Department of Alternative
Energy Development and Efficiency
MINISTRY OF ENERGY

Renewable Energy Plan in Thailand

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November 12, 2014

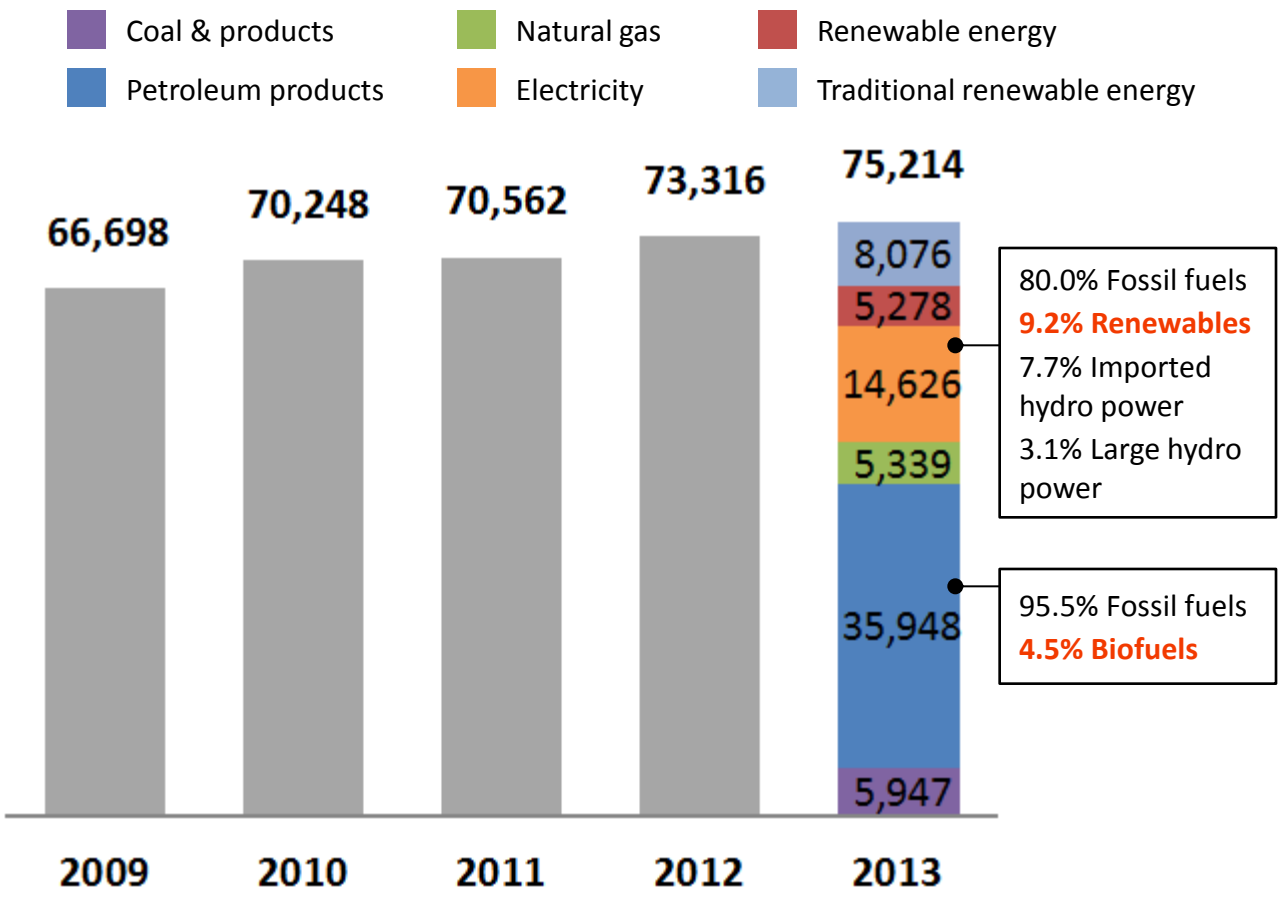
Content

Thailand's Energy Situation

Energy consumption has been growing at 2.4% per year; renewable account for >10% of consumption

Thailand final energy consumption, 2009-2013

Ktoe



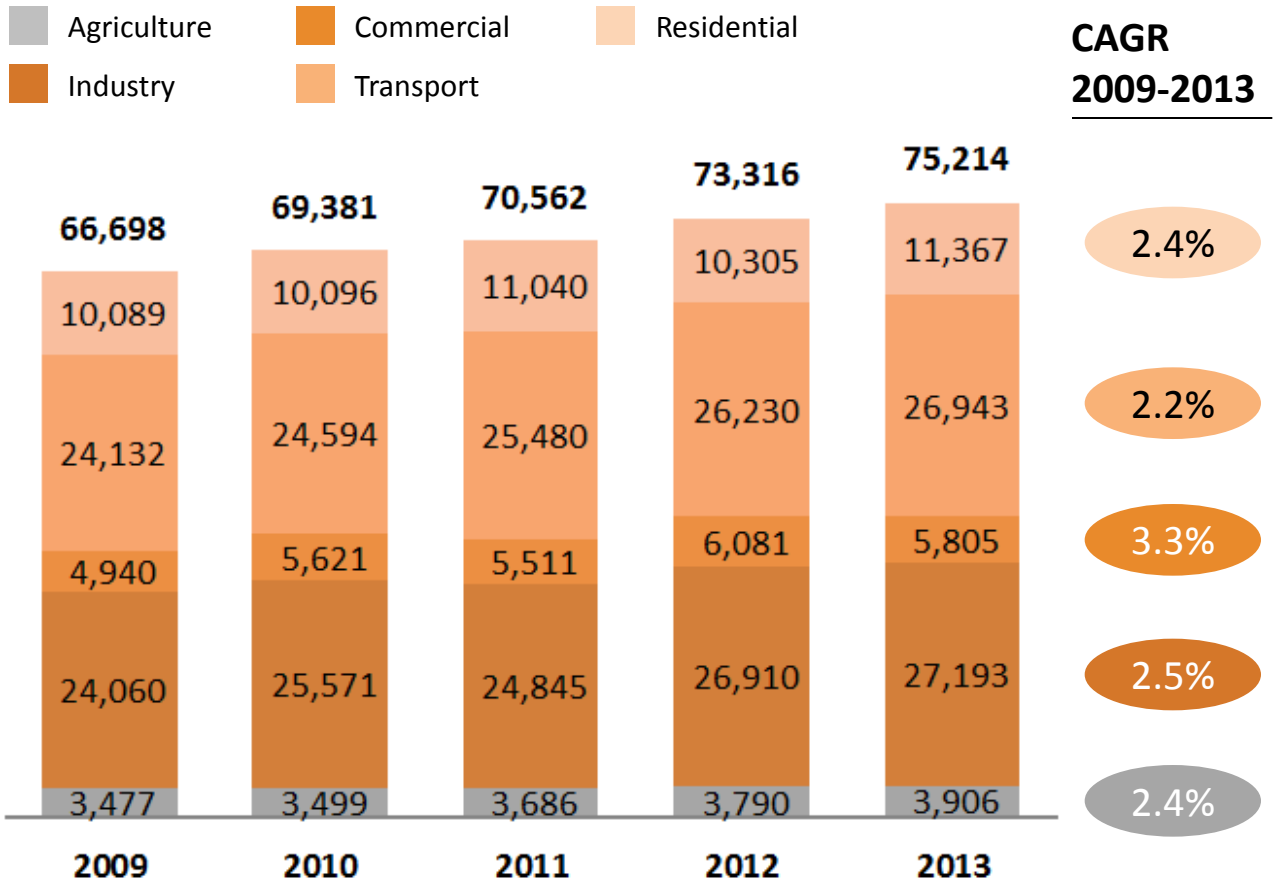
- Since 2009, final energy consumption has been growing by ~2.4% per year
- In 2013, renewables accounted for a total of 8,232 ktoe of consumption, or ~11%
  - 5,278 ktoe direct
  - 1,612 ktoe fuel
  - 1,342 ktoe converted electricity

