REACHING THE CLIMATE OBJECTIVES OF FOREST MANAGEMENT IN LATVIA WITHIN THE SCOPE OF EUROPEAN CLIMATE POLICY

Kristīne Kalniņa, Ainārs Lupiķis

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The aim of the paper – analysis of the challenges and opportunities of the national forest in Latvia within the scope of European Union's climate change mitigation policy. Climate change mitigation is complex process because of cyclical nature of carbon turnover, thus implementation of the policy is complicated and requires country specific solutions. It is estimated that measures in sustainable forest management will pay off after several decades, therefore implementation of long-term targets requires timely actions.

According to LULUCF regulation the climate change mitigation target in forest management is set by the Forest reference level (FRL) which is substantiated in the National forestry accounting plan (NFAP). According to the study results Latvia's FRL for 2021...2025 is -42 kt CO_2 eq. and 574.6 kt CO_2 eq. year, if the instant oxidation method is applied to the calculation of harvested wood products. Sustainable harvest rate is expected to grow by 2022 due to increase of age of forest stands. According to "business as usual" scenario, continuing of forest management practices in 2011…2016, the rate of harvest will increase, but will remain below the sustainable harvest rate ensuring regeneration of mature forests. In the period 2021…2030 the forest management is expected to be a net source of emissions due to GHG emissions from organic soils.

One of the most visible threats to Latvia's forestry in the context of European Union's climate policy, is rules for setting of sustainable harvest rate, as the requirements of the regulation can be interpreted as demand to reduce harvest rate to the level of 2000-2009 when it was affected by economic crisis and natural disturbances. Deforestation is significant but not the biggest risk, as the most of GHG emissions due to deforestation will be accounted in settlements category and will be excluded from the climate targets as technical corrections. The trading with the CO_2 removal units in the emissions trading scheme is questionable, because all European countries will be able to use compensation mechanism provided in Annex 7 of LULUCF regulation. At the same time, Latvia must take all possible measures to ensure an increase in CO_2 sinks in 2021…2030 to be able to use national level flexibility tools.

Key words: LULUCF, forest management, climate change mitigation policy, forest reference level.

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INTRODUCTION

The development of the climate change mitigation policy and its successful implementation is one of the greatest economic challenges in this century. Forest is an important part of climate policy, since it is one of the largest and the most dynamic carbon sinks, which can be significantly increased by targeted management measures.

The European Parliament and the Council have approved the regulation of greenhouse gas emissions and removals from land use, land use change and forestry (LULUCF) for the period 2021-2030 (LULUCF regulation further in text). It is based on the Paris Agreement ratified by the United Nations Framework Convention on Climate Change (UNFCCC) with long-term objective to keep global temperature below 2ºC above pre-industrial level, in an effort to limit the temperature increase to 1.5ºC. In order to achieve this objective, each involved State has to ensure national pre-determined contributions to climate change mitigation for the period (Land use, Land.., s.a.).

The aim of the paper – analysis of the challenges and opportunities of the forest management in Latvia emerging from the European Union's climate change mitigation policy as set by the LULUCF regulation and Paris agreement.
The scientific tasks of the paper:

1. to evaluate national forest management objectives in 2021…2030 emerging from the European Union's Climate change mitigation policy;
2. to elaborate the forest management assumptions for the FRL and alternative policy scenarios;
3. to analyze the interaction between LULUCF and forestry sector by evaluation of the possible contribution for achieving a common goal.

Land use has always played an important role in the development of climate change. In 2010, agricultural land, forests and other land uses were responsible for 24% of anthropogenic GHG emissions. While demand for food is increasing, CH_4 and N_2O emissions from land use are increasing as well. On the other hand, global demand in the forest sector is mainly based on fuel wood and industrial round wood (Biesbroek et al. 2010).

LULUCF is GHG accounting sector defined by the Intergovernmental Panel on Climate Change (IPCC) and it includes anthropogenic GHG emissions resulting from land surface carbon stock changes, wildfires and other processes. LULUCF applies to biomass (above and below ground), dead organic matter (dead wood and litter) and soil carbon sink for certain land categories (forest land, wetlands, grassland and cropland; Kuikman et al., 2011). In the LULUCF regulation it is emphasized that this sector can contribute to climate change mitigation in variety of ways, mainly by reducing GHG emissions and maintain an increasing existing carbon sinks in a sustainable way (EP 2018/841, 2018). In this case emphasis is placed on forests that play the greatest role in accumulation of carbon.

