Is wood logging really a greener alternative to coal?

Not only are the rainforests in Brazil in danger of deforestation, but also rainforests in Asia and boreal forests in Europe. In several European countries, like Estonia and Poland, deforestation is performed to create wood pellets, a so-called green alternative to coal. There is an international demand for renewable energy policies, and this is looked upon as a great idea regarding sustainability (Sheffield, 2021). The idea is that trees that are cut down can be burned instead of coal in power plants and are replaceable with new sprouts.

However, creating wood pellets is done by clear cutting, whereas large areas of mature forests are being cut down. This anthropogenic disturbance has a major effect on carbon storage and ecosystems (Rebane *et al.*, 2020). So, is this clean alternative sustainable after all, and how does it affect biodiversity and the climate? Moreover, who benefits from this deforestation to make "green energy"?

Diversity loss of lichen pine forests in Poland

In Poland, there are stands of lichen pine forests, which occur nationwide (Krzaczek, 2018). These forests are often 100-120 years old and consist mostly of pines with different lichen species on the surface. The canopy of elder lichen pine forests reduces the amount of sunlight hitting the ground, which holds back the growth of expansive species (Krzaczek, 2018). At the same time, we have lichen species that benefit from the reduced amount of sunlight on the forest's surface. The trees also absorb a huge amount of water, which gives the soil a moisture that supports the lichen. Further, the soils in these forests are nutrient-poor, which supports the growth of these different lichen species.

In the years between 1951-2011 scientists have found that there is a decreased diversity in Poland's lichen pine forests, mainly caused by clear-cutting of these (Krzaczek, 2018). Right after logging, young pines are planted. However, the canopy is lost, and more sunlight hits the surface. The young trees do not absorb the same amount of water, so the soil moisture also increases. The increased amount of these abiotic factors supports the growth of competitive species, such as mosses and bushes. Therefore, the number of competitors increases, whilst the number of lichen species decreases. This leads to an increased biomass, which leads to an increased accumulation of nitrogen in the soil, which again supports these competitive species. Therefore, the growth of the lichen species will be prevented, and the diversity of these is lost.

Energy conversion

Democracy, a fundamental that is made to ensure that Joe and Jane have a say in things, since we

have indirect democracy, there will be a lot of cases where Joe and Jane do not know the full picture. This brings us back to our green mindset and one of the biggest challenges for the whole world. Our energy consumption. Coal, oil and gasses are burnt to make energy in power plants. We all know it, therefore we try to find other ways to make energy. Nuclear, solar, wind or water are big energy suppliers on the world market. And not to mention, biofuel. By burning biofuel instead of coal we do not add extra CO_2 into the atmosphere, since decomposition of plants and forest releases CO_2 to the atmosphere anyways.

One might think this is a good idea, but there is a big problem, where do we get the trees? We cut down rich biodiverse old forests in east Europe and Asia, to make the fuel. If we look at timber-prices from 1980 they are stable at sub 300$ per 1100 square meters. But in early 2020 the prices skyrocketed and are now at 1422$ (Trading Economics, 2021). People are using wood at an alarming rate. If we cut down forests, we get a spike in the global emissions in the short term, the argument is that the new forest will capture the CO_2 over time. But climate change is now, and we don't have a long timeframe to work with. Even if the new forest could take back all the CO_2 over a long time, the old biodiverse forests are gone.

The earth has a potential of sustaining 4,4 billion hectares of canopy coverage, in other words we can plant 0,9 billion more hectares of trees. The extra planted trees could store 205 gigatons of CO_2, that is equivalent to 25% of the carbon in the atmosphere. Sadly, at the rate of deforestation, instead of planting 0,9 billion hectares on a global scale there will be a net loss of 223 million hectares by 2050 (Bastin, J. F. et al. (2019)).

Environmental impact of non-protective deforestation strategies

Recently, due to global awareness about CO_2 emission and raising global temperature by its fact, forest and bioenergy has become the center of attention for many policy makers as a replacement for fossil fuel. These kinds of strategies can impact the net flux of carbon to the atmosphere through different mechanisms: biosphere carbon storage, carbon storage in forest, biofuel to replace fossil fuel, use of wood as raw material for production which compared to other raw materials is less fossil fuel demanding. (Bright, R. M., et al, 2012).

