Annex 22

Assessment of GHG emission reductions report

For the GCF-FAO Project "Enhancing the resilience of Serbian forests to ensure energy security of the most vulnerable while contributing to their livelihoods and carbon sequestration (FOREST Invest)"

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1. Project information

The project aims to support the Republic of Serbia in enabling its forest sector to contribute to the country's goals with respect to climate change adaptation and mitigation and support the most vulnerable households. It will do so by upgrading management capacities of key institutions and communities, expanding ecosystems services to reduce poverty among communities, incentivizing private companies to decarbonize their processes while contributing to forest's restoration and better management and stabilizing and increasing carbon removals.

The project will address bottlenecks to climate change adaptation and mitigation and aims to achieve the following three outcomes:

Outcome 1 – National-level upscaling of sustainable and climate adaptive silviculture and carbon finance framework

Outcome 2 – Improved energy security and livelihood from climate resilient forest ecosystem and as well as GHG emission reductions from increased carbon sinks and decarbonization opportunities

Outcome 3 – Private sector is engaged in climate adaptive silviculture and decarbonization investments

Taken together, **these actions will enable Serbia to reduce the vulnerability of its forestry sector and enhance incomes and energy security of the poorest households while increasing total $CO_{2eq.}$ removals and biodiversity.** Given the ownership and management structure of forests in Serbia, the project will operate at the national level while taking into account regional specificities.

The project aims to **enhance the resilience of over** 647 thousand vulnerable persons **while increasing and preserving carbon stock from the forestry sector[1] (7.6 $MtCO_{2eq}$ (27Y))** and **reducing net emissions by the private sector by 0.8 $MtCO_{2eq}$ (27y).**

[1] Including harvested wood product and avoiding forest degradation

1.1 Project Site

Project activities will be carried out in Serbia, a landlocked country located on the Balkan Peninsula with hilly terrain and mountains dominating the southern third of the country. Serbia's total surface area is 88,361 km^2 and a total population of 6,926,705[2] people (2020). Direct beneficiaries of the project are 759,665 (379,833 women) and indirect beneficiaries 2.9 million (1,4 million women).

The climate of Serbia can be defined, using the Köppen-Geiger climate classification (Beck et al., 2018), as a warm-summer humid continental climate (Dfb). Temperatures reach their minimum in January (average temperature around 0°C) and their maximum in July (average temperature around 21°C). Rain is relatively constant (40 to 55 mm of monthly accumulated precipitation), with a small rainy season from May to June, with about 70 mm of accumulated precipitation monthly. Snowfall starts in October and gradually increases until January when it reaches on average slightly more than 30 mm of water equivalent per month.

[2] https://www.stat.gov.rs/en-us/oblasti/stanovnistvo/procene-stanovnistva/

2. Mitigation Impact

2.1 The Nationally Determined Contribution Expert Tool (NEXT) tool

The Nationally Determined Contribution Expert Tool (NEXT) is a new generation of greenhouse gas (GHG) accounting tool developed by the Food and Agriculture Organization of the United Nations (FAO) to support annual environmental impact assessment for the Agriculture, Forestry and Other Land Use sector (AFOLU). It provides a 30-year time series of annual and cumulated estimates of carbon removal and greenhouse gas emission reductions from actions determined by Parties in their climate policies. NEXT was developed using the Intergovernmental Panel on Climate Change (IPCC) methodologies, and estimates can be made using either the IPCC 2006 guidelines or the IPCC 2019 refinement to the IPCC 2006 which are both complemented with the IPCC 2013 Wetlands Supplement. The tool was designed to provide results that directly respond to the provisions of the Enhanced Transparency Framework and support the Nationally Determined Contributions (NDC) development as required by the modalities, procedures and guidelines. NEXT provides a detailed temporal series of results and a wide set of indicators, including the social value of carbon, enabling a comprehensive environmental and economic overview of climate actions in achieving mitigation targets. The tool helps countries to interpret, track and scale up ambition of their NDCs which could ultimately inform the global stocktake of the Paris Agreement in a harmonized way. NEXT is a land-based accounting standard for national and subnational GHG reduction goals, measuring annual carbon stock changes per unit of land (in hectare), methane (CH_4) and nitrous oxide (N_2O) emissions, expressed in tonne of carbon dioxide equivalent per year, tCO_{2eq} /year. NEXT provides the annual and cumulated estimation of the potential changes in GHG emissions from a set of climate actions over 30 years reading grid, (Schiettecatte et al., 2022 a,b[3]).

