



# Biomass

Industry Outlook and Investment Opportunities

9 October 2020

## Introduction

As energy utilities move away from fossil fuels to meet international emission reduction commitments, all sources of renewable energy resources have experienced considerable growth. While solar photovoltaics and wind turbines are often the first technologies that come to mind, the International Energy Agency predicts bioenergy will contribute the most renewable production over the next five years and account for more than 30% of growth. In its simplest form, biomass contains stored energy from the sun. The most common materials used for bioenergy are plants, wood, and waste. Biomass can be used for energy by a process called thermal conversion and is most often co-fired in coal plants. Additionally, biomass can also be used to create biofuels such as ethanol and biodiesel. Lastly, biomass is rich in hydrogen, methane, carbon dioxide, and other gases, and can be used to create biogases.

New regulations and subsidies, carbon pricing in Europe, depletion of fossil fuels and discussions surrounding CO<sub>2</sub>-induced climate change have widened the biomass market, which in addition to its low carbon attributes, offers attractive benefits to grid operators for its dispatchability, sources of electricity that can be used on demand and dispatched at the request of power grid operators according to market needs and reliability. To support these growing markets, sustainable ecosystem management must be central to bioenergy supply chain operations, as mismanaged ecosystems are environmentally destructive and detrimental to climate mitigation efforts.

## Highlights

- Bioenergy accounts for roughly one-tenth of the world's total primary energy supply.
- Global biofuel production reached 154 billion liters in 2018, realizing a 7% year-on-year increase.
- The U.S. has the potential to produce 1 billion dry tons of non-food biomass resources annually by 2040. This could generate 85 billion kilowatt-hours of electricity to power 7 million households.
- Biomass fuels provided about 5% of total primary energy use in the United States in 2018. Of that 5%, about 46% was from biofuels (mainly ethanol); 44% was from wood and wood-derived biomass; and 10% was from the biomass in municipal waste.
- The biogas market is expected to rise at 4.65% CAGR between 2018 and 2026.

## Biomass for Electricity Production

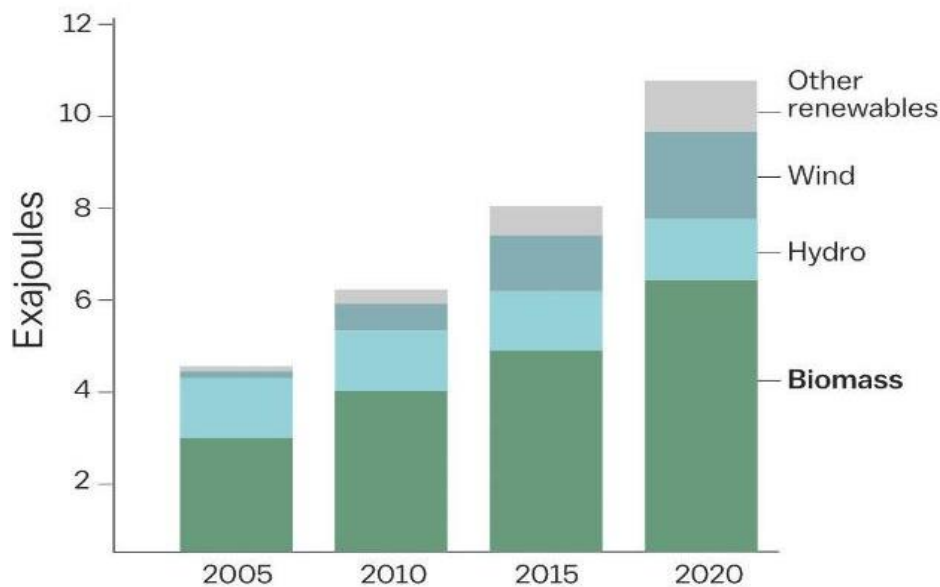
Biomass is often used for electric power generation, and specifically for combined heat and power. Various types of biomass are used for this including household waste, but the largest contributor is woody biomass such as wood chips, wood pellets and sawdust. These woody biomass products are typically byproducts of the timber industry. When used for electricity generation these products can show significant improvements over coal and traditional natural-gas generation when sustainable forest management practices are in place. One of the advantages of electricity production using biomass is its dispatchability and reliability.

- In the U.S., small scale biomass electric plants show a levelized cost of energy of \$0.08 to \$0.15 per kilowatt hour (kWh)
- Global weighted LCOE is just below \$0.07 per kWh.

- Global investments in biomass and waste-to-energy technologies was \$9.3 billion in 2018. A significant part of this comes from Europe where biomass electricity production has seen a staggering growth partly due to subsidy incentives.

