



Production of sustainable energy from biogas for transportation and smart grid

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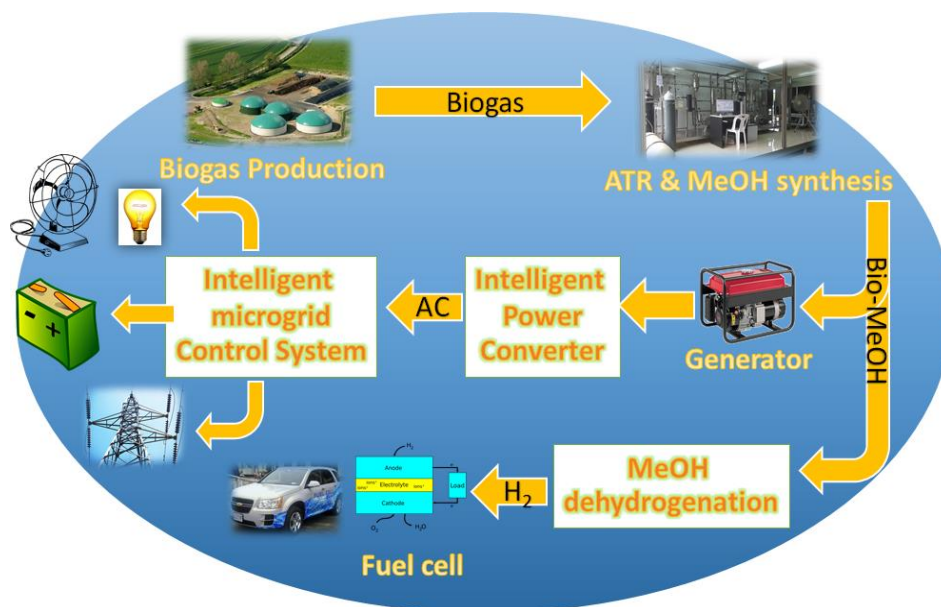
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Thailand is an agricultural country including agriculture and livestock. Large quantities of agricultural waste remain from agro-industry, such as sugarcane leaves, cassava leaves, leaves or peels of rubber trees, cornstalk, and rice straw as well as residues from agricultural processing such as molasses and bagasse fiber from sugar mills, rice husk from rice mills, palm shell from palm oil extraction, pulp waste from paper mills, wood chips from furniture industries and municipal waste, could be utilized as natural renewable resources for the production of sustainable biomass energy. The simple and cheap conversion of biomass is biogas production, which farmers can produce their own biogas. The main compositions are methane and carbon dioxide. Almost gained biogas is burned to produce heat energy for cooking in small scales/households or combusted to generate thermal or electric power in large scales/industries. Due to biogas requires high volume space for storage, it shows low heat density relative to volume and lower than conventional liquid fuels. The handling of volatile gas (methane b.p.: -161.5 °C) and potentially explosive hydrocarbon gas necessitates special conditions such as high pressure, use of special materials to minimize diffusion and leakage, and extensive safety precautions, which is energy intensive and expensive. Besides the mentioned difficulties of biogas storage and distribution, need the development of infrastructure for the biogas economy. Therefore, the application of biogas to current automotive is limited. As a result, biogas conversion into liquid fuels for vehicles and transportation is a challenge to current research and development.

One of interesting alternative liquid fuel is Methanol. Owing to it is an energy-dense liquid that can be transported easily with existing infrastructure. In addition, methanol is a versatile molecule as it can be used for fuel cells (DMFCs); blended with gasoline; converted to gasoline or dimethyl ether, which is a component of diesel fuel; and converted to ethylene and propylene, which are precursors to a wide range of chemicals. In nearly future, it is highly possibility to replace fossil fuels. Given the chemical properties and versatility of methanol as well as renewable biogas from biomass, the conversion of biogas via methanol to energy is indeed a dream process which we need to achieve. Jitrwung et al. [1], [2], [3] have studied the conversion of biogas to methanol by using continuous semi-pilot scale reactor. The reforming process of biogas can be also transformed carbon dioxide, which is a major compound in biogas. An advantage of the technology, is reducing the emission of the important greenhouse gas such as methane and carbon dioxide unlike directly burning which remain incombustible like carbon dioxide. Moreover, using of methanol as a liquid fuel for vehicles, is applied. Direct methanol fuel cell (DMFC) is a very attractive technology especially for portables, mobiles and stationary applications. An electrochemical energy conversion device such DMFC that converts the chemical energy of liquid methanol into electrical energy directly inside of vehicle under atmospheric condition and below 100 °C is a promising technology. For stationary application such as in household, methanol can be also applied to generators. The produced electricity is fed into an intelligent inverter for dynamic current modification. After that, the modified electricity can be used directly with electric appliance. Needed excess electricity could be reserved in a battery or released into the smart grid for further distribution.

Therefore, the corporation of Thai researchers in Germany and Thailand is occurred to integration expertise for improvement the technology of the electricity and biofuels production from bio-waste

residues. This project can be developed to the industrial level. In addition to increasing the value of the waste generated by agricultural production. It also reduces agricultural waste, fossil energy consumption, and the impact on the environment. Moreover, it will decrease the dependence on Thailand's energy imports in response to Thailand's alternative energy policy for a sustainable society.



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Keywords:

Bio-gas, Bio-methanol, Fuel cell, Intelligent inverter, Smart grid

Explain the impacts of your work especially to Thailand.

Thailand relies on importing energy and high technology from abroad for a long time. As a result, the promotion and development of technology in the country will enhance the country's ability to develop and reduce dependence, a result is energy security. Thailand is an agricultural country. The majority of the population is in farming and animal husbandry result in difficult access to advanced technology. Therefore, cooperation of many sectors for development of alternative energy production could be sustainable by using easy access technology and abundance of raw materials in the country, especially the agricultural waste. Thus, production cost from feedstocks is reduced while farmers gain increasing

income. Moreover, it could reduce social inequality as well as also promote the security of energy supply for country.

Explain how your work fits with the ATPER conference theme

The goal of the ATPER conference is to build up a collaboration between researchers in Thailand and researchers or Thai people working in Europe to integrate their knowledge and experience to develop innovation effects to Thailand development.

The project, which will be presented at the ATPER conference, is a research and innovation cooperation among a Thai research team with potential and experience in biogas research and methanol production from biogas collaborate with European experts in the field of agricultural industry, electrical network of power generation, and smart grid to completely connect from upstream to downstream. This research is consistent with the main theme of the event, "Smart Cities". People can live by their self-sufficiency on energy produced in the community, both in terms of electric power for home use and liquid fuels for transportation and communications.