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Biomass Resource: A potential energy source for green future

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Abstract

In Vietnam, biomass energy use has been around for a long time, but it is still small at the household level for cooking or small production. These are fuels derived from biomass materials (biomass) such as firewood, wood, straw, rice husk, dung ... but this is only a raw fuel. The use of raw biomass materials on an industrial scale is very difficult and economical due to the low calorific value of fuel (15 to 18 MJ / kg for firewood, wood and 12-15 MJ / kg for rice husk) leads to small, scattered exploitation, supply and use. Meanwhile, the biomass energy potential from vegetable oil plants such as cassava (wheat), corn, pineapple, peanuts, basa fat, molasses (from sugar cane) is processed into alcohol mixed with gasoline, sesame (sesame) oil. Palm ... in Vietnam is quite large (Khai, 2003). Biogas technology in recent years mainly developed at the family level. At the moment there is no exact statistics but according to the evaluation of the national target program on clean water and rural sanitation, about 7% of animal breeding facilities treat waste (the target is 30 %). RCEP said biomass energy differs from other types of renewable energy in two aspects. First, unlike wind and wave energy, biomass is controllable. Second, biomass at the same time provides both heat and electricity. Biomass comes in many forms: wood, forestry by-products such as sawdust, agricultural waste such as straw, manure, energy crops (sugarcane, willow). In addition, there is vegetable waste from parks, gardens, roadsides. All of these are available in the UK. The RCEP report calls on the British government to mandate current heat suppliers (oil, gas and electricity) to provide part of the heat from renewable energy sources. This provision will take effect at a specific time. In addition, it is necessary to establish a biomass forum between the government and the heat and electricity supply industry. All new development projects must be planned to build a factory to produce combined heat, electricity and biomass fuel

Keywords: Biomass energy, conversion technology, biomass resources, biodiesel production

1. Introduction

Biomass is an organic material that stores sunlight as a chemical energy. When burned, this chemical energy is released as heat. What we today call biomass has been heating homes and buildings around the world for thousands of years. In fact, biomass continues to be a major source of energy in developing countries. Wood is still the largest source of biomass energy in the world. The real environmental and energy security benefits of biomass will arise when humans use large amounts of biomass to produce electricity, heat and other biofuels, thus reducing the use of chemical fuels. Jelly. The carbon cycle is the principle behind biomass technology. As plants grow, they absorb CO₂ in the environment and store it through photosynthesis. The same amount of CO₂ is released when plants naturally decompose or burn. That means biomass does not contribute to greenhouse gas emissions. Biofuels nlike other renewable energy sources, biomass can be turned directly into liquid fuels - biofuels - for vehicles (cars, trucks, buses, airplanes). , train). The two most common types of biofuels are ethanol and biodiesel. Ethanol is an alcohol, similar to the alcohol in beer and alcohol. It is produced by fermenting any type of biomass with a high carbohydrate content (starch, sugar or celluloses) through a process similar to beer fermentation. Ethanol is primarily used as a fuel additive to reduce the amount of carbon monoxide and other smog emissions from vehicles. There are already flexible fuel vehicles including gasoline and 85% ethanol. Biodiesel is produced by combining alcohol (usually methanol) with vegetable oil, animal fat

or recycled cooking fats. It can be used as a fuel additive to reduce vehicle emissions (20%). In pure form, biodiesel is used as fuel for diesel engines. Other biofuels include methanol and other denatured components of gasoline. Methanol, commonly known as wood alcohol, is currently produced from natural gas. However, it can also be produced from biomass. There are several ways to turn biomass into methanol, but the most common method is gasification. Gasification involves evaporating biomass at high temperatures, then removing impurities from the hot gas and passing it through a pulse. The catalyst converts gas into methanol. Most of the denatured components of gasoline produced from biomass are pollutant-reducing fuel additives, such as methyl tertiary butyl ether (MTBE) and ethyl tertiary butyl ether (ETBE). Facing the instability of oil prices, the anticipated exhaustion of fossil fuel resources around the world, forewarned environmental disasters, countries and scientists are trying to find solutions. New method to put renewable energy into the use [1][2]. Among these types of energy, bioenergy is considered one of the most reliable sources of energy because of the CO₂ cycle it produces [3]. Biofuels can be produced from a variety of fuels: starch, synthetic gas, Cellulose (ethanol, butanol) [4], oil, fat, microalgae (biodiesel), animal waste (biogas) [5][6], ... in which starch and cellulose are believed to be the most potential in terms of reserves and applicability of the product [7].