Thanks to the 30 years reading grid, NEXT can be used at multiple points in time of the climate mitigation commitments, including NDC, investments and projects:

- Before the implementation of a climate action to evaluate its potential changes on GHG emissions reductions
- During the implementation of a climate action to assess and report progress toward the mitigation goal, and evaluate additional GHG emissions reductions to achieve the mitigation commitments,
- At the end of the climate action period to assess its achievement in term of GHG emissions reductions.

The 30-years' time-series of results per gas, activities and per carbon pool allows to understand the impact of past and current climate actions and shape the necessary actions and related international and national investments in order for countries to meet their climate targets.

2.2 Methodology for determining the baseline

NEXT allows users to assess the impact of climate actions against a hypothetical reference scenario. In NEXT's terminology, the climate action is defined as the target, while the hypothetical scenario is the

[3] Schiettecatte, L-S., Audebert, P., Umulisa, V., Dionisio, D., and Bernoux, M., 2022a The Nationally Determined Contribution Expert Tool (NEXT): A Comprehensive Greenhouse Gas Accounting Tool to Support Annual Environmental Impact Assessment Over a 30-Year Time Series in the Agriculture, Forestry and Other Land Use Sector. Front. Clim. 4:906142. doi: 10.3389/fclim.2022.906142

Schiettecatte, L-S., Audebert, P., Umulisa, V., Dionisio, D., and Bernoux, M., 2022b. Technical Guidance to the Nationally Determined Contribution Expert Tool, NEXT. Rome: FAO.

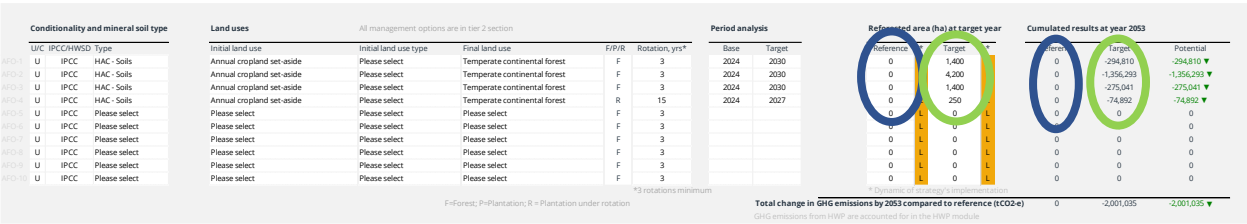
reference. The climate action can be a policy or low carbon measures implemented within the country or region of interest.

The reference scenario in the context of low carbon development refers to scenarios based on the assumptions that no mitigation policies or measures will be implemented beyond those already in force or planned to be adopted. The reference scenario is not a prediction of the future, but rather a counterfactual projection based on information retained as indicative of what the level of emissions could be without any mitigation policy. The term "**reference scenario**" can be used interchangeably with **baseline scenario, BAU scenario or no policy scenario**.

Once users have provided a set of basic information per activity, which is the area, the start and end of the climate action, and the land management practices, NEXT will estimate the annual and cumulated GHG fluxes and carbon stock changes from the transition of the initial land-use or management practices to the final land-use or management practices, including changes in GHG fluxes and carbon stocks that will keep occurring after the end of the climate action. These estimates are done for the target, the reference scenario and ultimately the balance. The final results provided by NEXT are the potential changes in GHG emissions reductions per activity and per gases. This potential change in GHG emissions reductions, or balance, is defined as the difference between the gross fluxes from the target and those from the reference.

