FACT SHEET

Bioenergy

Bioenergy explained

Biomass refers to all biological material from living or recently living organisms that can be burned, gasified or fermented to produce bioenergy. Beneficial sources of bioenergy can be divided into four categories:

1) Energy crops grown specifically for use as biofuel on land that cannot be used for food crops(more advanced technology can use algae harvested from water)
2) Agricultural crop residues, such as rice husks
3) Sustainable wood and forest residues
4) Urban and industrial wastes.[1]

How it works

As with geothermal and solar thermal energy, steam generated from burning organic matter can be used to turn a turbine to produce electricity or can be used directly to heat an adjacent space. Organic matter can also be heated under pressure to form a gas called syngas, which can power gas or steam turbines or be further processed into combustible liquid biofuel. Organic matter, most typically municipal or agricultural wastes, can be digested anaerobically (in oxygen-free environments) to produce combustible methane gas. Because biomass electricity production relies on thermal energy conversion, it is well suited for cogeneration or combined heat and power (CHP) production.

Opportunities in Asia and the Pacific

- **Abundant resources, such as agricultural waste and energy cropland:** The region is very rich in biomass resources, with more useable resources from agricultural waste and energy cropland than any other continent.[2]
- **Easily used in the existing fossil fuel power plant:** Fuels from biomass are particularly well-suited for electricity production in the region because they can be added to the fuel mix in many coal- and natural gas-burning power plants, avoiding the need to build all new infrastructure. Co-firing can also be done at a small scale with the addition of combustors and gasifiers to micro-turbines and Stirling engines, which will then buttress a system of distributed generation to electrify rural parts of the region.[3]

Trends in development

Heavy reliance on traditional burning of biomass for cooking and heating: As of 2008, 1.7 billion people relied on traditional biomass fuels, mostly in South Asia.[4] Although derived from renewable resources, traditional biomass usage does not have mechanisms in place to limit local air pollutants or greenhouse gases. It leads to negative health impacts, particularly on women and children in the home. The use of traditional biomass is mainly limited to the household and small-scale industrial sectors and is highly inefficient when compared with modern biomass technologies.

[1] Union of Concerned Scientists website "How Biomass Energy Works" (29 October, 2010). Available from www.ucsusa.org/clean_energy/technology_and_impacts/energy_technologies/how-biomass-energy-works.html#18 (accessed 26 September 2011).

[2] K. Sakanishi, "Bio-fuels (bioethanol and BDF) production from various biomass resources in Asian countries", PowerPoint presentation. Available from http://home.hiroshima-u.ac.jp/hicec/coe/kaigi/6thSympo/PPT_Dr.Sakanishi.pdf (accessed 26 September 2011).

[3] R.L. Bain, W.A. Amos, M. Downing and R.L. Perlack, *Biopower Technical Assessment: State of the Industry and Technology* (Golden, Colorado, National Renewable Energy Laboratory, 2003). Available from www.fs.fed.us/ccrc/topics/urban-forests/docs/Biopower_Assessment.pdf (accessed 26 September 2011).

[4] ESCAP estimate based on International Energy Agency data.

Modern production is underdeveloped: Modern biomass energy production, including CHP, remains underdeveloped in the Asia-Pacific region. In 2008, biomass power plants accounted for 3,272.43 MW of electric generation capacity in ASEAN countries.[5] Across the region, biofuels contributed 28,730 GWh, or 0.4 per cent of total electricity production.[6]

Biofuels for transport: A number of countries in the region are seriously looking at increasing energy production from biomass, particularly by using liquid biofuels to displace the use of oil for transport purposes. The Philippine Government has set the most ambitious targets in the region, namely to displace 15 per cent of diesel and 20 per cent of gasoline with biofuels by 2030. Indonesia has a broader goal of supplying 5 per cent of the total energy mix with energy from biomass by 2025.[7] With transport sector energy consumption projected to grow faster than any other sector (5.6 per cent) in ASEAN states, developing alternative fuels from biomass could help alleviate issues associated with oil imports, including price fluctuations and energy security.