For many countries including Vietnam, starch is still considered an important food source[8]. The tradition of using starch in many places does not agree with the use and

use of them as industrial fuels[9]. However, the use of starch produced into fuel is relatively easy, the product cost is low [10][11]. Vietnam is a developing country mainly based on agriculture and forestry, so the potential of energy from biomass is very diverse and has a large reserve [12]. Therefore, in Vietnam, the research on the use of energy from biomass gradually replaces fossil energy sources that are of interest to state agencies and scientists [13][14]. Biomass used for bio-oil production is plant biomass, including: wood, grass and agricultural crops, identified as a renewable energy source [15][16]. The main chemical composition of biomass includes cellulose, hemicellulose and lignin [17][18]. The major elemental components of biomass are hydrogen, carbon, oxygen; whereas sulfur and nitrogen elements can be present in very small quantities [19][15]. In this article, the authors will present a brief review of the biomass energy conversion process, with an emphasis on the production of gas fuels suitable for internal combustion engines [2][12]. The purpose of this production is to supplement the supply of methane rich gas produced by the anaerobic process of organic waste in waste treatment and residues. Currently in developed countries, the gas produced from the decomposition of organic matter is widely used as fuel for power plants. Electricity produced in this form is considered as an environmentally friendly renewable energy source at competitive prices. The use of gas from organic matter dispersal also provides an opportunity to use waste to produce biomass energy, thereby helping to promote landfill waste disposal as a sustainable form of waste management.

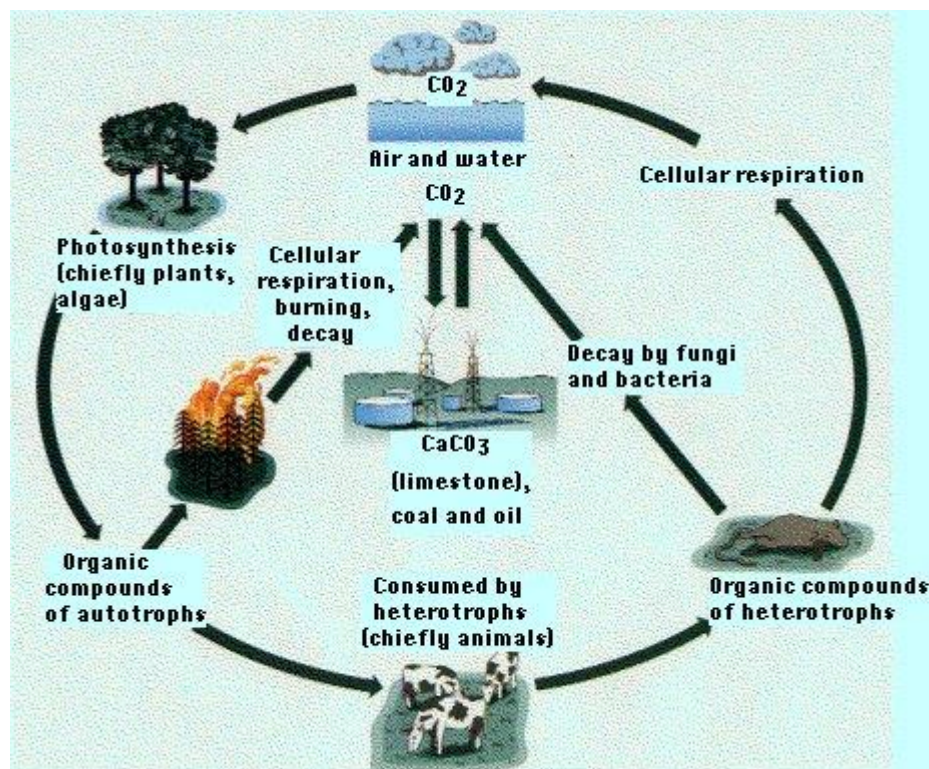


Fig. 1: Carbon cycle

Demand for energy use of Vietnam increases with economic growth and industrial development. Vietnam's energy source is based mainly on coal and oil resources are gradually depleting in reserves and territorial waters. Hydropower is based on abundant water resources but 60% of water resources come from outside the territory. In 2010,

