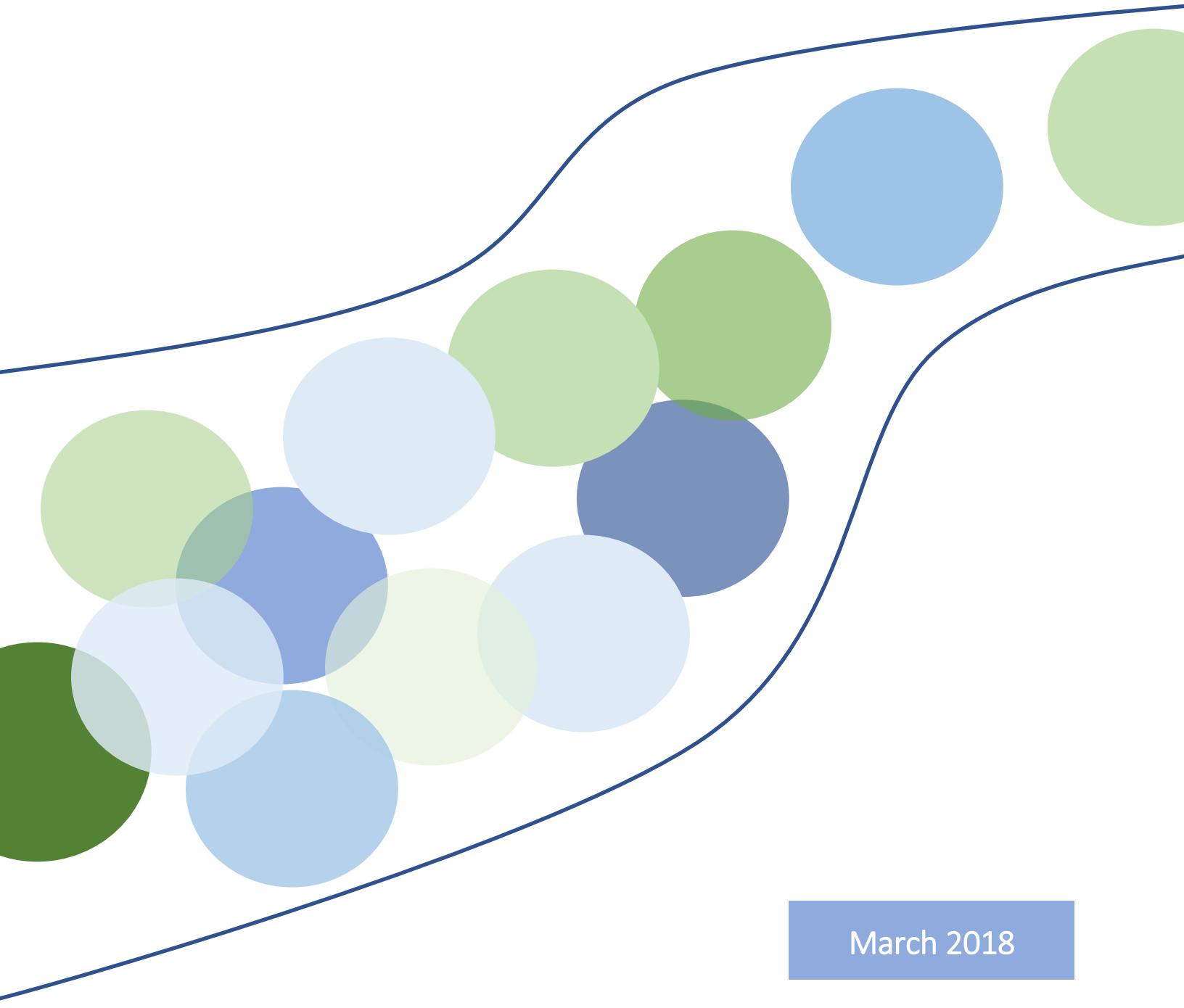
Accounting for Ecosystem Services in Energy Planning

Policy Brief



March 2018

About this report

This Policy Brief constitutes the Deliverable 5.5a of the REEEM Project, which analyses economic, social and environmental impacts of pathways towards a low-carbon EU energy system. The deliverable provides policy recommendations based on a detailed analysis focusing on Lithuania reported in Deliverable 5.4 – Ecosystem Services Case Study Report. The case study assessed impacts of alternative forest management strategies on multiple ecosystem services (bioenergy feedstock, industrial wood, carbon storage, recreation and habitat that supports biodiversity), as well as developed and discussed linking between an ecosystem service assessment tool and an energy systems model in order to integrate ecosystem services in sustainability assessment of energy policy and related forest bioenergy options.

