BELLONA

The fundamental requirements of 121 solutions

121 solutions
The fundamental requirements

This booklet is part of the first version of Bellona's climate solution system, and is a work in progress. In it, we describe five fundamental requirements – how they work, and why we need these to actually make other climate solutions work.. The booklet is published as part of our work at the UN climate summit in Scotland in 2021 – COP26.

The Bellona Foundation is an international environmental NGO based with headquarters in Norway. Founded in 1986 as a direct action protest group, Bellona has become a recognized technology and solution-oriented organizations with offices in Oslo, Brussels, Berlin, St. Petersburg and Murmansk and representation in the UK, USA and other EU countries. Bellona employs more than 60 engineers, ecologists, nuclear physicists, economists, lawyers and political scientists. Environmental issues are an enormous challenge. They can only be solved if politicians and legislators develop clear policy frameworks and regulations for industry and consumers. Industry plays a role by developing and commercializing environmentally sound technology. Bellona strives to be a bridge builder between industry and policy makers, working closely with the former to help them respond to environmental challenges in their field, and proposing policy measures that promote new technologies with the least impact on the environment.

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Sustainable biomass production

1. What is it and what does it do?

Biomass is here defined as renewable organic material that comes from plants and animals. The material can be used for a range of different purposes, and in principle, everything that is made of petroleum products today can be made using biomass.

Biomass is a source for food, feed, medicine, plastics, chemicals and energy. Biomass can directly supply heat, it can be transformed into biofuels and biogas, it can substitute carbon-intensive materials and products, and it can be used in power generation, potentially attaining negative emissions if coupled with carbon capture technology.

Sources of biomass include e.g. wood and wood processing wastes, agricultural crops and waste materials, seaweed, biogenic materials in municipal solid waste, as well as animal manure and human sewage.

2. Why does Bellona define this as a fundamental requirement?

Biomass is a source of biogenic carbon and can be used to replace fossil carbon in industrial processes and in materials, stopping more fossil CO2 from being added to the atmosphere. Replacing fossil carbon is a prerequisite for a zero-emission society.

Furthermore, biomass can play a role in reducing levels of CO2 to limit global warming. It can help us enable permanent carbon dioxide removal to balance out emissions that are impossible to prevent and to physically remove CO2 from the atmosphere.

A clear strategy for sourcing sustainable biomass and guidelines for effective and efficient use (where and how) will be crucial.

3. What is needed for this to be deployed and scaled up?

Scaling up production of biomass can be achieved by utilizing new areas for cultivating crops, by making use of new and more productive crops or by more efficient use of existing land areas for biomass production. There is also a considerable potential to increase the amount of available biomass resources through increases in production efficiencies, by reducing waste, and turning waste streams into resource streams. We can use non-agriculture land, desert areas, and the sea to grow biomass. For biomass production to be sustainable, we have to take into account the inherent boundaries that limit this production – including fresh-water access on a global scale, as well as the importance of avoiding negative impacts on ecosystem services and resilience.

To allow for efficient and effective biomass use, we need to build new sustainable bioeconomy industries. We need to deploy biorefineries that can develop biomass for different purposes, ranging from pharmaceutical products to alternatives to fossil fuels. Governmental support is needed for a rapid transition.

4. Examples of solutions that depend on this?

Example 1 - Energy:

Solutions for negative emissions may depend on biomass. As the biomass has absorbed CO2 from the atmosphere, solutions to capture and store this CO2 can potentially produce net negative emissions, as a form of Carbon Dioxide Removal (CDR).

Burning biomass in a power plant allows for zero emission energy production. If the same process is coupled with carbon capture and storage technology, it enables net negative emissions. This process is called Bio-CCS.

Production of biogas also relies on access to biomass. Biogas can be produced through pyrolysis of biomass or anaerobic digestion of biomass, e.g. food waste. This gas can be used to replace fossil fuel gas to allow for zero-emission solutions. Biogas for energy production with carbon capture and storage allows for negative emissions.