SOURCE: Energy in Thailand – Facts and Figures

The transportation and industrial segments account for 72% of Thailand's energy consumption

Thailand final energy consumption by industry, 2009-2013

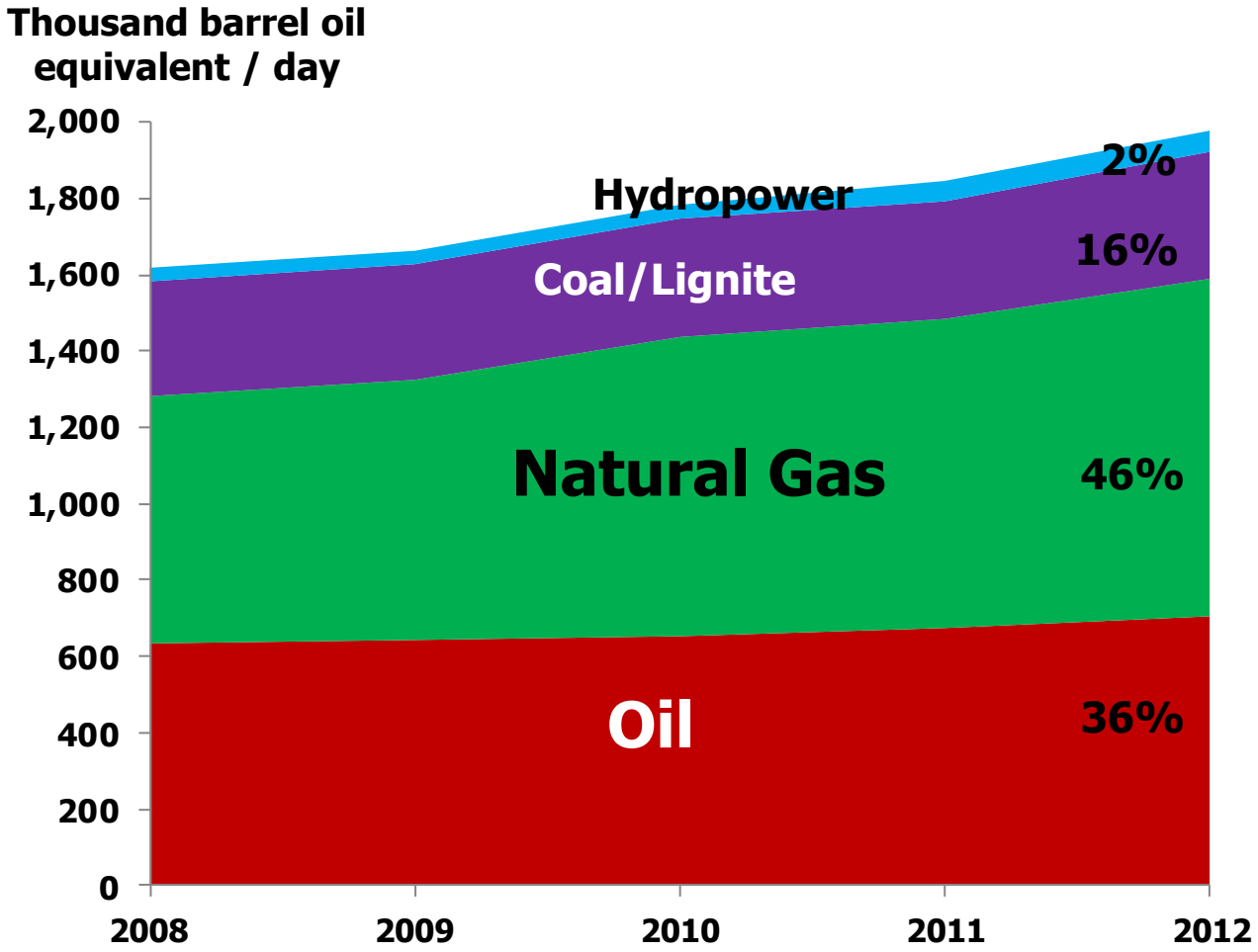
Ktoe

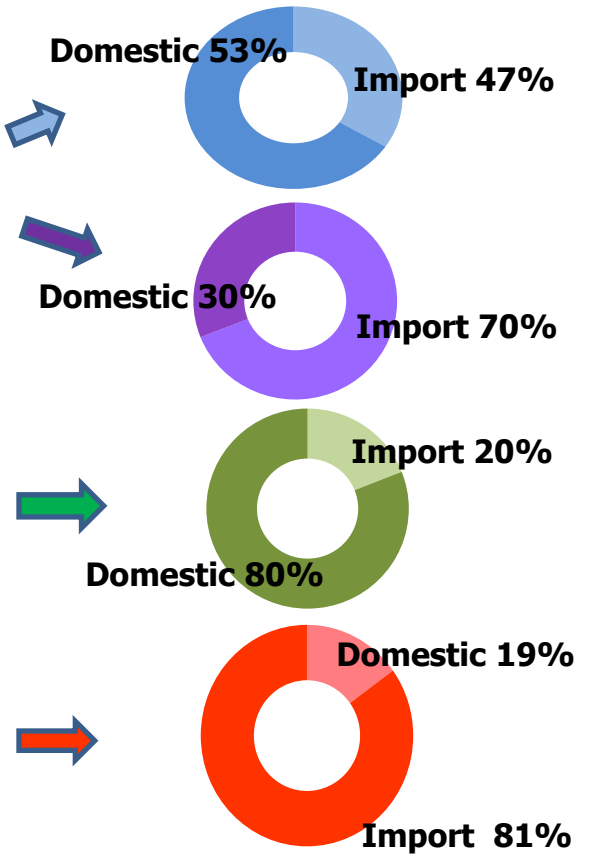


- Since 2009, the industrial sector has overtaken the transportation sector as the largest source of demand
- Commercial sector is second smallest but fastest growing
- Industry and transportation both account for ~ 36% of total energy consumption

SOURCE: Energy in Thailand – Facts and Figures

Final Energy Consumption 2013





Consumption	Oil	Natural gas	Coal/Lignite	Electricity	Total
Thousand barrel oil equivalent / day	727.56	917.02	313.42	46.64	2,004.63
Growth (%)	4.7	9.2	5.0	3.4	6.7

