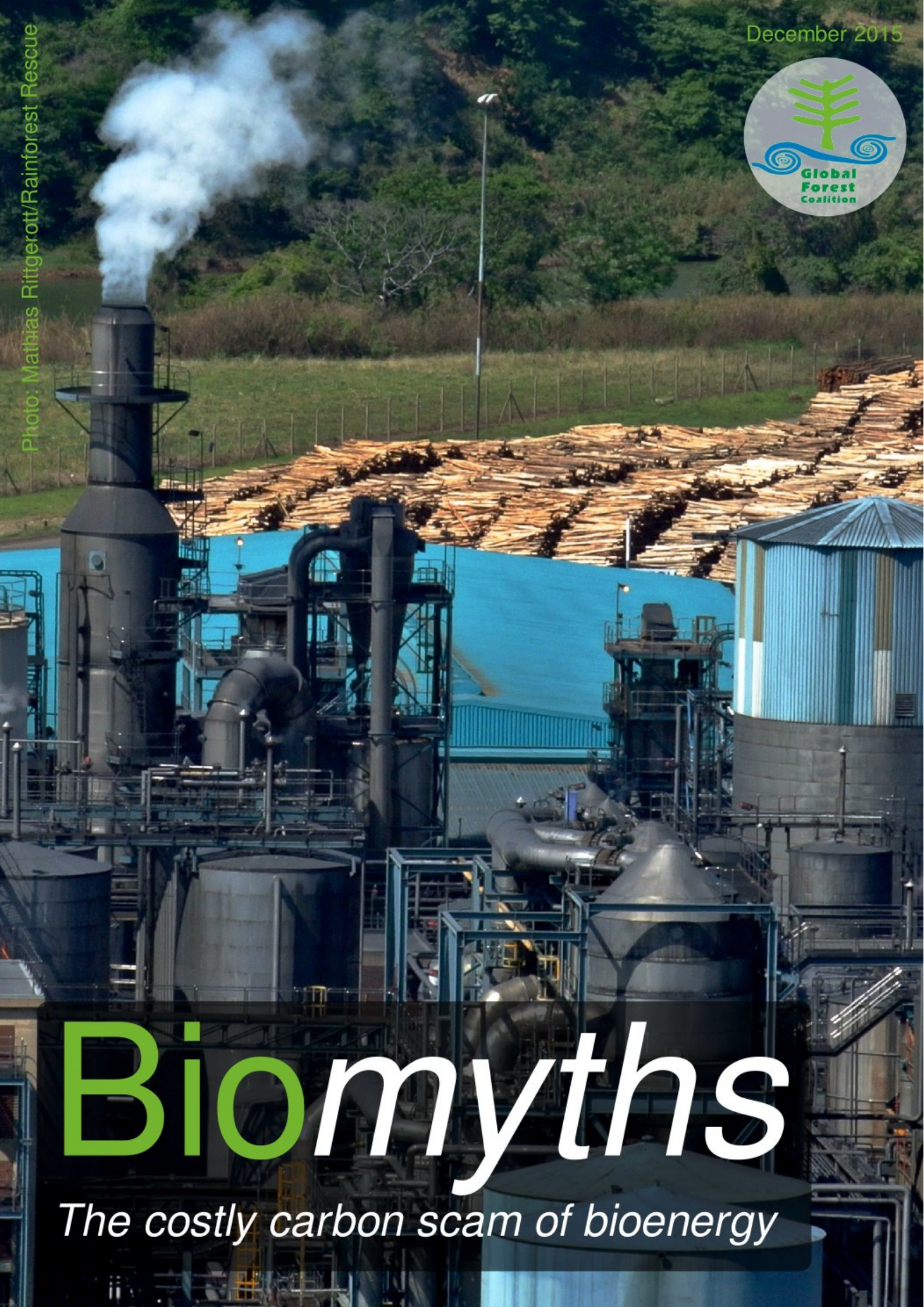

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Global Forest Coalition

Biomyths

The costly carbon scam of bioenergy

Executive Summary

The term 'wood-based bioenergy' refers to a range of different types of wood-based fuels, which are used in different ways and on different scales. On a smaller scale, wood, wood residues and charcoal are traditional fuels, and wood is still the main energy resource for poorer communities across the world. However, 'wood-based biomass' is now being promoted as a means of providing energy on an industrial scale, with potentially devastating consequences for forests and biodiversity, forest-dependent peoples, and climate change. Feedstocks for these power plants include forest residues, sawn wood offcuts, wood chips or sawdust. However, there is an increasing use of wood pellets, which are made from compressed, dry sawdust. These are more energy dense and easier to transport, facilitating international trade in addition to local production and consumption.

At present industrial-scale wood-based biomass consumption for energy is primarily located in the Northern hemisphere, mostly in the US and the EU. However, there is potential for this scenario to change. Investments in wood-based biomass facilities in Asia certainly indicate that Asian production and consumption of wood-based fuels are increasing rapidly. In general, bioenergy is already the world's largest source of 'renewable' energy. Total primary bioenergy supply stands at 50EJ, but the International Energy Agency (IEA) anticipates that this could more than triple by 2050, to 160EJ, with 100EJ of this being for the generation of heat and power.

Countries are supposedly switching away from fossil fuels and to biomass, including wood-based biomass, for three reasons: to ensure security of energy supply, to avoid the volatility of fossil fuel prices, and to mitigate climate change. The use of biomass as a key tool to combat climate change is based on the myth that it is carbon neutral. However, this is not the case.

Firstly, trees that are no longer standing are not available to continue carbon sequestration, meaning that atmospheric carbon concentration will be higher than it would have been if the trees had been left standing. Secondly, there is no guarantee that trees that are burned for bioenergy will actually be replanted, and that there will be replacement trees that will regrow and mature. Thirdly, it may be many decades before the carbon released is fully re-adsorbed by growing trees (the main argument used to promote biomass), but the time available to reduce carbon emissions before climate change reaches 'tipping point' is severely limited. Furthermore, harvesting trees and burning wood actually releases more carbon dioxide than burning coal, which is shocking given that coal is one of the dirtiest energy sources in use.

Finally, the IEA states that studies suggest that the increased demand could be met through wastes, residues and 'purpose grown energy crops' but even if this were possible, it does not mean that cheap timber from plantations would not be used. In the absence of any relevant regulations it will be the cost of relative wood-based feedstocks that determines which are used, not whether they are waste materials or not. Overall, this 'carbon neutral' accounting loophole is set to undermine progress towards climate change. It will permit power plants to go on pumping carbon emissions into the environment whilst countries falsely claim that they are reducing emissions.

Because wood pellet prices generally compare unfavourably with fossil fuel prices, many governments are using or have used a range of economic incentives to make the use of wood-based bioenergy attractive to industry. This transition away from fossil fuels is also driven by renewable energy targets in most countries. By mid-2015, 164 countries had at least one type of renewable energy target, up from 45 countries in 2005. Developing and emerging economies now account for 131 of those 164 countries. These targets range from government announcements and sectoral plans through to legally binding obligations.

For example, the EU's Renewable Energy Target requires at least 20% of energy use to be met from renewable sources by 2020, and the EU's 2030 new Climate and Energy Framework includes a target of 27% by 2030. By 2012, biomass and waste combined accounted for about two thirds of all renewable energy consumption in the EU, and forest biomass is now the main source of renewable energy in the EU. Most of the EU's biomass supply is domestic, with real and potential

impacts for Europe's forests, biodiversity and food production. However, wood-based biomass imports are increasing. In 2010 2.7 million tonnes of wood pellets were imported into the EU. In 2013, this figure stood at 4.3 million. By 2020 it is expected to be some 15-30 million tonnes, with serious implications for forests and biodiversity in both Europe itself and exporting countries, such as the US and Russia.

Figures from the UK tell a similar story: UK wood pellet imports increased almost 15-fold between 2008 and 2014, when nearly 4.8 million tonnes were imported and the use of wood pellets in the UK's major power stations accounted for more than 22% of all renewable energy sources and 36% of bioenergy fuels used to generate electricity. In 2008 both of these figures were less than 0.5%. According to UK government data, net imports supplied more than 95% of the wood pellets used by the main power stations between 2011 and 2014.

Another myth underpinning the growing use of wood-based biomass is that it is an efficient use of land to produce what is essentially solar energy. This has been roundly rebuffed by calculations from the World Resources Institute, which show that meeting the target proposed by the International Energy Agency— of supplying 20% of the world's energy from bioenergy in 2050—would actually require biomass equivalent to the "the entirety of human plant harvests in the year 2000"—including crops, plant residues, harvested wood and grazing land. In comparison solar photovoltaic (PV) systems use land 30-70 times more efficiently than biomass (Searchinger, & Heimlich, 2015).

Furthermore, the use of raw materials for bioenergy has various environmental, social and economic impacts, both in terms of the production of bioenergy feedstocks, and related to their eventual conversion into energy, either in unventilated houses or in power plants. The fact that increased imports of wood-based feedstocks seem to be an inevitable requirement means that these impacts will be felt both in countries producing for local consumption and in countries exporting biomass for energy.

