POLICYBRIEF

NOVEMBER 2025

BLENDING MORE PROBLEMS

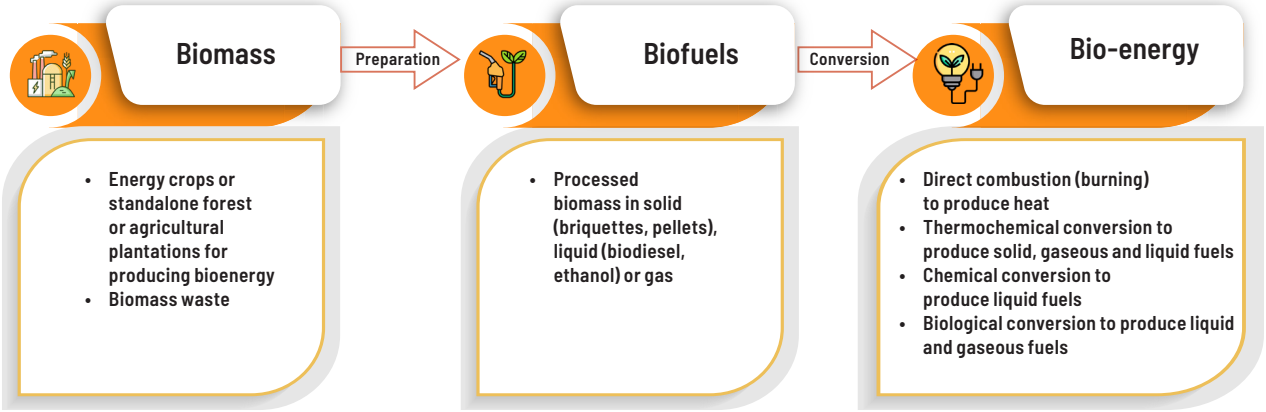
CO-FIRING BIOMASS WITH POWER PLANTS

WHAT'S AT STAKE

Co-firing biomass is a technology that burns biomass alongside other fuels, typically coal, in existing power plants. This technology presents a different set of complexities and harms. In the context of ADB's policy to support the early retirement of coal-based power plants—including decommissioning of coal-fired power plants and site redevelopment for new economic activity—co-firing of biomass with power plants, whether from energy crops or biomass waste, poses risks with long-term harms to air quality, local communities, ecosystems and efforts to address the triple planetary crisis of climate change, pollution, and biodiversity loss in a region most vulnerable to these interlinked threats.

As Asia strives to find greener, affordable and reliable sources of energy during its transition away from fossil fuels while meeting its growth targets, biomass has gained prominence as a "sustainable material" or "transition fuel" for the world's shift to a sustainable and low-carbon economy. Biomass is the organic matter from living or dead organisms which can include dedicated grown crops and waste materials to produce biomass energy. **(See Figure 1)**. Although biomass feedstocks have traditionally excluded fossil fuel-derived materials, new legislations and techno-centered fixes have included discarded plastics and tires which are derived from fossil fuel components as sources of sustainable feedstock for bioenergy. **.(See Box 1).**

FIGURE 1. PROCESS FLOW FROM BIOMASS TO BIOENERGY



A circular economy primarily aims to reduce the extraction of new materials in the economy to avoid more wastage, then prioritize reuse and then recycling of these resources. Incineration or waste burning destroys the potential of materials for environmentally and socially desirable alternatives.

The Asian Development Bank, the region's largest development investor, is proposing to include co-firing with "clean fuels" such as "sustainably sourced biofuels" in existing coal and gas-fired power plants in the Energy Policy 2021 aimed at achieving a low-carbon future. The same policy commits to circular economy and has laid down prerequisites for utilization of feedstock for energy conversion "first reducing waste generation, then exploiting the options for reusing and recycling materials, then using waste to recover energy or usable materials, followed by sanitary engineered landfilling as the last option. ADB support for waste-to-energy investments will promote sustainable livelihood opportunities for the poorest people working along the waste value chain and at landfills".

