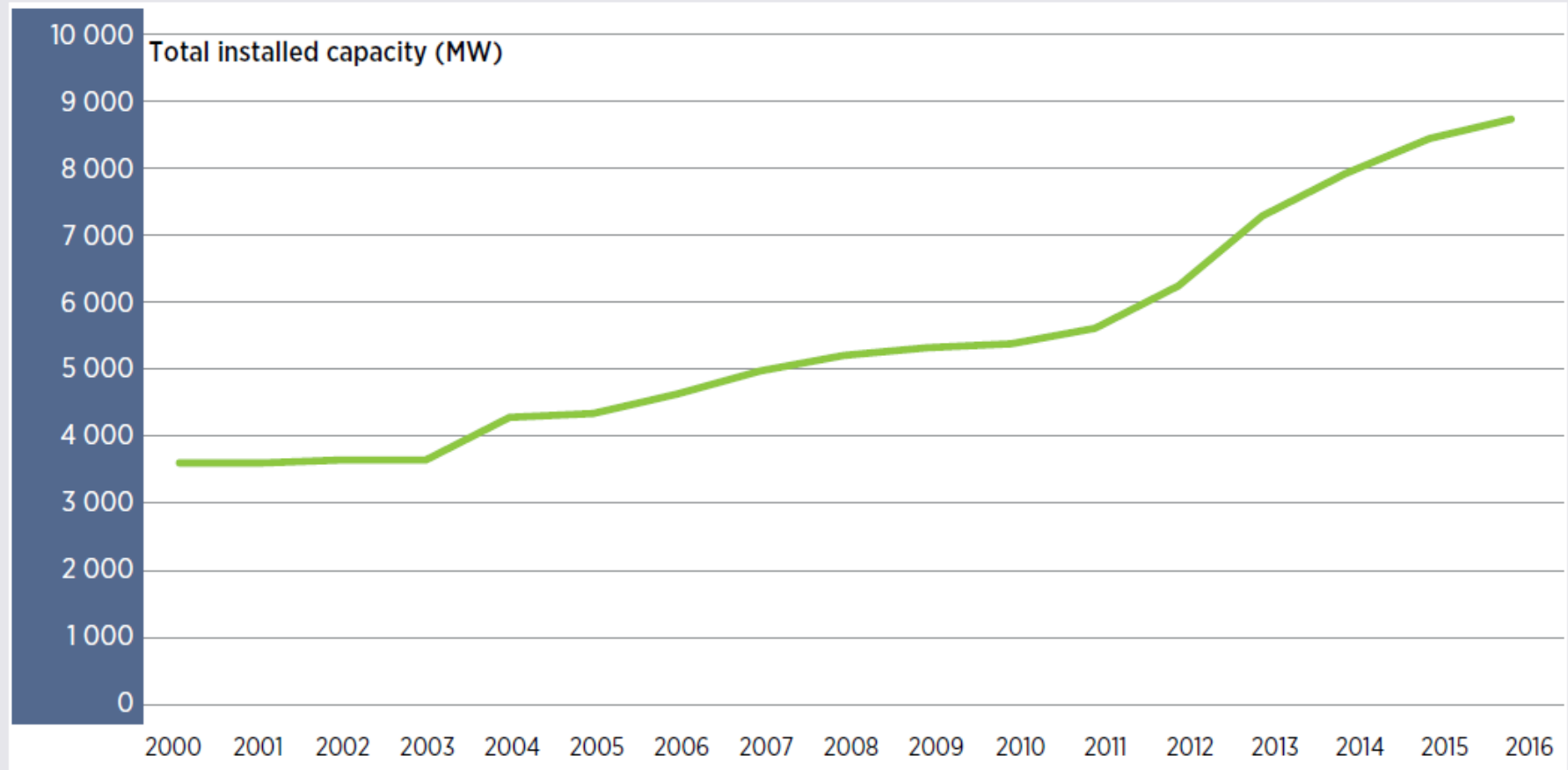
- As far as the power sector is concerned, **installed renewable energy generating capacity has doubled** over the past decade and seen a steeper ramp-up since 2012, as illustrated in Figure 9.
- Among the power mix, **hydropower and bioenergy** account for the lion's share, while the share of **solar PV and wind power** has **quickly caught up**, attributed largely to the generous adder rates and **favourable feed-in tariffs (FITs)**.
- However, **large-scale hydropower in Thailand reached almost 3 GW in 2000**, which leaves **little room for further development** in view of its potential environmental impacts, **while small hydropower has been on the rise but at a modest rate**.
- Bioenergy has scaled up by a factor five over the same period.