Concerning the data for the establishment of the baseline, which regards in the first place the definition of the Forestry practices in the NEXT tool, the experts for sustainable forestry practices of the FAO design mission took into account experience gained in the region and confronted them with information provided by local experts. TIER 2 values were used to estimate carbon balances for reforestation and forest management activities.

Figure 1 Screenshot of the spreadsheet "Forest land" of the NEXT-tool, which includes modules to assess any forestry-based activities such as (af/re)forestation. The blue ellipse represents the reference ("baseline") in which no land is reforested and the green ellipse the situation after the implementation of the project activities leading to in total 7,000 ha of reforested land with a new carbon sink.



2.3 GHG Analysis utilizing NEXT

NEXT is built up of several modules allowing the evaluation of GHG emissions in the AFOLU sector. The present analysis was done using NEXT standardized to the IPCC 2006 methodologies, using the GWP of the 5th Assessment report[4]. Several modules were used to take into account activities implemented by the

[4] AR5 without climate-carbon feedback, i.e. 28 for CH_4 and 265 for N_2O.

project, i.e. the afforestation module, the forest management module, the Cropland and Grassland module, and the harvested wood product module.

While the project will be implemented over a period of 7 years, NEXT will keep capturing the full impact of management and conservation strategies on biomass and soil carbon stocks until the different carbon stocks, in particular soil and biomass, are reaching their respective equilibrium. For instance, in the case of the conversion from a set aside land to a forest over an implementation period of 7 years, NEXT will estimate the soil organic carbon (SOC) stock changes until years 7+20[5] when the last unit of set aside land converted to forest will have reached its SOC equilibrium. Thus, in NEXT carbon stock changes (biomass, litter, deadwood and soil) are estimated over the period plus the period needed for each carbon stock to reach their respective equilibrium. The changes in biomass carbon stock will be estimated over the 30-years' time series. Total lifetime considered for the project is 27 years to capture SOC changes and equilibrium until the year 2050.

2.4 Data used for the carbon accounting analysis

All components have a climate change mitigation impact. The corresponding activities are summed up in table 2.

[5] The IPCC guidance is assuming a default 20 years' time period for carbon stocks, in particular soil organic carbon (SOC), to come to equilibrium. This is not the case for biomass which can reach equilibrium before or after according to the land use type, e.g. forest, agroforestry among other.

Table 1 Activities considered for the Carbon Accounting

	Activity description	Tools	Baseline & additionality	Common practice
Component 1	500,000 ha (18% of total present forest cover) are under climate adaptive silviculture management practices	NEXT worksheet FOREST LAND (forest management)	Forest degradation, along with resulting habitat loss and fragmentation, is one of the key environmental problems of Serbian forests at present, resulting in loss of forest carbon, biodiversity and other key ecosystem goods and services, including the potential to act as carbon sinks. It is estimated that about 6.47 percent of the total territory of Serbia is degraded (UNCCD default data 2001-2015). In the absence of climate adaptive silvicultural practices, it is expected that land and forests will maintain or worsen its degraded state. Through the climate adaptive silvicultural practices introduced by the project, it is assumed, as a very conservative approach, that (i)1% of the land, i.e. 5,000 ha, would preserved and be prevented from being fully degraded, and (ii) new management practices would ensure a regeneration on 1% of the remained forest, 4,950 ha.	Close-to-nature forest management, which takes into account the multi-functionality of forests, has become the guiding principle of the Serbian forestry sector, and several GEF projects, implemented by FAO, are preparing the country to adopt this approach. However, the responsible entities are currently not yet equipped to implement climate adaptive silviculture on a larger scale and the forestry sector is therefore not ready for climate challenges.
Component 2	7,000 ha of newly established forest	NEXT worksheet FOREST LAND ((af/re) forestation)	Under the baseline scenario, no afforestation activities would take place in the project area. While the country is currently engaged in increasing its forest cover, the state does not dispose of the necessary resources to cover the additional costs of climate change adaptation/mitigation in the project area. In this regard, GCF funding will support the forestry investments to ensure investments that could otherwise currently not take place.	One of the priority activities of the low carbon development strategy is to plant 5,000 ha climate adapted forests every year up to 2030 (to be continued up to 2050). Public enterprises for forest management and line agencies currently lack however the capacities to prepare enough seedlings to support afforestation and the forestry stakeholder do not have yet the knowledge to carry out climate adaptive planting, management and monitoring of planting sites. The project is therefore essential to overcome these barriers.
	33,000 ha of degraded coppice stands on state owned shifted into high forest	NEXT worksheet FOREST LAND (forest	Inefficient coppicing practices in the public and private sectors are currently carried out in first place due to the lack of knowledge on alternatives. The project will hence carry out capacity development on modern forestry processes disseminating and emphasizing the economic	Coppice stands occupy 64.7% of the total forest territory, and natural high stands only 27.5%. In general, the status of both state and private forests is considered unsatisfactory due to the total growing stock of forests revealed by the results of the NFI in 2008 which is below the forests'