Also, hydrogen production from biogas with CCS has the potential for negative emissions.

Example 2 – Fodder:

Biological waste, such as sludge from fish farms, can be used as a substrate for instance for insect production that again can deliver raw materials to production fish feed, substantially decreasing climate emissions and land use change.

A wide range of studies has documented that adding seaweed and kelp to fodder for ruminants like sheep and cattle has the potential to substantially lower methane emissions.

CO_2 transport and storage

1. What is it and what does it do?

CO_2 (carbon dioxide) Transport and Storage are two of the three main activities required for Carbon Capture and Storage (CCS). They are preceded by CO_2 capture, the first step in CCS. Altogether, their objective is to prevent CO_2 emissions from entering or staying in the atmosphere and causing further global warming. Through CO_2 Transport and Storage networks, CO_2 captured from industrial installations, power plants or directly from the air can be delivered by various modes of transport (pipelines, ships, trains, trucks or barges) and stored in geological formations in a safe and permanent manner.

2. Why does Bellona define this as a fundamental requirement?

CO_2 Transport and Storage are indispensable to keep captured CO_2 away from the atmosphere. They help decarbonise industries considered to be hard-to-abate (i.e. where emission reduction is technologically difficult and costly), so that no sector is left behind in a net-zero world. Access to CO_2 Transport and Storage infrastructure underpins a just transition to climate neutrality giving carbon-intensive industries and regions a possibility to reduce their emissions quicker while keeping the jobs.

CO_2 Transport and Storage are particularly effective as an emission abatement solution for industrial clusters, and can complement the deployment of renewables.

Importantly, CO_2 Transport and Storage are critical for offsetting remaining unavoidable emissions from sectors like agriculture through carbon dioxide removals.

3. What is needed for this to be deployed and scaled up?

CO_2 Transport and Storage need political and public support, funding and a regulatory framework to be deployed at a scale necessary to move the needle on climate change mitigation. In addition to that, they require strategic planning and coordination at national and often regional/international level, between industries, states and local communities, not least to allow sufficient lead time to identify optimal CO_2 storage sites and build connections with industrial emitters. Flexibility should be prioritised in first CO_2 Transport and Storage networks so they can scale up as new emitters are connected.

4. Examples of solutions that depend on this?

Industrial decarbonisation depends on access to CO_2 Transport and Storage. Energy-intensive industries have so far proven to be difficult to decarbonise. For some industrial sectors, CCS offers the only viable option to cut their emissions. Cement production is the most notable example, contributing to between 5 and 10% of global CO_2 emissions. The nature of its feedstock (carbon-containing limestone) and the way it is processed to make cement result in unavoidable CO_2 emissions. However, most of these process emissions from cement manufacturing can still be captured and kept away from the atmosphere thanks to CCS. Similarly, emissions resulting from waste incineration can be reduced only with the help of CCS. Some of the most advanced CCS projects, e.g. Northern Lights in Norway, will provide a cement producer and waste incinerator with access to CO_2 transport and storage, thus enabling their decarbonisation and paving the way for other emitters to join.

Furthermore, when CO_2 from biogenic waste and from the air are captured and stored, they are effectively removed from the natural cycle and become negative emissions. In these cases, access to CO_2 Transport and Storage is an enabler of carbon dioxide removals. Finally, in cases where electricity grids are too carbon-intensive for the production of clean hydrogen through electrolysis, CCS provides a low-carbon hydrogen by capturing and storing CO_2 from methane reforming, which can help decarbonise sectors historically depending on hydrogen as feedstock, e.g. ammonia/fertiliser production or petroleum refining. Beyond these applications, low-carbon hydrogen (or its derivative: ammonia) can be used in energy storage or as a transport and power generation fuel.

Cradle to grave accounting

1. What is it and what does it do?

Comprehensive greenhouse gas (GHG) accounting methods calculate the total emissions caused by a product, service or an organisation in the economy. By providing a way to quantify the climate effect of various parts of the economy, they contribute to measuring climate change.

