IIASA Policy Brief

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Resource efficiency of future EU demand for bioenergy

EU bioenergy demand is set to rise sharply. We examine the impacts on land use, greenhouse gas emissions, and biodiversity, both inside and outside the region.

Summary

- Increasing demand for bioenergy in the EU means that there is a pressing need to understand the impacts this might have on land use, greenhouse gas (GHG) emissions, and biodiversity, both regionally and globally.
- In this brief we examine the results of modeled policy scenarios to explore how these factors are affected.
- All other factors being equal, a scenario where the EU target of an 80% reduction in GHG emissions by 2050 is met leads to a rise in: wood pellet imports, the amount of wood harvested from EU forests, and in the area of land used for short rotation coppicing (fast-growing tree plantations).
- There are clear synergies between conserving biodiversity; protecting unused forests and avoiding the conversion of natural land; and reducing global GHG emissions from the land-use sector.
  - Restricting the use of land that has high biodiversity value, or high carbon stocks, means global emissions savings from the land-use sector.
  - The results also highlight the importance of examining the global implications of EU policy. When biodiversity and carbon storage are protected, for instance, EU land-use emissions increase, although they fall on a global scale. As well as rising EU emissions, more EU-grown wood that is of sufficient quality to use for other wooden products is used directly for bioenergy.
  - Capping the amount of high-quality wood that can be used directly for bioenergy, in addition to biodiversity or carbon storage protection, results in even greater global emissions savings.

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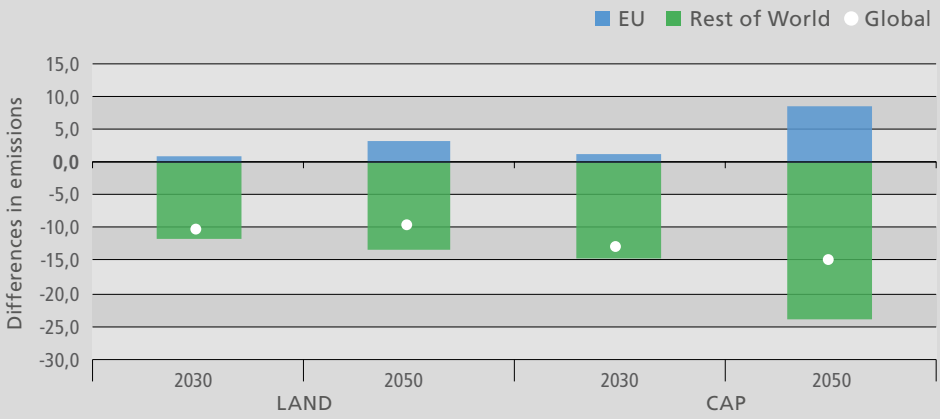


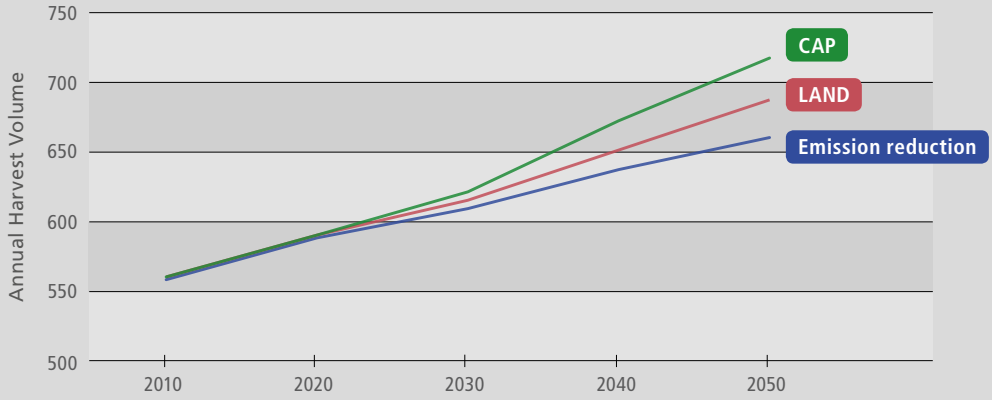
The differences in GHG emissions between the basic emissions reduction scenario and the LAND scenario (which restricts use of areas with high biodiversity and carbon storage) and the CAP scenario (which also includes restrictions on use of high-quality roundwood).