4. Overview of renewable energy development in Thailand (cont'd)

- As regards solar PV, although the first solar PV farm, with a capacity of 504 kilowatts (kW), was installed by EGAT in 1996, the real take-off began in 2007 when **favourable policy and regulatory schemes were put in place.**
- Thailand started to exploit its wind energy as early as 1983 with several small wind turbines ranging from 1 kW to 150 kW in Phuket Island in southern Thailand, but the country has scaled up deployment at a modest growth rate due to the relatively low wind speed, especially in the areas close to load centres or transmission grids.
- Thailand has **very modest geothermal potential in northern Thailand.** In 1989, the first geothermal power generation facility with a capacity of only 300 kW was built in the Fang District. However, the development of **geothermal has since then been stagnant due to very little resource availability.**

4. Overview of renewable energy development in Thailand (cont'd)

Figure 9. Thailand's total renewable electricity generating capacity, 2000-2016



Note: MW = megawatt.

Source: Based on IRENA's statistics database, at <http://resourceirena.irena.org/gateway/dashboard/?topic=4&subTopic=16>.

4. Overview of renewable energy development in Thailand (cont'd)

- On transport fuels, Thailand has a **strong motivation to replace petroleum-derived fuels with alternatives**, given its high dependency on road transport as well as on the importation of gasoline and diesel for transport.
- Although the share of energy used for transport in TFEC remained in the region of 36% over 2005-15, the absolute amount of energy increased by **20% over the same period**, reaching 28,501 ktoe in 2015, due to **the growth in the number of vehicles and motorcycles**.
- This increase in consumption also corresponded to the rising energy dependency ratio, as illustrated in Figure 2, indicating the **dominance of petroleum derived transport fuels**, accounting for more than **two-thirds of the total energy consumption in the transport sector**.
- Taking all liquid fuels into account, about 92% are consumed by the entire transport sector, 69% by road transport alone.
- **Biofuel blending, namely gasohol and blended biodiesel, is now a common practice in Thailand after a decade of development.**
- In 2015, the volumetric share of liquid transport fuel consumption that was met with **biofuels stood at around 11% in the case of gasoline and 6% in the case of diesel**. The **overall volumetric** share was **close to 8%**.

4. Overview of renewable energy development in Thailand (cont'd)

- Gasohol covers E10, E20, and E85, among which **E10** account for **80%** while **E85 for only 3.5%**.
- For biodiesel blending, the maximum ratio was frozen at **B7 in 2016**, due largely to the supply constraints experienced in 2016, and to some extent the automobile industry was somewhat **concerned about the risk** that a continued increase in **the blending ratio to B10** might challenge compliance with exhaust gas emission standards if set at any level above Euro 4 level.

5. Support programmes for renewable energy development

- The Government of Thailand **has long recognised the importance of alternative, especially renewable, energy sources**, but also realised that there was a need to introduce programmes in support of renewable energy development and deployment.
- With that, a **variety of support programmes** have been put in place to promote renewable energy development, ranging from **tax exemptions, a feed-in premium (FIP)/adder programme and FITs to competitive bidding**, to address the various challenges that renewable energy projects face in the early stage of development.