The GHG accounting methodology used by countries reporting their emissions to the United Nations Framework Convention on Climate Change (UNFCCC) is outlined in the reports of the International Panel of Climate Change (IPCC) , .

Other than the official methods for reporting emissions to the UNFCCC, there are private initiatives that outline methodologies to calculate GHG impacts of products and organisations. One of the most widely used GHG calculation methods is the Greenhouse Gas Protocol developed by the World Resources Institute and World Business Council for Sustainable Development . The International Standardisation Organisation has also developed a standard for the quantification and reporting of greenhouse gas emissions .

2. Why does Bellona define this as a fundamental requirement?

To reach climate targets, emissions and emission reductions will need to be monitored with the help of robust greenhouse gas accounting methods. The more our calculations reflect the actual changes to the climate, the better we will be able to manage the effects of climate change and adjust our climate policies to meet the emission reduction targets.

In the past few years, some stakeholders have creatively accounted for their emissions. While some have downplayed the emissions of their products by planting trees , others have exaggerated the emission reductions potential of their products by omitting parts of their lifecycle .

To avoid such mislabeling, an honest representation of the physical changes to the climate is needed. GHG accounting methods must account for all emissions going to the atmosphere and avoid any assumptions that are not based on physical measurements in the system.

3. What is needed for this to be deployed and scaled up?

The current global GHG accounting methodology, defined by the IPCC, already accounts for the emissions to the atmosphere.

The main goal of policymakers and NGOs in the coming years should be to keep the integrity of this measurement and avoid overcomplicated accounting schemes that run the risk of over or underestimating GHG emissions to the atmosphere. Voluntary GHG markets should also be kept separate from the national GHG emission reduction targets to ensure that emissions are reduced in time to reach climate goals.

4. Examples of solutions that depend on this?

The integrity of climate action as a whole package of solutions depends on honest accounting of GHG emissions. With increasing complexity and an increasing amount of GHG accounting methodologies, standards and certificates appearing on the market, safeguarding the integrity of GHG calculations is crucial for reaching climate targets. By ensuring that the GHG accounting reflects the changes to the physical environment (i.e., climate), climate change mitigation policies can stay on track and reach their targets – not only on paper, but in reality. Accounting for all impacts human activities have on the climate also enables the objective and impartial evaluation of various climate solutions.

Example 1: Labelling materials as 'waste' to claim they're carbon neutral

In recent years, fuels made out of plastic waste have been pitched to policymakers as a viable climate solution for sectors such as shipping and aviation.

However, a full GHG accounting analysis shows that by promoting plastic fuels through various channels, the oil, gas and petrochemical industries can continue extracting and releasing fossil carbon into the atmosphere without any economic or political consequences. Partial lifecycle assessments and mislabeling of inputs for plastic fuels play into such narratives since they omit over 90% of the GHG emissions they cause:

