biomass connect

www.biomassconnect.org

Biomass Connect is funded by the: Department for Energy Security & Net Zero

BIOMASS CROP END USES

Biomass crops are:

- non-food crops where the whole aboveground plant material is harvested to produce bioenergy (e.g., for electricity and heat) or other materials and chemicals,
- typically herbaceous or woody perennial plants of high calorific value, with high growth rates but limited requirement for nutrients or heavily managed cultivation,
- efficient ways to remove carbon dioxide (CO_2) from the atmosphere.

Bioenergy

Biomass crops can be used much like traditional fossil fuels to generate heat and power in. e.g.,

Large scale power generation - Burned in a boiler to produce steam, drive turbines and generate electricity. Contemporary carbon captured during photosynthesis is re-released upon combustion, whereas combustion of fossil fuels releases ancient carbon and results in a net increase in CO_2. If CO_2 emitted during combustion is captured and stored, this process (known as Bioenergy with Carbon, Capture and Storage) can be carbon negative.

Combined heat and power - Produces electricity or mechanical power whilst capturing and utilising associated thermal energy (heating and/or cooling) at or near the point of consumption, achieving 10 to 30 % energy efficiency increase compared to conventional technologies. It is mostly used in large commercial and industrial applications.

Domestic fuel - Logs, chips, pellets, and briquettes can be burned in biomass heating systems for domestic heat and hot water. Feedstock prices vary but are often cheaper than other heating options (space is required to store the feedstock).

Anaerobic digestion - Biomass is broken down by micro-organisms in the absence of oxygen to produce biogas with a high methane content. The biogas is captured and burned to produce carbon neutral heat and/or electricity. Residual digestate (indigestible plant material and dead microbes) is nutrient rich and can be used as a fertiliser.

Materials

Biomass crops can be used to manufacture multiple bio-based products, including materials in the chemical sector (i.e., bioplastics), which is heavily dependent on fossil fuels for most hydrocarbon-based products. Lignin is the major constituent of plant cell walls and is thus abundant in the biosphere. It is non-toxic, biodegradable, and has antibacterial and antioxidant properties, making it a popular and valuable biomaterial with utility for:

Delivery of active ingredients - Lignin-based microparticles can be developed as controlled-release carriers of active ingredients such as fertilisers, herbicides, or pesticides for agriculture, or medicinal compounds for healthcare, delivering targeted and precise amounts.

Construction materials - Novel construction products containing biomass crops (i.e., 'hempcrete' blocks) are carbon sinks, removing more CO_2 from the atmosphere than emitted in manufacture, and storing CO_2 after the building's end of life. Other products include insulation materials, fibreboards, furniture, and moulded products for car bodywork.

Textiles - Fibres from e.g., hemp and Miscanthus can be blended with cotton, silk, and a variety of other fibres for geotextiles to help meet the growing demand for environmentally responsible textiles.

Packaging - Bio-based packaging materials (with minimal environmental impacts and low carbon footprints) are increasingly sophisticated replacements for synthetic plastics, the accumulation of which constitutes 60% to 80% of global waste and poses a serious threat to the biosphere.

Health and Beauty

Biomass crops are a source of natural polymers and bioactives, with multiple utilities in physical and chemical applications for the health and cosmetic industries, including for:

Pharmaceuticals Food supplements - Examples include salicin (for pain relief), xylitol (a sugar substitute), and multiple compounds with anti-inflammatory and antioxidant properties.

Cosmetic and skincare - Extracts from e.g., hemp and eucalyptus are high in essential fatty acids, polyunsaturated fatty acids, antioxidants, and other nutrients, useful as moisturisers and included as components in cosmetic products including soaps, shampoos, lip balms, massaging oils and other skincare and hair products.

Agriculture

Animal bedding - Biomass crop physical and biological properties compare well to alternative bedding materials. Farmers can grow their own bedding, building self-sufficiency and reducing transport and emission costs.

Compost - Using biomass-based compost for gardening and horticulture reduces peat utilisation and its associated greenhouse gas emissions.

Phytoremediation - Biomass crops have potential in various remediation strategies, including stabilising or removing pollutants from contaminated sites (e.g., heavy metals, pesticides, leachates from landfill).

