BIOPOWER

Biopower generates electricity through combustion of organic feedstocks, such as crops (most commonly soy and corn), agricultural residues, wood and wood processing waste (such as wood pellets, wood chips, sawdust, and black liquor from pulp mills), biogenic materials in municipal solid waste (such as paper, cotton, food waste, and yard waste), or algae. These materials can either be burned directly, added to fossil fuels in co-burning processes, or converted into other combustible materials usable for energy generation, such as pyrolysis oil (a type of tar that can be burned for energy or used to make plastics and fuels) or syngas (short for "synthetic natural gas," which can be converted to methane and used as a replacement for natural gas or further processed into transportation fuels and fertilizers).[1]

In 2020, biopower accounted for about 5% of total U.S. energy consumption.[2] U.S. biopower installed capacity totals 12.4 GW, which includes 9.9 GW in solid biofuels and renewable waste, 1.1 GW in renewable municipal waste, 8.8 GW in other solid biofuels, 2.3 GW in biogas, and 0.2 GW in liquid biofuels.[3] Total U.S. technical potential for biopower is estimated at 62 GW,[4] about five times current capacity.

Like any form of combustion, biopower emits carbon dioxide, but because its plant-based feedstock also sequestered carbon dioxide while it was living, this type of energy is effectively net-zero in its GHG emissions. Nonetheless, some experts caution against is widespread use, saying that it should be considered a "bridge fuel" that is most useful to span the gap between the dirty energies of today and the clean energies of tomorrow.[5] The volume of emissions produced by biomass energy is highly variable and depends on the feedstock and technology used. The GHG emissions reduction potential and environmental impacts of each project should be considered on a case-by-case basis, but in general, the use of perennial crops may provide greater climate benefits than the use of annual crops.[6]

Biomass production has implications for land use and food production that can be ameliorated through selection of feedstocks and growing location. Dedicated energy feedstocks (non-food crops such as switchgrass, miscanthus, bamboo, sweet sorghum, tall fescue, kochia, and wheatgrass) are best grown on marginal lands that are not suitable for food crops, in order to avoid competition with food production.[7] Dedicated production can also occur with fast-growing hardwood trees for biomass (such as hybrid poplar, hybrid willow, silver maple,

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[1] DOE. "Biopower." https://www.energy.gov/eere/bioenergy/biopower

[2] EIA. "Biomass explained." https://www.eia.gov/energyexplained/biomass/

[3] IRENA. 2021. *Renewable capacity statistics 2021.* https://www.irena.org/-/media/Files/IRENA/Agency/Publication/2021/Apr/IRENA_RE_Capacity_Statistics_2021.pdf

[4] NREL. 2012. *U.S. renewable energy technical potentials: A GIS-based analysis.* https://www.nrel.gov/docs/fy12osti/51946.pdf

[5] Project Drawdown. "Biomass power." https://drawdown.org/solutions/biomass-power

[6] Project Drawdown. "Biomass power." https://drawdown.org/solutions/biomass-power

[7] DOE. "Biomass resources." https://www.energy.gov/eere/bioenergy/biomass-resources

eastern cottonwood, green ash, black walnut, sweetgum, and sycamore), which can be harvested within 5-8 years of planting.[8] While growing, they provide wildlife habitat, improve water and soil quality, and diversity farm income. Agricultural residues (such as stalks and leaves left over after harvest) are one of the friendliest forms of biomass because they complement, rather than compete with, food production by turning a waste product into an additional profit stream.[9] Burning forestry residues (such as misshapen trees, diseased trees, and leftover limbs and tops) for biomass can help reduce the risk of wildfires, while aiding in forest restoration and resilience.[10] Algae (including seaweed, microalgae, and cyanobacteria) can be grown in brackish, salt, or freshwater, including groundwater, seawater, and wastewater.[11]

Biopower can also be produced from sorted municipal waste (such as yard waste, paper, and food waste) and liquid waste (such as commercial, institutional, and residential food waste, treated sludge from sewage treatment plants, processing residues from pulp and paper mills, and animal manure).[12] By repurposing existing waste streams to generate biomass energy, valuable co-benefits can be created. For example, incinerating municipal waste may be helpful in areas with inadequate waste collection or landfill capacity.[13] However, some experts consider waste-to-energy a last-resort climate solution that should only be used on a transitional basis, due to its GHG emissions and potential to create emissions of toxic compounds and heavy metals; a preferable alternative, in their view, would be to reduce waste in the first place.[14]