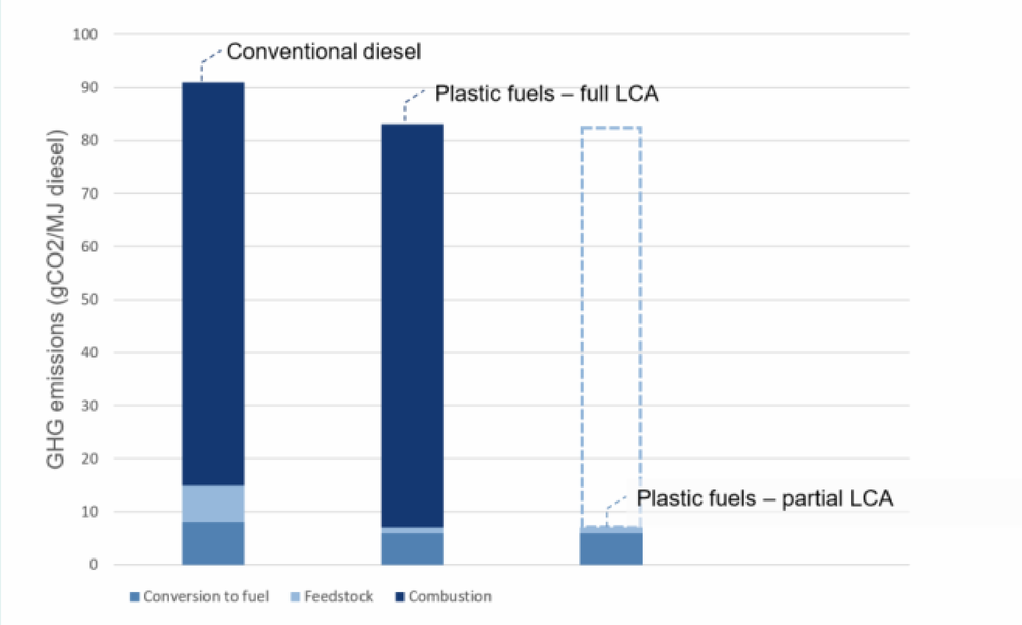
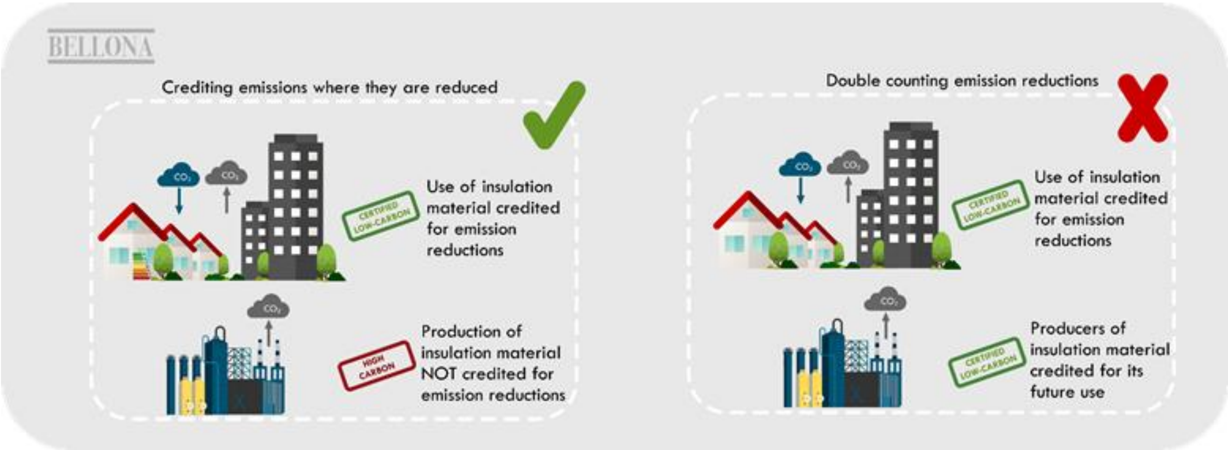


Figure 1: Not accounting for the combustion of plastic fuels leaves approximately 90% of the emissions related to the fuel unaccounted for. Adapted from Benavides et al. 2017 (Benavides, Sun, Han, Dunn, & Wang, 2017).

Example 2: Double counting emission reductions because of 'avoided emissions'

Products such as polystyrene insulation in houses and lightweight plastics in cars have been advertised to 'avoid' emissions during the use of the product. For instance, the insulation keeps the house warmer and therefore less energy is needed to heat it. While that does indeed increase the efficiency of the energy use for the house, that reduction in emissions is already recognised in the housing sector. Instead of attributing the emission reduction to the producer of insulation, it is attributed to the building itself, where the actual emissions (and any potential reductions) due to energy use happen.

If emissions avoided during the use of the product would be recognised for the producer of the insulation as well, it would lead to a double counting of emission reductions in the system and create a false image of what climate measures were actually taken in reality.