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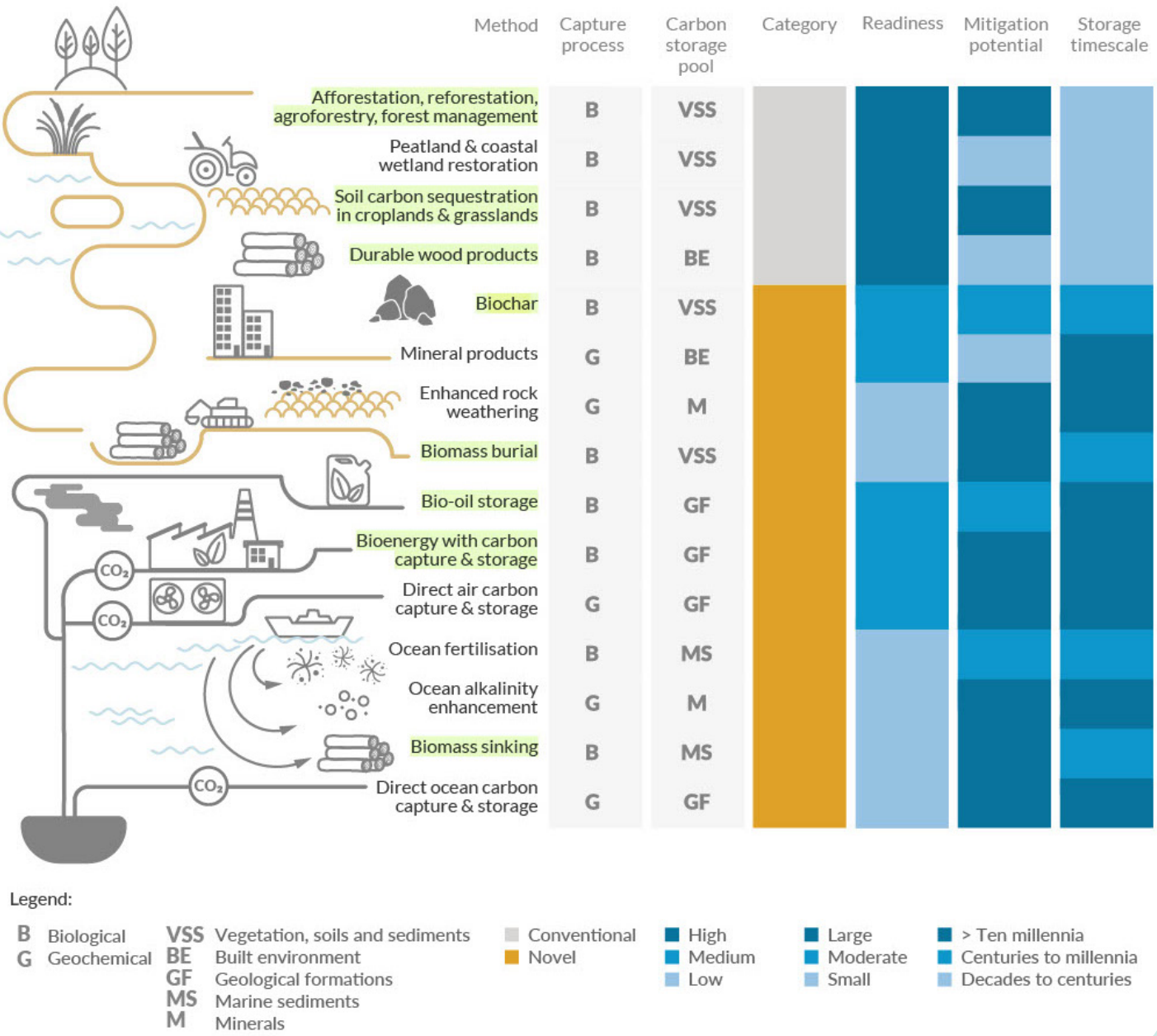

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Further Considerations

An important consideration in biomass crop end use is their potential for carbon dioxide removal (CDR), which is a necessary strategy to reduce historic greenhouse gas emissions and achieve the Paris Agreement on climate change.

The State of Carbon Dioxide Removal 2024 report highlighted a wide range of possible CDR methods, many of which involve biomass (highlighted in the graphic to the left). It shows that:

- the 'readiness' of biomass crops for CDR is high,
- the mitigation potential is large,
- and storage timescales range across all the categories (from decades to >ten millennia).

Adapted from Smith, S. M., Geden, O., Gidden, M. J., Lamb, W. F., Nemet, G. F., Minx, J. C., Buck, H., Burke, J., Cox, E., Edwards, M. R., Fuss, S., Johnstone, I., Müller-Hansen, F., Pongratz, J., Probst, B. S., Roe, S., Schenuit, F., Schulte, I., Vaughan, N. E. (eds.) The State of Carbon Dioxide Removal 2024 - 2nd Edition.