Impacts include deforestation (to produce cheap biomass and to make way for tree plantations), loss of biodiversity, land grabbing, water

The expansion of wood-based biomass in Sweden

Sweden is an example of the expansion of wood-based biomass use in the EU. The country has been using biomass, especially wood pellets, as a fuel since the 1980s, mainly to fuel district heating plants and combined heat and power plants for both heat and electricity production. Overall, Sweden has a higher proportion of its energy coming from renewables than any other country in the EU, and has already surpassed its target for 2020.

To drive this transition, Sweden uses a variety of measures including an energy tax, an electricity tax, a sulphur tax, a vehicle tax, and biofuels obligations. It provides some exemptions from the energy and carbon dioxide taxes including for 'CO_2-neutral fuels'. The government has also provided investment grants for producing electricity from biomass, wind power and small-scale hydropower. In 2011, however, the Swedish National Audit Office concluded that the tax exemption for biofuels is an expensive way of achieving the Swedish climate quality objectives. It also concluded that the tax exemption has not been conducive to sustainability or predictability.

Consumption of wood pellets has been steadily increasing in Sweden, and production capacity has almost doubled since 2004. Raw materials shortages are a recurring problem and several producers have difficulty in sourcing their feedstock because of high raw material prices. Thus Sweden also imports wood-based biomass, especially from Russia, Finland and the Baltic states (as well as exporting to Denmark and the UK). Investment in new power plants in Sweden continues, with an increasing focus on the use of forest biomass rather than waste. Sweden has at least ten power plants that are based solely on the use of wood (as opposed to wood waste or other organic materials), and major new investments include new biomass plants planned in Linköping and Stockholm. Swedish energy company Fortum also has its eye on the "fast-growing Asian energy markets".

contamination, reduced water availability, and loss of food security and soil fertility, especially in the tropics and sub-tropics. Specifically with respect to climate change, deforestation and forest degradation result in loss of carbon stocks in vegetation and soil, as well as affecting water retention and micro-climate regulation.

As production and use are primarily in the US, the EU and Russia at present, these are clearly where the impacts are being felt first. For example, new data indicates a 150% increase in wood pellets from the US in the last three years, primarily bound for Europe, and further increases are expected to intensify ecosystem damage in 'wood sourcing hotspots' in southeastern US.

In the EU it seems that meeting demand for forest biomass for the EU's bioenergy needs in 2020 will require more intensive forestry operations or the addition of tens of millions of hectares of land for forestry. This would mean losing land that is being used for other purposes at the moment, or a reduction in the many benefits that natural forests currently provide. For example, forests' role in regulating hydrological systems is likely to be compromised by more intensive forestry practices. Biodiversity will also be affected by the removal of forest residues that various species depend upon, such as beetles, flies and wasps, with consequent impacts on species higher up the food chain, such as woodpeckers. In addition the monoculture plantations that would probably be planted as quick growing energy feedstocks have a low biodiversity value, require much more water, and are more vulnerable because they are at more risk of being attacked by pests.

A report prepared for the European Parliament anticipates that in the future, biomass, including woody biomass, may also be imported to the EU from countries in West and Central Africa and Latin American countries, especially Brazil. Thus it is also possible to anticipate that the impacts already being experienced as a result of expanding monoculture plantations—including land grabbing, deforestation, and long term impacts on local food and energy security—will be exacerbated in these countries in the future.

There is some evidence of foreign investors acquiring land in Africa, South America and Southeast Asia specifically to produce biomass for energy, indicating that these changes may already be underway. On the other hand, wood, even in pellet form, is relatively expensive to transport long distances, and there are examples of projects focused on international trade that seem to be failing, indicating that the situation with respect to anticipated demand and prices is also highly volatile, and that local opposition to such projects can be vocal and effective.

For example, companies already operating in Africa include the subsidiary of a Canadian business, which runs a eucalyptus plantation in Congo that supplied around 350,000 tonnes of wood chips to Europe in 2009. Another example is that of old rubber plantations in Ghana and Liberia being replanted to produce woodchips for export to Europe (although Vattenfall's project in Liberia collapsed in 2012, seemingly due to political opposition relating to energy access in Liberia). In Brazil, local communities have opposed the development of new eucalyptus and acacia plantations to export wood pellets to the EU. In the Philippines a new company was established in 2011 specifically to "produce sustainable biomass feedstock" using "idle land" in the Philippines. There is also evidence of land grabs for monoculture tree plantations in Africa and Brazil being justified by companies who are citing the growing EU biomass demand, even though the timber may actually be used for other purposes.

Overall it seems that Asia will be the next region to become heavily engaged in energy-related wood-based biomass production and consumption. Demand for wood pellets to feed biomass power plants in Japan is encouraging biomass production and consumption across Asia, and creating demands for imports from further afield, as evidenced, for example, by a contract between Sumitomo, who will build a 50MW biomass facility in Northern Japan, and French utility company Engie, formerly GDF Suez, which has been contracted by Sumitomo to supply one million tons of wood pellets between 2018 and 2028.

The situation in countries in Sub-Saharan Africa is rather different, in that household use of wood for energy, especially from charcoal, is still the dominant form of wood-based bioenergy use, whilst industrial-scale bioenergy production tends to focus on biofuels. The number of people relying on wood-based biomass energy in this way in Sub-Saharan Africa is expected to reach almost one billion by 2030.

The general governmental and intergovernmental focus in Africa is on improving the efficiency with which this wood-based biomass, especially charcoal, is used at the domestic level, as well as promoting low-carbon growth strategies and energy access. Carbon offsetting is being promoted: it is argued, for example, that one ton of 'sustainable charcoal' would offset one ton of non-sustainable charcoal or nine tons of carbon dioxide. This erroneous approach brings together the flaws associated with carbon offsetting (including the fact that short-term carbon sequestration in plants is wrongly equated with long-term underground storage of fossil fuels) and the 'carbon neutral' myth (described above). This approach is being incorporated into proposed climate-related forestry project proposals in Africa under, for example, REDD+ and Forest Investment Program.

In Latin America the situation is different yet again. There is widespread use of wood-based bioenergy for local and even national consumption, and charcoal production for industrial and/or urban use has had a devastating impact on forests, indigenous peoples and local communities in countries like Paraguay. There seems to be scant evidence of wood-based biomass being exported to other continents at the moment, although this situation could change in the future as the development of the Pinnacle Green resources wood pellet mill in Guyana indicates. At the moment, however, the focus is on the domestic and commercial use of charcoal. South America is second only to Africa in total and per capita charcoal use. Wood chips are also used extensively for pulp and paper production, rather than energy generation, and countries in South America, including Brazil, are ramping up pulp and paper production capacities, with most wood expected to be used locally.

The consumption-based impacts of burning wood-based biomass are also problematic. The health impacts resulting from the domestic use of biomass in small unventilated houses, especially in Sub-Saharan Africa, are well documented and programmes to improve cookstoves are underway. For example, a partnership between the World Bank and the Global Alliance for Clean Cookstoves aims to "spur a transition to clean cooking for 100 million households." However, in practice public-private partnerships such as these tend to work to improve corporate profits and corporate control over the domestic energy sector.

There is also increasing concern about impacts on the health of communities living around power plants burning biomass. The health impacts of any particular power station depend on the particular pollutants being emitted, pollution regulations in force, and the underlying health of the population affected (especially since research shows that the plants may often be located in areas with high levels of deprivation). Typical impacts related to air pollution include bronchitis, asthma, heart disease, stroke, cancer, and reproductive problems including birth defects.

Given the fact that the use of wood-based biomass is based on a set of myths, it is clear that a new and radically different approach is needed in order to mitigate climate change effectively and meet the 2030 Sustainable Development Agenda goals, which include reaching 'zero deforestation by 2020'.

This new approach should focus on keeping fossil fuels in the ground, addressing the drivers of deforestation by slashing consumption, and promoting agroecology and agroforestry as win-win ways of mitigating and strengthening resilience to climate change, at the same time as promoting food sovereignty and protecting biodiversity. It also entails ending trade and investment liberalisation agreements that fuel deforestation, rejecting monoculture tree plantations, and recognising land rights. It should ensure that:

• Bioenergy, including wood-based biomass, is no longer treated as carbon neutral and no longer classed as a renewable energy source, implying it is removed from all national and international renewables targets.

• Subsidies provided to fossil fuels and/or biomass providers are redirected to real solutions to climate change, especially community-based, small-scale wind and solar power initiatives, in order to drive a real and rapid transition to a genuine carbon-free future.

• Forests are redefined to exclude plantations, recognising their true and unmatched potential in terms of regulating climate change and protecting biodiversity, and their value for forest-dependent peoples.

• Climate change mitigation proposals intended to increase forest cover focus on community-led reforestation initiatives using native species.