Introduction

In the EU, the use of bioenergy (*see box: What is bioenergy?*) is on the rise. This is due to an increased focus on renewable energy, intended to reduce greenhouse gas (GHG) emissions and increase energy security. However, the impact of increased bioenergy use on land use, GHG emissions, and biodiversity is not fully understood. Nor do we know how a surge in demand for bioenergy might impact related industries using the same feedstock such as wood pulp producers, sawmills, or particle board producers. The aim of the *Resource efficiency impacts of future EU bioenergy demand* report, and its follow-up report, is therefore to examine the consequences of pursuing different bioenergy policy pathways from 2010-2050 by building a series of possible future scenarios, using the IIASA Global Biosphere Management Model (GLOBIOM) and Global Forest Model (G4M).

What is bioenergy?

Although there are various types, in this brief we focus on **bioenergy** generated by burning **biomass**, in this case, plant matter. Many different types of woody biomass can be used for bioenergy. Firewood is widely used for domestic heating, for instance. Larger-scale bioenergy production might use **wood pellets**, which are dense, compressed pellets. In the EU these are mostly made from industrial by-products such as wood chips, sawdust, or shavings. In this brief we also discuss the likely increasing use of **roundwood**, defined here as logs that are of sufficient quality to be used for wooden products such as plywood or planks, but are used for energy production instead. Another source of fuel for bioenergy that may become increasingly important is **short rotation coppices**—intensively harvested, fast-growing tree plantations grown on agricultural land. Increasing demand for these **feedstocks** can have important impacts on land use, GHG emissions, and biodiversity. Furthermore, globalized trade means that demand in the EU can affect the rest of the world and vice versa, as has already been seen, for example, with increased EU imports of wood pellets from the USA.



The amount of wood harvested from EU forests (in millions of cubic meters) under the basic emissions reduction scenario; the LAND scenario (which restricts use of areas with high biodiversity and carbon storage); and the CAP scenario (which also includes restrictions on use of high-quality roundwood).

Possible futures

The **Baseline Scenario** depicts the target of a 20% reduction of emissions in the EU28 by 2020, and runs to 2050, providing a point of comparison for other policy directions.

In this scenario, increased demand for bioenergy will lead to a considerable increase in EU production of woody biomass by 2030 (as much as 10% more than in 2010). Industrial by-products, such as sawdust and wood chips, will become increasingly in demand, and more land will be used for short rotation coppices (*see box: What is bioenergy?*). In addition, harvesting in EU forests intensifies, and roundwood imports increase. From 2030 to 2050, the EU domestic production of biomass stabilizes.

EU reliance on imported biomass also increases—in particular wood pellet imports will rise by 90% by 2030 compared to 2010. Since estimates suggest that outside the EU a large share of wood pellets are made from roundwood—and therefore require direct forest harvesting—these imports may have important consequences for biodiversity loss and land use change outside the EU.

The EU Emission Reduction Scenario (now updated in the report: *Follow-up study on impacts on resource efficiency of future EU demand for bioenergy*) examines the additional policy target of decreasing GHG emissions by 80% by 2050 in the EU.

As the demand for bioenergy in this scenario rises sharply to meet GHG emissions reduction targets, there is an increasing need for all forms of feedstock. The reliance on imported pellets increases seven-fold from 10 million cubic meters in 2010 to 70 million in 2050, with possibly serious implications for global biodiversity loss. Short rotation coppices are also expanded to cope with the stark rise in demand. Large quantities of EU-grown roundwood, which could otherwise have been used to produce wooden goods, are also burnt for energy.