5. Support programmes for renewable energy development (cont'd)

- The Thailand **Board of Investment (BOI)** is an institution established half a century ago with **a mandate to promote investment**, and was known as the Board of Industrial Investment until 1972.
- Since 2004 it has provided alternative energy projects with support, mostly in the form of **tax exemptions**. Examples include the following:
 - Projects using **waste**, including refuse-derived fuel, **to produce electricity** or steam are eligible for **eight year corporate income tax exemption** without an exemption cap, as well as exemption from import duty on machinery, and other non-tax incentives.
 - Other renewable energy projects that have an **eight year corporate income tax holiday, import duty exemption on machinery and non-tax incentives**, include the manufacture of **solar cells** and/or raw materials for solar cells, as well as power produced from renewable energy sources, e.g. *solar energy*, wind energy, biomass or biogas.

5. Support programmes for renewable energy development (cont'd)

- Projects that target **biofuel production** from **agricultural products** and by-products, for example biomass to liquid (BTL) or biogas from wastewater, are given an **eight-year corporate income tax holiday**, **import duty exemption on machinery and raw** or essential materials used in manufacturing export products, as well as other non-tax incentives.
- Projects aimed at **biomass briquettes and pellets** are **exempt for five years from corporate income tax** and **import duty** on **machinery** and other nontax incentives.

5. Support programmes for renewable energy development (cont'd)

- By June 2015, the **BOI had approved 845 renewable energy projects**, while an additional **93 projects were approved in 2016**, as shown in Table 3.
- Under the **Adder Programme**, the **premium rates added on top of wholesale electricity prices** vary according to the technology and scale of installed capacity that SPPs or VSPPs adopt in their projects.
- The programme was designed for **10 years for solar PV and wind**, and **7 years for biomass, biogas, MSW and mini/micro hydropower**, starting from the COD with **provision of an internal rate of return of 10-12%** for the project developers/investors.
- It **jumpstarted** the deployment of **solar PV** and **wind power** systems in Thailand from the outset.

5. Support programmes for renewable energy development (cont'd)

- However, **after three years** of operation **several disadvantages** of the Adder Programme were identified, as listed below, which effectively triggered the policy change **from the adder to FITs** in Thailand.
 - One of the key issues was the **uncertainty associated with the computation of tariffs** paid to the SPPs/VSPs.
 - Given that **basic power tariffs and automatic tariff adjustment vary with global energy commodity prices**, the Adder Programme, building on such variables, the privileges granted to renewables investment demonstrate the degree of the government's support for the sector.
 - Causes some level of **uncertainty in the long-term tariffs paid to investors/developers** as well as **the end users**; in addition, it **does not** accurately reflect **the levelised cost of energy (LCOE)**. Supported by this argument, the **policy was shifted from the adder to the fixed FIT in 2013** to enhance investors' confidence.

5. Support programmes for renewable energy development (cont'd)

- However, because of the interruption in implementing the adder over 2010-13, **concerns over policy consistency arose among the investors.**
- Following the FIT scheme, and with **drastic cost reductions for solar PV and onshore wind installations**, the government has introduced a competitive bidding scheme with the FIT set as the ceiling price.
- This is aimed at **allowing the market to determine the real prices** at which **renewable electricity should be paid.**
- This would help the **government minimise the risks of over-subsidising** renewable energy projects. Thailand started testing the scheme with **several pilot bioenergy projects** in the southern regions in 2016-17, as a stepping stone towards nationwide adoption.
- The **COD is expected to be reached in 2018**, following postponement from the original estimate of 2017.

6. AEDP 2015: Observations and discussions

- Over the **eight-year period from 2007 to 2015**, Thailand **revised its renewable energy targets four times**.
- The most recent revision, which was made in 2015, has set a target of 39,388 ktoe, representing **30% of TFEC in 2036**, with a breakdown shown in Table 4 below.
- It has raised the level of ambition compared with the previous targets, driven by the government's strategic decision to **replace imported primary and secondary energy sources**, i.e. natural gas and electricity respectively, **with indigenous energy sources** – to a large degree from **renewables**.
- More profoundly, the **extension of the planning timeframe from 10 to 20 years** was an important revision as it provides investors and developers with a **stable and consistent policy framework**, allowing them to have **a longer-term business plan**.