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About REEEM

REEEM aims to gain a clear and comprehensive understanding of the system-wide implications of energy strategies in support of transitions to a competitive low-carbon EU energy society. This project is developed to address four main objectives: (1) to develop an integrated assessment framework (2) to define pathways towards a low-carbon society and assess their potential implications (3) to bridge the science-policy gap through a clear communication using decision support tools and (4) to ensure transparency in the process.

The REEEM project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 691739. This publication reflects only the views of its authors, and the European Commission cannot be held responsible for its content.

Summary

We expect that the use of biomass will increase significantly as the world is focusing on increasing the share of renewable energy to mitigate climate change. The unchecked increase in use of forest biomass can have negative environmental effects. In the EU significant focus is given to ensuring that the energy derived from biomass is sustainable. Based on the Ecosystem Services Case Study focusing on Lithuania that was carried out in the REEEM Project, we came up with the following recommendations:

- Apply a bi-directional and iterative process when formulating National Energy and Climate strategies, so that local constraints and availability of resources are taken into account;
- Support the process by applying the tools that can bring ecosystem services consideration in energy planning;
- Give sufficient focus to forest management strategy as this is a crucial linkage between forest biomass extraction and other ecosystem services.

Introduction

Forests are important for climate change mitigation: they provide bioenergy feedstock to substitute fossil fuels and they store carbon. Forests are also important for other ecosystem services (benefits people obtain from ecosystems). They include **provisioning services** such as food, water, timber, and fibre; **regulating services** that affect climate, floods, disease, waste, and water quality; **cultural services** that provide recreational, aesthetic, and spiritual benefits; and **supporting services** such as soil formation, photosynthesis, and nutrient cycling. Increasing use of renewable energy sources (RES), such as forest bioenergy feedstock, could potentially conflict with environmental goals, affecting the sustainability of the delivered energy, which is one of the three overarching policy challenges mentioned in SET-Plan Roadmap [1]. The EU Renewable Energy Directive (2009/28/EC) aims to promote RES and to reduce greenhouse gas emissions in a sustainable way, ensuring that negative effects on ecosystem services are avoided [2,3]. Therefore, it is essential to integrate multiple ecosystem services in assessments of energy policies and plans for increasing use of forest biomass. However, energy policy assessments seldom take landscape-level ecosystem services into account [4]. Moreover, development of methods and tools for sustainability assessment of renewable energy options is needed, that can link energy models with ecosystem services assessment tools for integrated analyses and allow for balancing various ecosystem services and analysing implications of forest bioenergy options.

Deliverable 5.4 of the REEEM Project – Ecosystem Services Case Study Report – assessed the implications of the use of forestry biomass to meet the decarbonisation targets included in the Lithuanian National Energy Strategy [5]. This Policy Brief presents main findings of the assessment and provides policy recommendations based on the results of the assessment.

How was the assessment performed?

The analysis considered two pathways for the development of biomass demand in Lithuania. In one pathway, Biomass Low, the biomass potential was limited according to assumptions on its availability on the domestic market [5]. The other pathway, Biomass High, assumed a higher availability of biomass and a lower price, resulting in a higher biomass demand. Both pathways represented the same energy policy conditions for the renewable energy share in the final energy demand.

The impact of these pathways on ecosystem services was analysed across the following categories: industrial wood production and

bioenergy feedstock representing provisioning services; carbon storage representing regulating service that affects climate change; forest recreation evaluation representing cultural services; and habitat indicators of essential biodiversity components. Different intensity of forest management was considered.

What tools were used in the assessment?

A bottom up energy system model for Lithuania formulated in the MESSAGE [6] framework was used to estimate the cost optimal forest biomass use for bioenergy purposes in Lithuania for the two pathways Biomass Low and Biomass High. The model covers a wide variety of energy technologies including different types of heat plants and CHPs, technologies for electricity production, storage, etc. The model reflects existing and prospective policy measures [5], as well as electricity exchange with other countries.

The Landscape simulation and Ecological Assessment (LEcA) tool [7] was used to assess impact on ecosystem services. The LEcA tool allows assessing several ecosystem services together, including sustainable production of forest bioenergy feedstock. The integrated assessment of forest ecosystem services is aided by three modules embedded in a GIS framework: 1) LandSim simulates forest growth and management; 2) Storage and yield estimator uses spatially-distributed output of LandSim to aggregate and estimate the storage of carbon and the yield of industrial wood and bioenergy feedstock; and 3) Habitat assessment tool localises and quantifies habitat with high value for forest biodiversity as well as for recreation. The LEcA tool uses land use data and data from the Lithuanian State forest cadastre [8,9].

