

CHAPTER 1

INTRODUCTION

1.1 Rationale

Energy is considered a prime mover for the socio-economic growth of most countries. In general, economic growth will demand more energy to sustain human activities. Fossil fuels accounted for 81% of the global primary energy supply in 2011, and this may be attributed to the current infrastructure, ease of storage and transport, and consumption subsidies for these fuels. However, the main concern over the use of fossil fuels is the finite amount of petroleum reserves and emissions that contribute to pollution (International Energy Agency, 2010). Thus, there is a need to seek alternative, reliable, and cleaner energy sources. Renewable energy (such as wind and solar) provides such an avenue, supplementing the use of fossil fuels. The global total installed capacity of wind turbines stood at 282.5 GW by the end of 2012, representing a cumulative market growth of 19%, with China having 26.7 % of the total global installed capacity (Figure 1.1) (Global Wind Energy Council , 2012).

Thailand lies within the tropical latitudes $5^{\circ} 37' N$ to $20^{\circ} 27' N$ and longitudes $97^{\circ} 22' E$ to $105^{\circ} 37' E$ and has a land area of 513,115 km² (TMD, 2012). Thailand shares its borders with Myanmar to the west and the northwest, Laos to the north and the northeast, Cambodia in the east, Malaysia to the south. The Central and Eastern regions are also adjacent to the Gulf of Thailand while the South is also adjacent to the Gulf of Thailand to the east and the Andaman Sea to the west (Figure 1.2). With an installed capacity of 31,000 MW, electricity in Thailand is generated from various sources with a large proportion (~73.1%) from natural gas, compared to 6.5% from renewable energy sources as shown in Figure 1.3 (DEDE, 2013). The high reliance on fossil fuels for electricity generation at 93% has created some challenges due to diminishing natural reserves and the need for imports, and this has led to the promotion of renewable energy by the Thai government. Under the Alternative Energy Development Plan 2012-2021, a renewable energy portfolio of 25% of the total energy consumption is targeted for the year 2021. Solar and wind energy are expected to contribute 2,000 MW and 1,200 MW respectively.

Wind power is influenced by factors such as air density, area of wind turbine rotor, and wind speed. Given that wind power is directly proportional to the cube of wind speed, it is seen that wind speed is the most significant factor for wind energy. Wind speed is influenced by seasonal and diurnal variation, terrain, obstacles, and vertical profile. Thus, it can be seen that the intermittent nature of wind speed is significant. Due to its variable nature, its electricity generation may not be readily controlled unlike fossil-fueled power plants where feedstock can be fully controlled. This challenge becomes crucial for electric grid management and planning. As the share of wind energy in a power system grows, the grid will be affected. In order to deal with this, transmission system operators need to coordinate the supply from the various sources and schedule reserve margins. Thus, the capability to predict wind speed and power is useful in setting reasonable estimates for the reserve capacity, scheduling of power plants for economic dispatch and determining market prices for energy. Wind speed or power forecasting covers different time horizons. For example, short-term horizon may be up to 72 hours ahead. Short-term forecasting of wind speed is useful for power system planning in electric grids that have input from wind turbines while medium-term forecasts are useful for maintenance planning for power supply lines, wind turbines and auxiliary equipment as shown in Table 1.1 (Monteiro et al., 2009).

Rayong Province lies in the Eastern region of Thailand and has a coastline in the southern part adjacent to the Gulf of Thailand. Rayong has a relatively high gross domestic product per capita among all 76 provinces in Thailand, being home to the largest industrial complex of Thailand (NESDB, 2011). Main industries include petrochemical industry, metal processing, oil and gas refining, electricity generation, and a seaport (Chusai et al., 2012). The study site is located near the coastline to the Gulf of Thailand in Mueang district of Rayong province. The topography of Rayong is composed mostly of plains with some hills whereas the site considered is on a slightly-sloped terrain at about 45 m above the mean sea level (msl). Owing to the site being at a distance of 6.2 km from the coastline, it is likely that the wind flow over the area will be under the influence of sea breeze as well as the regional prevailing winds, suggesting that the site could have substantial wind resource potential. An overall perspective of the wind resource at the site, wind speed forecasting techniques and suitability of the methods under the current circumstances will be assessed in this study.

1.2 Objective

The objective of this study is to investigate the applicability of a number of standard time-series models to the short-term forecasting of wind speed over a coastal area.

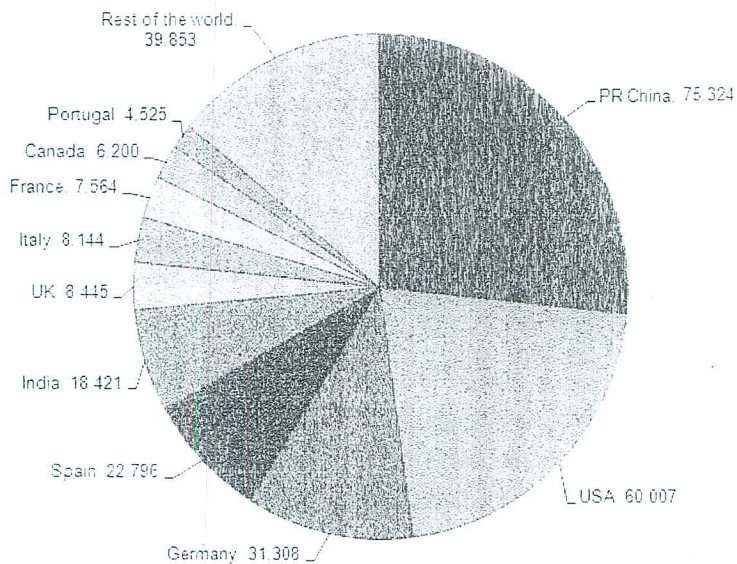


Figure 1.1: World installed wind capacities (MW)
(Source: Global Wind Energy Council, 2012)