	18,000 hectares of private coppice stands is shifted to high forest.	managemen t)	advantages of healthy forests that will increase the willingness of the public and private sector to be involved in the project activities. The forest sector in Serbia is highly fragmented with limited investment capacity. Out of the over 2,000 companies involved in forestry (mostly in wood processing), about 97% are micro/small enterprises with limited human capital and access to credit due to lack of collateral. Further, forest owners do not see investments in forestry as viable due to the limited scale emanating from their small plots. Beyond the public budget, there are limited resources to address the bottlenecks of the Serbian forestry sector and sustain the national decarbonization process. The technical assistance provided by the project is a necessary condition to ensure the financial attractiveness and viability of investments.	potential capacities. The results indicated a low standing volume of about 161 m^3/ha; a low annual increment of about 4.0 m^3/ha; and an unfavorable structure.
	500 ha of abandoned private lands are cultivated with agro-forestry and short rotation forestry for soil rehabilitation purposes	NEXT worksheet CROPLAND& GRASSLAND	Decades of intensive farming compromised the quality of agricultural land leading to 424,054 ha unused agricultural land (5.5% of the territory)[6]. This phenomenon is particularly evident in Vojvodina (northeastern districts) where farmers have started to abandon agriculture and left their fields. The project will support the private sector in planting trees that will allow farmers to profit from their lands with a reduced investment need and that will allow soil to recover. In a BAU scenario, abandoned lands (set-aside land under NEXT) would maintain their degraded state and NEXT adopts a conservative approach considering the carbon stocks of initial land are at equilibrium (no loss, no gain of soil and or biomass).	In representative surveys it appeared that currently only between 3% of the interviewees from Southern Serbia and Belgrade region to 20% from Eastern Serbia show interest in the rehabilitation of abandoned agricultural land, whereas all other interviewees were not interested, or not aware of the process. It is therefore necessary to spread the knowledge of the advantages of the activity and to provide demonstration of the feasibility for the methodology to promote land rehabilitation.
	USD 50 million from national and international	N/A	Beyond the public budget, there are limited resources to address bottlenecks and sustain the national decarbonization process. The technical assistance	According to surveys in the industry sector from the chamber of commerce in the year 2022, most assessed companies are only in the early phase of planning and

[6] Radojević et al, 2015

	finance institutions are disbursed to private sector companies to execute their respective climate change plans (including insetting),		provided by the project is a necessary condition to ensure the financial attractiveness and viability of decarbonisation investments at the firm level. These measures will contribute to increasing financial returns, augmenting scale and the affordability of financial instruments for decarbonisation (provided by national and international financial institutions).	consideration of efficient use of resources and energy, although 68% assign to circular economy a high to top priority. Only 10% of the companies had in this regard successfully implemented measures related to the reduction of electricity and / or fuel consumption. At the same time 60% of the companies agreed that certification schemes like carbon footprints will be required for products to be sold on the EU market. There appears therefore a high awareness and willingness to invest in low carbon development. However, as also confirmed by commercial banks, due to lacking awareness on clear strategies from both private sector and lending partners, implementation of measures is slow and not conducive of a thorough decarbonization of the industrial sector.

2.5 Boundaries/impact

GHGs considered for the carbon accounting are CO_2, CH_4 and N_2O.