Source : Ministry of Energy 2013

Thailand's Energy Policy

Energy Policy

Thailand's Energy Policies

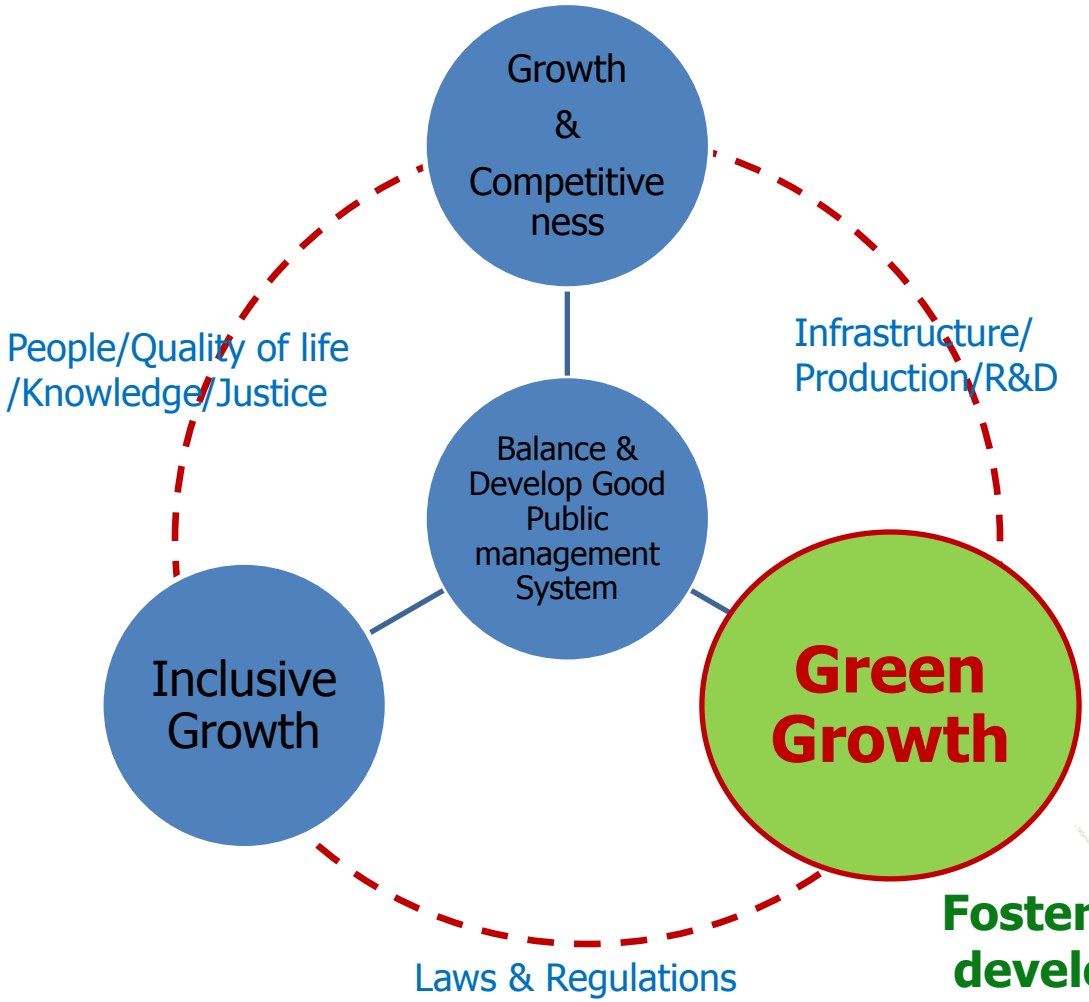
พลเอกประยุทธ์ จันทร์โอชา
นายกรัฐมนตรี

✓ Secure Thailand Energy supply
- Exploration and production of natural gas and crude oil both in the sea and on land
- More new power plant by government agencies and private organizations
- Increase the use of renewable energy
- International energy development cooperation

✓Fair Energy Pricing
- Energy price restructure
- Appropriate tax between different types of oil

✓ Energy conservation
- More efficient use of energy
- Awareness of consumer

Country Strategy



Green Economy

Economic Growth
Sustainable Development
environmental friendly

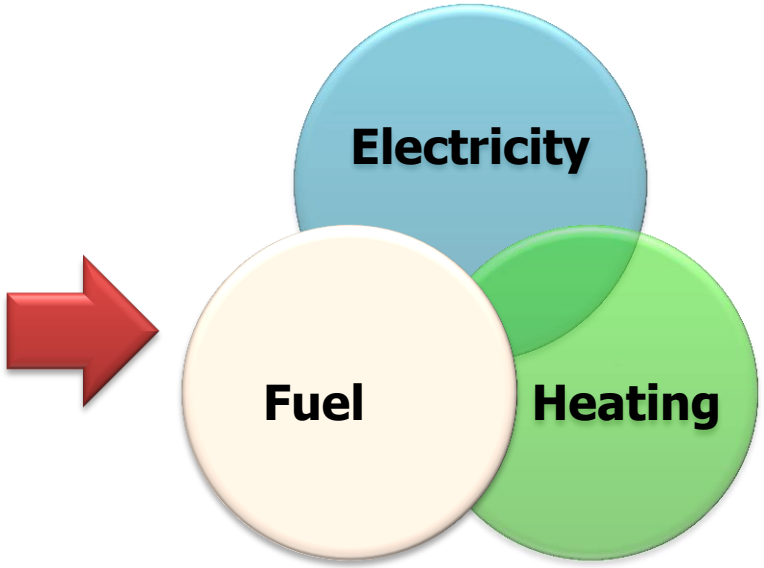
Fostering economic growth and development in environmental friendly way

Thailand's Alternative Energy Potential

Natural
- Solar
- Hydro
- Wind

Crop
- Sugar cane (Molasses)
- Cassava
- Palm

Waste
- Agricultural wastes
- Industrial wastes
- Municipal solid waste (MSW)



Renewable Energy Development

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The Alternative Energy Development Plan is the current roadmap for renewable energy development targets

Foundation: Commitment to the development of a low-carbon society

Facilitator: *Private-led investment*

Strategy: Alternative Energy Development Plan 2012-2021

Facilitator: *Government funded RD&D*

Goal: Target 25% renewables in Total Energy Consumption by 2021

Bio-Energy

Biomass	Biogas	MSW
4,800 MW	3,600 MW	400 MW
8,500 ktoe	1,000 ktoe	200 ktoe

8,800 MW Power | 9,700 Ktoe Heat

Bio-Fuel

Ethanol	Biodiesel	2nd Gen.
9 ML/Day	~7 ML/Day	3 ML/Day

Solar

3,000 MW
100 Ktoe

4,800 MW Power | 100 Ktoe Heat

Wind

1,800 MW

Hydro

Mini (<1 MW)	Micro (<100 kW)