more than half of the nation's electricity capacity belonged to coal-fired thermal power, oil was the major source of CO₂ emissions in Vietnam. Coal thermal power accounts for 18.5%, gas and oil thermoelectricity accounts for 36.6%. In the energy sector, coal-fired power plants generate 54% of CO₂ emissions, gas-fired power plants

contribute 40%. Each kWh of Vietnam's electricity emits 0.52 kg of CO₂ (Ministry of Industry and Trade, December 2011, Carbon Recovery and Retention Technology Project). Vietnam has a lot of sunshine, rain, flora and fauna, diverse microorganisms grow fast. Looking at Vietnam's Statistical Yearbook, we can see potential biomass from rice, maize, sugarcane, cassava, coconut, coffee, rubber, oil crops, algae, aquatic resources and many natural sources. This article summarizes the researches on using biomass to create bio-energy sources, especially the generation source of biofuels of the second generation from waste biomass.

2. Potential of waste generation in Vietnam, rate of generation, collection and transportation

Bioelectricity is the use of biomass to produce electricity. There are six major bioelectric systems in the world including direct biomass burning, co-combustion, gasification, anaerobic digestion, pyrolysis and small bioelectric systems, modules. It is estimated that by 2020, the world's bioenergy output will be over 30,000 megawatts (MW). The United States is the world's largest producer of biomass, with more than 350 bioelectric plants producing more than 7,500 megawatts of electricity each year, enough to power millions of households and create 66,000 jobs. These plants use waste from paper mills, sawmills, agricultural byproducts, foliage from fruit orchards. The US Department of Energy forecasts that advanced technologies currently being developed will help biomass power industry produce over 13,000MW in 2010 and create 100,000 more jobs. Biomass energy accounts for 4% of total energy consumed in the US and 45% of renewable energy. Most bioelectric power plants in the world use direct combustion systems. They burn biofuels directly to create steam. That steam is captured by a turbine and the generator then turns it into electricity. In some industries, steam from power plants is also used for manufacturing or to heat buildings. These power plants are called combined heat - power plants. For example, wood by-products (sawdust) are commonly used to produce both electricity and heat in paper mills. Biomass is all organic matter capable of biodegradation, vegetation, animals, terrestrial microorganisms, underwater, other organic substances and also waste biomass, biomass of forestry, agriculture, industry and daily life.

Animal manure includes organic matter, moisture and ash. When decomposing CH₄ aerosols, CO₂, and organic matter are stable for soil and biogas fuel. The project 2010 has specifically evaluated the characteristics of biomass in Yen Lac - Vinh Phuc area with the rate of waste biomass generation, the ratio of TS dry matter, the ratio of VS volatile substances, C / N ratio, biogas birth rate of biomass of cow dung, pig, water hyacinth, tapioca processing waste water. Appropriate anaerobic decomposition occurs when the C / N range of 25-30 can yield up to 20-30 l of gas / kg of cattle manure, pig manure with C / N of 12-15 is collected as 40-60 l / kg, water hyacinth C / N is 12-25 births 0.3- 0.5 liters / kg, rice straw has a C / N ratio from 48 to 117 births 1.4-2 liter gas / kg of raw materials. Estimated livestock waste biomass in 2010 is over 145 million tons / year. City and industrial waste: is a huge organic biomass, generating over 80% in urban areas. The amount of urban solid waste generated has been studied in Hanoi and Ho Chi Minh City from 2004 to 2009, at the rate

of 0.85 kg / person / day and 0.75 kg / person / day. Meanwhile, this ratio in Dong Nai, Ba Ria - Vung Tau, Hai Phong, Da Nang and Hue respectively 0.73; 0.7; 0.74; 0.72 and 0.6. This rate is expected to increase rapidly to over 1.3 kg / person / day in 2025. Study on the potential of methane generation from the landfill of Nam Son - Soc Son - Hanoi and Thuy Phuong - Hue for conclusion air berries up to 280 liters CH₄ / kg VS from domestic waste at landfills. Research on clean development mechanisms and sustainable technologies to reduce the greenhouse gas emissions of landfills for major cities in Vietnam has been addressed, with a focus on solutions to convert waste into energy. The results of the study on the potential of methane gas production from food processing waste obtained experimental results reached 0.35m³ CH₄ / kg COD.