Section 1: Wood-Based Biomass and Climate Change

The term 'wood-based bioenergy' refers to a range of different types of wood-based fuels, which are used in different ways and on different scales. On a smaller scale, wood, wood residues and charcoal have traditionally been used to provide energy, and are still the main energy resource for poorer communities across the world, in both rural and urban areas, and especially in Africa. Now 'wood-based biomass' is being promoted as a means of providing energy on an industrial scale, with potentially devastating consequences for forests and biodiversity, forest-dependent peoples, and climate change.

When used on this industrial scale, wood-based feedstocks may take the form of forest residues, sawn wood offcuts, wood chips or sawdust, but increasingly they are in the form of wood pellets, which are made from compressed, dry sawdust. Pellets are more physically and energy dense than wood and correspondingly easier to transport and store (Billington bioenergy). Other energy dense wood-based feedstocks include torrefied wood pellets (which are even denser than standard pellets and can be mixed more effectively with coal in co-fired power plants) and pyrolysis oil (a plant-based liquid produced using a thermo-chemical process) (Cocchi, 2011). Wood feedstocks are labelled as 'biomass', as opposed to ethanol and biodiesel, which are liquid 'biofuels' used for energy generation and transport fuel.

Countries are supposedly switching away from fossil fuels and to biomass and biofuels for three reasons: to ensure security of energy supply, to avoid the volatility of fossil fuel prices, and to mitigate climate change (Billington bioenergy). However, if countries' bioenergy demand is so high that they become dependent upon imports of wood pellets their supplies can hardly be guaranteed, and neither can feedstock prices. Furthermore wood pellet prices generally compare unfavourably with fossil fuel prices, especially when oil prices are low. They are affected by a range of complex factors including exchange rates, changing demand (including because of government policies on renewables), and new technologies (DECC, 2012).

Thus many governments are using a range of economic incentives to drive the transition away from fossil fuels and towards renewable energies (IEA; IEA, 2015). Wood-based bioenergy—which is erroneously being counted as a 'renewable' energy (see Box: The Carbon Neutral Myth)— generally qualifies for these subsidies, making it attractive to industry. In addition—and again because biomass fuel is falsely considered 'carbon neutral'—it is also attractive to energy producers as a fuel that will not attract carbon levies (Billington bioenergy).

In addition, switching from coal to co-firing with wood-based biomass has enabled some power stations, such as Drax in the UK, to remain open when they would otherwise have had to close because of EU limits on emissions of sulphur dioxide (which would have meant plants being closed by the end of 2015) (Smolker, 2014).

Most countries now have renewable energy targets driving the transition away from fossil fuels (for a list of examples, see Searchinger & Heimlich, 2015, p11). By mid-2015 164 countries had at least one type of renewable energy target, up from 45 countries in 2005. Developing and emerging economies now account for 131 of those 164 countries. These targets range from government announcements and sectoral plans through to legally binding obligations (IRENA, 2015. For a list of targets in various countries see Searchinger & Heimlich, 2015, Table 2) and some of them include specific bioenergy sub-targets.

The development of 'second generation' sources of biofuels and biomass—trees that are genetically engineered to make processing easier—is also under way. For example, trees' lignin content is increasingly a focus of attention, both in terms of reducing lignin content to enable the production of biofuels (which is highly problematic since its reduces trees' resistance to pathogens) (Global Justice Ecology Project, 2014), and increasing lignin content to create denser biomass (Welker et al, 2015).

Myth 1: The ‘Carbon Neutral’ Myth

Because it is assumed that a harvested tree will eventually be replaced by another tree that will sequester the same amount of carbon from the atmosphere, wood-based biomass is considered to be ‘carbon neutral’. As a result, when power plants burn wood, the only carbon dioxide pollution they are likely to be required to report is from the burning of fossil fuels needed to manufacture and transport the woody fuel.

But burning wood-based biomass is far from being carbon neutral. Firstly, trees that are no longer standing are not available to continue carbon sequestration, meaning that atmospheric carbon concentration will be higher than it would have been if the trees had been left standing (Ter-Mikaelian et al, 2015) —as observed by the European Environment Agency’s Scientific Committee:

“If bioenergy production replaces forests, reduces forest stocks or reduces forest growth, which would otherwise sequester more carbon, it can increase the atmospheric carbon concentration…To reduce carbon in the air without sacrificing other human needs, bioenergy production must increase the total amount of plant growth, making more plants available for energy use while preserving other benefits, or it must be derived from biomass wastes that would decompose and neither be used by people nor contribute to carbon sequestration… The potential consequences of this bioenergy accounting error are immense. Based on the assumption that all burning of biomass would not add carbon to the air, several reports have suggested that bioenergy could or should provide 20% to 50% of the world’s energy needs in coming decades. Doing so would require doubling or tripling the total amount of plant material currently harvested from the planet’s land.” (European Environment Agency, 2011)

In the EU for example, even though the Renewable Energy Directive does include provisions for life cycle analysis of the greenhouse gas emissions associated with particular bioenergy, it does not account for changes in the carbon stock of a forest, foregone carbon sequestration of land, or indirect impacts on carbon stocks in other areas of land (Stephenson & MacKay, 2014).

Secondly, there is no guarantee that trees that are burned for bioenergy will actually be replanted, or that any replacement trees will regrow and mature. Thirdly, it may be many decades before the carbon released is fully re-adsorbed by growing trees (the main argument used to promote biomass), but the time available to reduce carbon emissions before climate change reaches ‘tipping point’ is severely limited. Harvesting trees and burning wood actually releases more carbon dioxide than burning coal, which is shocking given that coal is one of the dirtiest energy sources in use (for example, see PFPI). For example, analysis of data from the Drax power plant in the UK reveals that its boilers release 15-20% percent more carbon dioxide when it burns wood than when it burn coal (Climate Central, 2015). This is now acknowledged in the UK, in the form of a sustainability standard requiring subsidised electricity to come from solid biomass that has a lower greenhouse gas emissions intensity than electricity from fossil fuels—but only from 2020 (see Impacts below) (Stephenson & MacKay, 2014).

Overall, the ‘carbon neutral’ accounting trick is set to undermine progress towards climate change. In particular it will permit power plants to go on pumping carbon emissions into the environment whilst countries falsely claim that they are reducing emissions.

Wood-Based Bioenergy Case Study - Sweden

Sweden has invested heavily in alternative energy sources since the oil crisis in the 1970s. In terms of electricity, the main sources of power are nuclear and hydroelectric, which together account for 78% of electricity generation. Combined heat and power plants, which are mostly powered by biofuels, account for a further 10% (with the remainder imported (8%) or from wind power (4%)). Overall Sweden has a high rate of electricity consumption, but its carbon emissions are relatively low (5.1 tonnes of CO_2/year, compared with the EU average of 7.9 tonnes and the US average of 19.1 tonnes) (Swedish Institute).

Sweden has been using biomass, especially wood pellets, as a fuel since the 1980s, mainly to fuel district heating plants and combined heat and power plants for both heat and electricity production (Cocchi, 2011). However in recent years there has been a significant shift towards wood-based biofuels by domestic households. In 1997 only 8% of wood pellet use was by domestic households, but by 2010 this figure had jumped to 34%. In terms of actual quantities the use of wood pellets in private households has increased 20 times over 13 years (Cocchi, 2011). This trend is associated with a declining use of oil for residential heating and is thought to be the main reason for Sweden's low use of oil, which accounted for just 21.5% of Swedish energy supplies in 2012 (Swedish Institute). Increasing household use of biomass has been driven by high oil and electricity prices, which are in turn relatively high because of fossil fuel taxation (Cocchi, 2011).

With respect to Sweden's overall supply of energy, bioenergy represents about 30% of Sweden's total supply of energy, and 85% of that comes from the forestry sector (Swedish Institute).

Consumption of wood pellets has been steadily increasing, reaching 2,280,000 tons in 2010 (Cocchi, 2011). Investment has increased steadily. Production capacity has almost doubled since 2004, to 2,400,000 tons in 2010. There are now 81 pellet plants in Sweden, with two that are able to produce more than 100,000 tons annually, and 40 small plants that produce less than 5,000 tons annually (Cocchi, 2011).

According to the International Energy Agency, the largest producers in Sweden use fresh and dry sawdust and shavings as feedstocks. However, raw materials shortages are a recurring problem and several producers have difficulty in sourcing their feedstock because of high raw material prices (Cocchi, 2011). Thus Sweden also imports wood, in the form of round wood, pellets, chips, bark, and sawdust recovered wood fuels (Hektor, 2011). 695,000 tons of wood pellets were imported in 2010 (Eurostat quoted in IEA). Wood pellets used to be imported from Canada and Poland but nowadays they are more likely to come from Russia, Finland and the Baltic states. Sweden also exports wood pellets (an average of 100,000 tons annually) mainly to Denmark and the UK (Cocchi, 2011). Sweden is also considered to be the largest EU consumer of wood chips for energy purposes, with imports supplementing domestic production, especially in the winter months (Cocchi, 2011, see also Hektor, 2011).

