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Energy scenario and biofuel policies and targets in ASEAN countries

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ABSTRACT

Present energy situation of the world is unsustainable due to unequal geographical distribution of natural wealth as well as environmental, geopolitical and economical concerns. Ever increasing drift of energy consumption due to growth of population, transportation and luxurious lifestyle has motivated researchers to carry out research on biofuel as a sustainable alternative fuel for diesel engine. Biofuel such as biodiesel and ethanol, produced from renewable feedstock's, are the most appropriate alternative of petroleum fuels. Government of many countries has set a target to use biofuel in transportation and industrial sectors to reduce the fossil fuel demand in their countries. This report compiled the findings on global energy scenario, potential of biofuel as a renewable energy source, biofuel policy and target of some selected countries and the effect of mixed blends of biofuel and diesel on engine performance and emission parameters of a diesel engine. The study concluded that the energy consumption and CO_2 emissions in ASEAN countries increasing day by day. To reduce the energy consumption and harmful gasses emission to the environment, government of ASEAN countries have set target to use biofuel in diesel engines as biofuel-diesel blend have potential to reduce dependency on fossil fuel as well as the exhaust emissions of the engine.

Contents

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1. Introduction

Fossil fuels are widely used as a transportation and machinery energy sources due to its high heating power, availability and combustion properties but its reserve is depleting day by day [1–3]. Today diesel-powered vehicles represent about one-third of the vehicles sold in Europe and the United States and it is being predicted that the sales of diesel run automotive will rise from 4% in 2004 to 11% by 2012 [4]. However, emission produced by burning of petroleum derived fuel has a serious effect on both the environment and human health [5–9]. Every year more than 15 billion tons of CO_2 is added to earth's atmosphere. The combustion of fossil fuels is a big contributor to the increase in the level of CO_2 in the atmosphere which is directly associated with global warming [10–13]. As an alternative to petro diesel in the transportation sector, biofuel development has potentials in addressing issues related to energy and food security, climate change, and rural development. First, biofuels can be regarded as integral part of emerging bio-economy and exhibiting increasing potential to substitute materials including fuels from fossil oil in the near future. Second, as a renewable energy, biofuels are derived from plant materials which can contribute to the reduction of greenhouse gases (GHG) emissions when replacing fossil oil if they are sustainably managed [14–17]. Third, biofuels production is often associated with farmers in rural and/or poor areas. It has the potential to produce new incomes for farmers while generating new jobs and new businesses to alleviate poverty and improve farmers' life standards [18]. Agricultural biomass is a relatively broad category of biomass that includes the food based portion (oil and simple carbohydrates) of crops (such as corn, sugarcane, beets) and the non-food based portion (complex carbohydrates) of crops (such as the leaves, stalks, and cobs of corn stover, orchard trimmings, rice husk, straw), perennial grasses, and animal waste [19].

To ensure the sustainability of biofuels, different regions including the European Union, the Unites States and other countries are developing their national strategies on biofuel development [20,21]. The United States National Biofuel Action Plan has covered the whole chain of the biofuel production process, including feedstock production and logistics, conversion technologies, distribution and end use while at the same time, addressing the biofuel sustainability issues. New regulations on biofuels are, however, under-developed [22]. The EU sets out seven strategic policy areas for the production and use of biofuels, including measures of stimulating demand for biofuels, ensuring environmental benefits, developing the production and distribution of biofuels, expanding feedstock supplies, enhancing the trade opportunities of biofuels, supporting developing countries, as well as supporting research and innovation activities. In 2010 worldwide biofuel production reached 105 billion liters (28 billion gallons US), increasing almost by one-sixth from that of 2009. Biofuels met nearly 2.7% of the global fuel demand for road transport. This contribution was largely made up of ethanol and biodiesel [23].

Although there are large number of literatures to research on engine performances and its emissions when using biodiesels, especially in last decades, only fewer people have analyzed and reviewed them. This paper intends to summarize the different production systems of biofuels, current status of application of biofuels and their future perspective in ASEAN countries.

2. ASEAN energy and CO_2 emission scenario

2.1. ASEAN energy consumption

Global energy consumption is growing every day [24,25]. In 2011, the total primary energy consumption of ASEAN was equivalent to Japan's, which is around 444 Mtoe [26]. It is predicted that, in 2040, ASEAN energy consumption will rise to 1186 Mtoe, rising at an annual rate of 3.1%. Indonesia will surplus Japan's energy consumption in 2035 and it is predicted that they will become 5th largest energy consumer of the world. However, as Malaysia and Thailand population growth will decelerate from 2025, their primary energy consumption rate will be slower than other ASEAN countries (Fig. 1).

In the last few years, industries facing problem of hiking labor cost and earning less profit has shifted their operation to Myanmar and other neighboring countries from Malaysia and Thailand. As a result, primary energy consumption of Myanmar will increase almost 2.5 times in the next 30 years.

2.1.1. Energy demand by fuel type

ASEAN countries are heavily dependent upon fossil fuel. The demand is projected to rise from 76% in 2011 to 80% in 2035 [27]. Compared to 2011, oil demand will rise by 25.6% and 58.1% annually per annum in 2020 and 2035. However, there total share will drop to 31% from 38%. Coal demand increases three fold during this time period, increasing at a rate of 4.8% per year. In 2035, it will have the second largest market share of 28% overtaking natural gas. Due to higher gas prices, the gas demand growth will be slower compared to other sources. The market share of natural gas will remain almost same during this time period, at just over 20%. However, introduction of more strict pollution regulation might boost the prospects of natural gas.

2.1.2. Energy demand by sector

Energy demand in the buildings sector increases by 1.8% year, which results in more than 50% overall increase during the time period [27]. Whereas, global energy demand for building sectors increases with an average annual growth rate of 1.6% per year [28]. World energy consumption in the transportation sector increases

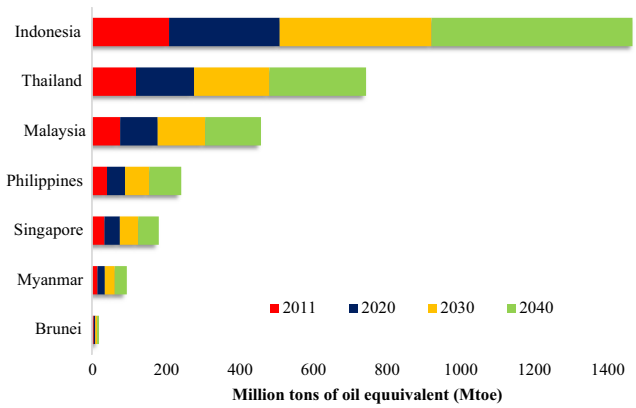

Fig. 1. ASEAN primary energy consumption (2011–2040).