Biomass can be converted into useful energy forms using a number of different processes. Factors affecting the selection of conversion technology are: types and quantity of biomass materials, technical requirements of products, economic conditions as well as other factors for implementation of each project. Biomass can be converted into three main product categories, of which two related to energy are electricity / heat and transport fuel, another is chemical materials. Converting biomass into energy is done using two main technologies: thermal and biochemistry. In addition, there is another form to convert biomass into energy that is bio-gasoline production. However, bio-gasoline is not yet popular, but with increasing pressure on reducing emissions, reducing environmental pollution, especially in big cities, will change to the use of bio-fuels. in the near future. Currently, there are four forms of thermal conversion: burning, pyrolysis, gasification and liquefaction. Biochemical transformation consists of two main forms: digestion and fermentation. Converting biomass into bio-energy through: biogas, ethanol, biodiesel biogas, syngas is a sustainable low-carbon growth model. The survey investigation is linked to specific technology development: 1) Experimental determination of metabolism and influencing factors; 2) Develop an optimal problem; 3) Establishing calculation and experiment models, establishing optimal technological factors; 4) Compatibility testing; 5) Carry out technical research and design of biomass conversion equipment based on: heat transfer, mass transfer, hydrodynamic process. The device is studied and designed according to the principles of heat transfer, mass transfer and forward and reverse phase contact, through fixed or suspended layers for converting biomass into bio-energy and creating a calculation basis. Transform scale, put research results into practice. In addition to waste biomass conversion to create compressed, pressed, direct burning fuels, waste gas gasification is an effective and environmentally friendly way to produce energy, convert solid biomass into gas fuel, less air pollution than coal burning due to low sulfur, application for generator engine, fuel combustion for boiler. The optimum working temperature of 700°C has been found, the amount of oxygen is limited to not completely burn solid fuel. Synthetic gas is flammable fuel gas including H₂, CO, CH₄, CO₂, nitrogen, sulfur (small amount, depending on input), alkali and tar compounds are high calorific fuel sources. Air supply location, temperature, air and secondary feed rate affect the composition of syngas. When there is CO reduction reaction and water needs to burn / supply secondary heat. Concentrations of CO₂, CO, H₂ and CH₄

increase with the concentration of O₂ of the inlet air and how to maintain air flow. The composition of synthetic gas differs when the rate of secondary gas flow changes. With heat recovery and waste gasification and combustion technology, the KC03.DA02 project, under Program KC03, has researched, designed and manufactured waste incinerator systems and emission control for urban and industrial areas with the result of building mathematical models to determine the elements of the source: humidity (internal and external), calorific value, ratio of raw materials (C, H, N, P, S) and volatile substances, ash / residue, alkali metal content, cellulose / lignin / hemicellulose ratio to the calorific value and thermal yield of the device. The optimal problem in industrial solid waste combustion has been developed to control emissions according to environmental standards with the proposal of mixing waste with different calorific value, gas supply and transfer regime. change garbage into heat, fuel-saving heat, control air pollution to serve urban waste treatment, save fuel for the system and have modeled the optimal calculation of technology and data sources to control get the process of realization and reduce pollution of emissions. A system of energy research and biomass research equipment funded by NEDO is installed in Cat Que village - Hoai Duc - Hanoi and the project "Research and improve the process of biomass gasification technology for business Industry "is being developed to create an alternative energy source of 10kW capacity for food processing enterprises from available waste biomass.

