



ELSEVIER

Contents lists available at ScienceDirect

Renewable and Sustainable Energy Reviews

journal homepage: www.elsevier.com/locate/rser

Critical review of the current status of wind energy in Thailand



Sakkarin Chingulpitak, Somchai Wongwises*

Fluid Mechanics, Thermal Engineering and Multiphase Flow Research Lab. (FUTURE), Department of Mechanical Engineering, Faculty of Engineering, King Mongkut's University of Technology Thonburi, Bangmod, Bangkok 10140, Thailand

ARTICLE INFO

Article history:

Received 22 August 2012

Received in revised form

22 October 2013

Accepted 18 November 2013

Available online 18 December 2013

Keywords:

Wind energy

Wind energy potential

Wind farm

Electricity

Renewable energy

Thailand

ABSTRACT

Thailand generates electricity from many sources, including natural gas, coal/lignite, fuel oil, diesel, and renewable energies, such as wind, hydroelectricity, and solar power. In 2012, the main electrical energy sources in Thailand were natural gas (63.8%) and coal/lignite (27.7%). Due to fuel price spikes and global warming, several countries are now more interested in studying and developing sources of renewable energy.

Wind energy – an unlimited and environmentally friendly form of natural energy – has attracted increasing levels of investment, particularly in China, which derives more of its electricity from wind energy generation than any other country in the world. Thailand has also developed and promoted the use of wind turbines to generate electricity. In 2012, Thailand generated about 111.7 MW of electricity from wind energy. By 2021, the Thai government's goals are to increase the use of alternative electric energy to about 25% of fossil fuel use and to achieve 1800 MW of electricity output from wind energy.

This article will present a critical review of the current status of wind energy in Thailand, including future plans for using wind energy in place of fossil fuels – oil, natural gas, and coal – to generate electricity.

© 2013 Elsevier Ltd. All rights reserved.

Contents

1. Background	312
2. Energy and electricity situations in Thailand	313
3. Wind energy potential in Thailand	313
4. Current status of wind energy in Thailand	314
5. Thailand's wind energy policy	316
6. Conclusions	318
Acknowledgments	318
References	318

1. Background

For past several decades, energy has been an important, fundamental factor in daily life, business, and industry, including the

Abbreviations: AEDP, alternative energy development plan; GWh, gigawatt hour; GRP, glass-reinforced plastic; DEDE, department of alternative energy development and efficiency; EGAT, electricity generating authority of Thailand; EIA, environmental impact assessment; EPPO, energy policy and planning office; ktOE, kilotons of oil equivalent; kWh, kilowatt hour; PDP, Thailand power development plan; PEA, provincial electricity authority; SPPs and VSPPs, small and very small power producers, respectively; US\$, US dollar (31.245 baht/US dollar foreign exchange rate, as of 13 August 2013)

* Corresponding author. Tel.: +66 2470 9115; fax: +66 2470 9111.

E-mail address: somchai.won@kmutt.ac.th (S. Wongwises).

transportation, manufacturing, and telecommunications sectors. For this reason, a reliable energy supply with sufficient quantity, good quality, and reasonable prices is vital. However, the unstable price of energy in the world market, especially the steadily increasing price of crude oil, has had a serious effect on the economies of several countries, particularly those that must import significant quantities of oil. Furthermore, the use of fossil fuels also contributes to the problem of global warming. As a result, several countries have supported the use of renewable energy to promote energy security and environmental conservation. In 2012, China increased its wind-powered electricity generation and had the highest rate of wind-powered energy generation in the world. Thailand has also developed and promoted wind turbines to generate electricity because it is clean, eco-friendly, and cost-effective.

This paper presents the current status of electricity generation and the proportion of electricity generated from renewable resources, especially wind energy. Wind energy potential is investigated and compared to other countries in Southeast Asia, including its obstacles to development and promotion, as well as future plans to use wind energy in Thailand.

2. Energy and electricity situations in Thailand

The final energy consumption of Thailand in 2012 was about 73,316 ktoe [1], an increase of 13% [2] from 2007. The total value of the final energy consumption was US\$57,545.21 million. As shown in Fig. 1, petroleum products, renewable energy, electricity, coal/lignite, and natural gas represented 48.0%, 18.2%, 18.9%, 7.9%, and 7.0% of the total final energy consumption in 2012, respectively.

Considering the trends in primary energy supply (excluding energy exports) and final energy consumption from 2007 to 2012, as revealed in Fig. 2, it is observed that the primary energy supply

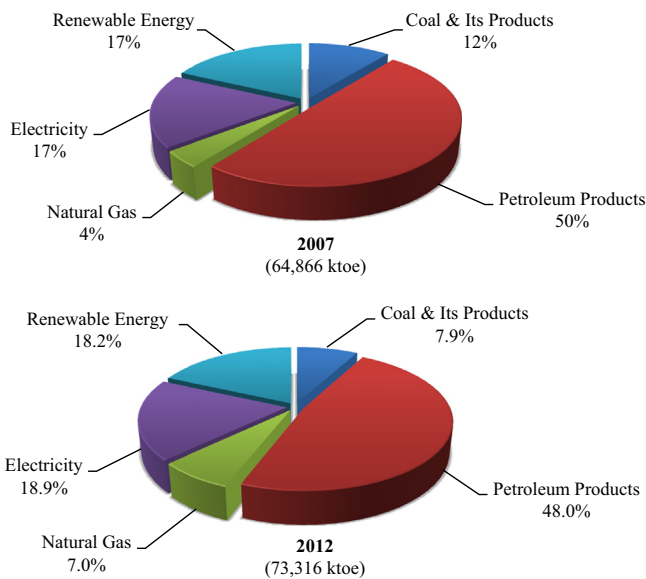


Fig. 1. Final energy consumption by types of Thailand for years 2007 [data from [2]] and 2012 [data from [1]].

