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The feasibility and implications for conventional liquid fossil fuel of the Indonesian biofuel target in 2025

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HIGHLIGHTS

- Indonesian energy demand in 2025 was forecasted by using LEAP.
- The biofuel target (5% of the total energy mix in 2025) requires 782 PJ of biofuel.
- The target can be achieved under the scenario of maximum blending alternative.
- The target requires up to 5.2 million ha of palm oil and sugar cane plantation area.
- It may offer potential new employment for about 3.4 million people.

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ABSTRACT

This paper identifies conventional liquid fossil fuels that can be replaced or blended with biofuel and quantifies the biofuels required to meet the Indonesian biofuel target of at least 5% of the total primary energy mix in 2025. The analysis was conducted using the Long range Energy Alternatives Planning (LEAP) system with an energy elasticity of 1 and maximum allowable biofuel blending ratios according to the current best practices. The results show that the target could be achieved with the maximum blending alternative based on constant energy demand growth of 6%. The target requires a total contribution from biofuel of about 8–27 GL in 2025 depending on blending ratios. In energy terms, these are equivalent to 232–782 PJ or about 40–135 million barrels crude oil, which constitute roughly around 3.3–11.0% of the estimated liquid fossil fuel oil annual consumption in that year. The results imply that it may have detrimental environmental impact, as it requires 5.2 million ha of palm oil and sugar cane plantations. On the positive side, achieving the target offers potential new employment opportunities of about 3.4 million jobs, particularly in the agricultural sector relevant to liquid biofuel production.

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1. Introduction

Liquid biofuels in the form of biodiesel and pure plant oil from vegetable oils such as palm or Jatropha, and bioethanol from either cassava or sugar cane have been considered as potential alternative renewable fuels for Indonesia. A number of reasons support this claim including the potential amount of biofuel raw materials produced in this country. Indonesia for example has surpassed Malaysia as the largest palm oil producer in the world when the total production for the marketing year of 2011/2012 was estimated to reach 25.4 Mt (USDA Foreign Agricultural Service, 2012). The production is expected to increase further as approximately 2.2 million ha of planted immature palm area is nearing productive age (Shean, 2009). Similar to the case of palm oil plantation, Indonesia during the Dutch colonial era was one of the largest producers of sugar cane in the world up until the late 19th century. Despite its rapid decline in the 20th century, the sugar cane production still plays an important role in the Indonesia economic sector. The Indonesian government has implemented a policy to revive this industry by introducing various measures including promoting high yield seeds and soft loans worth US $ 360 million (Sinar Tani, 2008). Developing bioethanol from sugar cane could coincide appropriately with the government revitalisation programme for the sugar industry.

In addition to having access to abundant biofuel based raw materials, a greater share of liquid biofuel in the Indonesian energy system may provide environmental benefits as developing these fuels in a sustainable manner could reduce greenhouse gas emissions, but may also incur environmental risks associated with plantation development. The biofuel utilisation could also provide additional diversity of energy sources in the light of decreasing Indonesian oil and gas production for the past 6 years (EIA, 2010).

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As this biofuel industry is most likely to be built in many parts of this island nation, in the vicinity where the raw materials are grown, such a development may provide potential employment opportunities and promote economic growth in rural areas. This would primarily be in the agricultural sector and some small portion in the biofuel processing industry. Moreover, the use of palm oil, sugar cane or cassava, for purposes other than food may attenuate price fluctuations during periods of high crop production. This helps smallholder plantations especially in the palm oil and sugar cane sector where prices may become volatile due to various reasons in the world competitive market.

Indonesian Presidential Regulation no. 5 issued in 2006, commonly called the national energy policy, suggested the use of biofuel as a part of the renewable energy sources. Biofuel is stipulated to contribute more than 5% to the national energy consumption by the year 2025 (Government of Indonesia, 2006). Biofuel availability is expected to reduce the role of conventional fossil oil in the total primary energy mix while coal and natural gas gain significant share. The regulation also sets a target for the nation's energy elasticity (ratio of energy growth rate to economic growth rate) to be less than one. Following this regulation, minimum volumetric utilisation targets for 2025 were launched in 2008 to further strengthen government effort to develop the biofuel industry (Ministry of Energy and Mineral Resources Indonesia, 2008). It was stipulated to have 20% of the total volumetric automotive diesel fuel consumption replaced by biodiesel, 15% of the total projected petrol consumption replaced by bioethanol and 10% of the total volumetric diesel fuel consumption replaced by pure plant oil in 2025.