### Biomass Used for Biofuels

Biomass is the only renewable energy source that can be converted into liquid biofuels such as ethanol and biodiesels, helping meet transportation fuel needs. Though not as efficient as gasoline, biofuels can be blended and do not release the emissions associated with fossil fuels. One of the major disadvantages of ethanol biofuel is that it requires farmland to grow biocrops and thus directly competes with food production. To overcome this, some cleantech start-ups are focusing on algae (i.e. seaweed) for biofuel production.



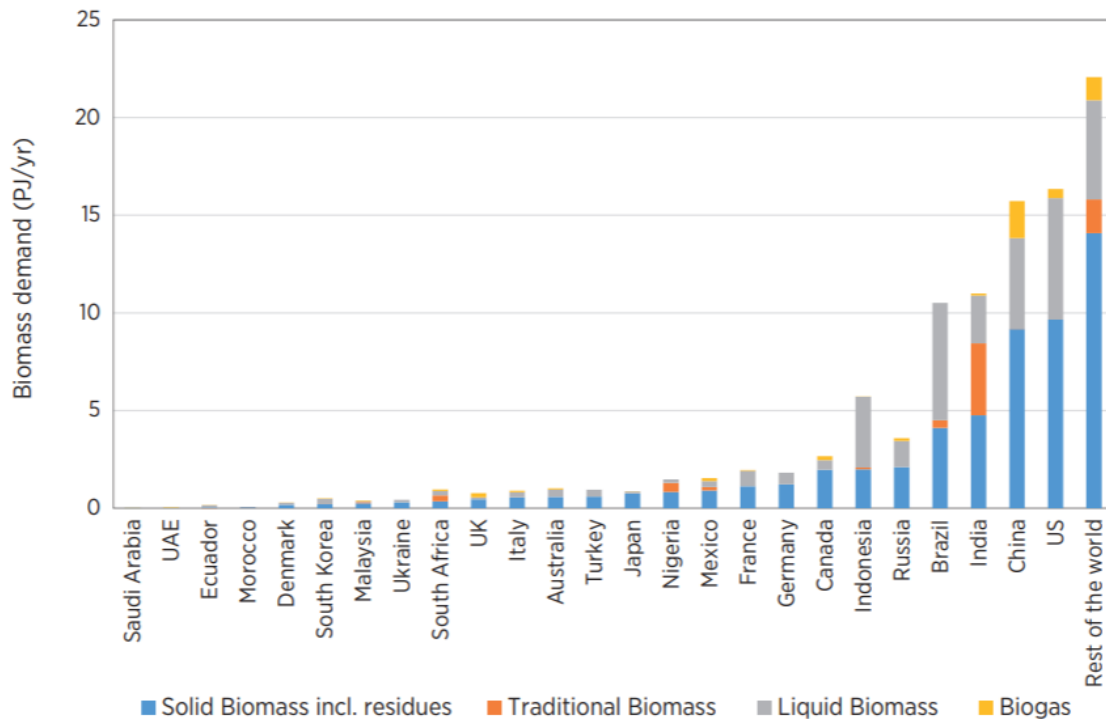
*Growth in Europe's biomass production 2005-2020*

- The biofuel market is expected to grow at a CAGR of 4.4% in the period 2019-2025, reaching a \$247 billion market size.
- Major airlines ( Lufthansa, Air France/KLM, British Airways, United Airlines) have signed contracts or expressed clear goals to have 10-20% of their fuel intake come from biofuels to reduce their GHG emissions.
- Large scale biojet fuel deployment is necessary for realizing a net carbon growth in the aviation industry by 2050.
- The U.S. Department of Energy estimates that it would take roughly 15,000 square miles (half the size of the U.S. state of Maine) to grow enough algae that could replace all petroleum-fueled energy needs in the United States.
- There was a 90% reduction in the modeled cost of algae biofuels over the period 2008-2018; prices fell from more than \$100 per gallon to nearly \$5 per gallon during this time.

## Biomass for Biogas

Biogas is a type of biofuel naturally produced from the decomposition of organic waste. It is an environmentally friendly energy source as it alleviates methane released from global waste production and reduces reliance on fossil fuels to meet global energy demand.

- The U.S. has only 2,200 operating biogas systems, which equals less than 20% of its potential of over 13,500 systems.
- The global biogas market is expected to reach a value of \$30 billion by 2026 and rise at 4.65% CAGR between 2018 and 2026.