324 MW

New-Energy

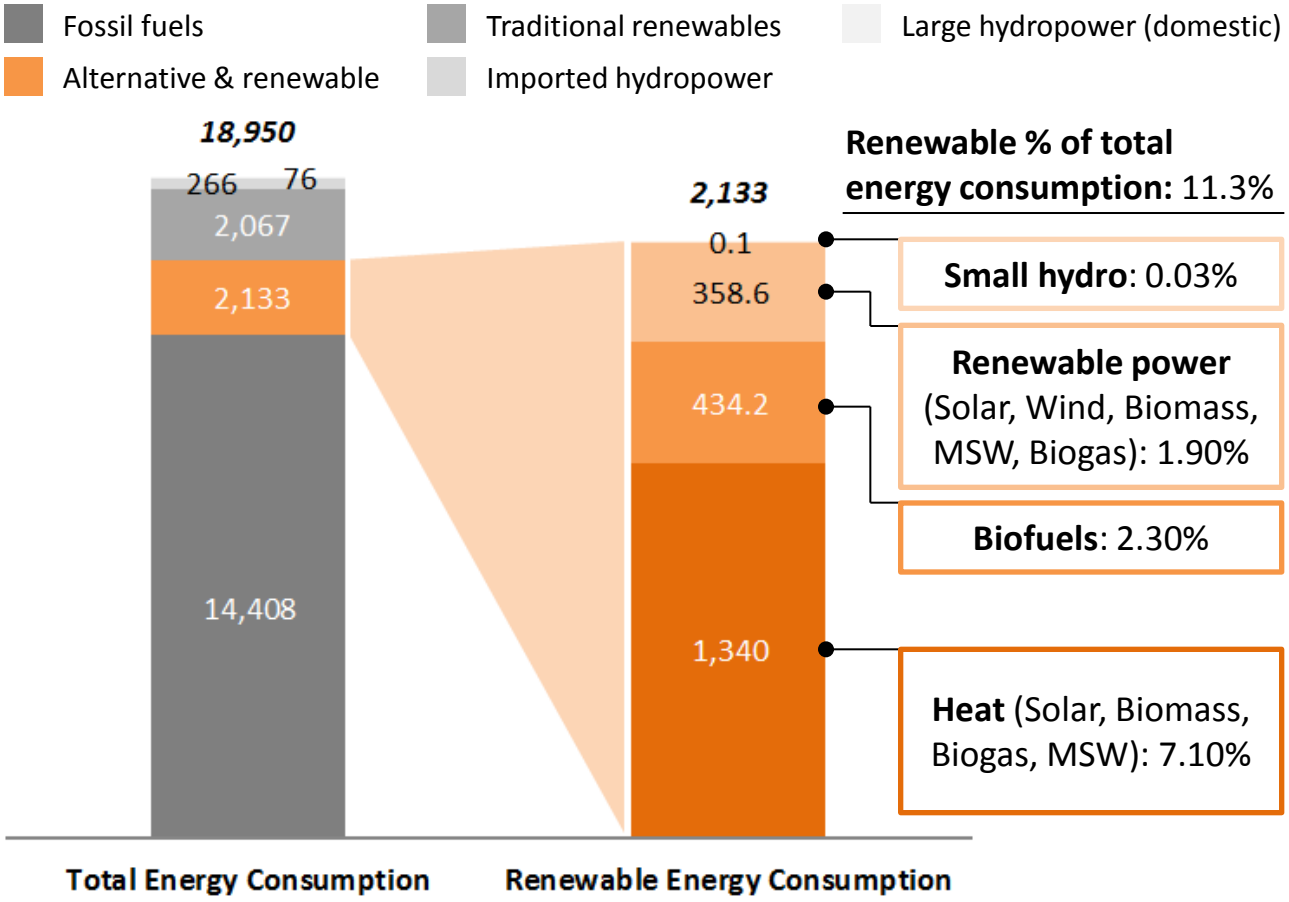
Tidal Wave	Geothermal
2 MW	1 MW

3 MW

In Q1 2014, renewables accounted for 11.3% of energy consumption, mostly in the form of heat

Thailand final energy consumption, Q1 2014

Ktoe



- In the first quarter of 2014, renewable consumption increased slightly to 11.3% of overall consumption
- Majority of renewables consumption is in the form of heat, but power and biofuels are contributing a growing share of renewable energy

SOURCE: Energy in Thailand – Facts and Figures

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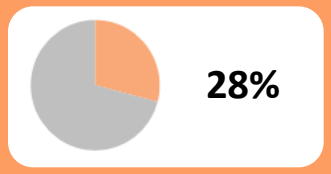
Progress towards 2021 AEDP goals varies significantly by energy source

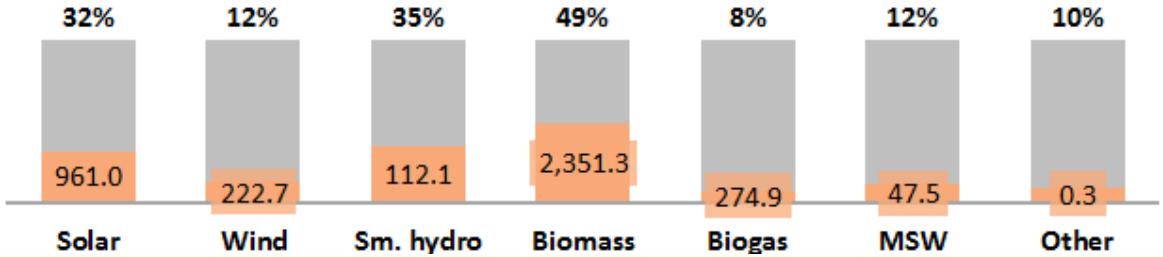
Renewable Electricity



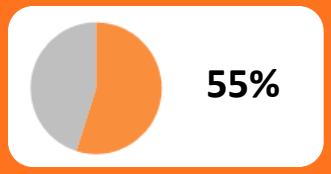
28%

3,969 MW / 13,927 MW

Development progress, MW and % target



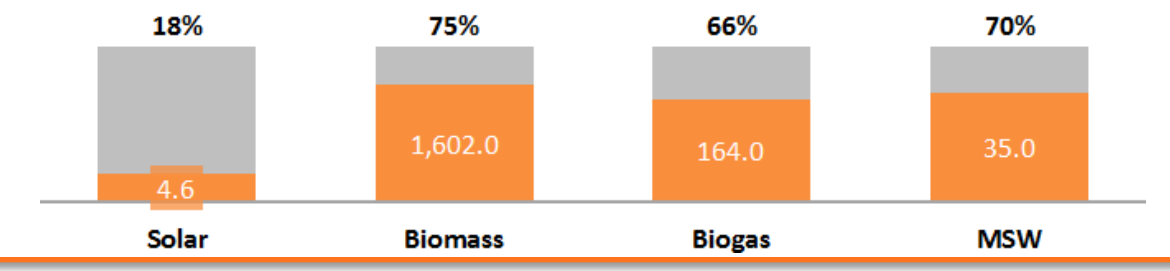
Renewable Heat



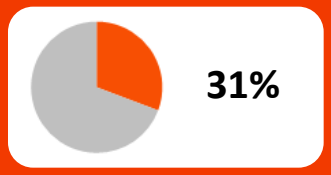
55%

1,345 ktoe / 2,450 ktoe[1]

Development progress, ktoe and % target[1]



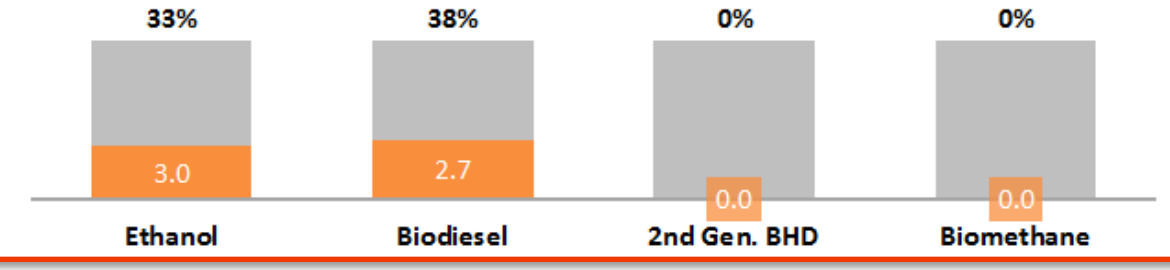
Biofuels



31%

5.9 ML/day / 19.2 ML/day

Development progress, ML/day and % target



1 Note that the full year target is 9,800 ktoe; this is a prorated target for Q1

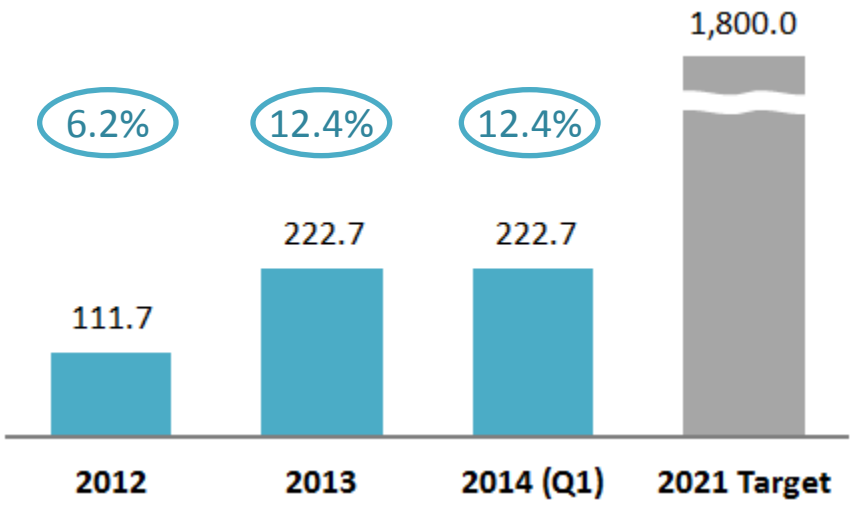
SOURCE: Energy in Thailand – Facts and Figures