Research on fermentation technology, anaerobic decomposition of organic waste sources with the topic of Vietnam Academy of Science and Technology "Biogas model to improve treatment of high-carbon pollution sources and credit fund applications carbon in environmental protection (2009 - 2010). Results of biogas collection from livestock waste are combined from plants, especially with water hyacinth[24]. Water hyacinth and other organic biomass such as cassava starch production waste. Pre-treatment of lignocellulosic biomass minced / crushed, soaked with wastewater (taken from the output of the biogas tank), treated with 1% caustic soda, weak acid, treated with heat, enzymes and then added to the raw material Anaerobic decomposition device has a markedly increased effect on gas production. Research cooperation funded by Japan New Industrial and Technical Energy Organization (NEDO) (2011 - 2012) when combined yeast has received methane conversion from cassava production waste with CH₄ biogas yield 380l / kgVS, methane gas has a content of 52% CH₄, 43.4% CO₂ gas other 4.7% used for generators, replacing 90% of fuel DO used in the traditional way. In addition, waste oil, palm oil and biodiesel have also been tested to show the effectiveness of replacing fossil fuels well, improved emissions, and good performance. Fermentation of methane biomass of waste water with a load of 1kg COD / m³ / day transferring waste into biogas to heat and generate electricity for the point project in Nguyet Duc Commune - Yen Lac - Vinh Phuc (2009 - 2010) and Minh Duong Food Company (2012 - 2013). Wastewater after anaerobic decomposition, further treatment with anaerobic system enhances, good separation of liquid solid system of post-treatment waste (sand/sludge filtration) allows to receive waste stream with COD lower than 400mg/l. In order to effectively apply wastewater treatment methods with biofiltration technology or

measures, stable bio-waste and wastewater treatment ponds meeting environmental standards QCVN14-2009, low cost. Applying methods are used to reduce greenhouse gas emissions such as AMS.III method. D (recovery of CH₄ for manure management system), AMS.III.E (gasification combustion control, thermo-mechanical reduction CH₄), AMS. III.F (Biological treatment of controlled biomass CH₄), AM0010 (CH₄ emission reduction for livestock waste management systems), AMS.III.H (CH₄ recovery from wastewater treatment system), AMS. III.I (replacing CH₄ non-aerobic anaerobic wastewater treatment system with CH₄ reducing aerobic treatment system), AMS.R (CH₄ collection from small-scale agricultural production), AMS.Y (Separation solid - liquid, livestock waste treatment reduced CH₄), AMS. IC (using thermal energy from renewable energy), collecting biogas, treating waste, taking advantage of gas generation to reduce to 0.476t CO₂ / emission (pig) / year Compared to no treatment to see the potential of waste biomass conversion has contributed greatly to combating climate change. Fermentation of methane gas versus ethanol yield shows the ratio of methane/bio-ethanol from lignocellulose biomass of corn and rice, about 1.15; 1.07 high methane energy generation rate, less energy input, low anaerobic investment, production of environmentally friendly, environmentally friendly methane gas with little harm.

The amount of waste oil and grease in Vietnam that has not been managed is the source of food insecurity and environmental pollution. With the main characteristic of the free fatty acid content (FFA) in high acid index waste oil, the study found the appropriate technology that can be removed by the esterification reaction with the thermally reactive ethanol H₂SO₄ Reaction level from 50-70°C[42]. The optimum found conditions were: molar ratio of ethanol / FFA = 50/1, 5% catalyst of H₂SO₄, 70°C after 2 hours of reaction time, acid index of original waste oil decreased from 25.2 down to 1.8 mg KOH/g oil. For ester displacement reaction, the optimal efficiency of step one is 84.1% achieved when molar ratio of ethanol/oil = 9: 1, 70°C, 120 minutes. Meanwhile, the efficiency of step 2 reaches 99.5% provided ethanol/oil = 9:1; 70°C, 60 minutes. The process of testing the process of washing anhydrous biodiesel with Truc Thon bentonite and clay adsorbent, MgSiO₃ and purifying through microfiltration ceramic filter applied to the production process of biofuel from grease and waste using low ethanol waste generation. This orientation was confirmed when synthesizing nano-catalyst ZrO₂ Vanadium doped by hydrothermal method in alkaline environment, at 190°C, for 24 hours collecting catalytic monoclinic crystal structure, spherical particles, size 15 ÷ 20 nm. V/ZrO₂ material has good catalytic ability in the synthesis of Biodiesel from waste oil and ethanol. The survey results of some factors affecting biodiesel synthesis with ZV catalyst samples (1% V/ZrO₂ doped sample) were found at 70°C, 12% catalyst, oil / ethanol volume ratio was 1:12, the 7-hour time to get biodiesel is 83%; increasing the ethanol utilization rate and reaction time to 8 hours, the efficiency was over 96%, the catalyst was reusable. The study comparing FAME methyl ester and FAEE when using ethanol, the results showed that it is possible to use the same device to perform methylation or methylation (FAME, FAEE), using ethanol has many outstanding advantages. Environmental friendly opens up a wide range of applications for waste oil collection