These demands also affect land use in the EU, and along with the increase in coppice plantations there is a rise in forest area of almost 14 million hectares by 2050 compared to 2010. The land converted to forest and coppice plantations is generally natural land, such as abandoned cropland or unused grassland.

As demand for wood as a material and a source of energy grows, forests become more intensively harvested in the EU, with the amount of wood harvested reaching a level 12% higher in 2050 than in 2010. Such intense use of forests is likely to have serious impacts on European wildlife, hastening biodiversity decline in the region.

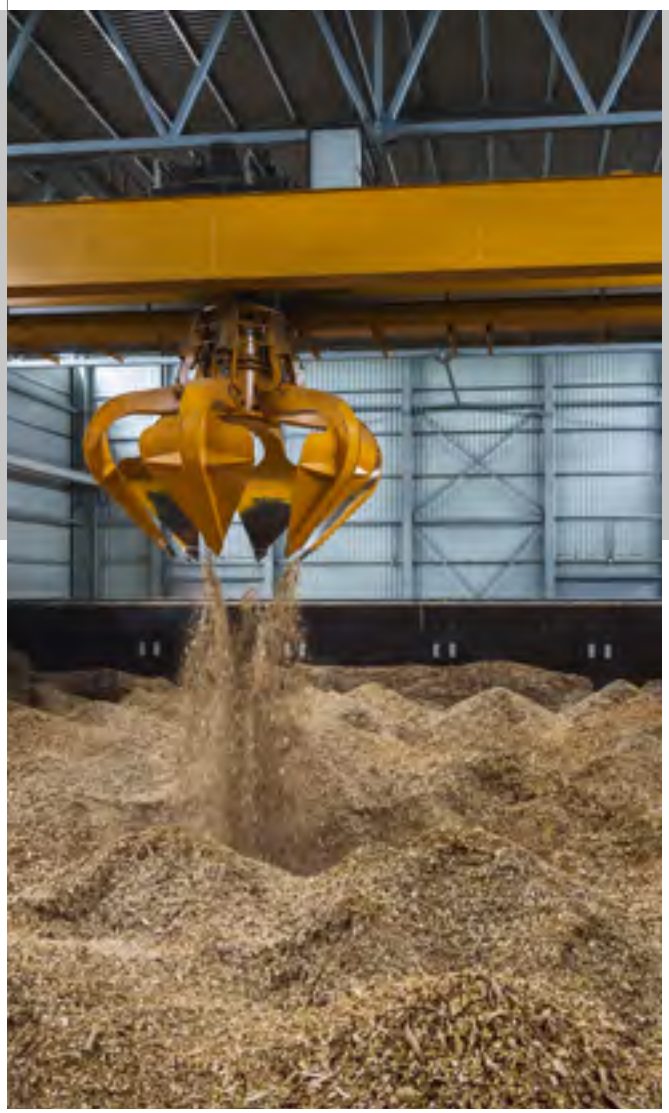
Importing wood, exporting pressure

The reliance on imports in the emissions reduction scenario raises the difficult question of whether the EU will simply export the problems of land use and biodiversity decline elsewhere. The **Increased EU Biomass Import Scenario** investigates what would happen if this was taken to the extreme, by decreasing the trade costs in the model. As expected, EU imports of roundwood and wood pellets are significantly higher than in both the baseline and the emissions reductions scenarios. While this takes the pressure off EU forests, as harvests do not increase as fast as they otherwise would, it exports biodiversity and land-use issues to the rest of the world. GHG emissions from the land-use sector in the EU fall, but global land-use emissions are similar to the baseline scenario.