Renewable energy class detail: *Wind*

Current development progress

Power generation development

MW installed capacity



Development initiatives

- Promote **community scale usage**
  - Co-generation (e.g. wind & solar) off-grid applications
  - Direct agricultural applications (e.g. irrigation pumping)
- Accelerate **amendment of laws** and regulations which do not currently support wind energy development
- Improve **infrastructure system**
  - Establish the extension plan for transmission
  - Support emerging electricity storage technologies
- Establish **network of producers and consumers**
- **Promote R&D** on wind turbine design

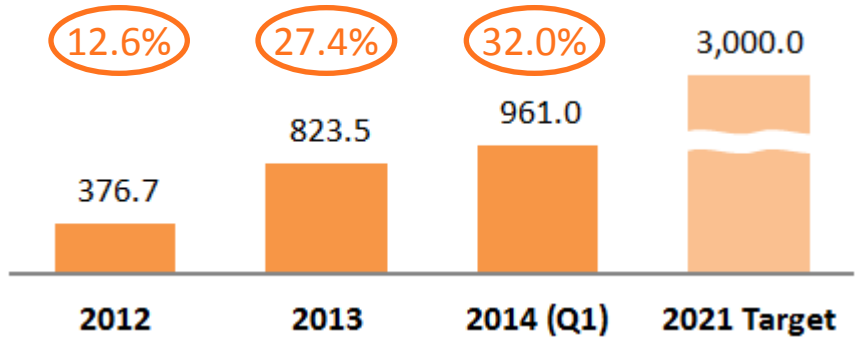
SOURCE: Energy in Thailand – Facts and Figures

Renewable energy class detail: *Solar*

Current development progress

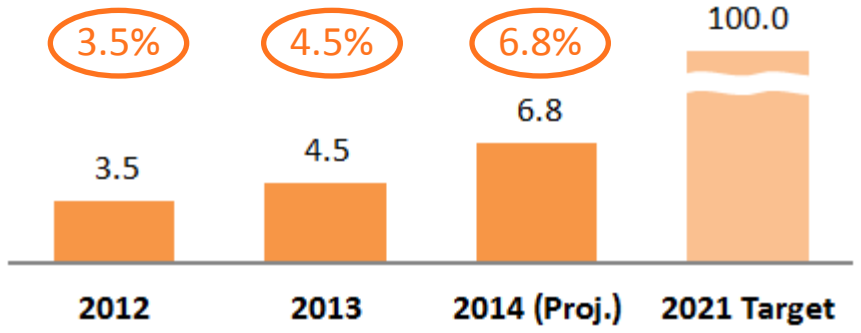
Power generation development

MW installed capacity



Heat development

ktoe



Development initiatives

- Promote implementation of **community/ residential scale solar** system projects
- Promote integrated **upstream industry** for domestic solar panel production (e.g. silicon wafer plant support)
- Assign Electricity Generating Authority of Thailand (in conjunction with PEA and MEA) to review **transmission and distribution network development** to support increased solar generation
- Develop **efficiency standards** for solar collector systems
- Accelerate the **amendment of Laws and Industrial Act**, 1992 (B.E. 2535)
- Supplant ADDER incentive system with revised **feed-in tariff** (FiT) system

SOURCE: Energy in Thailand – Facts and Figures

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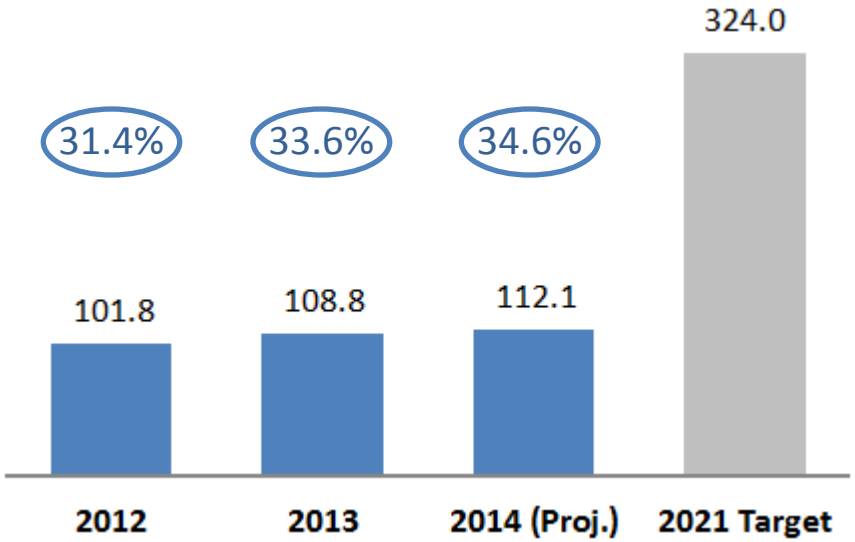
Renewable energy class detail: *Small Hydro*

Current development progress

Power generation development

MW installed capacity



Development initiatives

- Support construction of hydropower at a **community level**
- Work with EGAT on developing small hydropower system for **downstream irrigation dam and mini hydropower systems** with power capacities ranging from 0.2 to 6 MW
- Disseminate and conduct **public relations** on information and advantages of hydropower projects
- Develop **higher efficiency Micro Hydro Turbine** (run-of-river) designs
- Study and **develop low head hydro turbines**

SOURCE: Energy in Thailand – Facts and Figures; Images: palangthai.org

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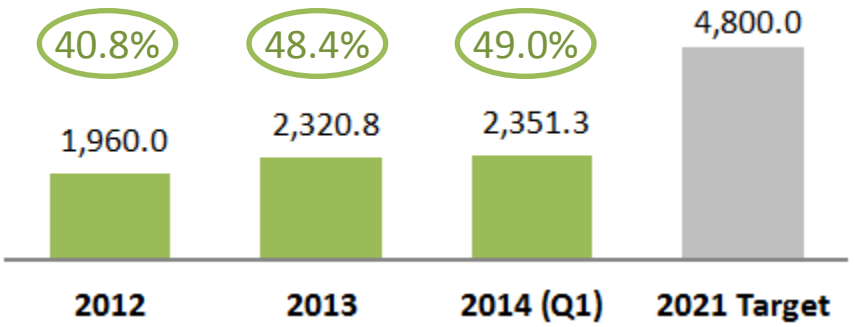
Renewable energy class detail: *Biomass*

Current development progress

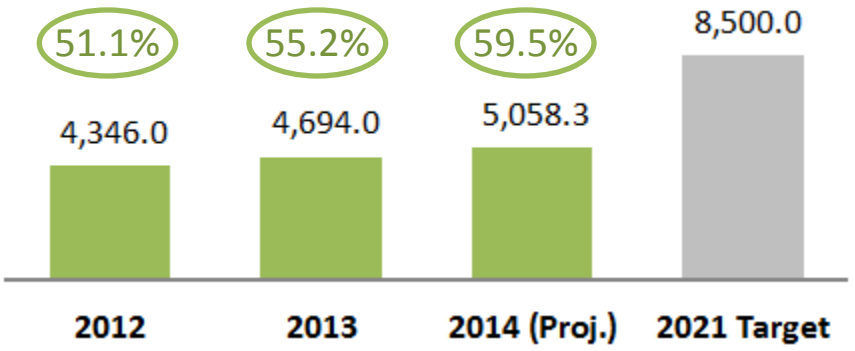
Power generation development

MW installed capacity



Heat development

ktoe



Development initiatives

- Promote **plantation of fast growing trees** that can be used as feedstock for power/heat generation
- Develop **production and standard of biomass pellets** for future biomass fuel
- Develop **advanced gasifier and gas engine technology** as well as **biomass-to-liquid** (BTL) technology
- Promote **use of high pressure boilers** to improve efficiency of power generation from biomass
- Promote Distributed Green Generation (DGG) – **community level biomass** energy
- Coordinate with EGAT to develop necessary **transmission and distribution infrastructure**