Despite providing clear quantitative mandatory targets, such a government policy requires details on the volume of each type of biofuel required to meet the target. Furthermore, implications of the policy on social, environmental and technical aspects need to be understood. Capstick (2007) though, has attempted to estimate the demand of biofuel and found that it could reach up to 9.65 GL annually in the year 2025. However, such a study only considered the use of bioethanol and biodiesel and assumed a maximum 5% blending with the conventional liquid fuels. The estimate falls well short of meeting the target of 5% of the total primary energy mix due to the inclusion of coal and gas in the mix. Other types of liquid biofuels such as pure plant oil and the question as to whether they could contribute to the biofuel target were not addressed. This paper therefore aims to explore and identify the type of conventional fossil fuels in Indonesia that can potentially be substituted and to estimate the quantity of biofuels required to meet the set target assuming coal and gas will have an economic advantage of liquid fuels for many purposes. The implications of this Indonesian energy policy on social, environmental and technical aspects are also discussed.

2. Snap shot of the current energy situation in Indonesia

Indonesia has significant economically exploitable conventional fossil energy resources such as oil, gas and coal. Figures released in a 2004 report by the Department of Energy and Resources, Indonesia revealed an estimated total crude oil reserve of about 526,667 PJ or equivalent to 86.9 billion barrels with a proven reserve of 54,545 PJ (9 billion barrel) (Ministry of Energy and Mineral Resources Indonesia, 2004). The same report also confirmed a relatively high proven reserve of natural gas at about 197,400 PJ or equivalent to 5.324 trillion standard cubic metres while the coal proven deposit stayed at about 491,273 PJ or equivalent to 19.3 billion tons of coal.

The national energy flow in 2008, presented in Fig. 1 and detailed further in Appendix A, revealed a total annual flow of 5930 PJ primary energy, excluding biomass. The Indonesian primary energy mix in 2008 indicated how heavily dependent it is on

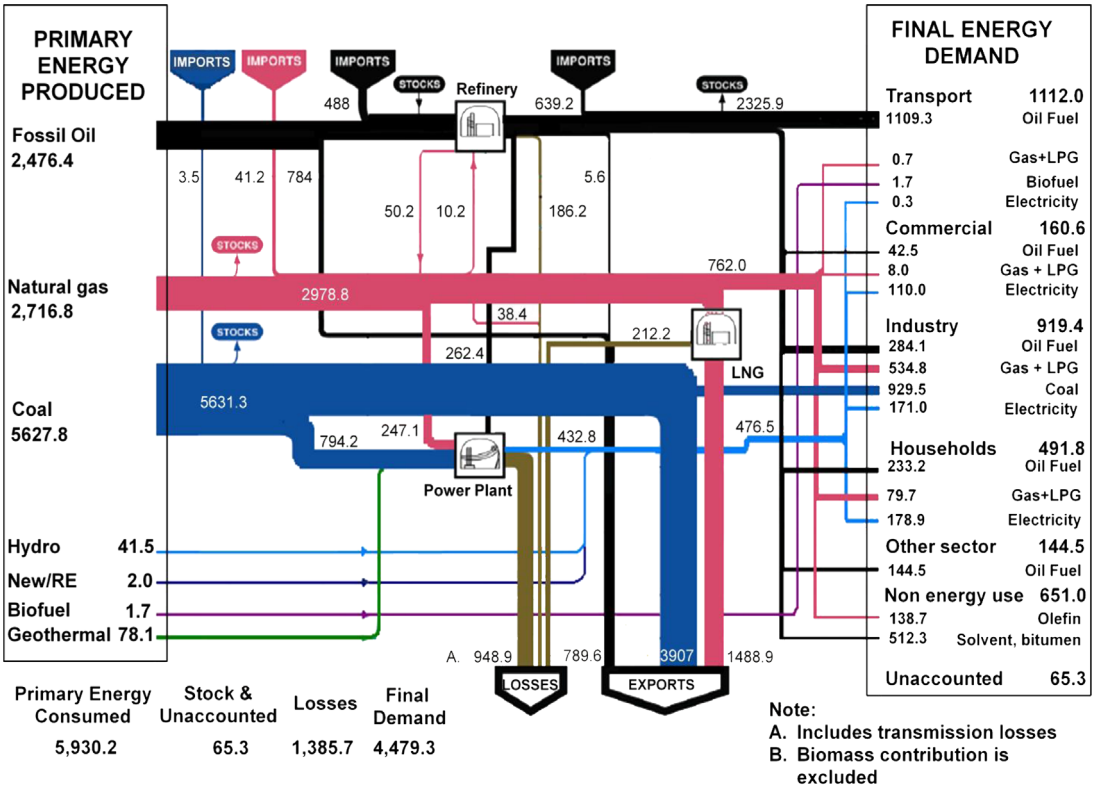

Fig. 1. Indonesia Energy Flow 2008 (PJ) excludes Biomass (Source: the Centre for Energy and Mineral Resources Information and Data—Ministry of Energy and Mineral Resources Indonesia (2008), adapted from Geoscience Australia (2008)).

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