In Asia, countries that employ co-firing are China, India, Japan, South Korea ,and recently, Indonesia. Major criticisms of the technology include the hidden costs for carbon and toxic emissions around biomass co-firing, availability of feedstock, land use, food security, human rights, and economic viability. A dearth of evidence exists on the ill-effects of dedicated crops planted solely for biofuels. However, if it is biomass wastes or discarded organic materials, should it be classified as "sustainably sourced biofuels" and be part of the energy transition?

BOX 1. TYPES OF BIOMASS WASTE USED IN CO-FIRING

Biodegradable fraction of municipal waste. A significant portion of Asia's municipal solid waste are in this category including garden waste, food waste, timber, paper, and textiles. There are also liquid municipal byproducts such as used cooking oil and sewage sludge that are being converted into biofuels, but conversion processes remain uncertain.

Refuse-derived fuel (RDF). Contains as much as 50% plastic waste mixed with combustible household and industrial wastes. They are often pelletized for cofiring in cement kilns and thermal power plants. Plastic is 99% fossil fuel-derived material containing toxic chemicals. Burning them releases GHG and toxic emissions. Many policies falsely categorize it as biomass feedstock, qualifying for public subsidies for generating "green" and "sustainable" energy.

Tire-derived fuel (TDF). The presence of natural rubber wand other organic materials in spent tires allows it to be categorized as "biomass". Burning them, emits toxic emissions including dioxins, furans, PCBs, and chlorobenzenes, mercury, lead, arsenic and chromium.

Biodegradable fraction of industrial waste. Industries such as food processing, paper, leather, wool, dairy, textile mills, and meat processing produce these types of waste.

Animal waste includes feces, dairy factory wastes, liquid slurry, and used bedding from intensive livestock operations. It releases nitrogen monoxide)NOx) sodium dioxide (SO2), carbon monoxide, particulate matter, hydrochloric acid, antimony, manganese, and mercury

Forestry residues. These include oil palm residues and natural forest, plantation forest, and logging residues. Biomass removal can reduce soil organic matter and water retention, potentially impacting soil quality. These materials should stay in the forest to support ecosystem regeneration, safeguard biodiversity, and strengthen carbon sinks rather than be collected to be burned for energy.

Agro-industrial residues. Typically include rice husks, rice straw, coconut husks, coffee husks, cocoa husks, corn stalks, rubber plantation, oil palm residues and sugarcane bagasse. These materials should be removed as feedstock because they are already used as animal feed, aquaculture feed, biochar, building insulator, organic fertilizers, and decentralized biofuels.

KEY POINTS

The Asian Development Bank should avoid including biomass co-firing in power plants due to the following reasons:

Violation of ADB's own order of priority in using wastes as feedstock for energy development. The mandatory order is to prioritize waste minimization, reuse, then recycling before converting wastes into energy. This hierarchy of options is the universal and sustainable way of managing material resources. It reduces the amount of materials consumed in the first place, reduces emissions of greenhouse gases, avoids pollutants, saves energy, creates jobs, and stimulates the development of real green technologies. To date, ADB has yet to show compliance on this provision stated in the Energy Policy 2021.

The real GHG emissions of biomass energy is largely underestimated. Biomass co-firing is a thermal process, thus it emits huge amounts of CO2 to generate biofuel. When biomass materials are combusted, the emissions are not counted. However, when they are combusted for energy, both fossil and biogenic emissions should be estimated. Current GHG inventories only calculate reduced coal use without considering emissions from the entire biomass lifecycle such as harvesting, drying, processing, and transport. This incomplete calculation of total emissions skews the structure of incentives in favor of co-firing against truly renewable and safer alternatives.

Co-firing can add to air pollution, thus aggravating health disparities. A study in China projecting the potential health impacts of co-firing reveals that air pollutants such as sulfur dioxide,sulfur dioxide (SO2)), particulate matter (PM2.5,) and nitrogen dioxide (NO) x will increase by an average of 27.9, 38.04, and 42.79% respectively compared to the scenario without the technology, with risks 19 times higher for more vulnerable populations. Without strict regulations, co-firing can also lead to the release of various pollutants, including mercury, carbon monoxide (CO), hydrogen sulfide (H_2S), and heavy metals like arsenic (As) and lead (Pb).