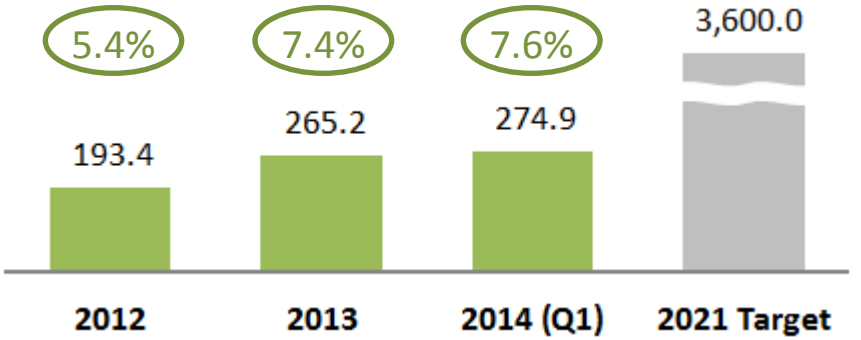
SOURCE: Energy in Thailand – Facts and Figures

Renewable energy class detail: *Biogas*

Current development progress

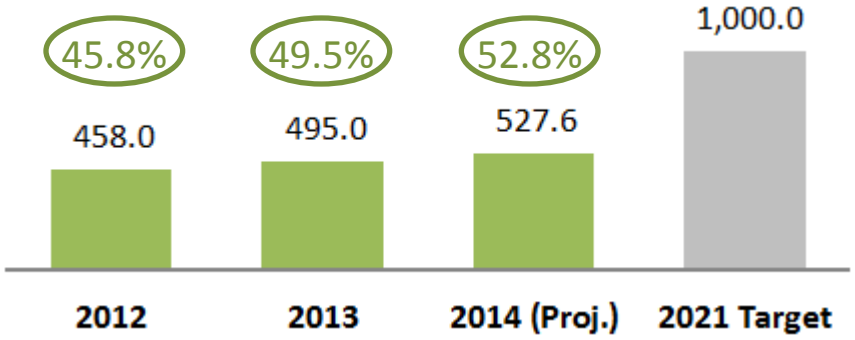
Power generation development

MW installed capacity



Heat development

ktoe



Development initiatives

- Promote and support biogas **production at a household level**
- Support **community self-management** of biogas assets
- Study biogas production from **alternative feedstock sources**
- Promote production and utilization of **compressed bio-methane gas** (CBG) from biomass and energy crops for transportation and power generation
- Study and develop **regulations for biogas safety** standards
- Conduct **public relations** to disseminate knowledge and news to help build public image of safe biogas usage

SOURCE: Energy in Thailand – Facts and Figures

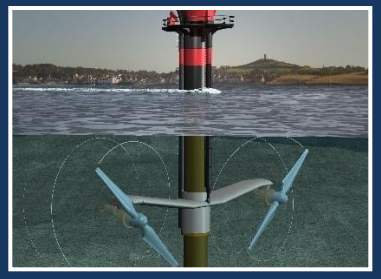
Renewable energy class detail: *New Energy*

Geothermal Energy

2021 Target: 2 MW

- Develop potential map for geothermal sources & tech
- Assess feasibility in development of geothermal sources by appropriate technologies
- Evaluate cost effectiveness, environmental impact, and social impact
- Develop and adopt moderate temperature technologies

Tidal/Current Energy



2021 Target: 1 MW

- Accelerate study on sources and technology types which may be appropriate for Thailand: expected potential areas are located around Phuket, Koh Sa Mui, and Koh Tan
- Assess development potential and readiness to develop pilot project
- Utilize pilot project data to assess further development

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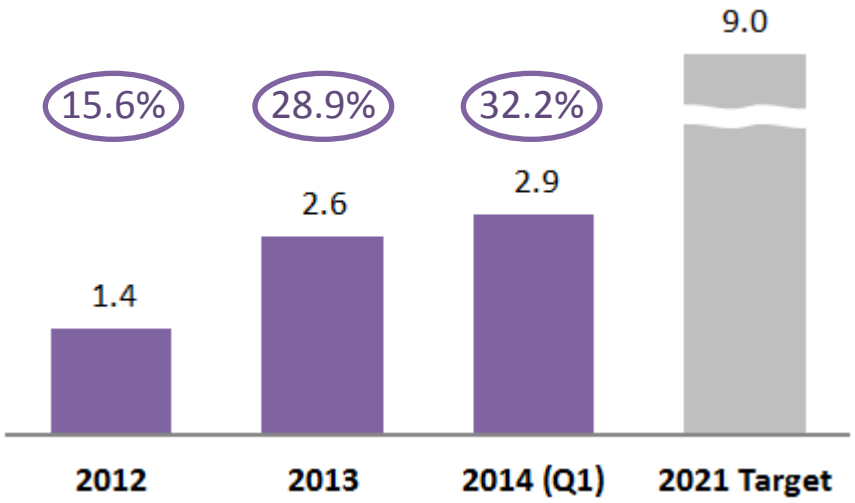
Renewable energy class detail: *Bioethanol*

Current development progress

Fuel usage development

ML/day



Development initiatives

- Continue to increase the **share of "Gasohol" on the market** (current share, including E10, E20, and E84 is 92%)

E10 E20 E85 น้ำมันของคนไทย

- Develop **supply chain for multiple feedstock types**: energy plants, cassava, and sugarcane
- Encourage **ethanol-flexible drivetrain technology** adoption
- Amend laws and regulations to **support ethanol free trade in AEC2015**

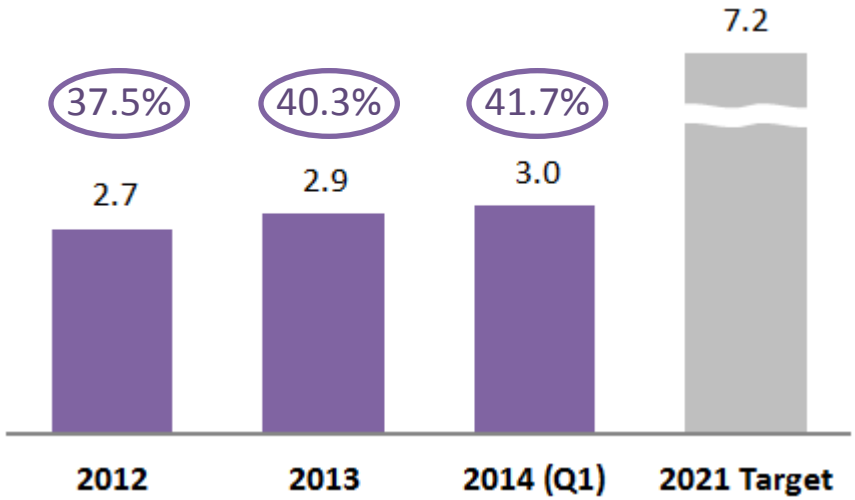
SOURCE: Energy in Thailand – Facts and Figures; Images: eandt.theiet.org,