Concerning the accounting of GHG emissions in the forestry, LULUCF regulation includes the concept of forest reference level (further in text - FRL). The FRL is the estimate, expressed in tons of CO_2 eq. per year, of the average annual net emissions or removals in managed forest land on the territory of a Member State in period 2021…2025 and 2026…2030. Regulation has chosen to continue the sustainable forest management practices of the 2000…2009. Emissions and removals in the reporting period (2021…2025 and 2026…2030) are compared to a projected FRL (EP 2018/841, 2018, Guidance on developing.., 2018).

The implementation of LULUCF regulation is not as simple as it might seem. The new climate and energy system lead to cross-sectoral conflicts, as this policy will increase importance of the bioeconomy, and thus increase use of biomass for energy and other applications. As a result, fellings are likely to increase, leading to a reduction in

carbon stock levels in the next 10 years. Current trends in recent years shows increase in forest growth, as well as the harvest level. Studies as well call into question the emission accounting methodology proposed in the regulation and chosen period for sustainable forest management practice continuation (Grassi G. et al. 2018, House et al. 2017).

In recent years the role of the forest sector has increased in Latvia's climate change mitigation policy; support for sustainable forest management measures is increasingly being granted. Fig.1 shows policy documents affecting climate change mitigation policy in forest sector. Hierarchically superior document is middle term Latvia's National Development plan, where they accent forest as one of Latvia's natural treasures, managed in sustainable way (Latvijas Nacionālais attīstības plāns 2014.–2020. gadam, 2012). Under development is Latvia's Rural Development program for the period after 2020. During the development of the program, the objectives and priorities identified as a result of the EU Common Agricultural policy. The rural development program implements the following forest measures:

- afforestation;
- forest regeneration after wildfires and natural disasters;
- investments to improve the resilience and ecological value of forest ecosystems (Ministry of Agriculture of Latvia 2018).

All of these measures have a long-term impact on climate change. Short-term impacts on GHG emissions are relatively low (Informācija par zemes...2016).

Forestry and related development guidelines 2015…2020 are the most directly relevant to the forest sector. Their implementation involves achieving at least 6 of Europe 2020 thematic objectives, such as:

- contribution in researches, technological development and innovation;
- supporting low-carbon economy;
- promoting resource efficiency and protection of environment (Meža un saistīto nozaru attīstības pamatnostādnes 2015.-2020.gadam, 2015).

Climate change mitigation policy is complex of interfering measures for successfully implement, it requires support for a number of forest management measures at national level. The studies have proven positive effects on climate change mitigation of the following sustainable forest management measures:

- maintain or increase forest area;
- forest monitoring for the rapid detection and prevention of outbreaks of pests and diseases;
- effective forest fire prevention;
- restoring forest functions after disturbances;
- afforestation;
- tending and improvement of the

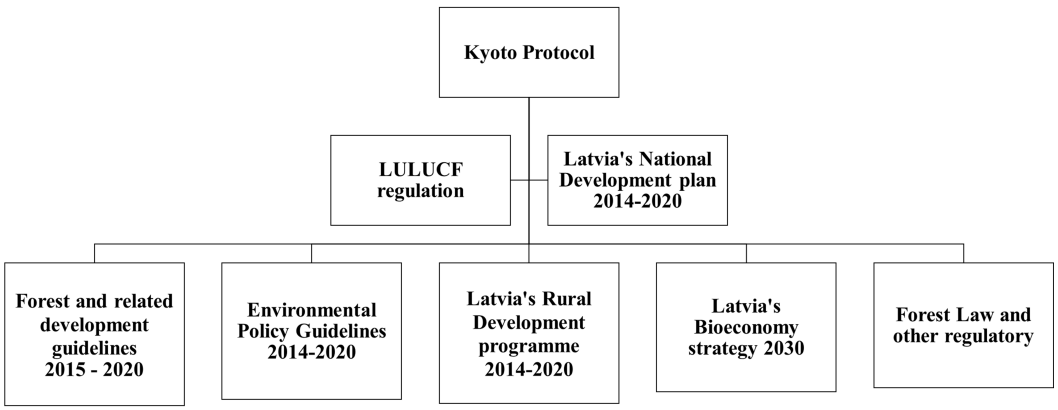

Fig.1. Policy documents affecting the Climate Change Mitigation policy of the Forest sector by 2020.

composition of young stands;
- renewal of existing drainage systems and the establishment of new ones (Ministry of Agriculture of Latvia, 2018);
- forest fertilization and use of wood ash in the forests (Broadhead et al., 2009, Siltumnīcefekta gāzu emisiju…, 2018, Millar et al. 2007).