BELLONA
Crediting emissions where they are reduced
Use of insulation material credited for emission reductions
Production of insulation material NOT credited for emission reductions
Double counting emission reductions
Use of insulation material credited for emission reductions
Producers of insulation material credited for its future use

Resource extraction

1. What is it and what does it do?

Resource extraction provides necessary raw materials for decarbonisation of society, including transportation, industry and renewable energy production. While resource extraction is necessary for decarbonisation, it has a significant environmental footprint in the form of land degradation, chemical use and emissions to air, water and soil.

2. Why does Bellona define this as a fundamental requirement?

Meeting our climate targets requires large-scale deployment of renewable energy, electrification of transportation and industry, and the combination of biomass and CCS to create carbon negative solutions. This in turn implies a huge increase in demand for raw materials such as minerals, metals and biomass. The materials already in circulation are not sufficient to provide the required amounts. It is not even possible to recover all of the material in circulation, because of losses through dissipation and weathering (e.g. fertilizer, rust, etc.) as well as quality loss and shortcomings in recycling technology. Hence, continued resource extraction is necessary for the decarbonisation of society.

3. What is needed for this to be deployed and scaled up?

Acknowledgement of resource extraction as necessary even in a circular economy. Reduction of environmental footprint from resource extraction through better practices, such as mining without the use of hazardous chemicals, and the utilization of mine tailings for construction materials.

4. Examples of solutions that depend on this?

Several of the climate solutions we rely upon require extraction of virgin materials to be deployed at sufficient scale.

Some examples:

Solar energy, which requires silicone. Electricity grids require copper. Lithium-ion batteries require lithium, as well as nickel and manganese.

Zero-carbon electricity

1. What is it and what does it do?

Zero-carbon electricity is produced from renewable sources, with no emissions associated. Decarbonising the electricity grid is key for a zero-emissions economy, as direct electrification will be responsible for a great share of the energy solutions of the future.

2. Why does Bellona define this as a fundamental requirement?

Sufficient and available zero-carbon electricity is a requirement for cutting emissions in all sectors of society. Expanding the production of such energy is also the best strategy to ensure a just transition, as electricity is the cheapest decarbonisation strategy.

Direct electrification based on zero-carbon electricity is also the most efficient decarbonisation strategy. For instance, electric motors are much more effective than their combustion engine counterparts, even more so if we look at cars powered by synthetic fuels or hydrogen. The same is true across many sectors, such as heating, where heat pumps are more efficient than any gas-fired boiler system.

3. What is needed for this to be deployed and scaled up?

Grids are a fundamental enabler of zero carbon electricity. In a highly electrified world, where the great majority of the energy needs are covered by electricity, grids must be dimensioned to transport this load. Moreover, as renewable electricity often comes in an intermittent form, grids must be highly interconnected to ensure that electricity can be produced where the wind is blowing and the sun is shining and consumed wherever needed.

As the share of renewables increases in the grid must be enabled to deliver smart services. In a fossil world, electricity production is shaped on demand, however, this is only partially possible on a grid running on renewables. Smart grids can ensure that energy is used where needed, when needed, and distributed accordingly.

4. Examples of solutions that depend on this?

Electrification of all sectors depend on the availability of zero-carbon electricity. A large part of current decarbonisation strategies relies on electrification in the transport, buildings and industry sectors. Things like heat pumps, electric vehicles and electrified industrial processes need to be deployed to replace fossil fuelled processes.

Hydrogen as a climate solution is also dependent on zero-carbon electricity. Green hydrogen, produced with electrolysis powered by electricity, must be produced with emission-free electricity to actually have a climate impact. It is important that we plan for increased zero-carbon electricity production particularly for increased production of green hydrogen - as this is a very power-hungry process. If not, we risk that hydrogen production will use what additional capacity we build, and we have less left to directly electrify other processes with zero-carbon electricity.