Overall, Sweden has a higher proportion of its energy coming from renewables than any other EU country, and has already surpassed its target for 2020. It aimed to get 50% of its energy from renewable energy by 2020; but by 2013 this figure was already 52.1% (Eurostat). By 2050, Sweden aims to have 100% of its energy coming from sustainable, efficient and clean energy resources with no net emissions of greenhouse gases to the atmosphere (Government of Sweden, 2008).

The targets vary by sector: renewable sources should cover 62% of heating consumption, 63% of electricity demand, and 14% of transport (IEA, 2010).

	Imports	Exports
Roundwood	7.5 million m^3	915,000 m^3
Chips and particles	1.1 million m^3	157,000 m^3
Pellets	1.2 million m^3	285,000 m^3
Sawdust, wood residues, etc	807,000 m^3	740,000 m^3

Figure 3: Swedish imports of wood biomass that could be used for fuel in 2013. Source: Swedish Statistical Yearbook of Forestry http://www.skogsstyrelsen.se/en/AUTHORITY/Statistics/Statistical-Yearbook-/

Sweden is using a variety of policies and measures to drive the use of renewable energy sources. These include an energy tax, an electricity tax, a sulphur tax, a vehicle tax, and biofuels obligations. The National Renewable Energy Action Plan provides some exemptions from the energy and carbon dioxide taxes including for CO_2-neutral fuels (IEA, 2010).

In terms of increasing the share of bioenergy use in domestic energy consumption, relevant measures are the tax on carbon emissions (introduced in 1991), the certification of green electricity (introduced in 2003), a tax exemption for vehicles using biofuels, and support for direct investment for the development of bioenergy (Andersson, 2012). The Swedish government has also provided investment grants for producing electricity from biomass, wind power and small scale hydropower (Hektor, 2011).

The Swedish National Audit Office (which audits state administration) concluded in its report (2011) that the tax exemption for biofuels is an expensive way to achieve the Swedish climate quality objectives. The tax exemption has not been conducive either to sustainability or predictability and has given rise to a number of counter-productive effects.
It is not fully clear how emissions from biofuels should be measured. Different studies yield different results depending on the assumptions made. Also, the tax exemption is not structured to be sustainable in the long term (Swedish National Audit Office, 2011).

Investment in Sweden

Although bioenergy has been used in Sweden for many years, investment in new power plants continues, with an increasing focus on the use of forest biomass rather than waste. Sweden has at least ten power plants that are based solely on the use of wood (as opposed to wood waste or other organic materials) (Biomass Power Plants in Sweden).

Current investment in new plants includes, for example, a decision by the Nordic Investment Bank to invest €50 million in building a new combined heat and power plant in Linköping in central Sweden, to be fuelled by biomass as well as waste (Nordic Investment Bank, 2014).

FortumVärme (co-owned by Fortum and the City of Stockholm) is investing approximately €500 million in the new Värtan plant to provide additional heat and electricity to Stockholm. The European Investment Bank is providing a €260 million load to FortumVärme for design, construction and operation of the new plant, as well as financing biomass handling facilities and upgrading port facilities (European Investment Bank, 2014).

Due to be commissioned in 2016, its production capacity will be 280 MW heat and 130 MW electricity. It is explicitly intended to use forest biomass as its primary fuel. Anders Egelrud, Managing Director of FortumVärme, says that the new plant will help reduce carbon dioxide emissions in Stockholm by an estimated 126,000 tonnes annually, and these reductions are being counted towards Stockholm's climate targets. However, the use of biomass is not carbon neutral (see The Carbon Neutral Myth section) meaning that these reductions are fictitious (Fortum website).

Fortum also has its eye on the "fast-growing Asian energy markets" (Fortum, 2012).

The EU's Renewable Energy Target and its impacts on biomass use

In 2009, the EU introduced a Renewable Energy Target requiring at least 20% of energy use to be met from renewable sources by 2020 (European Union, 2009), which is implemented by Member States via National Renewable Energy Action Plans. The EU's 2030 Climate and Energy Framework includes a target of 27% by 2030 (European Commission, 2014b).

In 2012, biomass and waste combined accounted for about two thirds of all renewable energy consumption in the EU (European Commission website), and forest biomass is now the main source of renewable energy in the EU (Arias Cañete, 2015). In the same year, the European bioheat and bioelectricity sectors generated a total turnover of at least €33 billion and employed over 374,800 people (European Commission, 2014). According to the 2030 Climate and Energy Framework Impact Assessment, the use of biomass to produce heat and power is expected to increase in the medium term (European Commission, 2014). Member States' estimates (in their NEAPs) indicated that biomass supply is projected to increase by nearly 37% by 2020 (European Commission, 2014, p6).

Most of the EU's biomass supply is domestic, with potential impacts for Europe's own forests and biodiversity. However imports are increasing. In 2010, 2.7 million tonnes of wood pellets were imported. In 2013, this stood at 4.3 million. By 2020 it is expected to be some 15-30 million tonnes (European Commission, 2014), with serious implications for forests and biodiversity in exporting countries, such as the US and Russia.

In order to drive this transition, EU governments have so far subsidised various renewable energy power providers at the national level (European Commission, 2014c) (although the European Commission is pushing to harmonise energy policy across the EU through an 'Energy Union', giving it greater control over national energy policies (Coyne, 2015). An Energy Union Framework Strategy was adopted in 2015 (European Commission, 2015). Whilst these subsidies may be invaluable in terms of swiftly transitioning to solar and wind power, when it comes to biomass they are effectively wasting climate finance that should be spent on renewable technologies that actually reduce emissions.

However, some renewables subsidies are being capped or removed. For example in 2015 the UK government announced plans to remove support for small-scale solar projects, end new subsidies for onshore wind generation, and modify subsidies for biomass plants, including for conversions of coal-fired power plants to biomass. Germany and Spain are also reported to have capped subsidies for renewables (Twidale, 2015).

Section 2: Current and Potential Impacts of Wood-based Bioenergy

The use of raw materials for bioenergy leads to various environmental, social and economic impacts, both in terms of the production of bioenergy feedstocks, and their eventual conversion into energy, either in unventilated houses or in power plants.

Production-related impacts

The environmental impact of bioenergies will vary depending on the scale, intensity and type of production, and the crops and cropping systems used. However, some impacts are specific to wood-based bioenergy. As production and use is primarily in the US, the EU and Russia at present, these are clearly where the impacts will be felt first.

In general, deforestation and forest degradation not only result in loss of carbon stocks in vegetation and soil, they also greatly affect biodiversity, water retention, micro-climate regulation, and soil fertility, especially in the tropics and sub-tropics. Moreover, monoculture plantations, which might be planted specifically as biomass feedstocks, have a low biodiversity value, require much more water, and are more vulnerable because they are at more risk of being attacked by pests (Evans, 2001; Eshenaur, 2014). The expansion and intensification of the industrial forestry sector may also impact on the land rights and livelihoods of local communities and indigenous peoples

Indirect impacts are likely to include impacts caused when displaced activities, such as food production, happen elsewhere instead. For example, displaced farmers might convert a natural ecosystem to agricultural land. Land-use change can also include changes in crop rotation patterns and/or intensification of the land used for food production (Bendes, 2011).

The International Energy Agency warned in 2012 about potential impacts in the large-scale deployment of bioenergy:

"However, there are some sensitive aspects to be considered in the sustainable development of bioenergy for heat and power. The large-scale deployment of bioenergy can create competition with existing uses of biomass such as for food and feed, or forest products, or can compete for land used for their production. This competition can create upward pressure on agricultural and forestry commodity prices and thus affect food security. In some cases bioenergy may also lead to direct and indirect land-use changes resulting in release of GHG emissions, more intensive land use, pressure on water resources and loss of biodiversity."
(International Energy Agency, 2012)

Myth 2: The myth that bioenergy is an efficient use of land

Using bioenergy to produce energy is an extremely inefficient way of using available land. The World Resources Institute (WRI) has calculated how much energy there is in all the crops, plant residues and wood harvested by people for all uses, plus grazing land, and compared that figure with the International Energy Agency's suggested goal of supplying 20% of the world's energy from bioenergy in 2050. **They calculate that meeting this 20% target would require 180EJ, and that, factoring in inefficiencies in the combustion process, this would effectively be equivalent to *"the entirety of human plant harvests in the year 2000."*** (225EJ) (emphasis added) (Searchinger & Heimlich, 2015, p13).

Furthermore, WRI argues that there are other much more efficient ways of using land. For example, although there can still be impacts in terms of using land that might be needed for other purposes, **solar photovoltaic (PV) systems can be up to 55-70 times as efficient as bioenergy** in terms of the land required (and at least 30 times as efficient even when various commercial constraints are taken into consideration). Comparing solar energy to biomass used specifically to produce electricity results in even higher ratios (Searchinger & Heimlich, 2015, p14).

