CHAPTER I
INTRODUCTION

1.1 Overview of Thailand Economics and Energy Situation

By year of 2004, Gross Domestic Product (GDP) of Thailand was 3,676,090 million Baht, or 57,860 Baht/capita (DEDE, 2004). Represented in Figure 1.1, GDP per capita was increasing by factor of 1.19 during the period of 2000-2004. Along with the economic growth, the energy consumption per capita seems to grow somewhat more rapidly, increasing from year 2000 by factor of 1.24.

The total energy consumption has increased from 47.8 Mtoe in year 2000 to 61.1 Mtoe in year 2004 (Figure 1.2). However, the domestic energy production capability can cover only 49.5 Mtoe or about 81%. To fill the gap, Thailand must obliquely import energy and annual net cost worth 462 thousand million Baht. Compared to 246 thousand million Baht in year 2000, the net energy import value was increased by 87% within four year period. However, this gap is likely to continue increasing in near future.

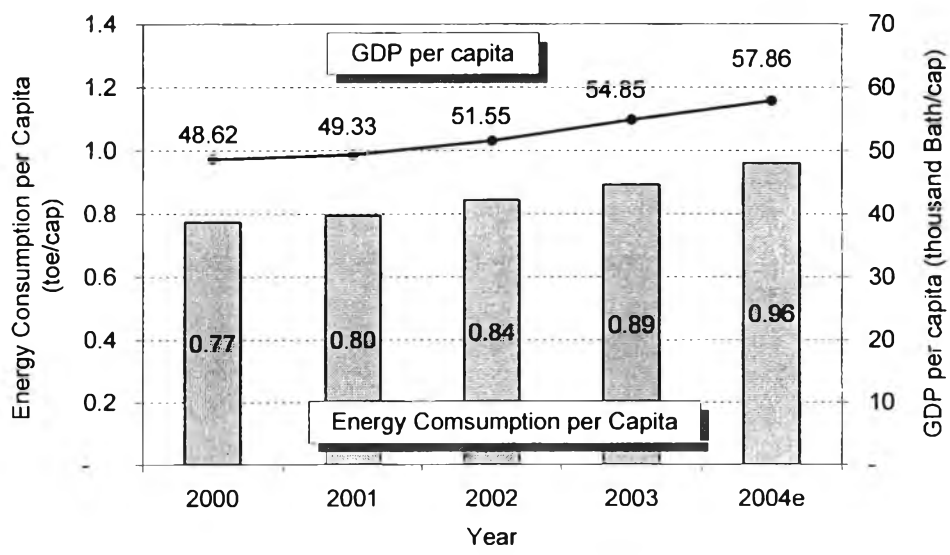

Figure 1.1 Thai economic indicator and energy consumption growth (DEDE, 2004).

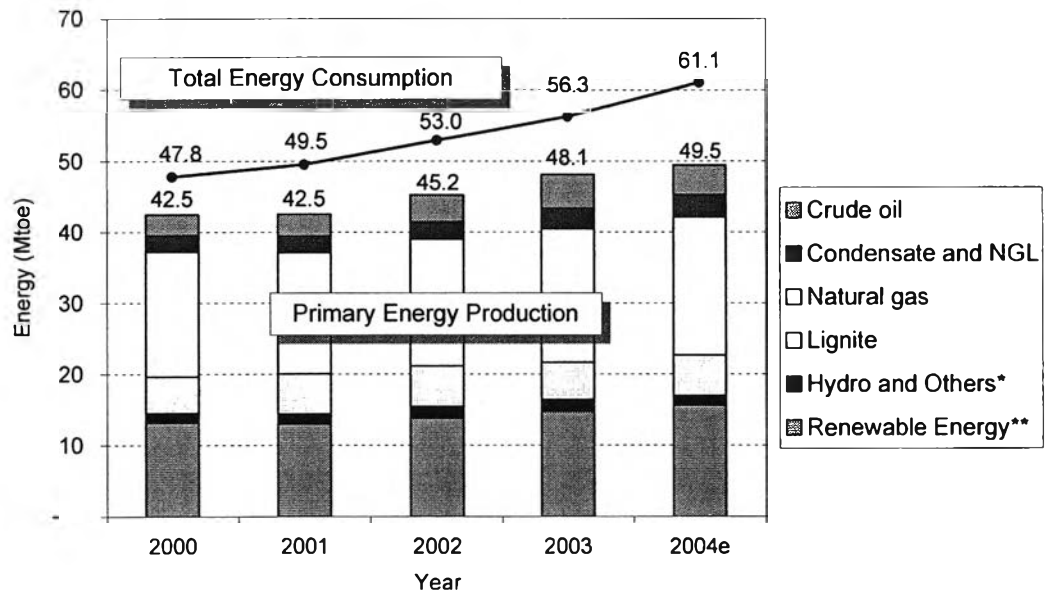

Figure 1.2 Thailand total energy consumption and primary energy production by fuel (DEDE, 2004), * others include geothermal, solar cell and wind power, ** renewable energy includes fuel wood, charcoal, paddy husk, bagasse, garbage saw dust and agricultural waste.