6. AEDP 2015: Observations and Discussions (cont'd)

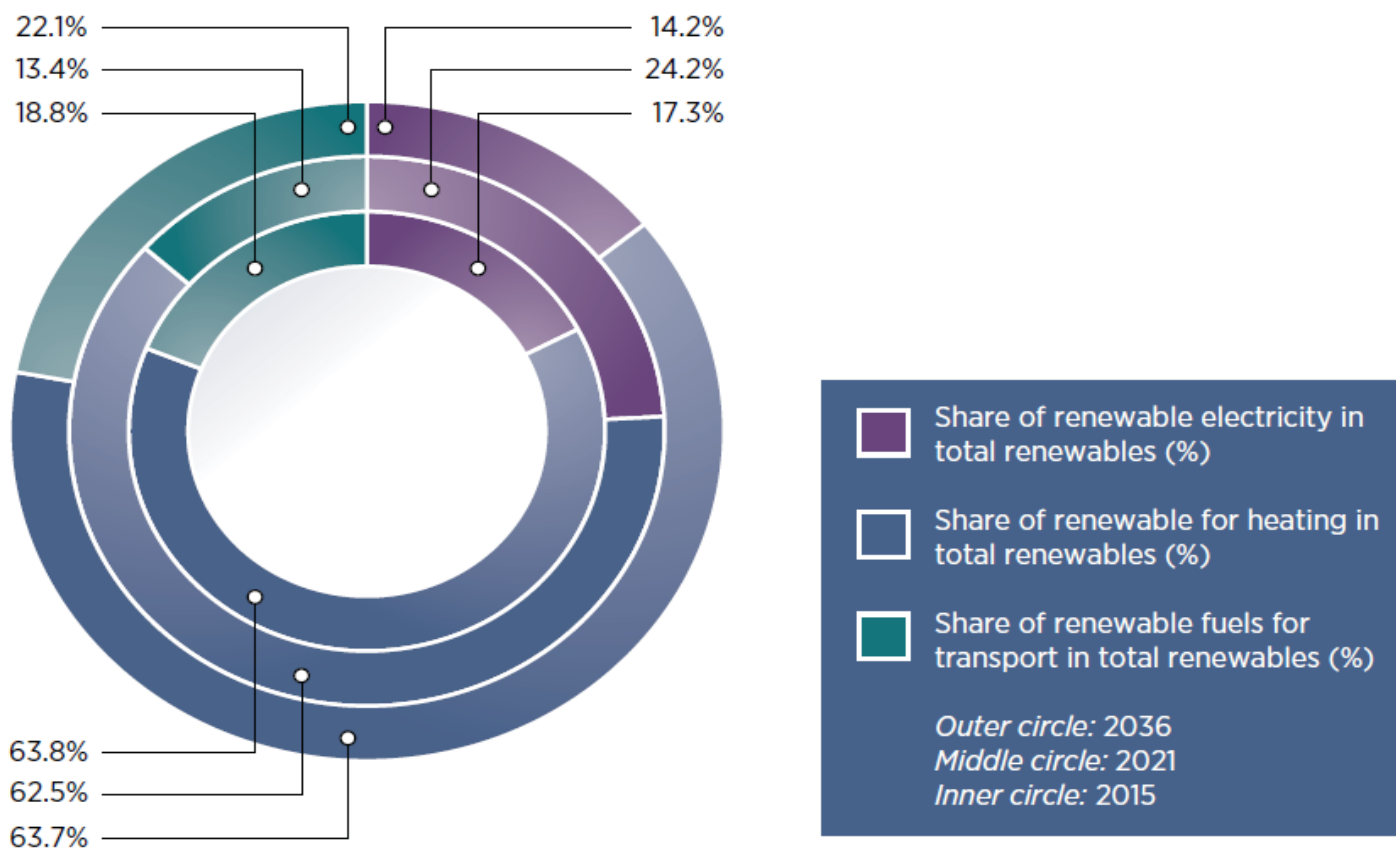
- As shown in Table 4, the 2036 renewable energy target (30%) is distributed among:
 - a) **renewable electricity**, which is expected to contribute **4.2%** (5,588 ktoe)
 - b) **renewables for thermal use**, which are expected to account for **19%** (25,088 ktoe)
 - c) **biofuels** representing the remaining **6.7%** (8,712 ktoe)
- In terms of installed power generating capacity, solar PV is expected to meet 31% of the total with 15% from wind, and the remainder from biomass-based sources and hydropower stations.

