

## ETC Key Messages -

### ***Bioresources within a Net-Zero Emissions Economy: Making a Sustainable Approach Possible***

#### **Top line**

Rapidly increasing demand for bioresources is likely to outstrip sustainable supply, undermining climate mitigation efforts and harming biodiversity, unless alternative zero-carbon options are rapidly scaled-up and use of bioresources carefully prioritised.

#### **Key messages**

##### *Sustainable supply of bioresources*

**While bioresources are in principle renewable, not all forms of biomass use are beneficial from an environmental perspective: not all biomass is 'good' biomass.** To be sustainable, biomass production should have low lifecycle GHG emissions. Its production should:

- not compete with use of land for food production
- not trigger any land use change that could release carbon stocks into the atmosphere (especially deforestation),
- not fail to take into account the 'opportunity cost' related to carbon that could be sequestered without intervention,
- not negatively impact biodiversity and ecosystem health.

**Thus, biomass sources should be limited to waste & residues, dedicated energy crop production on degraded / marginal lands, or where current crop / pastureland can be released.**

On the basis of strict sustainability criteria, the ETC estimates that a prudent scenario for the quantity of clearly sustainable biomass available by mid-century without major changes in land use, technology, and consumer behaviour is **c.40-60 EJ/year**. **There is a potential upside of up to c.60 EJ/ year** if, and only if,

- productive land is freed up by a shift to plant-based diets or cultured meat, improved agricultural productivity and reduced food waste;
- the production of seaweed-for-energy significantly scales up; and,
- organic waste collection and management is improved.

##### *Demand for sustainable bioresources in a net-zero GHG emissions economy*

As countries and companies endeavour to reduce their GHG emissions, the use of biomass as an alternative lower-carbon fuel has grown dramatically due to its easy substitution as a "drop-in" substitute to fossil fuels for industrial combustion and feedstock purposes.

**Many sectors and applications across the mobility, industry and buildings sectors are currently planning to use biomass as a key decarbonisation route.** But potential demands far exceed sustainable supply. Left unchecked, these trends would heighten the risks of unsustainable management of the bio resource, including deforestation, biodiversity loss and soil depletion. Many current policies and climate mitigation scenarios often fail to consider claims on bioresources wholistically, incentivising uses in sectors where alternatives exist, and jeopardising a sustainable management of the resource.

**Alternative zero-carbon solutions, like clean electrification or hydrogen use, should be developed rapidly to lessen the need for bio-based solutions.** Dramatic cost reductions have already been seen and further reductions are expected in renewable power generation, clean hydrogen production, and grid stability management. As such, industry and policymakers to limit the use of bioresources in applications where cheaper alternatives exist or are within reach. These include road transport, bulk power generation without CCS, residential heating and shipping – with the exception of select specialised niches (e.g. local waste-to-energy district heat networks), especially in those locations where bioresources are locally abundant.

**Biomass should be prioritised for use in a few sectors where there is limited to no alternative.**

- **Biomass is best used for materials rather than as an energy source**, so that its inherent characteristics can be taken advantage of and combustion (which contributes to local air pollution) avoided. This includes timber, pulp and paper and other wood products or as a bio-feedstock for the plastics industry.
- Few uses in the form of energy stand the test of resource efficiency and expected long term cost-competitiveness. **Aviation is the one exception:** biofuels could play a major role in the next decades as synthetic fuels made from power-to-liquids may not reach cost-competitiveness and scale fast enough to meet the needs of the sector.
- Finally, as **negative emissions** will be needed, in addition to rapid in-sector decarbonisation, to limit global temperature rise below 1.5°C, applications where carbon capture and storage can be applied – including power, hydrogen or biofuels production – could become more attractive uses of biomass if carbon prices create a revenue stream for carbon dioxide removals.

#### *Actions in the next decade*

Priorities for industry and governments to ensure a sustainable approach to and optimal use of bioresources:

- **Defining and enforcing clear sustainability standards for biomass supply:** Adopting comprehensive and specific biomass sourcing standards, banning conversion of preserved natural ecosystems to commercial biomass exploitation; creating mechanisms to allow transparency and traceability of biomass supply chains; improved data analysis and monitoring to inform land use policies.
- **Pursuing opportunities to further increase sustainable supply:** improving waste collection; innovations in seaweed-for-energy production; encouraging massive dietary change and technological developments to reduce land needed for animal meat and food production.
- **Creating the conditions for a prioritised use of bioresources:** use of carbon pricing to allocate scarce, sustainable supply, alongside policies to discourage suboptimal and encourage priority uses; developing explicit national and local strategies taking into account local land-use.
- **Supporting key technologies enabling efficient, sustainable supply and use of bioresources:** improving efficiency of existing land use; increasing waste collection; targeting funding (including R&D, and pilot funding) towards emerging bioenergy (e.g. algae, biogasification) and biomaterial (e.g. bioplastics) technologies.