businesses to convert waste biomass into biodiesel to serve the needs of businesses. Besides, the research results of ethanol production technology from cassava production and research and production of bio-blending additives E5 and diesel fuel were implemented and tested. Research and develop mining technology - effectively processing diversified and abundant biomass resources of Vietnam with scientific researches that have contributed methodologies, additional basic research databases on biomass resources. Developing technology for sustainable processing and processing biomass in energy saving, developing bioenergy production for sustainable development, combating climate change. The integration of gasification and utilization of combustion heat will ensure a conversion efficiency of 40-50% for a plant with a capacity of 30-60 MW. However, at present, BIG / CC technology only stops at the testing stage. In addition, the production of synthetic gas from biomass allows the production of methanol and hydrogen, in the future they can all become transportation fuels. The process of pyrolysis is mainly used for bio-oil production, if using pyrolysis flash allows conversion of biomass into raw biofuel with efficiency up to 80%. Bio-oil can be used in engines and turbines or its use as a raw material for refineries is also being considered. However, the problems of transition and the use of bio-oil products still need to be studied such as low thermal stability or engine corrosion. Currently, bio-oil can be improved by reducing the amount of oxygen and removing the alkaline by hydrogen and the catalytic cracking of the oil for use in certain applications. Many coal-fired power plants can use co-firing systems to significantly reduce emissions especially sulfur dioxide. Copper combustion involves the use of biomass as an additional source of energy in highly efficient boilers. With just a few minor changes, coal-fired power plants can use co-firing systems. Therefore, its development potential in the future is huge. Gasification systems use high temperatures and rare oxygen environments to turn biomass into a gas - biogas or biogas (a mixture of hydro, CO and methane). This gas provides fuel for gas turbines to produce electricity. There are also some power plants that use a slightly different cycle. Biomass fuel is transformed into pressurized, hot gases in the gasification chamber. They are cleaned (remove impurities) to avoid corrosion of the electricity production system. Next, clean gases are burned with the air in the combustion chamber before entering a turbine to generate electricity. The heat coming out of the gas turbine is fed into a heat exchanger chamber to heat cold water, which is supplied to households. Decomposition biomass produces methane which can be used as energy. At landfills (where composting organic materials such as manure, vegetables, straw ...), wells are drilled to extract methane gas from the decomposing organic matter. Then, the pipes from each well will transport the gas to a central place for filtration and cleaning before burning. Methane can also be produced from biomass through a process called anaerobic digestion. Anaerobic digestion involves the use of bacteria to decompose organic matter under hypoxia conditions. Methane can be used as a fuel in many ways. Most facilities burn it in a boiler, produce steam to produce electricity or use it for industrial purposes. Methane can also be used as fuel in fuel cells. Fuel cells act like batteries but do not need to be recharged. It generates electricity as

long as fuel is available. In addition to gas, liquid fuels are also produced from biomass through a process called pyrolysis. Pyrolysis occurs when biomass is heated in the absence of oxygen. After that, the biomass transforms into a liquid called pyrolysis oil. Pyrolysis oil can be burned like gasoline to produce electricity. A bioelectric system using pyrolysis is currently commercialized in the United States.

3. Conclusion

The biomass fuel used accounts for about 30% of the total fuel used in this country, being the most important fuel source used in over 90% of rural households and about 15% of urban households, especially useful for families with cattle. The biofilter is a facility that combines biomass conversion equipment and processes to produce biomass fuels, electricity and chemicals. The concept of a biofilter is similar to today's refineries that produce a lot of fuels as well as oil products. Industrial biofilters have been considered the most promising path to the creation of a new, bio-based industry. By producing many products, a biofilter can take advantage of the various components of biomass, while maximizing the value gained from biomass. Such a plant could produce one or more high-value, low-volume chemicals and a liquid fuel for low-value, high-volume transport. At the same time, the plant also produces electricity and heat for internal use and perhaps excess electricity for sale. High-value products boost profits, fuel masses to meet national energy demand and power generation to avoid greenhouse gas emissions as well as reduce costs. The National Renewable Energy Laboratory is implementing the Biomass Program, involving six major biofinery refinery projects. These projects focus on new technologies to combine the production of biomass fuels and other products in the same facility.

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