Renewable energy class detail: *Biodiesel*

Current development progress

Fuel usage development

ML/day



Development initiatives

- Promote **growing palm trees in sustainable areas** not competing with food crops
- Develop **alternative energy crops** for the production of biodiesel equivalents (details on next page)
- Increase **production capacity of crude palm oil**

SOURCE: Energy in Thailand – Facts and Figures; Images: Shutterstock, NYTimes, Biodiesel Magazine

Renewable energy class detail: *Second generation biofuels*

Second generation biodiesel alternative

2021 Target: 3 ML/day

- Promote research on **biodiesel production from algae**
- Promote research on future new fuel for diesel substitution comprising of:
  - **New energy crop development** (e.g. jatropha)
  - Use of **ethanol for blending** to substitute diesel oil, i.e. Fatty Acid Ethyl Ester (FAEE), Ethanol blended with additive (ED95), diesohol
  - Development of **oil conversion technology,** i.e. Bio Hydrofined Diesel (BHD) and Biomass to Liquid (BTL)

SOURCE: Energy in Thailand – Facts and Figures; Images: railnews.co.in

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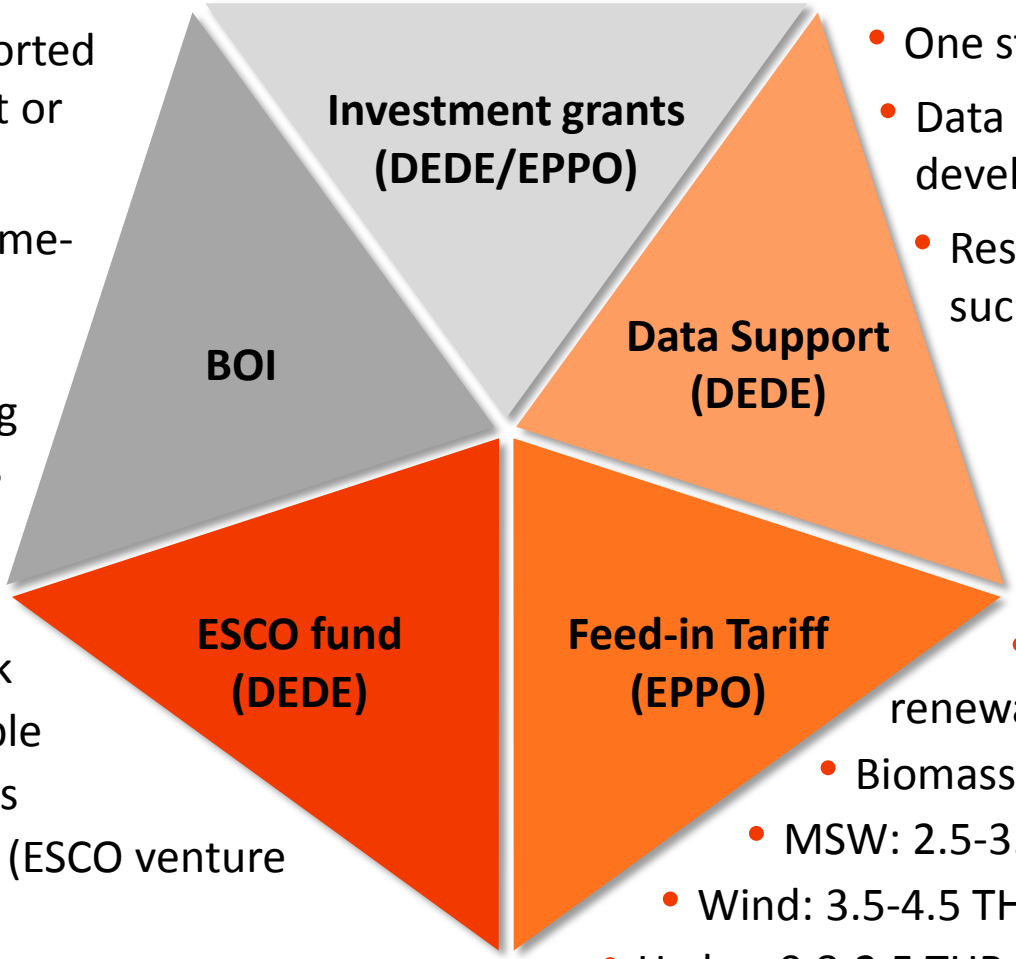
The Ministry of Energy employs several tools to incentivize renewable energy development

- Exemption of imported duty of equipment or machines
- Exemption of income-corporate taxes resulting from Selling RE or saving energy for periods up to 8 years



- One stop service center
- Data on renewable development progress
- Resource data maps, such as solar and wind

- Provides lower risk capital to renewable focused businesses
- Equity investment (ESCO venture capital)
- Equipment leasing
- Credit guarantee facility

- Premiums paid for renewable power generation
- Biomass & biogas: 0.3-0.5 THB
- MSW: 2.5-3.5 THB
- Wind: 3.5-4.5 THB
- Hydro: 0.8-2.5 THB
- Solar: 6.5 THB

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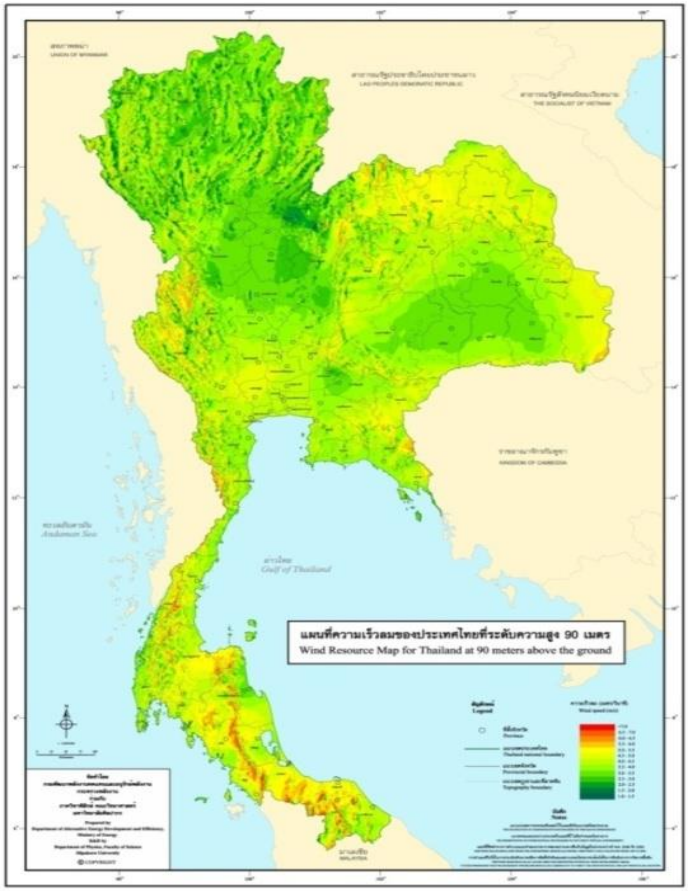
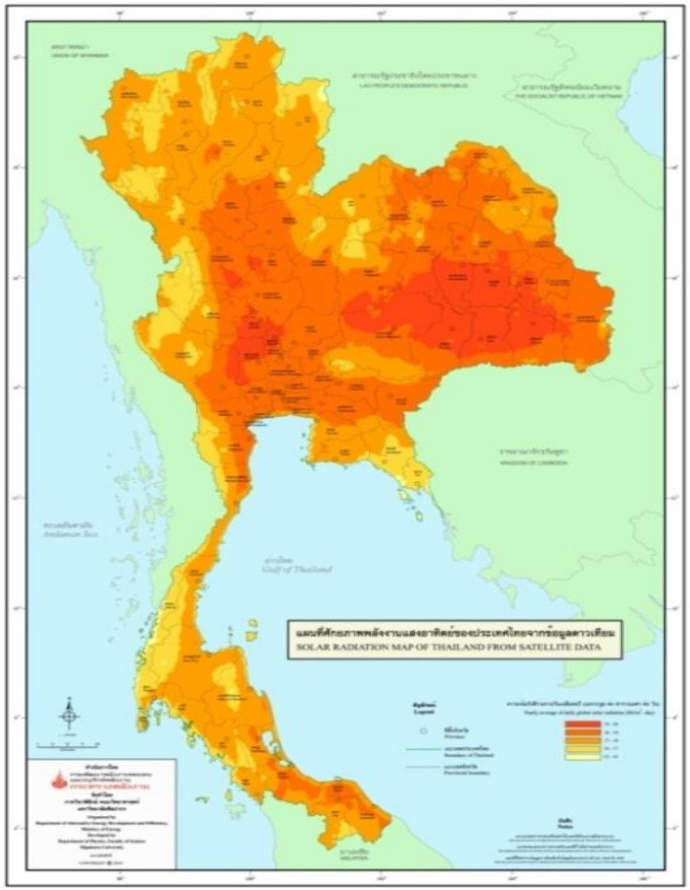
The Ministry of Energy functions as a single source for renewable capacity and development data