6. AEDP 2015: Observations and Discussions (cont'd)

- Figure 10 below shows the **changes in the share of renewables** respectively for power generation, thermal use/heating and transport in TFEC in 2015, 2021 and 2036, based on the current data and estimations of DEDE.
- It indicates that renewables for thermal use would largely remain the same and consistently account for the lion's share over the timeframe of AEDP 2015.
- Currently, electric vehicles play a very minor role in Thailand while **transport biofuels are regarded as the prominent alternative to fossil-derived transport fuels**.
- However, this might **alter in future if the use of electric vehicles could gradually scale up**.

6. AEDP 2015: Observations and Discussions (cont'd)

Figure 10. The shares of renewable energy production under the AEDP by sector in 2015, 2021 and 2036



Based on data in the DEDE (2015) Alternative Energy Development Plan

6. AEDP 2015: Observations and Discussions (cont'd)

Table 4. Renewable energy use and AEDP targets

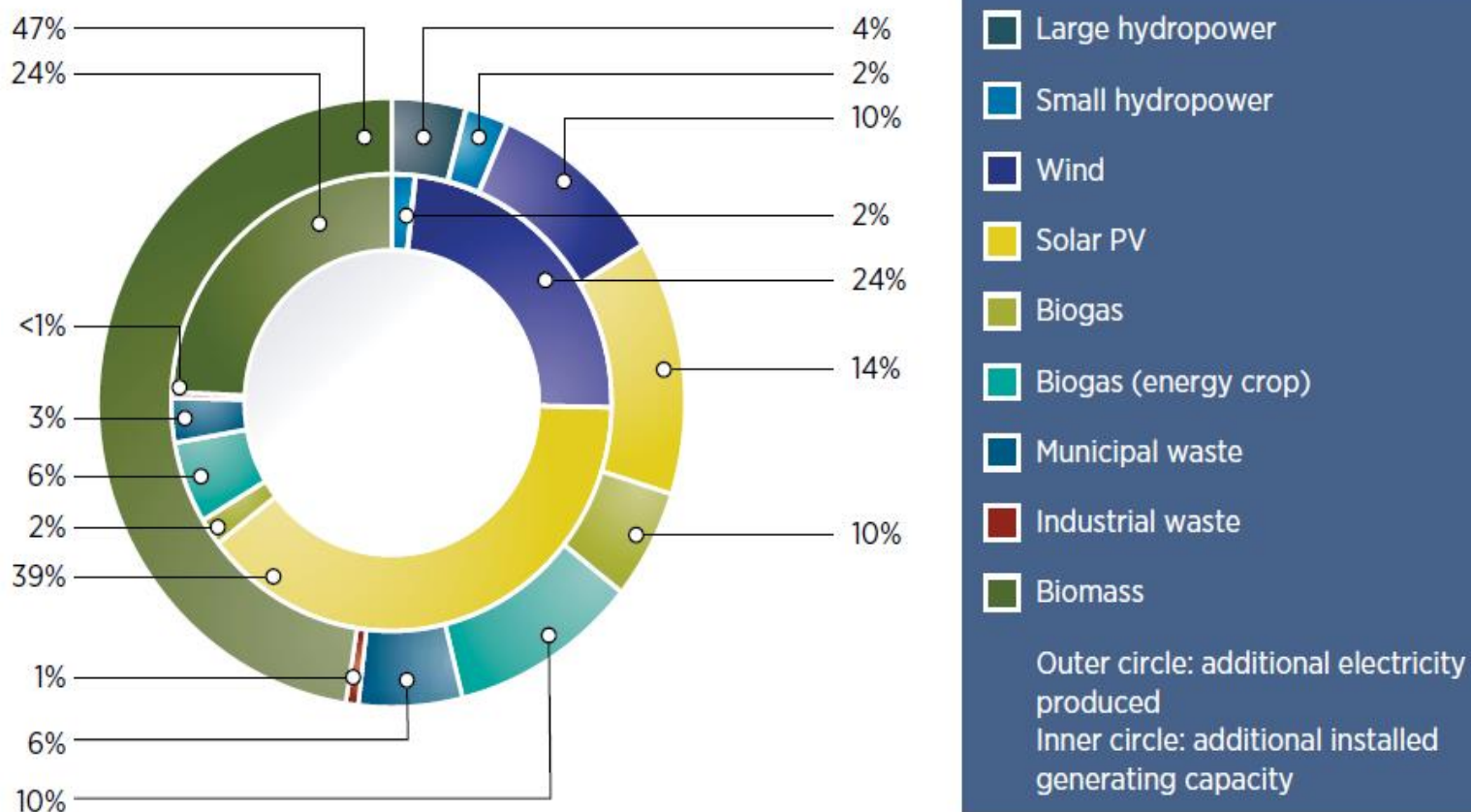
Energy type	Reference (2015)*	Target in 2021	Target in 2036	Reference (2015)	Target in 2021	Target in 2036
Power	Final energy consumption (ktoe)	Capacity (MW)	No. of power plants	Capacity (MW)	Capacity (MW)	Capacity (MW)
Municipal waste	44	214	261	131	410	500