Part of these measures mentioned above, are included in the Latvia's Rural Development program. However, these types of measures will only par off after several decades, so they are not always profitable and requires state support for implementation. This is one of the reasons why climate change mitigation policy is so complicated, because it needs to balance and find synergies between different sectors in long term.

MATERIALS AND METHODS

Latvian State Forest Research Institute Silava (LFSRI Silava further in text) is involved in development of the National Forest Accounting Plan (further in text – NFAP) according to LULUCF regulation and the proposed FRL for 2021… 2025 and 2026..2030.. The opportunities and threats posed by climate change mitigation policy to the Latvia's forestry sector has been selected as the object of the study. To analyze possible threats and opportunities, author used situation analysis (SWOT analysis). The study will use the data calculated by LFSRI Silava.

The calculated Latvia's FRL covers all carbon sinks listed in the EU and UNFCCC reports, as well other emissions related to forest lands have been included. The following carbon sinks are included at the FRL –
- living biomass;
- dead wood;
- litter;
- harvested wood products;
- emissions from drained soils;
- emissions due to biomass burning.

Forest fertilization is not included, since this measure was not used in 2000…2009 except in small areas of research forests.

In this study two scenarios for calculation of forest management projections were created in NFAP: the FRL scenario and "business as usual" scenario:

1. "business as usual scenario". The calculation is based on continuation of the practices (forest regeneration, tending, thinning, regenerative felling) is averages in 2011…2016. Harvest rates depends on the availability of wood resources for particular type of felling in forest stands with different dominant species, assuming that the intensity of utilization (harvested area divided by available area) is the same as in 2021…2030.
2. FRL scenario – the harvest level in final felling is adapted to specific age forest stands, which is increasing if the proportion of outgrown forest stands increases, thereby avoiding the ageing of forests. The FRL is intended as the average annual GHG stock for the period 2021…2025, based on carbon sinks and GHG emission simulations in forest lands since 2017 and continuing forest management practices including intensity of regenerative fellings in 2000…2009. The felling rate and the projections is corrected so to avoid increase of area of mature forest stands.

The definition of forest is harmonized between the Latvia's NFAP and the National GHG inventory. The transitional period between the land converted into forest land and forest land remaining forest land is set to 30 years. Table 1 shows criteria that describe the forest definition. It is important to note that Latvia uses 30 years period for afforestation accounting, instead of 20 years in the UNFCCC reporting.

The FRL for managed forest lands is based on projections of carbon stocks in 2021…2025. For the carbon stock change and GHG emission projections LFSRI Silava applied long-term forecast AGM model (Forest Growth Model), EPIM and Yasso model, as well as documented Stand Wise forest inventory data characterizing forest management in 2000...2009, including

Table 1. Forest definition in Latvia's NFAP

No	Parameter	Measurement unit	Value
1.	Minimal area of forest stand	ha	≥ 0.1
2.	Tree height at maturity age	m	≥ 5
3.	Basal area at maturity age	%	≥ 20
4.	Width of protective belts and other bands of trees	m	≥ 20
5.	Transition period between land converted to forest land and forest land remaining forest land	years	30

Source: LFSRI Silava

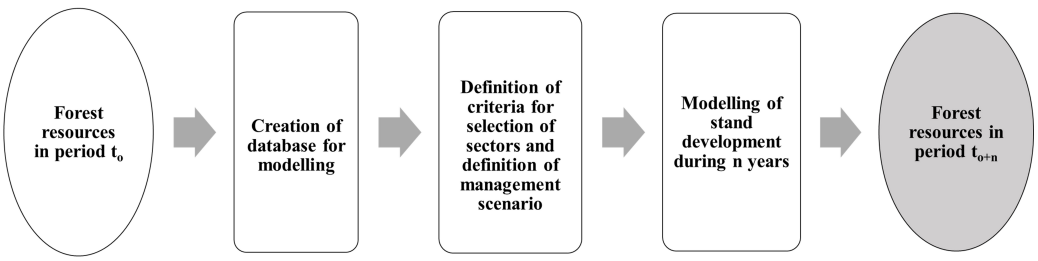

Fig.2. Scheme of LFSRI Silava changes in forest resources projections process based on Nation Forest Inventory data (Source: LFSRI Silava).

forest management and nature conservation measures. For the calculations of projections was done on the base of the National Forest Inventory (NFI) plots and using the methodology which is harmonized with the GHG reporting in LULUCF sector.