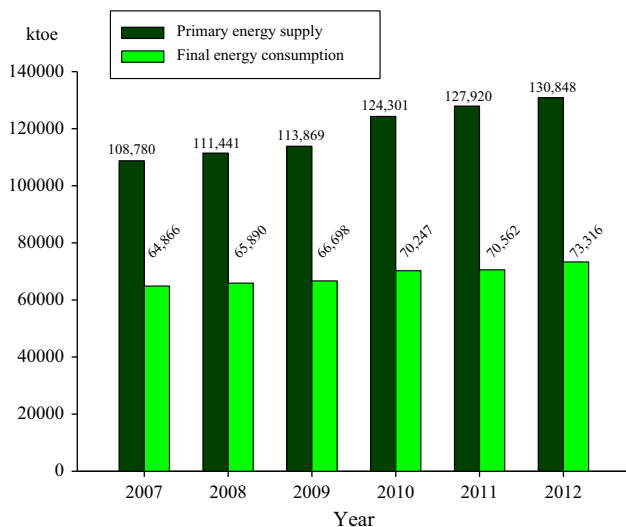


Fig. 2. Primary energy supply and final energy consumption from year 2007 until 2012 [data from [1] and [2]].

increases year-by-year. In 2012, the amount of primary energy supplies was 130,848 ktoe [1]. For primary energy supplies classified by energy type, the highest share, which contributed 82.8% of the total primary energy supply, was from commercial energy (crude oil, lignite, natural gas, and so on), followed by renewable energy, biofuels (ethanol and biodiesel), and other forms of energy (black liquor and residual gas), at 16.2%, 0.8%, and 0.2%, respectively.

Thailand's electricity consumption was 162,668 GWh [1] in 2012. Most of this electrical energy, equal to 82,068 GWh, was consumed by the industrial sector. The commercial sector (including government, non-profit organizations, and street lighting), residential sector, agricultural sector, transportation sector, and other sectors (temporary customers) used 47,210 GWh, 32,097 GWh, 70 GWh, and 930 GWh, respectively.

Table 1 shows electricity generation, installation capacity, consumption, and electricity generation by energy source from 2007 to 2012, according to Thailand Energy Statistics 2012 [1] and 2007 [3]. There is a trend towards increased electricity generation every year. Thailand's electricity consumption in 2010 increased 10.4% from that of 2009, whereas it decreased by 0.4% in 2011, due to severe flooding by that year end. In 2012, Thailand's total electricity generation was 168,471 GWh [1], of which 63.8% was generated by natural gas, followed by coal/lignite (27.7%), and fuel oil and diesel (1.6%), with the balance being renewable energy and other types of energy (6.9%). From Table 1, it is clear that use of natural gas and renewable energy are increasing slightly. On the other hand, use of fuel oil for electricity generation has decreased significantly, due to an unexpected increase in oil prices; thus, promoting alternative energy to replace oil is necessary, especially alternative energy that can be produced in Thailand, such as biomass, biogas, solar energy, hydro energy, wind energy, garbage reclamation, and natural gas.

According to the CIA World Factbook, which lists all countries by electricity consumption, China had the highest electricity consumption, of 4,693,000 GWh [4], followed by the United States, the European Union, Japan, and Russia. Thailand's electricity consumption is rated twenty-fifth in the world and is the highest in Southeast Asia.

3. Wind energy potential in Thailand

Thailand is located near the equator and has low to moderate wind speeds that average about 3–5 m/s. A study of wind energy potential in Thailand began in 1975, when the Department of Energy Affairs of the National Energy Policy Office made a map of wind speed for use in planning, design, and installation of wind turbines. Average wind-speed data were supplied by the Thai Meteorological Department. Field studies then surveyed, measured, collected, and analyzed the wind-speed data. However, since there were several restrictions in making a map of wind-speed potential, the data are only available for low elevations.

In 2001, the map of wind-speed potential in Thailand was improved to include higher-elevation wind data in the analysis. The suitable areas that were selected have average wind speeds of not less than Class 3: 6.4–7.0 m/s or 300–400 kW/m² at an elevation of 50 m [5]. The existing data indicate that the coastal area of the Thai Gulf has the best wind energy potential in Thailand, followed by the upper southern region around the western coast of the Thai Gulf, which has an average annual wind speed of 4.4 m/s at an elevation of 50 m, as shown in Table 2 and Fig. 3.

In the same year, the World Bank proposed a wind energy resource atlas report for four countries in Southeast Asia: Cambodia, Laos, Thailand, and Vietnam [6]. As shown in Tables 3 and 4, the report uses simulations based on global winds to demonstrate which areas are best for the development of wind energy. Table 3

Download English Version:

<https://daneshyari.com/en/article/8120327>

Download Persian Version:

<https://daneshyari.com/article/8120327>

[Daneshyari.com](https://daneshyari.com)