Development of biomass waste co-firing intensifies extraction and a linear use of agricultural and forestry material resources. As of 2024, total biomass use has reached 27 billion tonnes, 0.30 billion tonnes or 5% of which was used just for the world's energy needs. Around half of the biomass is extracted from Asia. Forest, agricultural, and food wastes are often produced from unsustainable forestry, monocropping, wasteful food processing practices intensifying climate change and inequities in the region. ADB's Environmental and Social Framework 2024 emphasizes on "safeguarding the life-supporting capacity of air, water, soil and ecosystems. For a project, the borrower/client will implement technically and financially feasible measures for improving resource conservation, minimizing the intensity of resource use, and ensuring efficient consumption of energy, water, soil, and raw materials, as well as other resources." Further, the policy states a preference for reuse of raw materials and use of recycled materials. Burning biomass in power plants not only emits more CO2 in the process, it also destroys their potential for reuse and recycling as sustaining biomass cofiring requires sustained production and disposal of biomass.

Feedstock supply for biomass co-firing can lead to massive land use change. There is not enough biomass waste available at scale. Thus economic and energy output projections risk creating large-scale land use change required to secure a steady feedstock supply risks triggering cascading socio-ecological consequences, including biodiversity loss from habitat conversion, displacement of local communities that rely on these lands, and the erosion of agricultural productivity as fertile land is diverted away from food production. Such pressures not only undermine food security but also exacerbate rural livelihood vulnerabilities, while monoculture energy crops intensify soil degradation, water stress, and ecological imbalance. The net effect is a paradox in which biomass co-firing, promoted as a renewable solution, reproduces the very environmental and social externalities it claims to mitigate, locking economies into land- and resource-intensive energy pathways with long-term costs that outweigh short-term gains.

Biomass waste co-firing expansion increases CO2 emissions due to intensified fuel consumption. Compared with coal, biomass has lower calorific value, hence more fuel would be needed to generate more biofuels. To keep its efficiency, coal plants can only typically burn with 2% to 10% biomass and 90% to 98% coal. Increasing biomass feedstock beyond 10% increases the risks for coal plants. Indonesia's experimentation with biomass co-firing using sawdust and rice husk at 5% heat with varying capacities resulted in a reduction in energy efficiency, attributed to the lower calorific value, thus needing more fuel. India has mandated all coal plants to use 5% biomass and so far, the plants have only accommodated biomass co-firing at 5-10%. Biomass waste, being more complex and moist, needs more pre-treatment and fuel to burn alongside coal, and thus have more CO2 emissions.

Biomass waste co-firing derails mandates for accelerated fossil fuel phase-out. For more than 20 years, biomass waste has been co-fired for power and heat in centralized and decentralized facilities, co-firing it with thermal power plants in Europe particularly in the Netherlands, Poland, UK and some Eastern European countries. However, they are now in decline with many countries choosing to phase-out coal power plants. ADB is steering the region in the opposite direction. Instead of shifting investments on affordable, cleaner, low-carbon, and safer renewable energy sources and supporting those whose livelihoods are disrupted by the energy shift, public money and political support gives social license for coal plants to extend their life in a planet which needs to keep global temperatures at 1.5% by 2030. Current investment plans and business models have also disenfranchised farmers, indigenous peoples, and wasteworkers in biofuel development from bioenergy development.

Biomass co-firing expands trade in hazardous waste. Simply put, RDF is processed unrecyclable and hazardous waste in bailed, shredded, or pelletized forms. They are the most preferred input for co-firing in power plants because it is cheap and highly combustible. Developing markets for co-firing creates an ecosystem for hazardous waste trade that is highly regulated internationally and prohibited in ADB's ESF policy: "production of or trade in any product or activity deemed illegal under host country laws or regulations or international instruments or subject to international phaseouts or bans, such as transboundary trade in waste or waste products." ADB risks magnifying the growing scrutiny on the exportation of RDF to Asia, particularly from countries like Australia due to concerns about its environmental and health impacts. Communities in Bulgaria, filed a court case on the air pollution from the burning of illegally shipped RDF in the country's aging coal plants.