Industrial waste	-	26	26	-	50	50
Solid biomass	1 104	2 059	2 910	2 726	3 940	5 570
Biogas	92	234	313	372	448	600
Biogas (energy crop)	-	225	395	-	387	680
Small hydropower	24	79	115	172	259	376
Wind	28	64	403	233	475	3 002
Solar	202	358	716	1 419	2 993	6 000
Large hydropower	290****	446	446	2 906	2 906	2 906
Sub-total	1 786	3 706	5 588	7 962	11 871	19 684
Thermal	ktoe	ktoe	ktoe			

6. AEDP 2015: Observations and Discussions (cont'd)

MSW	88	178	495	-	-	-
Biomass	5 990	8 649	22 100	-	-	-
Biogas	495	716	1 283	-	-	-
Solar	5	43	1 200	-	-	-
Other alternative energy**	-	0.35	10	-	-	-
Sub-total	6 578	9 586	25 088	-	-	-
Biofuel	ktoe	ktoe	ktoe	Million litres/day	Million litres/day	Million litres/day
Ethanol	879	892	2104	3.5	4.79	11
Biodiesel	1 063	1 126	4 405	3.4	3.58	14
Pyrolysis Oil	-	4	171	-	0.011	0.53
Compressed biogas (tonne/day)	-	33	2 023	-	78	4 800
Other alternative energy***	-	-	10	-	0.001	10
Sub-total	1 942	2 055	8 713	6.9	-	-

6. AEDP 2015: Observations and Discussions (cont'd)

Figure 11. Capacity additions and electricity generated by technology in 2036



Note: The inner circle represents installed generating capacity that would be added from 2015 to 2036, while the outer circle represents the electricity to be produced by the additional electricity generating facilities in question.