What were the main results?

The case study focusing on Lithuania assessed implications of the use of forestry biomass to meet the decarbonisation targets included in the Lithuanian National Energy Strategy [5]. When low prices and high availability of biomass were assumed (Biomass High pathway), biomass was found to have a considerable share in the energy supply mix of Lithuania. However, when applying an intensive forest management strategy to meet this demand, the use of biomass would exceed the country's resource base. This would cause damage to the ecosystem in the long run. This was found to be less probable under Biomass Low pathway and following a business-as-usual forest management strategy.

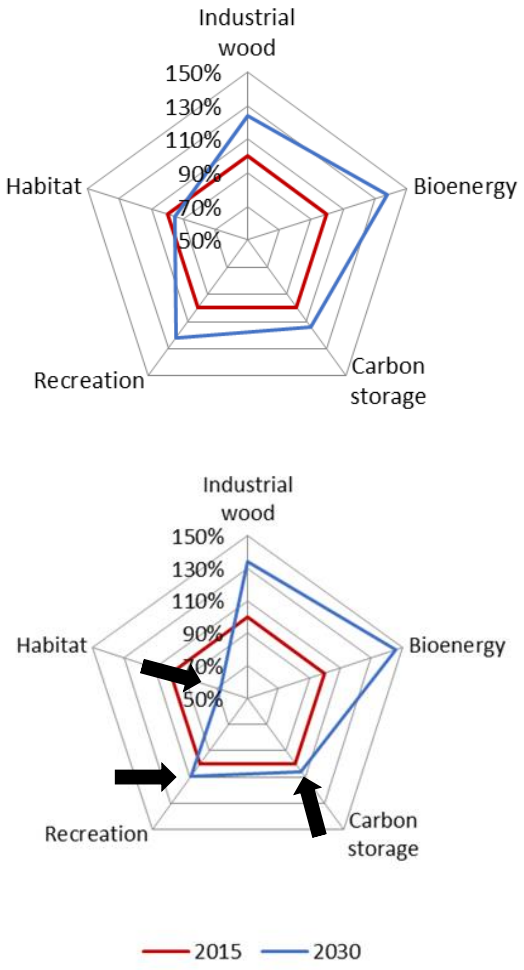

Figure 1. Impacts of the use of biomass for bioenergy on other ecosystem services in case of less intensive (top) or more intensive (bottom) use of biomass.

Intensive harvesting of forest biomass for energy use may be detrimental in the long term for ecosystem services such as habitat, recreation and carbon storage (Figure 1). Generally, when applying a more intensive management strategy, the biomass yields were considerably higher in the earlier simulation periods, but by the end of the modelling period (around 2050) the yields were on the same or declining level while the biomass demand in Biomass Low and Biomass High pathways increased. A similar effect was observed with regards to the yields of **industrial wood**: an intensive management strategy gave a much higher yield in the beginning of the simulation period, but after around 2040, the resources would be somewhat exhausted, and a decrease would follow. The management strategy also influenced **carbon storage**. A shorter rotation period i.e., the trees were harvested on average at a younger age, resulted in a lower carbon stock under a more intensive management strategy. The resulting smaller area of old and mature forest also led to smaller **recreational area**, as well as **habitat area** supporting biodiversity. The **habitat network area** was also higher under a less intensive forest management strategy.

Implications and Recommendations

As the case study focusing on Lithuania shows, the national decarbonisation targets can have substantial impacts on the ecosystem services. These impacts are not evident unless an assessment taking local conditions into account is performed. Under favourable conditions, biomass could constitute a considerable share in the energy supply mix of Lithuania. However, the high use of biomass could exceed the country's resource base, causing damage to the ecosystem in the long run. Even when the resource base is not exceeded, the impact of biomass use on the ecosystem depends on how intensive the forest management is. These results suggest the following:

- When developing the National Energy and Climate strategies, a bi-directional and iterative process could be appropriate, where local constraints and availability of resources are taken into account in the national policy making.
- This process can be supported by applying toolboxes integrating models such as MESSAGE and the LEcA tool (demonstrated in the case study) which can bring ecosystem services consideration in energy planning.
- Substantial focus should be given to developing management strategies that keep the desired level of ecosystem services while supporting fulfilment of national decarbonisation targets. The same level of biomass supply can often be obtained using a multitude of different forest management configurations, both with regard to the character of activities and their geographic allocation. Forest management strategy is a crucial linkage between forest biomass extraction and other ecosystem services.

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