One of DEDEs data capabilities is renewable resource mapping; comprehensive solar and wind maps have been developed





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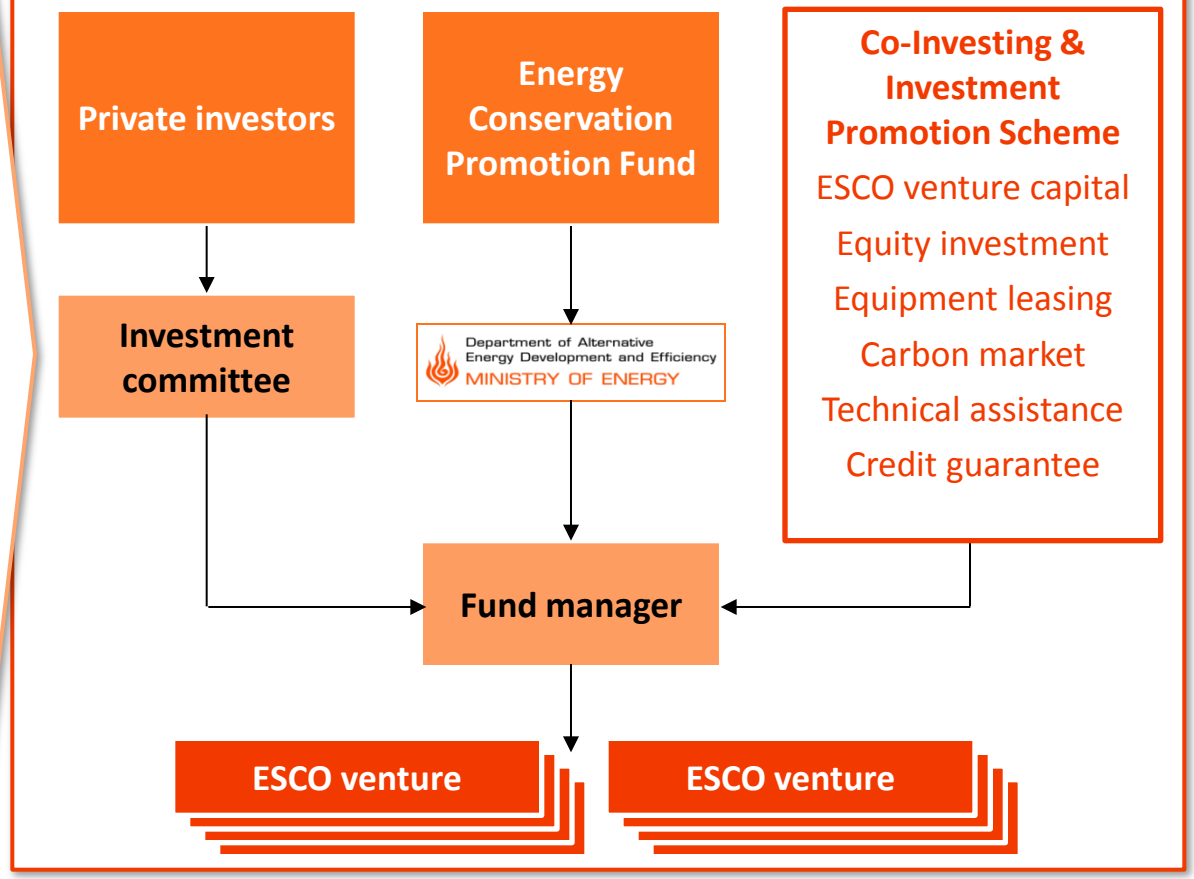
ESCO fund lowers cost of capital and other economic barriers for renewable developers

- DEDE has also developed an ESCO fund to de-risk and encourage investment in renewable focused ventures
- Fund pools capital from the Thai government's ENCON fund with capital from private investors
- In addition to capital funding, ESCO fund provides access to low cost equipment leasing
- Thus far, the ESCO fund has invested a total of 6.1 BN THB (510 MM THB from govt., remainder from private sources) in 54 separate projects accounting for a total energy savings of 1.1 BN THB

ESCO fund structure



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ADDER premiums and Feed-in-Tariffs support economically attractive renewable development

	ADDER (Baht/kWh) VSPP	ADDER (Baht/kWh) SPP	ADDER (US Cents/kWh) VSPP	ADDER (US Cents/kWh) SPP	Special ADDER (THB/kWh)	Supporting Period (yrs)
Biomass						
up to 1 MW ->	• 0.50	• Bidding	• 1.56	• Bidding	• 1.00	• 7
over 1 MW ->	• 0.30	• Bidding	• 0.94	• Bidding	• 1.00	• 7
Biogas						
up to 1 MW ->	• 0.50	• Bidding	• 1.56	• Bidding	• 1.00	• 7
over 1 MW ->	• 0.30	• Bidding	• 0.94	• Bidding	• 1.00	• 7
Waste						
AD & LFG ->	• 2.50	• 2.50	• 7.81	• 7.81	• 1.00	• 7
Thermal ->	• 3.50	• 3.50	• 10.9	• 10.9	• 1.00	• 7
Wind Power						
up to 50 kW ->	• 4.50		• 14.1		• 1.50	• 10
over 50 kW ->	• 3.50	• 3.50	• 10.9	• 10.9	• 1.50	• 10
Small Hydro						
up to 200 kW ->	• 0.80	• None	• 2.50	• None	• 1.00	• 7
50 to 200 kW ->	• 1.50	• None	• 4.69	• None	• 1.00	• 7
Solar	• Varies – detail on next page		• Varies – detail on next page		• 1.50	• 25

Feed –in-Tariff example: Solar PV Rooftop

- AEDP set aggressive targets for development of residential and community scale PV in addition to commercial PV

Solar rooftop target: 200 MW

Household: 100 MW	SME & factory: 100 MW

- Ministry of Energy sought to incentivize small scale solar development to help reduce peak loading and improve domestic energy security

- To help incentivize this development, the National Energy Policy passed a committee resolution on July 16, 2013 which established a tiered feed-in tariff
  - Residential (0-10 kW): 6.96 Baht per kWh
  - Small enterprise (10-250 kW): 6.55 Baht per kWh
  - Medium & large enterprise (250 kW to 1 MW): 6.16 Baht per kWh
- Support lasts 25 years and is intended to reflect different economics at different scales

Thank you for Your attention