Biomass facilities risk becoming stranded and non-performing assets. Biofuel-based projects directly contribute to patterns of overproduction, overconsumption, and heightened

pollution, while also stimulating tertiary industries linked to waste generation that further increase GHG emissions in order to sustain feedstock supply. In contexts where climate change and declining agricultural yields disrupt feedstock availability, such facilities risk becoming stranded and non-performing assets, ultimately transferring the financial burden to borrowers and, by extension, to the broader economy. These risks are compounded by the long-term trend of declining costs in renewable energy, which renders electricity from it increasingly uncompetitive, especially once transmission, distribution, and lifecycle costs are accounted for and eventually borne by end users through higher tariffs. In Asia, where the majority of energy subsidies are still directed toward fossil fuels, particularly gas, biomass energy without comparable subsidies will struggle to compete, leaving consumers exposed to persistently high electricity prices and governments vulnerable to sunk investments in stranded infrastructure.

RECOMMENDATIONS

Comply with the order of priority before converting waste into energy as mandated in the ADB Energy Policy 2021. The priority should be waste reduction, reuse, then recycling. The focus must be on returning organic matter to improving the soil ecosystem through composting rather than energy conversion. Only when this order has been observed can the remaining and sorted available supply of biomass waste be used for non-thermal, decentralized bioenergy systems through anaerobic digestion. Recently, about 65 countries committing to the COP29 Declaration on Reducing Methane from Organic Waste, underscored the necessity of waste prevention, circular economy and zero waste practices by adhering to the waste hierarchy.

Burn, thermal, or combustion conversion processes of biomass add GHG and toxic emissions to the environment. Burning biomass is not only carbon-intensive from a lifecycle analysis but also polluting. The range of pollutants depends on the kind of biomass fed into the power plants. Asia's regulations are not set up to measure GHG and hazardous emissions from power plants, especially co-firing. In some cases, required regulations for coal plants are lifted when the biomass is used.

Redirect resources toward the fast decommissioning of coal plants to accelerate climate-positive activities and interventions along the waste hierarchy. The long-term costs of climate change, environmental degradation, health costs, and poverty are understated in comparing costs for fast decommissioning of coal plants. Investments for co-firing takes away resources needed for economic diversification, just transition, safer and cleaner renewable energy options and higher interventions in the waste hierarchy.

Reinforce ADB's environmental and social safeguards. Improve appraisal tools and methodologies to include robust assessment and baseline measurements of material intensity, full lifecycle carbon accounting of feedstocks when comparing technologies, and comprehensive risk analyses with identified mitigation measures. These projects should not compete with existing uses of biomass waste, impair ecosystem health, cause economic and physical displacement, or result in more emissions which are harmful to climate and the environment. Ensure basic sectors most affected by biomass and waste energy production are meaningfully consulted and are part of plans and business models.

Restrict support to problematic biomass waste feedstocks. To avoid greenwashing, intensification of existing environmental and social harms, and displacing current economic uses, ADB must:

1). List all biomass feedstock for bioenergy production to guide stakeholders on feasibility, legality, safety, and appropriateness of business projections from biomass utilization.
2). This list must explicitly remove specified feedstocks, including but not limited to:
   a. Unsorted municipal mixed waste and industrial waste. And if sorted, organic fraction of the municipal waste should first be reused and recycled. The remaining supply will then be used for energy conversion through non-thermal options specifically, anaerobic digestion. .
   b. Fossil fuel-based materials such as processed discarded plastics and tires
   c. Feedstocks with competing uses in existing industries such as composting,bioenergy using anaerobic digesters, eco-building materials, animal feeds, and crafts, among others

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