Strengths with bioenergy

- **Sustainable use of resources:** Waste-to-energy biomass projects can provide the co-benefit of mitigating waste disposal challenges in the region's quickly growing urban areas.
- **Job creation potential:** Expanding bioenergy production facilities has the added benefit of a much higher job creation rate per TWh, compared with fossil fuel and nuclear energy.[8]

Challenges to using bioenergy

- **Low energy intensity:** Many types of biomass have relatively low energy intensities (compared with traditional fossil fuels).[9] Thus, efficiently collecting and processing biomass materials is a major challenge. Additionally, some types of biomass are better than others in terms of higher energy return and lower pollution levels.
- **Air pollution and emissions:** Some sources of biomass can actually emit more greenhouse gases than non-renewable sources, such as coal, because of their lower energy intensities. Burning biomass can also generate harmful air pollution, often more than natural gas-fired power plants, although less than coal-fired power plants of equivalent size.[10] Generally, the gasification process makes biomass burn cleaner, with fewer greenhouse gas emissions and other air pollutants.[11]
- **Transportation costs of bulky feedstock:** In addition to low energy intensities, biomass resources are produced over a wide-ranging area, requiring collection. The collection and transportation of biomass feedstock generally rely more heavily on truck transport as opposed to pipeline or rail, as in the case of fossil fuels. Transportation costs of moving feedstock from source to a processing plant and then to an electricity-generation facility can be high, both in economic and environmental costs.[12]

[5] M. H. Hung, "Status of renewable energy in the ASEAN region", PowerPoint presentation at the IEA-RETD Workshop on Cross-Regional Dialogue on Renewable Energy Visions and Initiatives, Tokyo, 18 November, 2009. Available from www.iea-retd.org/files/091118_ASEAN_policies.pdf (accessed 26 September 2011).

[6] Aggregation of 2009 electricity/heat generation data from IEA for Asia excluding China, China, and OECD Asia and Oceania. International Energy Agency, Statistics and Balances (Paris, 2009). *Statistics and Balances*. Available from www.iea.org/stats/electricitydata.asp?COUNTRY_CODE=12 (accessed 16 February 2012).

[7] ASEAN Center for Energy, *The 3rd ASEAN Energy Outlook* (Jakarta, 2011). Available from http://talkenergy.files.wordpress.com/2011/06/t3aeo-complete-outlook.pdf (accessed 26 September 2011).

[8] S. Karekezi, K. Lata and S. Teixeira Coelho, "Traditional biomass energy: Improving its use and moving to modern energy use", presented at the International Conference for Renewable Energies, Bonn, 1-2 June, 2004. Available from www.ren21.net/Portals/97/documents/Bonn%202004%20-%20TBP/Traditional%20Biomass%20Energy.pdf (accessed 26 September 2011).

[9] S. Ashton and P. Cassidy, "Energy basics", in W. Hubbard, L. Biles, C. Mayfield, S. Ashton , eds., *Sustainable Forestry for Bioenergy and Bio-based Products: Trainers Curriculum Notebook* (Athens, GA, Southern Forest Research Partnership, Inc., 2007).

[10] National Renewable Energy Laboratory, *Biopower Technical Assessment: State of the Industry and Technology* (Golden, Colorado, 2003). Available from www.fs.fed.us/ccrc/topics/urban-forests/docs/Biopower_Assessment.pdf (accessed 26 September 2011).

[11] Union of Concerned Scientists website "How Biomass Energy Works" (29 October, 2010). Available from www.ucsusa.org/clean_energy/technology_and_impacts/energy_technologies/how-biomass-energy-works.html#18 (accessed 26 September 2011).

[12] D. Yemshanov and D. McKenney, "Fast-growing poplar plantations as a bioenergy supply source for Canada", *Biomass and Bioenergy* (2008), vol. 32, pp. 185-197.

- **Trade-offs with food crisis and land-use issues:** The production of first-generation biofuels, which rely on oils from food crops such as sugarcane and corn, dominates current production and is likely contributing to rising food prices.[13] Ensuring wise land-use and sustainable harvesting practices may also present challenges, particularly when governments offer financial incentives for energy crop production.

Implementing strategies

Use careful policymaking to support sustainable production: Supporting some but not all types and methods of bioenergy production requires highly detailed policy informed by expert economic, environmental and land-use knowledge. Second- and third-generation biofuels do not rely on food crops for production and are one approach to reducing the impact of biomass energy production on food prices and availability. Second-generation biofuels harvest fuel from the processing of cellulose or from agricultural and forestry waste materials; but these processes are more complex than deriving fuel from first-generation biofuel sources. Third-generation biofuels encompass usable oils from algae. Policy incentives must be well defined to target those types of biomass energy production.[14]

Blanket rural users with education and training: To implement small-scale, distributed generation to minimize the transportation costs of feedstock, education and training programmes should be developed and made available in rural areas.

Invest in densification R&D: Investing in R&D for more efficient densification processes (pelleting and briquetting of solid biomass feedstock) could expand the economic and geographic range of electricity from biomass or co-firing as well as increase the efficiency of burning.

[13] International Energy Agency, *From 1st to 2nd Generation Biofuel Technologies: An Overview of Current Industry and RD&D Activities* (Paris, IEA and OECD, 2008).

[14] ibid.