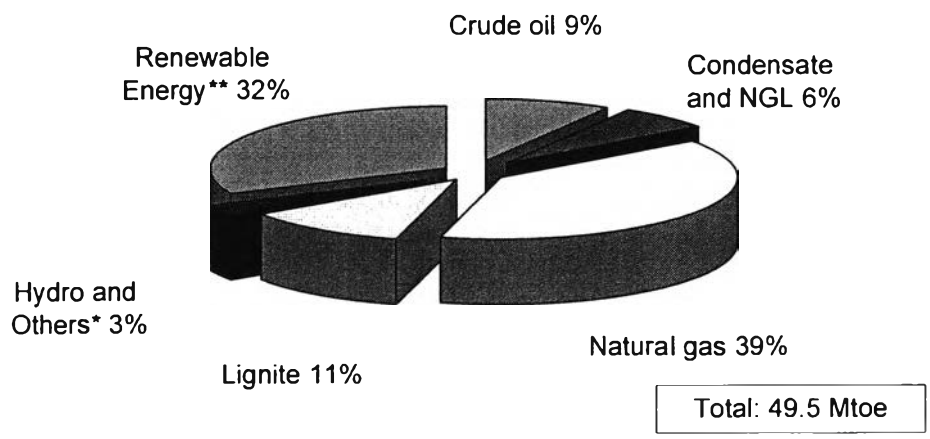

Figure 1.3 Domestic primary energy production by source (DEDE, 2004).

Consider the domestic capability of the primary energy production (Figure 1.3), the main energy source still involves fossil fuel (combined oil, gas and condensate and coal), up to 65%. Beside conservation measures, both finding alternative fuel source and the way of its efficient use are important issues and challenging for all people who involve with the energy policy, research, business, community or even end use. While the availability and production of fossil fuel is limited, a strategy to fight against the high increase of energy demand should be targeted toward an alternative energy resource such as renewable, biofuel and energy from waste etc.

1.2 Waste-to-Energy

The concept of waste-to-energy has drawn a lot of attention from community around the globe. Utilization of waste as for energy production provides not only an advantage on a recovery of energy and valuable matters but also a sustainable waste stabilization alternative. Many kinds of waste such as municipal solid waste (MSW), plastics, agricultural waste and sewage sludge etc. are considered as the hydrocarbon-rich compound, which benefit for use in energy production. This can be done via several routes including bioconversion, incineration or thermal conversion processes i.e. liquefaction, gasification and pyrolysis.

This work however was originated primarily emphasizing on converting sewage sludge to energy and chemicals. Sewage sludge, by definition, is a solid waste generated and accumulated from wastewater/water treatment system. Beside the energetic viewpoint, the idea of sewage sludge utilization by pyrolysis was originally created by an effort to find the most efficient disposal way. Pyrolysis provides the advantages over conventional sewage sludge treatment methods such as incineration, landfill and use for agricultural purpose. Incineration system needs high temperature. Indeed, it is costly extensive. An additional off-gas treatment is considerably serious issue and always required. Landfill also requires space and probably create new problems concerning to leaches or gas. Conflict with the local community is also a concern. Pathogenic organisms and heavy metals containing in sludge are released directly to surrounding when sludge was agriculturally used.

Thus, as an alternative, it is considered that pyrolysis process may be a promising solution for the problems of both secondary pollution and of large energy consumption incineration. However, an advanced technology in pyrolysis of sewage sludge is in the step of research and development.

1.3 Objectives of This Study

Primary study in Thailand has reported a potential amount of sewage sludge production for energetic use. In order to develop an efficient pyrolysis system, fundamental understanding of both process methodology and raw material characteristics is a necessity. By both environmental and energetic perspectives, this work was focused on investigation of fundamental characterizations of sewage sludge in Thailand concerning to the thermal and pyrolysis property. Thus the scope of this work starts at collecting the sewage sludge sample, characterization for its compositions, thermal property, and relating its compositions with property (Chapter IV). The pyrolysis property was then investigated emphasizing on the decomposition kinetics (Chapter V). Finally, the special issue on analysis of composition to describe its origin, property, or even global decomposition behaviour of sewage sludge was taken by analogy to those of biomass (Chapter VI). The information collected will be an advantage for the development of a sustainable pyrolysis system in the future.