#### **Supporting details**

A net zero GHG emissions economy by mid-century is technically and economically feasible, and will be built on abundant, cheap zero-carbon electricity. Rapidly falling costs of renewables and energy storage make it possible to achieve a massive expansion of clean power systems at low-cost, and in turn this will enable green hydrogen to be produced at scale, enabling further decarbonisation in heavy industry and bulk transportation. Together this will enable feasible non-bio resource alternatives to meet most energy demands by 2050.

Bio-resources have a legitimate but constrained and complementary place in a net-zero emission energy system, alongside critical uses in the wider, net-zero sustainable economy for materials and carbon dioxide removal.

### *Sustainable supply of bioresources*

**While biomass is in principle renewable, not all biomass is 'good' biomass from an environmental point of view.** Supply of biomass is limited by alternative uses of land and sustainability constraints. Sustainable, low lifecycle GHG emission biomass production should:

- **Avoid competition with other critical uses of land** (e.g., for food production, for biodiversity protection or reforestation)
- **Ensure a low lifecycle emissions footprint** by avoiding adverse land-use changes that release carbon stocks from the land into the atmosphere and accounting for the 'opportunity cost' related to the carbon that could be sequestered without intervention
- **Account for other critical environmental and social considerations** (e.g. biodiversity, ecosystem health, land rights)

**Estimates of sustainable, low life-cycle emission biomass supply are inherently uncertain** and vary considerably depending on the specific criteria applied. **A prudent scenario for the quantity of clearly sustainable biomass available by mid-century is c.40-60 EJ/year.** This is comprised of:

- Approximately 5-10 EJ/year from energy-crops such as miscanthus, willow or poplar grown on dedicated land (i.e., on marginal/degraded land or former crop- and pastureland);
- About 20-30 EJ/year from forestry, of which c.10 EJ/year is currently used for materials (i.e., timber) and should continue to be so, and c.10-20 EJ/year is forestry residues;
- Around 5-12 EJ/year of agricultural residues produced when using land primarily for food crop production (while limiting residue extraction to protect soil and ecosystem health);
- An additional c.6-9 EJ/year from biogenic municipal and industrial waste;
- A minimal amount from aquatic macroalgae sources of biomass (i.e., seaweed)

**Three possible, but highly uncertain, future developments which could potentially double the sustainable supply of biomass:** improved waste management and collection of organic waste; radical scaling of seaweed-for-energy cultivation; increased availability of dedicated land for biomass production through reallocation of former crop and pasture land. The latter would require massive dietary and behavioural changes in developed nations, including a major shift to reduce meat consumption (or development of new cultured or synthetic meat technology), a reduction in food waste and agricultural productivity improvements.

### *Demand for sustainable bioresources in a net-zero GHG emissions economy*

**Biomass should therefore be prioritised in sectors where it is most needed, and where alternative decarbonisation options are not available or prohibitively expensive.**

- There is a large and growing demand for biomass that is likely to exceed sustainable supply. If we use more biomass than is sustainably available, it will undermine climate mitigation, negatively affect nature and could compete with food production.

- In parallel, dramatic cost reductions have been seen and are expected in non-bio based decarbonisation options, such as clean electricity (further ~55% reduction by 2050) and green hydrogen (further 60%), and rapid scale up is essential to deliver climate targets.

**If demand for priority sectors (timber, pulp & paper, bio-feedstocks for plastics and aviation) was met entirely from bio resources would well exceed our 'prudent scenario', but demand from these sectors could lie just within the prudent range if bio resource use were combined with other decarbonisation options** – in particular recycling of plastics, and synthetic fuels alongside biofuels in aviation, or if sustainable supply is increased. Thus, a portfolio of decarbonisation solutions is required, and could free up supply for additional niche uses.

### *Carbon dioxide removals*

**For the world to reach net zero emissions, negative emissions are likely to be needed, in addition to, but not instead of, rapid in-sector decarbonisation.** Bioenergy with Carbon Capture and Storage (BECCS, e.g. for power, hydrogen or biofuels production) is an additional priority use of biomass.

If carbon prices enable a 'profit' for carbon dioxide removal, the relative cost competitiveness of different alternative uses of bio resource as material and energy will change, with applications where CCS is feasible – such as power generation and some direct heat applications – becoming more attractive.

It is difficult to be definitive about the future quantities of carbon dioxide removal that could be provided by bio-based options. This must therefore emerge in part from the interplay of carbon prices and tighter regulation.

**This will increase yet further the potential imbalance between demand and sustainable supply, and therefore both the price of biomass and the danger of an unsustainable supply response.** It may also imply that some uses which would be priorities in the absence of the carbon removal option – in particular aviation biofuels – may be squeezed out over time, increasing the importance of developing other decarbonisation options.