Myth 3: Plantations are the same as forests

Monoculture tree plantations are not the same as biodiverse natural forests, and this is especially true in relation to climate change. Old growth forest stores significantly greater quantities of carbon than either plantations or logged forests. Data from the Consultative Group on International Agricultural Research shows that intact old growth forest stores significantly greater quantities of carbon than either plantations or logged forests (Palm et al., 1999). Even the most conservative of its estimates indicates that plantations store only 20% of the carbon that intact old growth forests do. Replacing old growth forests with plantations (to produce biomass for energy, for example) is not climate neutral! It is essential to revise the FAO's existing definition of forests to exclude plantations. The current inclusive definition allows the expansion of plantations to be prioritised over and above the protection of old growth forest, to the detriment of the climate, biodiversity and peoples' livelihoods.

The fact that using biomass has the capacity to increase GHG emissions is shown by a 2014 study prepared for the UK's Department of Energy and Climate Change (Stephenson & MacKay, 2014)—which takes a Life Cycle Approach. This assessed the likely greenhouse gas emissions that would be associated with imports of wood-based biomass from North America over a period of 40 years (with a view to finding out whether those emissions would be above or below 200 kg CO_2e/MWh electricity, which is used as the figure for electricity generated from fossil fuels). It found widely varying scenarios, but was able to determine, for example, that the following sources of wood-based biomass would emit more than 400 kg CO_2e/MWh electricity (ie more than double the reference figure for fossil fuels):

• coarse residues that would otherwise be left to decay in a boreal forest (eg Canada)

• trees killed by natural disturbances (eg beetles), that would otherwise be left in a boreal forest (eg Canada)

• additional wood output from increasing the harvest rate of forests (reducing the rotation length)

• wood from a forest that would otherwise be harvested less frequently

• converting forests into energy crop plantations (eg short rotation coppice)

• converting land that would otherwise revert to forests to biomass plantations (pine or energy crops).

It is of great concern to note that it has been calculated that EU countries' National Renewable Energy Action Plans indicate that meeting demand for forest biomass for the EU's bioenergy needs in 2020 will inevitably require more intensive biomass production in the existing forests or the addition of tens of millions of hectares of land for forestry as it is practiced today (European Forest Institute, 2014, p81).

Land use change and loss of habitats are obviously key concerns, and the fact that FAO and other intergovernmental organisations continue to consider plantations to be forests means that there is a continuing risk of natural forests being clearcut and replaced with quick-growing tree monocultures. Increased demand for wood-based feedstocks is likely to exacerbate this situation. The alternative of more intensive forestry operations is also likely to affect forests and the many benefits they provide. For example the role forests play in regulating hydrological systems is likely to be compromised by more intensive forestry practices (European Forest Institute, 2014, pp85-86).

Threats to biodiversity are a key concern. In Europe for example, one of the most threatened forest regions is the Carpathian mountain range in eastern Europe, which contains Europe's largest surviving area of old growth forests and is home to brown bears, wolves and lynx (Pearce, 2015). Even in 'best case' scenarios, in which biomass is only derived from forest residues (which is unlikely if demand increases dramatically (Hetemäki et al, 2014, p3)), there are likely to be significant impacts on biodiversity, because deadwood is a central contributor to biodiversity. In North America, for example, the removal of deadwood will have significant implications for populations of red-back voles, salamanders, saproxylic insects, fungi, mosses and liverworts, with subsequent impacts through food

Examples of increasing investment in plantations for wood-based biomass in developing countries

Although trade in wood-based biomass is primarily between countries in the Northern hemisphere at the moment, there is some evidence of foreign investors acquiring land in Africa, South America and Southeast Asia to establish tree plantations for biomass energy (although some projects seem to be failing, indicating that the situation with respect to anticipated demand and prices is highly volatile). In addition to finding new forests and land to meet growing demand, tree growth rates in these regions are much higher, making tropical pine and eucalyptus plantations viable as biomass feedstock sources, in theory at least.

Examples of investment include the subsidiary of a Canadian business, which runs a eucalyptus plantation in Congo that, in 2009, supplied around 350,000 tonnes of wood chips to Europe. Another example is old rubber plantations in Ghana and Liberia being replanted to produce woodchips for export to Europe (Cotula et al, 2011) (although Vattenfall's project in Liberia collapsed in 2012, seemingly due to political opposition relating to energy access (Pearce, 2015)). In Brazil, local communities have opposed the development of new eucalyptus and acacia plantations for production of wood pellets to the EU (Overbeek, 2011). In the Philippines a new company was established in 2011 specifically to "produce sustainable biomass feedstock" using "idle land" (Futenco website).

There is also evidence of land grabs for monoculture tree plantations in Africa and Brazil being justified by companies who are citing the growing EU biomass demand, even if the timber is actually being used for other purposes (Ernsting, May 2014).

Popular trees for energy include fast-growing trees such as Populus, Salix, Eucalyptus and Acacia species. European power plants are also fed by biomass from bamboo from Guyana, Melia dubia from Ghana, eucalyptus from the Republic of Congo, rubber trees from Liberia, and eucalyptus and pine from Brazil (Cotula et al, 2011).

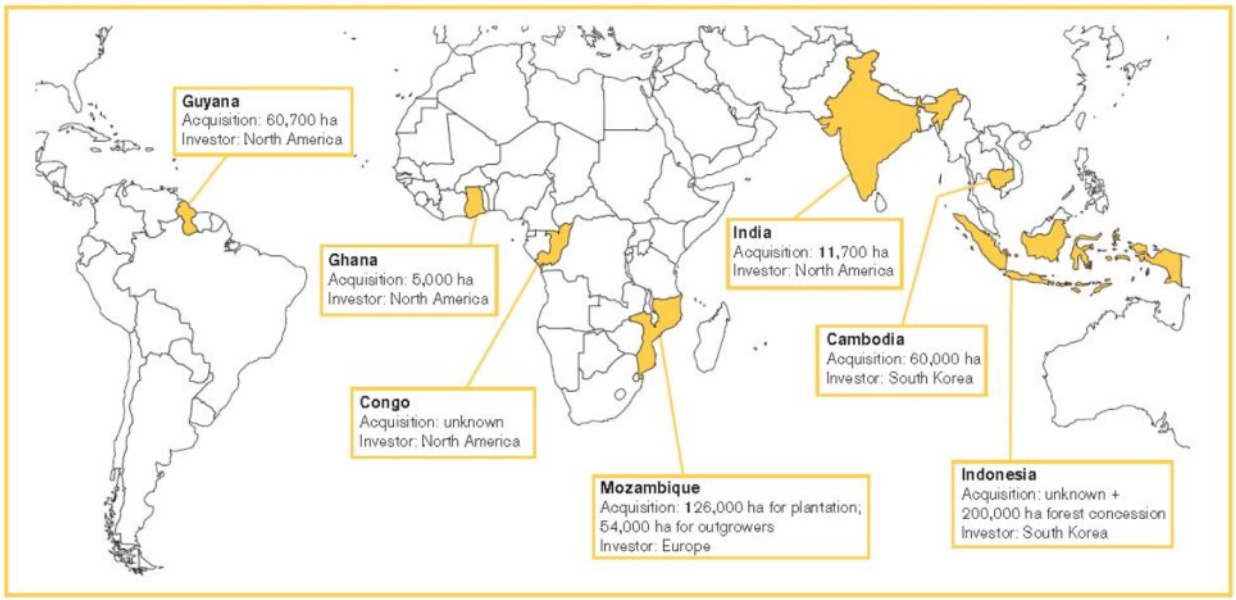

Figure 1: Examples of countries with tree plantations wholly or partly for biomass for energy. Source: Wunder (http://www.ecologic.eu/11998)

chains. In addition to changes in species present in forests, the removal of deadwood could also lead to nutrient imbalances (Stephenson & MacKay, 2014 p61; European Forest Institute, 2014 p86; Southern Environmental Law Center, 2013).

The fact that increased imports of wood-based feedstocks seem to be an inevitable requirement also means that there will be impacts in exporting countries to be taken into account. For example, new data indicates a 150% increase in wood pellets from the US in the last three years, primarily bound for Europe, and further increases are expected to intensify ecosystem damage in 'wood sourcing hotspots' in southeastern US. As a result there are increasing concerns about the fate of 'bottomland' hardwood forests, including in Alabama, southeastern Georgia, Louisiana, Mississippi North Carolina and Virginia (Spanne, 2015).

A report prepared for the European Parliament anticipates that in the future, biomass, including woody biomass, may also be imported to the EU from countries in West and Central Africa and Latin American countries, especially Brazil. It warns of the potential negative impacts of such imports, including deforestation when natural forests are replaced by monoculture tree plantations, and long term impacts on local food and energy security (Wunder et al, 2012, p15). Land grabbing is likely to be an additional factor in these countries.