The FRL is based on the data of NFI and Stand wise inventory. In order to describe forest practices since 2000, data of NFI are calculated backwards (from 2004…2008 to 2000) using the AGM model in opposite direction, using harvesting, forest regeneration and thinning assumptions according to synthesized data integrating the NFI and Stand wise inventory.
Projection of forest resources is based on three steps (shown in Fig.2):

1. development of activity data table for modeling;
2. defining forest management scenarios and forest management assumptions;
3. modeling of forest resource changes for future n periods.

The projections of harvest rate in the model is based on the harvest level (proportion of the volume extracted and volume available for the regenerative felling in 2000…2009), which is adapted to the age structure, so the share of mature stands of the growing stock (available for main felling) is not higher at the end of 2030 than the available at the end of 2009. Other emissions (e.g. from wildfires) are based on data acquired in 2000…2009 period (proportionally adapted to forest area) and projected organic soil areas during the period 2021…2025 and 2026…2030.

Forest land in Latvia according to GHG projections at the end of period 2021…2025 is 3084 thousand hectares, all of forest areas, except nature conservation areas where thinning and final felling is prohibited, are accounted as productive forests. Protected forests not available for logging are 216 thousand hectares. Approximately 50% of productive forests are managed by Joint Stock Company "Latvia State Forests". (Lazdiņš et al.. 2018a, Lazdiņš et al.. 2018b)

RESULTS

The FRL scenario

The proposed FRL for Latvia for 2021…2025 is -42 kt CO_2 eq. and 574.6 kt CO_2 eq. yr^{-1}, if the instant oxidation method is applied to the calculation of harvested wood products (HWP). Harvest rate is expected to grow by 2022, for 5 years and then it stabilizes in the calculation. The same intensity is applied for the period after 2030. Harvested wood products will significantly contribute to creations of the net removals in forest lands (-7723 kt CO_2 eq. yr^{-1} during the period 2021…2025), which is related to the expected increase in wood production and logging. HWP (paper, wood panels, sawn wood) is important carbon pool in Latvia. Accumulated amount of carbon in HWP has increased because of the growth of felling assuming the same efficiency of utilization of roundwood.

Projected GHG emissions tend to grow during the accounting period. It is expected that the afforestation measures implemented during the previous decades will have significant role in climate change mitigation after 2030.

Fig. 3 shows that after 2029 forest land will turn again into GHG sink and GHG emissions will continue to decrease in forest lands at least until 2050. Although this forecast does not include significant changes to forest management practices (insufficient investment in forest infrastructure, replacement of conifers by broadleaves etc.), so this projection may lead to overestimation of the CO_2 removals if no additional measures will be implemented to contribute to further reduction of GHG emissions. In addition, it should be noted that the accounting

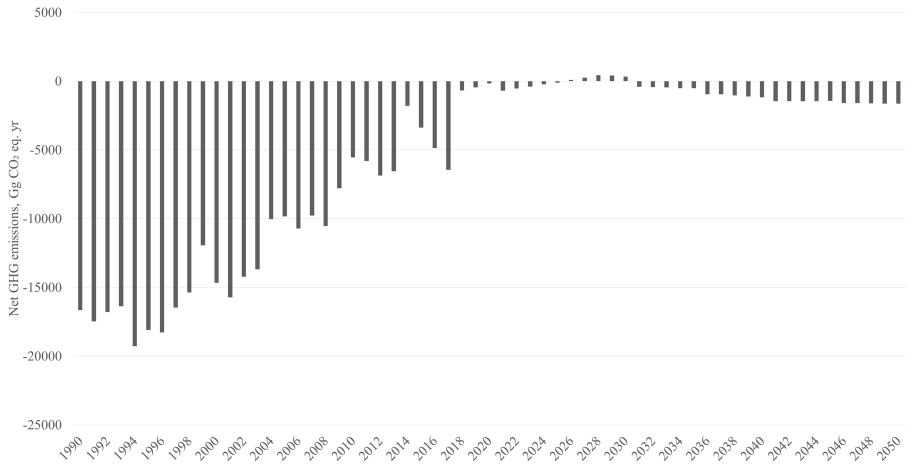

Fig.3. Net GHG emissions in forest lands, including afforestation (Source: LFSRI Silava).