The bioenergy and forest use as green energy is a very risky policy, if it's not implemented in a correct way with the right environmental concerns. The carbon cycle without human impact, over a long time can reach steady state (equilibrium) which means net carbon flux is zero. In another word carbon emission is equal to the carbon sink. After the deep ocean, forest is one of the most important carbon storages and has a strong impact on CO_2 absorption from the atmosphere

(Friedlingstein, P., *et al,* 2020). Building on the mentioned references, bioenergy can be a good alternative with consideration of avoiding clean cutting the forest, replacing natural forestry to intensive ones, harvesting rate higher than forest growth rate and performing sustainable reforestation and forest protection strategies among many other environmental measures.

We are going to illustrate 3 different scenarios about the impact of deforestation on the carbon cycle as a result of deforestation policies without protection strategies. The carbon cycle model is based on system dynamics methodology. The model developed by GLOBE Program and Charles University 2017 ("Carbon Cycle - GLOBE.gov," n.d.). And the following scenarios are designed as training tools by Mahla Rashidian, University of Bergen.

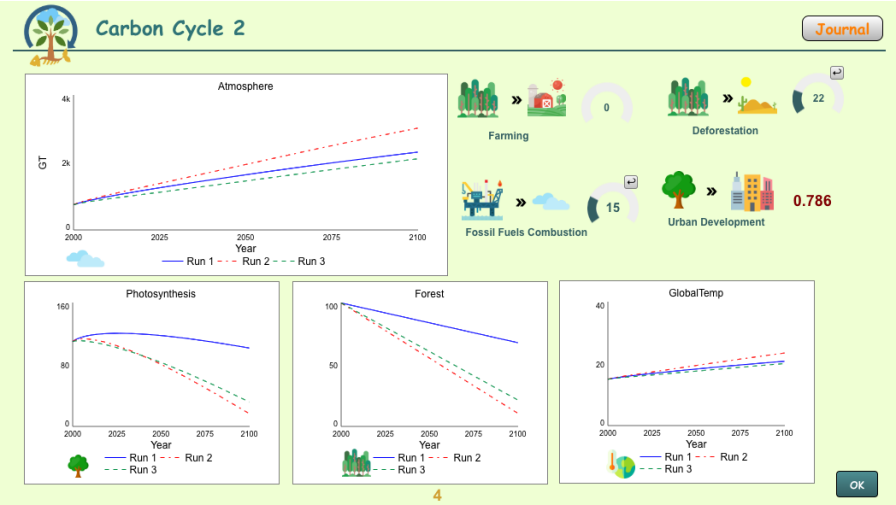

Figure 1: Global impact of non-responsible deforestation policies. Run 1 is the baseline and shows business as usual, based on the carbon budget 2020, CO_2 emission from fossil fuel combustion is 30 GT/year, and deforestation rate is 9%. Run 2, is to reduce the fossil fuel combustion by one third and increase deforestation to 50%. Run 3, is to reduce fossil fuel combustion by half and reduce deforestation by 22%.

As can be seen from the different run results, to transition from fossil fuel to green energy is not enough to just reduce fossil fuel and replace it with bio energy (figure 1). Following graphs demonstrate the impact that cutting wood and biomass removal can have on atmospheric carbon and global temperature. We can see forest depletion which shows the harvesting rate is higher than forest growth, and forest depletion causes dramatic reduction in photosynthesis and it leads to increased CO_2 concentration in the atmosphere (figure 1). The main message is, to visualize the impact of non-protective transitional policies without ecosystem causal relations considerations.

Conclusion

We do not want to conclude that fossil fuel is more environmentally friendly than bioenergy, nor that

wood as a source of energy is very bad and harmful for the ecosystem. However, if producing wood pellets results in clear cutting and deforestation, it will negatively affect the climate, biodiversity and carbon storage. This is only sustainable for nations buying the energy produced, and not for the nations that cut down forests. Burning trees might seem carbon neutral as trees store carbon and burning and replacing trees should not raise CO_2 levels in the air. However, this theory forgets that carbon uptake in new plants often need decades to reach the same level as mature trees, and burning trees release the carbon that is stored.

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