At the global level, deforestation and forest degradation continue, with agriculture, forestry and other land uses being responsible for 24% of annual greenhouse gas emissions (IPCC, 2014, p19). This is likely to be exacerbated by the increased use of wood-based biomass.

Consumption-based impacts

The consumption-based impacts of burning wood-based biomass are also highly problematic in terms of impacts on people's health when solid biomass is burned.
The health impacts resulting from the domestic use of biomass in small unventilated houses, especially in Sub-Saharan Africa (Duke University), is well documented and programmes to improve cookstoves are underway. For example, a partnership between the World Bank and the Global Alliance for Clean Cookstoves aims to "spur a transition to clean cooking for 100 million households" (World Bank, 2014).

However, in practice public-private partnerships such as these tend to work to improve corporate profits and corporate control over the domestic sector. For example, under the auspices of the Global Alliance for Clean Cookstoves, USAID is soliciting grant applications for cookstove distribution in Kenya, but only from those who "have the potential to achieve sales volume of several thousand units per month within the project period." (USAID & Winrock International, undated). Such corporate-controlled cookstove initiatives are attracting increasingly large funds.

There is also increasing evidence of health impacts in communities living around power plants burning biomass. Burning wood emits similar levels and a similar range of pollutants to coal, although more of some and less of others. In addition to emitting carbon dioxide, pollutants include volatile organic compounds (VOCs), oxides of nitrogen (NOx), carbon monoxide, small particulates and sulphur dioxide. Burning virgin wood also releases a range of other pollutants including antimony, arsenic, cadmium, chromium, copper, dioxins and furans, lead, manganese, mercury, nickel, polycyclic aromatic hydrocarbons (PAHs), selenium, vanadium and zinc. Burning chemically treated waste wood adds an even greater range of pollutants into the mix (Biofuelwatch, Undated).

However, the actual levels of pollutants emitted by a power plant depend on its size and efficiency, and whether it is regulated (for example, it may be required to be fitted with equipment to mitigate NOx and small particulate emissions, although no systems can completely eliminate NOx, particulates or any other pollutants (Biofuelwatch, Undated).

The health impacts of any particular power station depend on the particular pollutants being emitted, and the underlying health of the population affected (especially since research shows that the plants may often be located in areas with high levels of deprivation) (Biofuelwatch, Undated). Typical impacts related to air pollution include bronchitis, asthma, heart disease, stroke, cancer, and reproductive problems including birth defects (Biofuelwatch, Undated).

Myth 4: The Sustainability Standards Myth

Governments in numerous countries argue that the negative impacts associated with the use of wood-based biomass for energy can be countered by the implementation of 'sustainability standards'.

In the EU for example, potential biomass users 'should' ensure that the biomass in question comes from forests that comply with the principles of Sustainable Forest Management, and if wood is being extracted for energy, additional factors are supposed to be taken into account such as site suitability, impacts on biodiversity, erosion, and soil and watershed protection (European Commission website). In addition, the European Commission has published a report on sustainability requirements in relation to the use of solid and gaseous biomass for energy, considering how life cycle assessment should apply (European Commission, 2010). This may sound positive, but in practice it is almost meaningless.

To start with, there are currently no mandatory requirements for the sustainable use of biomass within the EU (as there are for liquid biofuels) (European Commission website). There is no mechanism for verifying compliance with SFM principles agreed at the intergovernmental level (European Commission, 2010), so, with respect to imports into the EU, the only other route is voluntary certification schemes, which are controversial and can easily be manipulated (Ernsting, March 2014). In fact, all major certification schemes, including the Forest Stewardship Council scheme, certify wood produced in monoculture tree plantations as "sustainable", despite the significant negative impacts of such plantations on biodiversity, including especially soil biodiversity, and water resources.

However, even if there were mandatory requirements, sustainability standards simply do not work because they do not address quantity-related impacts, including indirect impacts of increased wood production. By definition, the impact of wood production on forest biodiversity, including forest soil biodiversity, increases with the volume of wood produced, while the potential of regrowth decreases, especially in natural forests. Moreover, when more wood is extracted the carbon deficit caused by the time lapse between burning trees and growing new trees increases significantly. Indirect impacts of wood production increase with the volume produced as well. For example, woody biomass production in sites that are not deforested might displace food production or other activities to areas where deforestation or habitat loss is still taking place.

Increasing demand for wood-based bioenergy also affects the production of wood for pulp and paper, as some of the traditional production areas of wood for the pulp and paper market, like the southeast US, shift to pellet production to meet EU bioenergy demand, which means Latin American pulp and paper producers are able to expand to new markets. Similarly, hard-to-meet sustainability standards, should they be put in place, could also mean that non-forest residue timber is switched: the timber that meets the standards is pelletised and exported, and the timber that doesn't goes to the sawmills.

In addition, in spite of the life cycle analysis approach, biomass sustainability standards ignore most of the carbon emissions from cutting down and burning trees, as well as the length of time it takes for new trees to potentially re-adsorb carbon (Ernsting, March 2014).

A similar approach is evident in the UK's approach to sustainability standards. The UK government announced that from April 2015, only biomass that meets new sustainability standards will receive subsidies (except for some biomass burned in small installations, and the introduction of these standards has been delayed twice). Subsidised biomass is supposed to deliver at least 60% greenhouse gas savings compared to fossil fuels, but when calculating those supposed 'savings', the government is ignoring the bulk of carbon emissions that result from wood-based bioenergy—the CO_2 emissions from actually burning the biomass and the loss of carbon from forests when they are logged or converted to plantations. The standards again rely heavily on different voluntary forestry certification schemes and on company self-regulation, but these cannot guarantee that certified wood is not linked to environmental impacts and even human rights abuses. Excessive demand for wood is not addressed.

For in depth information see Sustainable Biomass: A Modern Myth (Ernsting, 2012)

Section 3: The State of the Wood-Based Energy Sector

Wood is a traditional household fuel. Nearly half of the world's population (and about 81% of Sub-Saharan African households) use fuelwood or charcoal for cooking (Africa Renewable Energy Access Programme, 2011). In some industrialised countries domestic households are returning to wood-based fuels for cooking and heating. For example, in countries such as Sweden and the UK, domestic biomass boilers are becoming increasingly popular.

However there is also a new industrial-scale trend to use vast quantities of wood to fuel entire power plants producing heat and electricity, or in some cases to co-fire the plants using a combination of wood pellets and coal. The biomass industry considers that there is still a largely untapped technical potential with respect to biomass, although it might not all be available for use or "contractable" (European Institute for Energy Research, 2013).

Critically, production on this scale requires certain guaranteed levels of inputs to keep the plant in operation. Thus, whilst the plants may be promoted as being an efficient way of producing energy from local forest waste and sawmill residues, in reality, if those residues are insufficient to keep the plant in operation, supplies will be sought elsewhere. This can include wood from plantations in the same country, and from plantations in other countries and continents.

At present industrial-scale wood-based biomass consumption for energy is primarily located in the Northern hemisphere, mostly in the US and the EU. However, there is potential for this scenario to change, given that demand for biomass generally is likely to increase and that there are efforts to promote the use of biomass and other renewable energies in other continents. Investments in wood-based biomass facilities in Asia certainly indicate that this region will be affected by the impacts of wood-based bioenergy use in the near future.

In general, bioenergy is already the world's largest source of 'renewable' energy. Total primary bioenergy supply stands at 50EJ,1 but the International Energy Agency anticipates that this could more than triple by 2050, to 160EJ, with 100EJ of this being for the generation of heat and power. Large-scale biomass power plants (with more than 50MW capacity) are considered to be integral to this. So too are international trade in and the "large-scale development" of biomass and its intermediates (International Energy Agency, 2012).

The IEA states that studies suggest that this increased demand could be met though wastes, residues and "purpose grown energy crops" but even if this were possible, it does not mean that cheap timber from plantations would not be used. In the absence of any relevant regulations it will be the cost of relative wood-based feed stocks that determines which are used, not whether they are waste materials or not.

Europe is currently the driving force behind the global wood-based biomass for energy sector. There is an increasing focus on using wood pellets, produced domestically or imported, primarily from North America and Russia (European Institute for Energy Research, 2013). In particular, the UK, Denmark and Italy have steadily increased their imports in the last few years (Zwolinski, 2015, p96).

Figures from the UK tell a similar story: UK wood pellet imports increased almost 15-fold between 2008 and 2014, when nearly 4.8 million tonnes were imported and the use of wood pellets by the UK's major power stations accounted for more than 22% of all renewable energy sources and 36% of bioenergy fuels used to generate electricity. In 2008 both of these figures were less than 0.5% (Zwolinski, 2015). Between 2013 and 2014, UK wood pellet imports jumped by 39% (and biodiesel imports by 50%) (DECC, 2015). The UK's Drax power station is expected to import up to 7 million m3 of wood pellets in 2016, from southeastern US, Canada and Brazil (Pearce, 2015). Imports from Russia, the Netherlands, Belgium and Spain have been displaced by a huge increase in wood pellet imports from the US. According to UK government data, net imports supplied more than 95% of the wood pellets used by the main power stations between 2011 and 2014 (Zwolinski, 2015, p98).