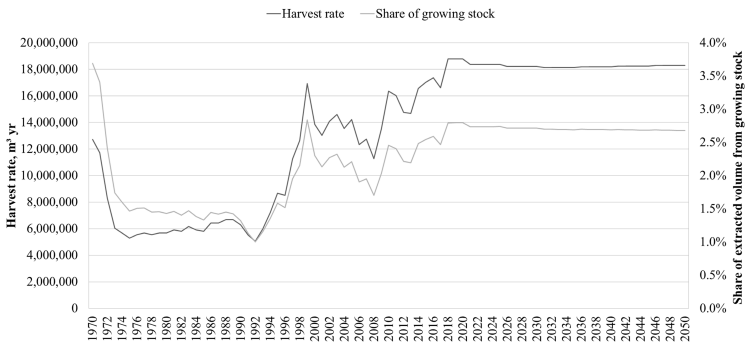

Fig.4. Projections of harvest rate in the Latvia's FRL scenario (Source: LFSRI Silava).

Table 2. SWOT analysis of implementing EU climate change mitigation policy in Latvia's forestry

Strengths	Weaknesses
Flexibility tools can be used to compensate exceeding GHG emissions if the climate change mitigation targets are not reached; however, this tool can only be used when other sectors cannot compensate exceeding GHG emissions in LULUCF sector Possibility to sell the CO_2 removal unit to other EU member states. Opportunity temporarily to increase the harvest rate to avoid the ageing of forests. Simplified accounting methodology by elimination of speculative economic criteria.	NFAP assessment can be subjective and broad interpretation of the LULUCF regulation is possible. The interaction between LULUCF and other sectors has been underestimated and can have hampering impact on bioeconomy. It is difficult to achieve climate change mitigation targets in forestry in short term.
Opportunities	**Threats**
Forest measures implemented by Rural development program. Development of agroforestry in extensively used farmlands. GHG emissions due to deforestation to settlements is not included in the accounting, as well as afforestation projections, which can be later reported as technical corrections Involvement of forest owners and wood industries in the evaluation of FRL.	Limitation of harvest rate due to application of the forest management intensities in 2000…2009. Potential construction projects can contribute to reduction of forest area. Climate change related natural disturbances – increased diseases, storms and wildfires, damages caused by pests. In the context of Paris Agreement the zero-emissions should be achieved in LULUCF sector, which can significantly increases the pressure on forestry in future.

Source: Created by authors

methodology may be changed in the future, which may have an impact in the results.

Harvest rate was projected according to the average intensity values in 2000…2009 (Fig.4). Flexibility to temporarily increase harvest rate to ensure GHG neutrality in forest lands has also been taken into account at the Latvia's FRL, in line with sustainable forest management principles set by forest regulations and voluntary certification schemes. By temporarily increasing the harvest rate in 2019…2022 in order to avoid continuation of the ageing factor of forest stands, that would have an impact on carbon stocks and emissions in living biomass. The FRL also takes into account dynamics of forest stand age in order to avoid unreasonable limitation of forest management intensity. (Lazdiņš et al. 2018a, Lazdiņš et al. 2018b)

"Business as usual" scenario

Harvest rate in "business as usual" scenario is elaborated according to average intensities of forest management inf 2011…2016 (Fig.5). The felling rate in regenerative felling in the "business as usual" scenario is smaller than in FRL scenario; however, ageing of forests is continuing resulting in reduction of CO_2 removals in forest lands and net GHG emissions from forest lands after 2050. The average share of biofuel in extracted biomass is 56% (in FRL scenario it is 52%). Existing bioenergy projects and industrial consumption, such as pellets, are accounted in harvest rate; however, they are not affecting harvesting projections due to exceeding availability of solid biofuel. Constant proportion of biofuel is considered for the whole period after 2020.

For projections for harvest rate roundwood demand forecasts are used, which are expected to increase according to the growing demand in bioeconomy (Lazdiņš et al. 2018a, Lazdiņš et al.. 2018b).