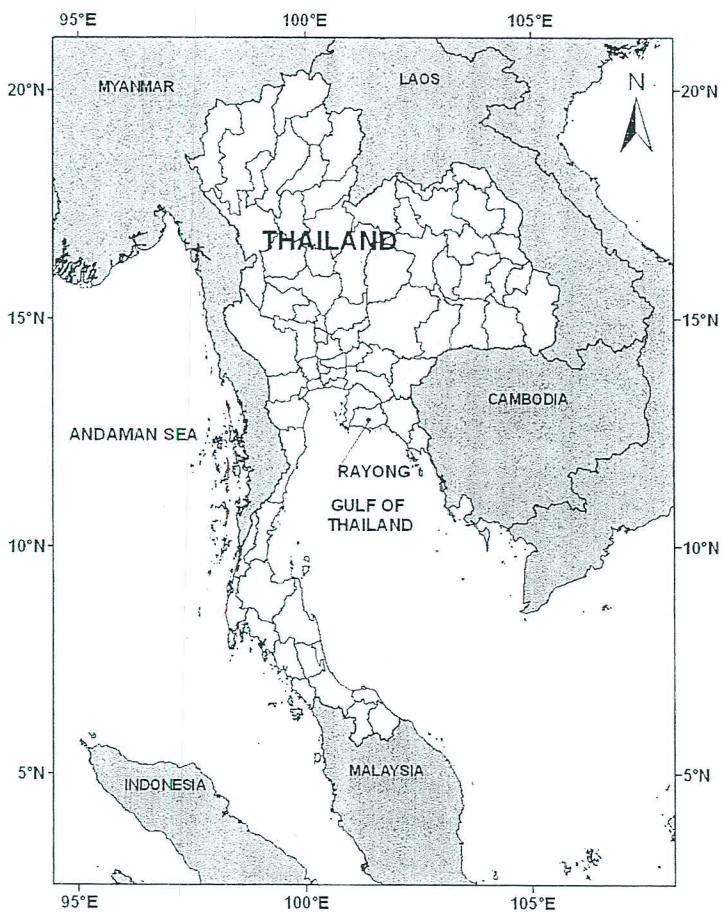


Figure 1.2: Map of Thailand

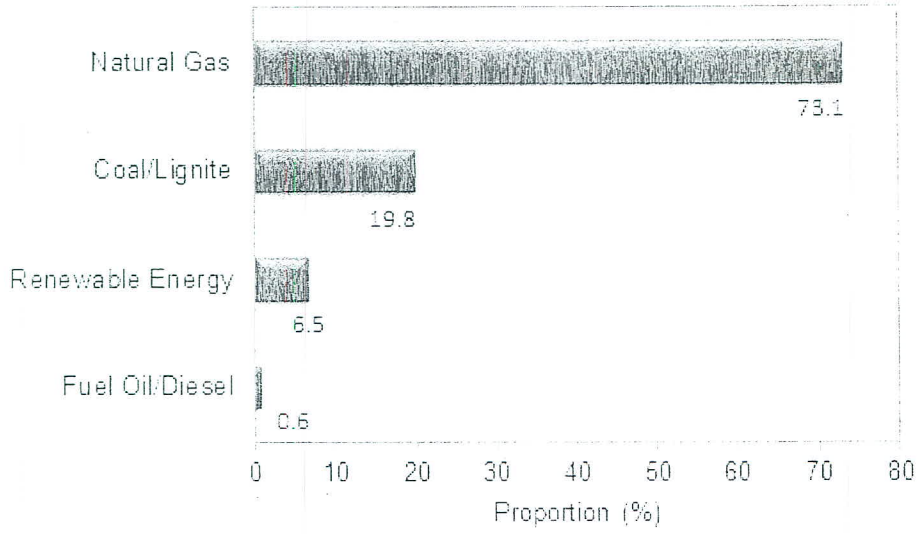


Figure 1.3: Electricity generation for 2012 by source in Thailand
(Source: DEDE, 2013)

Table 1.1: Time horizons for wind power forecasting (Source: Monteiro et al., 2009)

Time horizon	Span	Applications
Very short-term	Up to 9 hours	<ul style="list-style-type: none"> ▪ Intraday market ▪ Real-time market
Short-term	Up to 72 hours	<ul style="list-style-type: none"> ▪ Day-ahead market ▪ Wind farm maintenance planning ▪ Energy storage planning
Medium-term	Up to 7 days	<ul style="list-style-type: none"> ▪ Scheduled maintenance planning and costing ▪ Decision-making for unit commitment and reserve requirements