Wood chip production and trade

Only about 10% of reported trade in wood chips is related to energy, and energy-related wood chip trade now takes place almost exclusively to and within the EU, with Scandinavian countries and Italy being key markets.

Wood chips for residential use in the EU are primarily sourced locally. On the other hand EU industry is driving the international trade in wood chips for energy (in the form of wood chips or wood to be chipped at the power plant) (Lamers & Junginger, 2012, p8).

Between 2000 and 2005, wood chips were exported from the US to the EU, but this came to an abrupt halt when it was found that the trade was violating the EU's phytosanitary (plant health) standards. Current EU regulations mean that the chips would need to be kiln dried, which would burn them. In this respect a curious situation has arisen with respect to wood pellets. They should also fall foul of the EU's production standards, since the heat treatment used in their production does not meet the kiln-dried standard. But it seems that wood pellets are "literally exempt from any regulation and require no supportive scientific data for export to the EU."

With respect to the wood chip trade more generally, over the last decade major wood chip exporters (and pulp and paper producers) have included Canada (37% of world trade), Australia (8%), Sweden (7%), Russia (6%), and China/Finland (each 5%). However, production is shifting to the Southern hemisphere, with major wood chip producing nations expected to include countries in South America (eg Brazil) and South East Asia (eg Vietnam). The EU has been a net importer of wood chips, sourcing mostly from Russia, Uruguay, Brazil, and Canada.

In terms of future trade in wood chips for energy, Asia has been identified as an area where there could be a significant increase if policy incentives to use wood chips for energy are introduced in the region, especially in China, Japan and India.

Africa has also increased wood chip production, including for export to Sweden and Denmark, and companies currently investing in Africa are expected to eventually turn chips into pellets prior to transport .

Source: Lamers & Junginger (2012)

Sweden is also one of the main EU countries producing and consuming wood-based biomass (see case study below), and other key countries include Slovakia and Romania, which both rely on biomass for some 70% of their renewable energy needs (Pearce, 2015).

As a result of the increasing demand for wood-based biomass, wood pellet exports from the US and Canada have skyrocketed. Wood pellet manufacturing across southeastern US could increase twelve-fold by 2020 (Spanne, 2015), west coast ports in the US are preparing for log and biomass export expansion, and in 2013 alone, log and chip exports from the Northwestern US doubled (Chirillo, 2013).

Demand for wood pellets to feed biomass power plants in Japan is encouraging biomass production and consumption in Asia more generally (IEA, 2015; Biomass & BioEnergy Asia website) and creating demand for imports from further afield. For example, Japan's Sumitomo Corp will build a 50MW biomass facility in Northern Japan, supposedly fuelled by 'unused' wood (Simet, 2015). But it seems to be planning other supplies as well: in October 2015, French utility company Engie, formerly GDF Suez, signed a biomass delivery contract with Sumitomo. As of 2018, Engie will supply one million tons of wood pellets over a period of ten years (Yaneva, 2015).

Both Japan and South Korea are substituting coal with biomass, and South Korean demand has also resulted in a further dramatic increased of US pellet exports to Asia over the past two years (International Trade Administration, 2015). Bioenergy production is growing across Asia, including in China and India (European Institute for Energy Research, 2013), and Vietnam, Malaysia, China and

	2008	2009	2010	2011	2012	2013	2014
EU countries							
Belgium	21	-	-	2	-	-	-
Denmark	2	1	-	-	-	-	-
Estonia	-	18	-	10	-	2	46
Finland	18	7	-	-	-	-	-
France	2	1	-	-	-	-	-
Germany	3	1	5	4	5	56	21
Irish Republic	5	-	-	-	-	-	1
Italy	-	-	-	3	-	-	-
Latvia	34	4	-	-	102	165	408
Lithuania	3	-	-	-	-	-	42
Netherlands	26	-	-	-	0	5	6
Poland	4	-	-	5	-	-	4
Portugal	40	6	35	90	16	142	440
Spain	20	-	-	-	-	20	-
Sweden	3	2	-	-	-	-	-
Non-EU countries							
Canada	39	2	303	592	855	1,355	1,025
Malaysia	2	-	-	-	-	-	-
New Zealand	-	-	-	16	-	-	-
Russia	83	-	4	1	-	1	4
South Africa	-	-	16	17	34	-	-
United States	17	0	188	274	475	1,685	2,760
Total UK imports wood pellets	323	45	551	1,015	1487	3,432	4,757
Total UK exports wood pellets	23	12	60	41	53	105	98
Total UK exports other wood*	226	136	303	624	903	561	619

Figure 2: Pellet imports to the UK in thousands of tonnes.
***wood chips, sawdust and waste, fuelwood**
Source: UK Government, July 2015, https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/448355/DUKES_2015_Annex_G.pdf

Thailand are also exporting wood pellets (International Trade Administration, 2015). Relevant new investments announced in 2015 include:

• The **Indonesian** government has called for massive investment in bioenergy resources, with 1,000-1,200MW additional power generation within five years (Lubis, 2015) and is borrowing money from the Asian Development Bank to promote this and its energy sector more generally (power-technology.com, 2015). Indonesian palm oil company Sinar Mas plans to invest in developing biomass power plants with a total capacity of up to 1,000 MW in South Sumatra, to be operated by subsidiary logging company Asia Pulp and Paper (Lubis, 2015).

• In **Thailand**, Ua Withya PCL, a Thailand-based industrial equipment manufacturer, has bought three biomass power plants. The most recent is in Nakhon Rachasima, and it will be powered by locally grown 'energy crops'. It is exempted from income tax until 2019 as an incentive (Ekvitthayavechnukul, 2015). Thai wood furniture maker East Coast Furnitech PCL and local partners are also aiming to develop biomass power projects with a maximum capacity of 120 MW. The feedstock for the plants will be provided by a number of sawmill companies (Shumkov, 2015).

• Multinational Veolia has secured two 20-year contracts worth €90 million to operate two biomass-fired power plants in northern **Japan**, in partnership with local environmental services company Takeei. They will produce 100GWh of electricity annually, and will, they say, be fuelled with wood from the local forest industry. Veolia is becoming a biomass multinational—it has also won contracts to operate two of the largest biomass power plants in North America and the largest in Ireland (Bioenergy Insight, 2015).

Africa Renewable Energy Access (AFREA) Program proposals

The World Bank's AFREA Program proposes the following as important ways to improve the way in which wood-based bioenergy is used in Sub-Saharan Africa, given its implications for livelihoods:

(a) promoting secure and long-term tree and land tenure rights for communities

(b) implementing and sustaining community-based forest management, including agroforestry systems, and approaches for wood-based biomass production

(c) modernisation of wood-based biomass markets for both fuelwood and charcoal as an opportunity for stakeholders to engage formally in the sector

(d) application of improved kiln technologies

(e) reforms of taxation and revenue systems providing fiscal incentives supporting sustainably produced wood-based biomass

(f) promotion of improved cookstoves

(g) facilitate private sector investments in the sector, eg through harmonisation of technology and production standards. (Africa Renewable Energy Access Programme, 2011)

For example, AFREA has provided financial support for 'The Modernizing Biomass Energy in Benin' programme to promote sustainable wood fuel production and a market management system for 300,000 hectares of forests . (Africa Renewable Energy Access Programme, Undated).

Pinnacle Green Resources in Guyana

Pinnacle Green Resources appears to be planning to invest some US$30 million in Guyana, with plans including a 2,023 hectare plantation of *Leucaena leucocephala* (known in Guyana as "Jumbie Bean") in Pomeroon; a US$16.5 million wood pellet mill to export 200 tons a day to Sweden, using timber from the plantation; a biomass plant that will generate 8MW of electricity using *bagasse* (a by-product of the cane sugar industry), paddy husk, and waste wood from the logging and sawmilling industry; and an 'activated carbon' plant that will use coconut shells as raw material. Activated carbon is used in the process of gold extraction. Before the plantation produces any wood, the mill will use "species of wood that are not sought as timber species", and waste wood from logging operations.
Source: Lang, 2014

(Veolia describes itself as a leading producer of energy from wood biomass (Veolia website).

The situation in countries in Sub-Saharan Africa is rather different, in that household use of wood for energy, especially from charcoal, is still the dominant form of wood-based bioenergy use, whilst industrial-scale bioenergy production tends to focus on biofuels. The number of people relying on wood-based biomass energy in Sub-Saharan Africa is expected to reach almost one billion by 2030 (IEA, 2010). It is estimated that some seven million people in Africa, most of whom are money-poor, also depend on the production and sale of charcoal for their livelihoods and that this number could increase to 12 million by 2030 (Africa Renewable Energy Access Programme, 2011, p9).