SWOT analysis and Discussion

As it is mentioned above LULUCF sector has several cross-sectoral interferences with agriculture and energy sector at national and EU level. New energy policy requires the transition to renewable energy resources, including wood and replacement of fossils derived materials. This clearly confirms that demand for wood products will grow in the future and considerable growth is considered in external markets. Can the forest sector contribute to flexibility tools implemented in LULUCF regulation? Can wood be the main source in Latvia's energy sector, especially considering growing demand in the export markets? Is it possible to achieve carbon neutrality in 2050 and what it means in LULUCF sector? These are the questions, which needs to be responded in near future by efficient and sustainable measures.

In the SWOT analysis (Table 2) the strengths are the advantages and benefits of the EU Climate change mitigation policy for the country. Weaknesses are major shortcomings in the EU climate change mitigation policy, which can turn into a threat. The identified opportunities can be used in forestry sector to achieve the EU climate change mitigation policy targets or to defend national development targets. Risks that may

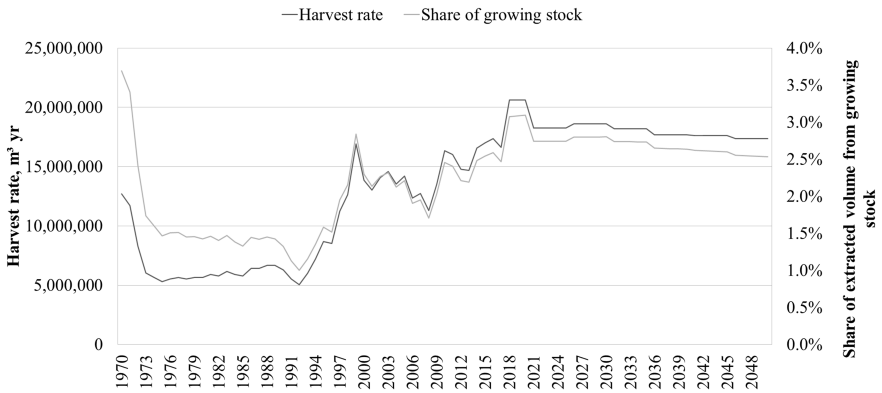

Fig.5. Projections of harvest rate in the "business as usual" scenario (Source: LFSRI Silava).

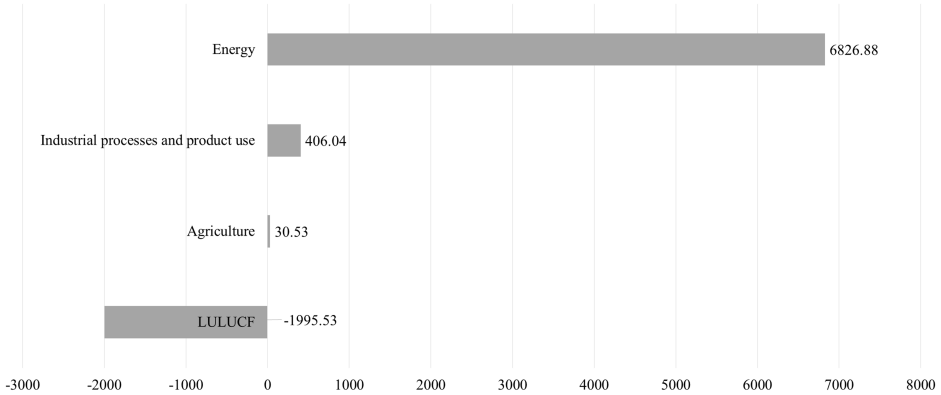

Fig.6. CO_2 emissions in Latvia by sources in 2016, CO_2 kt eq (Source: Created by authors after National GHG inventories).

have a negative impact on the Latvia's forestry sector are recognized as threats.

Technical Assessment of NFAP by European Commission as requested by the LULUCF Regulation suggested to Latvia to revise FRL values using the management practices as documented in the reference period (2000…2009, Synthesis Report: Latvia, 2019) ignoring the impact of economic crisis in 2008...2010 and impact of wind throw in 2005 on structure of harvests. Possible restrictions of harvest rate are not reflecting changes of forest age structure resulting in continuous ageing of forests and reduction of the CO_2 removals.

One of the opportunities provided by the EU LULUCF regulation is the non-inclusion of GHG emissions due to deforestation to settlements. New infrastructure projects await Latvia after 2020, as one of most important is the Rail Baltica railway infrastructure project. On the other hand, this opportunity can be seen as threat, because it contributes to deforestation and reduction of the GHG mitigation potential.