- Fishery friendliness: Impacts of biopower to fishery resources vary by location, feedstock, and technology used. Like any intensive agriculture, cultivation of dedicated biomass crops can cause erosion and runoff of pesticides, fertilizers, and herbicides, which can have impacts on water quality. Timber harvesting can have impacts on watersheds and water quality.
- Co-benefits: Waste-to-power systems can divert waste streams and reduce burden on landfills. Cultivation of dedication biomass feedstocks can provide supplemental income for farmers.
- Environmental externalities: There is intense debate about the GHG emissions of biopower and whether biomass should be considered a carbon-neutral or a dirty energy source. Waste-to-power systems can emit toxic pollution if municipal solid waste is used. Biomass cultivation can lead to competition with food production and can have land use implications and impacts on nearby water quality. For cultivation of dedicated feedstocks, impacts are in part a function of what a bioenergy feedstock crop is replacing: e.g., is it replacing natural vegetation or another crop?

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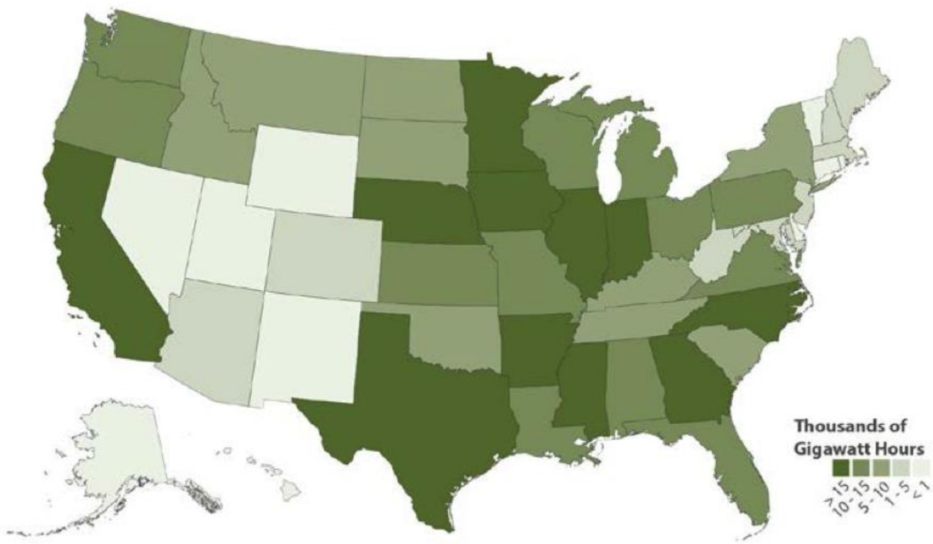
[8] DOE. “Biomass resources.” https://www.energy.gov/eere/bioenergy/biomass-resources
[9] DOE. “Biomass resources.” https://www.energy.gov/eere/bioenergy/biomass-resources
[10] DOE. “Biomass resources.” https://www.energy.gov/eere/bioenergy/biomass-resources
[11] DOE. “Biomass resources.” https://www.energy.gov/eere/bioenergy/biomass-resources
[12] DOE. “Biomass resources.” https://www.energy.gov/eere/bioenergy/biomass-resources
[13] Project Drawdown. “Biomass power.” https://drawdown.org/solutions/biomass-power
[14] Project Drawdown. “Biomass power.” https://drawdown.org/solutions/biomass-power

- Policy catalysts: Production of bioenergy can be promoted through tax incentives, standard offer contracts including feed-in tariffs, net metering programs, interconnection standards, grants, financing mechanisms, utility green power options, renewable/clean energy standards, and carbon pricing.
- More information:
  - Drawdown: Biomass power
  - Department of Energy: Biomass resources
  - NREL: Biomass energy basics
  - U.S. Energy Information Administration: Biomass explained
  - Wikipedia: Biomass
  - Wildlife Society. 2012. *Effects of bioenergy production on wildlife and wildlife habitat.*

Figure 1. Total estimated technical potential for biopower in the U.S. Source: NREL 2012.[15]



Continue reading at https://fisheryfriendlyclimateaction.org/solutions

[15] NREL. 2012. *U.S. renewable energy technical potentials: A GIS-based analysis.* https://www.nrel.gov/docs/fy12osti/51946.pdf