The GHG analysis does not include Life cycle GHG impact of the materials (e.g. for the production of the equipment of energy efficient measures) applied. The Climate Change mitigation impact of the different activities is explained in more detail in chapter 3 and calculated in the NEXT file.

2.6 Monitoring Approach

The verification of the GHG emission reductions will be monitored with the following steps:

- Ex-ante technical assessments of the forestry practices followed up by on-site verification
- Continuous site visits to monitor application of forestry and decarbonization practices
- EX-post Expert evaluation of activities related to forestry and decarbonization practices

2.7 Assumptions associated with the activity data

The assumptions related to the carbon impact of the activities indicated in table 2 are described further as follows.

Component 1 Forest management and governance

Climate Adaptive silvicultural management

For the carbon stock estimations resulting from climate adaptive silvicultural management practices of 500,000 ha of Serbian forest, it is estimated - as a conservative approach - that the project would (i) prevent 1% of the land to be fully degraded and (ii) on a further 1% of the remaining land regeneration would occur. Considering these assumptions the increased carbon sink can be calculated with the following approaches:

- Simple carbon stock approach: NEXT allows estimating the carbon stock changes in the carbon pools over the lifetime of the project. In this regard the tool estimates the carbon stocks changes between the BAU scenario and the project scenario on a total of 5,000 ha (1% of total area under climate adaptive silvicultural management with a current/initial state of 50% degradation). In the BAU scenario it is assumed that the 5,000 ha be fully degraded (99% degradation, 0.3 tC/ha remained) over the lifetime of the project, while in the target scenario this area would maintain its current state of degradation (50% degradation, 28.2 tC/ha). Carbon stocks at the start of the project, the reference and the target, are specified in the “tier 2” section of the tool.
- Gain loss approach: With NEXT the user can take into account gains through biomass regrowth following improved forest management. In this regard the carbon accounting considers that on 1% of the remaining 495,000 ha a regeneration of the biomass would occur due to the new climate adaptive silvicultural practices. The average of biomass growth rate of the afforestation component is used and informed in the “tier 2” section of the tool (average of table 2), i.e. 1.5 tC/ha/yr for forest less than 20 years old, and 3.2 tC/ha/yr for forest more than 20 years.

Component 2 Forests’ contribution to energy security, livelihoods and carbon removals

Afforestation activities

The project aims at reversing the national forest degradation trend through collaborative and more effective afforestation by planting forest trees, mainly Pine Forest (*Pinus spp*), Oak forest (*Quercus spp*) and Hornbeam forest (Carpinus). With the project implementation, the afforestation activities would take place on at least 7,000 ha of currently set aside land. Under the baseline scenario, no afforestation activities would take place. The hectares and biomass growth values (tC/ha/year) of the different tree species are indicated in table 3 below.

Table 2 Tier 2 data utilized in NEXT tool for calculation of carbon sinks through afforestation practices

NEXT Module		**Hectares**	**AGB<= 20 years**	BGB<= 20 years	AGB> 20 years	BGB> 20 years	**Reference for biomass growth rate**
Forest Land	Pine	1,400	1.0	0.3	2.2	0.6	Adapted from [2] [4] [8]
	Oak	4,200	1.7	0.4	3.4	0.9	
	Hornbeam	1,400	0.9	0.2	2.0	0.5	

Conversion of public coppicing stand to high forests

The current carbon content of the moderately degraded coppice stands in Serbia is 73.4 tC/ha [2] [4] [8]. The quantity of wood extracted from the coppice stands in the thinning process at the beginning of the conversion cycle will - in the short term - increase emissions, as the wood will be consumed by households for heating purposes. However, due to the higher average increment in high forests, the total balance will result in a significant increase in CO_2 sink. A conservative estimation is that during the conversion of the 33,000 ha of public coppicing stand foreseen by the project, the carbon content will grow in total on average by an additional 30% over a period of 27 years (the lifetime of the project). This data has been utilized in the forest management module of the NEXT tool with the simple carbon stock change approach to estimate biomass stock changes over the lifetime of the project. Carbon stocks at the start of the project, the reference and the target, are specified in the "tier 2" section of the tool.