*Breakdown of estimated biomass demand in 2030*

## Emerging Technologies / Companies

- [Bio-bean](#)

Bio-bean is a London based company that has scaled the process of converting waste coffee grounds into biofuels. Bio-bean currently recycles the beans from Costa Coffee, London Stansted Airport, and the UK's Network Rail. In November 2019 bio-bean raised £1.2 million in venture round funding.

- [Baltania OÜ](#)

Baltania is an Estonia-based company that produces carbon pellets for fuel through their patented torrefaction process. In November 2017 Baltania received an investment of \$53 million from Momentum Capital to build a bio-coal plant in Estonia. This plant will use their proprietary process to produce 15,000 metric tons of bio-coal product for energy use a year.

- [Waste2Fuels](#)

Waste2Fuels is a Barcelona-based company whose goal is to convert agro-food waste into biofuel. Waste2Fuels is aiming to produce biobutanol, which can be combined with gasoline and diesel fuel to make a good transition fuel that is more sustainable than diesel or gasoline. Since its inception in late 2018, Waste2Fuels has received over \$6 million in funding to develop their technology.

- [BioTrans Nordic](#)

BioTrans Nordic is a Denmark-based company that manufactures food waste disposal units to store and transport food waste for use in biofuels. Their product, The BioMaster, is able to store food from industrial kitchens, and provide analytics on how to better optimize waste processes through providing data to its users.

- [NEXT Renewable Fuels](#)

NEXT is an Oregon-based company that converts recycled organic materials into biofuel with the same functional use as diesel fuel. Their process reduces greenhouse gas emissions by up to 85%, and NEXT currently has a capacity of producing 37,500 barrels of biofuel per day.

#### VC Funds and other investors

- [Cycle Capital Management](#)

Cycle Capital is a Canadian impact investment firm dedicated to cutting edge technology and IP companies. In 2017 Cycle invested \$10 million in biomass company Airex Energy.

- [Marathon Capital](#)

Marathon Capital is a global energy and infrastructure investment bank. Marathon has served as an advisor for several biomass acquisitions, and most recently on Tokyo Gas's acquisition of Hecate Energy.

- [Braemar Energy Ventures](#)

Braemar is a VC-fund that focuses investments on early stage energy-tech companies. Braemar has a history of investing in emerging biomass companies, most recently in sustainable feedstock company NexSteppe.

- [Bioenergy Infrastructure Group \(BIG\)](#)

BIG holds one of the UK's largest portfolios of biomass and WTE facilities. BIG recently financed and constructed a 22 MW Biomass Plant in Ince, Chester.

- [Maven Capital Partners \(through Finance Durham Fund\)](#)

Maven is a leading UK PE fund focused on a wide variety of UK private companies. In 2018, Maven invested in a Consett-based biomass energy company through the Finance Durham Fund.

- [Denham Capital](#)

Founded in 2004, Denham Capital is a Boston-based PE fund focused on oil, mineral and energy companies. Denham is the majority owner of Greenleaf Power, a company that specializes in the acquisition and development of biomass companies and plants.

## Impact Measurement

- If all the potential biogas in the United States were to be utilized, the reduction in methane emissions would be equal to the annual emissions of 800,000 to 11 million passenger vehicles.
- Wood-pellet electricity production shows significant improvement in terms of GHG emissions compared to coal and natural gas production, under the condition that sustainable forest management practices are in place.
- The dispatchable and reliable nature of bioenergy enables faster replacement of coal electricity production, and growth of other renewable energy sources.
- Substituting biodiesel for petrol results in a GHG emissions reduction of 45-80%.
- Transporting agricultural and forestry residues to a biomass plant facility reduces air pollution emissions by up to 98% compared to open burning.
- To replace 50% of transport fuels in the U.S., 1540 million hectares of land would be needed for biodiesel from corn, but only 43 million hectares for biodiesel from microalgae.

## Investment Outlook

Investors can accelerate deployment of biomass across several directions (direct electricity generation by combustion, biofuel production or biogas production) through financing small-scale projects and partnering with research hubs. Providing growth-stage capital for private companies is one method for supporting technological and operational innovations. Venture-stage investments in bioenergy technologies can offer ancillary exposure.

The industry is creating new methods to increase the energy density of biomass, thus improving its electricity generation efficiency. The development of technologies for creating biofuels presents possible direct investment opportunities and insight into how to address current challenges.

Potential solutions revolve around core themes of:

- Sustainable biomass sourcing practices
- Preventing biofuel material input from competing with food production
- Improving biomass degradation rate, which impacts long distance transport and storage time