The energy sector remains the largest source of GHG emissions (mainly driven by the transport sector; in 2016 it was 3147.11 CO_2 kt eq., which is half of total emissions in energy sector) (Fig.6). More attention should be paid to energy sector in the next accounting period, otherwise total emissions could even increase due to economic development, despite the increase in the share of renewable energy sources (Eurostat). According to the flexibility tools implemented in LULUCF regulations forest management can compensate increase of GHG emissions in agriculture sector by 3.1 mill. tons CO_2 eq., however comparison of "business as usual" and FRL scenario clearly demonstrates that this value cannot be ensured without additional measures in forest management. There are few measures which can contribute to reduction of GHG emissions in short term, like forest fertilization, drainage, more efficient utilization of roundwood (Okmanis, Kalvis & Lazdiņa, 2018; Petaja, Okmanis, Makovskis, Lazdiņa & Lazdiņš, 2018). One of the most efficient example of short term actions is forest fertilization and wood ash recycling. Therefore, this measure needs to be implemented if following decade in large scale to ensure implementation of the flexibility rule in 2021…2030.

At the same time the potential increase in natural disturbances (damages caused by pests, increased diseases, storms and wildfires) will be one of the threats in the next LULUCF accounting period (Scelhaas et al., 2015) which needs to be considered to ensure continuation of increase of carbon stock of forest lands.

The advantage of the LULUCF regulation is simplified accounting methodology by avoiding speculative economic criteria. At the same time, evaluating process of NFAP and FRL organized by European Commission may be subjective, so Member States needs convincing substantiation to prove the compliance of the NFAP with the requirements of the LULUCF regulation. Latvia must raise awareness of national and international forest owners and wood industry organization to ensure their participation in evaluation of FRL.

In the context of Paris Agreement the zero-emissions target may be set to the LULUCF sector at national level, which can significantly increases the pressure on forestry in future. On November 28, 2018, the European Commission published a long-term strategy for a climate-neutral economy based on the achievement of the objective of the Paris Agreement. According to this strategy LULUCF sector has to contribute by 10% of the net GHG emissions by increase of carbon sinks (e.g. afforestation), as well as forestry measures, which has to increase biomass deliveries for bioeconomy sector. The possible solutions are intensification of forest management, afforestation of organic soils, agroforestry and other measures (A clean Planet.., 2018, In-depth analysis in…, 2018).

The cyclical nature of carbon turnover in nature, the uncertainty in the accounting methodology and the excessive emissions of the energy and agriculture sector, raises doubts on whether carbon neutrality can be achieved by 2050. A complete

transition to non-biomass renewable energy lacks realistic scenario at global level, however can be implemented locally. This scenario should be carefully and critically evaluated in Latvia and it is also necessary to increase government support to climate change mitigation measures contributing to short and long term climate policy targets. The climate change mitigation potential of forest is considerable, particularly in Latvia, but this potential should be prioritized in the national climate change policy considering the interferences and potential synergies with other sectors.

CONCLUSION

1. Latvia's proposed forest reference level for 2021…2025 is -42 kt CO_2 eq. and 574.6 kt CO_2 eq. year, if the instant oxidation method is applied to the calculation of harvested wood products. Harvest rate is expected to grow by 2022, due to increase of age of forest stands and implementation of flexibility rule to temporarily increase harvest rate.

2. According to "business as usual" scenario, the harvest rate will increase in near future, however it will be still below the threshold of sustainable harvest rate set by the FRL scenario.

3. In the period 2021…2030 the forest sector is expected to be a net source of GHG emissions in case of implementation of the FRL scenario, however the net removals of CO_2 will increase in future in contrast to the "business as usual" scenario, thus contributing to implementation of Paris agreement targets.

4. Implementation of the flexibility rule (compensation of 3.1 mill. tons CO_2 eq. in other sectors) requires implementation of the climate change mitigation measures like forest fertilization and wood ash recycling, which seems to be the most efficient climate change mitigation measures in short term. This measure needs support by the Rural development plan.

5. The main threat to Latvia's forestry in the context of European climate policy targets set by the LULUCF regulation, is possible restriction of the harvest intensity in FRL which is not reflecting changes of forest age structure, economic crisis in 2008…2009 and wind throw in 2005.

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