However, it is likely that other countries will also see an increase for bioenergy demand as they attempt to switch away from fossil fuels. In a world where countries outside the EU are using their own biomass resources, rather than exporting them, net EU imports of wood pellets are 25% lower than without this effect. In addition, EU roundwood imports decrease by more than 20% in 2050. This requires the EU to substantially increase the amount of biomass it produces through domestic short rotation coppicing.

Sustainability for the future

One of the major concerns over bioenergy is the amount of land needed to provide the fuel, and whether this will encroach onto natural land that is important for biodiversity or carbon storage. To investigate this issue, researchers used the **LAND Scenario**, which restricts biomass harvests in areas with high biodiversity value, high carbon stocks, or both (HBVCS areas). Under this



restriction, collection of biomass from HBVCS areas in the EU was limited and the conversion of HBVCS areas was forbidden all around the world. Because these restrictions were applied regardless of whether the use of resources was for bioenergy or not, they had far-reaching effects beyond bioenergy policy.

The restrictions lead to a global reduction in the availability of wood. EU pellet imports fall, and the use of domestic biomass resources rises; the amount of EU roundwood combusted directly for bioenergy is 23% higher in 2050 than in the emissions reduction scenario. This scenario leads to a net global emissions saving in the land-use sector of 10 megatonnes of CO_2 (Mt CO_2) in 2050, compared to the emissions reductions scenario.

It is important to bear in mind that the goal of climate mitigation is to reduce emissions worldwide, not just from the EU. This is highlighted by this scenario, which shows that while global emissions fall, emissions from the land-use sector in the EU increase compared to the emissions reduction scenario (about 4 Mt CO_2 higher in 2050). This is because without protections for biodiversity and carbon storage, the EU imports large quantities of wood for bioenergy, simply transferring emissions to other regions.

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This brief is based on the work by forest scientists, economists, and policy analysts at IIASA, Öko-Institut e.V., Institute for European Environmental Policy, European Forest Institute, and Indufor Oy. The consortium was led by Nicklas Forsell, research scholar at the IIASA Ecosystems Services and Management Program. The research received funding from the European Commission within the contract ENV.F.1/ETU/2013/0033 and ENV.F.1./ETU/2015/Ares(2015)5117224.

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Another major concern over bioenergy relates to the efficient use of biomass; burning roundwood that is of high enough quality to be used for wooden products is a wasted opportunity. After all, if a tree is used to make a table, at the end of its useful life the table itself can be burnt and used to produce energy, increasing resource efficiency. To examine what would happen if a cap was placed on the amount of roundwood that could be used directly and indirectly for energy after 2020, a **CAP scenario** was built.

As a result of the cap, the amount of wood pellets imported into the EU falls, since a large share of pellets from outside the EU are made from high-quality roundwood. The resulting gap in fuel for bioenergy in the EU is filled through use of industrial by-products, such as sawdust or shavings. The demand for these by-products increases their market value, meaning that sawmills become more profitable and their numbers rise. There is also an effect on the pulp and board industries, which shift towards use of roundwood as the price of by-products rises.

This roundwood CAP scenario is more effective for climate mitigation than the LAND Scenario, leading to net global emissions saving in the land-use sector of around 15 Mt CO_2 in 2050 compared to the emissions reduction scenario. Again, EU land-use sector emissions increase, to about 9 Mt CO_2 higher than the emissions reduction scenario, as of 2050; this is, however, more than compensated by decreased emissions in the rest of the world.

Further information

This modeling work stemmed from the **EU Reference Scenario 2013**, which details the EU energy, transport and GHG emissions trends to 2050. The assumptions for energy demand for the Reference Scenario 2013 are estimated using the **PRIMES** EU-wide Energy Model. The work described in this policy brief was published in two waves, the first was published in the *Study on impacts on resource efficiency of future EU demand for bioenergy (ReceBio)* [pure.iiasa.ac.at/14006], and the second in the *Follow-up study on impacts on resource efficiency of future EU demand for bioenergy (ReceBio follow-up)* [pure.iiasa.ac.at/14180].

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