The general focus with respect to wood-based biomass use in Africa is on improving the efficiency with which this wood-based biomass, especially charcoal, is being used at the domestic level, as well as promoting low-carbon growth strategies and energy access. Carbon offsetting is promoted—again on the basis of the erroneous 'carbon neutral' myth (see above)—and is being incorporated into proposed climate-related forestry project proposals in Africa under, for example, REDD+ and Forest Investment Program (Africa Renewable Energy Access Programme, 2011).

Nevertheless, there are some indications that land might be leased for wood-based biomass production. For example, MagForestry and the Republic of Congo have signed a contract for eucalyptus plantations, and this contract does not expire until 2075 (MAG Industries website). Lengthy contracts are highly problematic—the local communities' strategies and agricultural knowledge and livelihoods will be lost before the contract expires, and the landscape of the area is likely to be permanently changed. In addition MagForestry's sister company MagMinerals has been granted mining and mineral exploration permits that overlap a significant part of the same concession (MAG Industries website). Although there are formal provisions for the protection of the rights of indigenous peoples to their lands, and a requirement to consult with the public about the changes contained in the contract, they are not strong enough, and are even ignored most of the time.

In Latin America the situation is different yet again. So far there seems to be scant evidence of wood-based biomass being exported to other continents, although Brazil seems to be coming on stream (Pearce, 2015, and see case study). Rather the focus is on the domestic industrial and commercial use of charcoal. South America is second only to Africa in total and per capita charcoal use (Center for International Forestry Research, 2012). Wood chips are also used extensively for pulp and paper production, rather than energy generation, and countries including Brazil are ramping up pulp and paper production capacities, with most wood expected to be used locally (Lamers & Junginger, 2012). The use of plant-based biomass for domestic power capacity is beginning to be developed. At the moment renewables (other than large hydro) comprise 9% of total installed power capacity, and 4% of this is from biomass and waste. Between 2006 and 2012, installed renewable capacity more than doubled from 11.3 GW to 26.6 GW.20 and biomass and waste made up the majority of this growth (largely in Brazil) (Flavin et al 2014).

Section 4: Real Alternatives to False Solutions

Bioenergy, including wood-based biomass, is being promoted by governments—both within the UN Framework Convention on Climate Change and nationally and regionally—as a form of renewable energy that can help to mitigate climate change. But this is not the case. In fact, burning wood-based biomass on the scale needed to power energy-hungry industries and lifestyles has the potential to make climate change worse rather than better, as well as contributing to biodiversity loss and exacerbating food scarcity.

However, with blinkers firmly in place, governments continue to ignore the fact that they are prioritising a potentially disastrous 'solution', which does not even make economic sense. Wood pellet prices generally compare unfavourably with fossil fuel prices, and many governments are using or have used a range of renewable energy targets and economic incentives, including subsidies, to make the use of wood-based bioenergy attractive to industry. Thus they can be seen to be scaling-up the use of a false solution to climate change—rather than implementing real and effective measures that might be rather more uncomfortable.

The promotion of wood-based biomass is only possible because four myths are being peddled:

Myth 1: Wood-based biomass is a 'carbon neutral' form of renewable energy

Wood-based biomass is considered to be 'carbon neutral', on the basis that the trees being burned will eventually be replaced by other trees storing an equivalent amount of carbon. As a result of this myth, power stations burning wood pellets or wood chips are not obliged to account for carbon dioxide released into the atmosphere. This assumption ignores the fact that trees that are no longer standing are not available to continue carbon sequestration—meaning that atmospheric carbon concentration will be higher than it would have been if the trees had been left in place (a fact made crystal clear by the European Environment Agency's Scientific Committee). Secondly, there is no guarantee that trees that are cut for bioenergy production will actually be replanted, so in many cases bioenergy is not a renewable source of energy at all. Thirdly, even if they are replanted, it may be many decades before the carbon released is fully re-adsorbed by growing trees, but the time available to reduce carbon emissions before climate change reaches 'tipping point' is severely limited. As a result, harvesting trees and burning wood can actually release more carbon dioxide than burning coal, which is shocking given that coal is one of the dirtiest energy sources in use.

Myth 2: Growing biomass is an efficient use of land

Recent calculations from the World Resources Institute show that using up valuable land to grow biomass is an extremely inefficient way of producing what is basically solar energy. They have calculated that meeting the target proposed by the International Energy Agency— of supplying 20% of the world's energy from bioenergy in 2050—would actually require biomass equivalent to the "the entirety of human plant harvests in the year 2000"—including crops, plant residues, harvested wood and grazing land. In comparison solar photovoltaic systems use land 30-70 times more efficiently than biomass.

Myth 3: Plantations are the same as forests

Increasing the stock of monoculture plantations to cope with the increased demand for wood-based biomass and other products is not the same as increasing the area of forest. Monoculture tree plantations have very different environmental and social impacts from biodiverse natural forests, and this is especially true in relation to climate change. Old growth forests store significantly greater quantities of carbon than either plantations or logged forests. Even the most conservative of estimates indicate that plantations store only 20% of the carbon that intact old growth forests store. It is essential to revise the FAO's existing definition of forests to exclude plantations. It is also important to recognise that land for new tree plantations still has to come from somewhere, with potential impacts for natural ecosystems, rural development and food production.

Myth 4: Sustainability standards can ensure that biomass only comes from sustainable sources

Governments in numerous countries argue that the negative impacts associated with the use of wood-based biomass for energy can be countered by the implementation of 'sustainability standards'. This is not true. Sustainability standards tend to rely heavily on different voluntary forestry certification schemes and on company self-regulation, but neither can guarantee that certified wood is not linked to environmental or human rights abuses, such as clear cutting of old growth forest and large-scale evictions.

Direct and indirect quantity-related impacts that are triggered by excessive demand for wood, whether for biomass of other purposes, are not addressed by sustainability standards either. The dilemma with wood production is that its environmental sustainability decreases when the amount produced increases. This is because the negative impacts on forest biodiversity, including forest soil biodiversity, increase when more wood is extracted from the forest, and at certain levels exploitation surpasses regrowth of forest resources. Moreover, the carbon gap due to the regrowth time lapse also increases with the volume of wood produced, which means the impacts on climate change accumulate in line with the quantity produced.

Yes, in spite of the fact that the use of wood-based biomass can have negative impacts on forests and biodiversity, climate change, and even food production, the sector is surging, and wood is even being used to fuel power plants providing heat and electricity. For example, EU wood pellet imports are expected to have jumped from 2.7 million tonnes in 2010, to 15-30 million tonnes by 2020. In the UK, wood pellet imports increased almost 15-fold between 2008 and 2014, when nearly 4.8 million tonnes were imported. Data also shows that more than 95% of the wood pellets used by the main power stations in the UK between 2011 and 2014 were supplied by net imports.

Even in Sweden, a traditional user of wood-based biomass, raw materials shortages are a recurring problem and feedstocks are increasingly imported from Russia, Finland and the Baltic states. This indicates that the scaled-up use of wood-based biomass cannot be delivered by relying on wood waste and forest residues alone (and even the use of forest residues impacts on biodiversity and ecosystems). Sweden appears to have at least ten power plants that are based solely on the use of wood (as opposed to wood waste or other organic materials), and major new

investments include new biomass plants planned in Linköping and Stockholm.

Overall it can be predicted with some confidence that this ongoing trend will have ever greater impacts in countries currently exporting wood pellets to the EU, especially the US and Russia. The same problems can be expected to unfold in Asia, where the use of wood-based biomass for energy is now increasing, especially in Japan and South Korea. In Africa and Latin America the situation is rather different, although still problematic, with more of a focus on charcoal production for domestic consumption (in Africa) and pulp and paper production (in Latin America).

Given the fact that the use of wood-based biomass is based on a set of myths, it is clear that a new and radically different approach is needed in order to mitigate climate change effectively, and meet the 2030 Sustainable Development Agenda goals, which include reaching zero deforestation by 2020. This new approach should focus on keeping fossil fuels in the ground, addressing the drivers of deforestation by slashing consumption and promoting agroecology and agroforestry as win-win ways of mitigating and strengthening resilience to climate change, at the same time as promoting food sovereignty and protecting biodiversity. It also entails ending trade and investment liberalisation agreements that fuel deforestation, rejecting monoculture tree plantations, and recognising land rights. It should ensure that:

• Bioenergy, including wood-based biomass, is no longer treated as carbon neutral and no longer classed as a renewable energy source, so that it is removed from all national and international renewables targets.

• Subsidies provided to fossil fuels and/or biomass providers are redirected to real solutions to climate change, especially community-based, small-scale wind and solar power initiatives, in order to drive a real and rapid transition to a genuine carbon free future.

• Forests are redefined to exclude plantations, recognising their true and unmatched potential in terms of regulating climate change and protecting biodiversity, and their value for forest-dependent peoples.

• Climate change mitigation proposals intended to increase forest cover focus on community-led reforestation initiatives using native species.

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