Planting of shelterbelts

The project will intervene as well in the introduction of 500 ha shelterbelts (hedgerows) on bordering agricultural land to mitigate wind erosion and increase carbon sinks. Tier 1 data has been utilized for the calculation of the carbon sink increase through the shelterbelts.

Rehabilitation of degraded land

To demonstrate the possibilities for soil rehabilitation the project will apply 350 ha of agroforestry and 150 ha of Short Rotation Forestry on degraded agricultural land. As degraded land is not an IPCC land use type, we used annual cropland set-aside as a proxy. Tier 1 data has been utilized for the calculation of the carbon sink increase through agroforestry.

Component 3 Private sector engagement

Conversion of private coppicing stand to high forests

As described in component 2, the current carbon content of moderately degraded coppice stands in Serbia is 73.4 tC/ha. The quantity of wood extracted from the coppice stands in the thinning process at the beginning of the conversion cycle will - in the short term - increase emissions, as the wood will be consumed by households for heating purpose. However, due to the higher average increment in high

forests, the total balance will result in a significant increase in CO_2 sink. A conservative estimation is that during the conversion of the 18,000 ha of private coppicing stand foreseen by the project the carbon content will grow in total on average by an additional 30% over a period of 27 years (the lifetime of the project). This data has been utilized in the forest management module of the NEXT tool with the simple carbon stock change approach to estimate biomass stock changes over the lifetime of the project. Carbon stocks at the start of the project, the reference and the target, are specified in the "tier 2" section of the tool.

Decarbonization of the private sector

Currently it is not possible to analyze the carbon-offsets and the decarbonization processes of the Serbian private sector in component 3 with NEXT. The emissions reductions due to implementation of the decarbonization loan in component 3 is hence estimated by utilizing the following equation:

$$\text{Emissions}_{\text{reduction decarbonization}} = L_{\text{decarbonization}} / \text{Cost}_{\text{decarbonization}}$$

Where:

- $\text{Emissions}_{\text{reduction decarbonization}}$ = Total amount of $CO_{2eq.}$ avoided or removed through the implementation of the loan
- $L_{\text{decarbonization}}$ = total amount of the Loan available for decarbonization of the agribusiness sector, i.e. USD 50 mln.
- $\text{Cost}_{\text{decarbonization}}$ = Average cost in USD per tCO_{2eq} avoided or removed by the private sector

There is so far only limited information available about the average costs per tCO_{2eq} avoided and/or removed. According to authors calculations based on case studies of the Center of Cleaner Production of the University of Belgrade (2021), the investment costs for installation of biomass boilers and biogas plants to utilize the residues of agribusinesses for energy purposes corresponded to approx. 13 USD per tCO_{2eq} and 60 USD per tCO_{2eq} respectively. It can be assumed that costs for energy efficiency or land use investments would be even lower. However, for the purpose of the analysis and to remain within conservative estimations, a cost of 60 USD per tCO_{2eq} has been utilized for the estimation. Dividing the total loan amount available of USD 50 mln with the aforementioned cost of USD 60 per tCO_{2eq} results therefore in total reductions of 833,333 tCO_{2eq} over the lifetime of the project.

It can be assumed that:

- 50% of these measures will be dedicated to Renewable energy interventions, including solar, wind and bioenergy generation and access (MRA 1: Energy Access and power generation). This corresponds to mitigation impacts of 416,667 $ktCO_{2eq}$
- 50% of these measures will be dedicated to energy efficiency interventions in industries, e.g. reducing process emissions from industries (MRA 3: Buildings, cities, industries and appliances). This corresponds to mitigation impacts of 416,667 $ktCO_{2eq}$

3. Greenhouse Gas Appraisal results

The carbon accounting of the forestry activities is presented Figure 1 for the following years: (i) year 2030 at completion of the activities related to afforestation activities; (ii) year 2043, i.e. 20 years after the start of the project, and (iii) year 2050 to capture the impact over the whole lifetime of the project.

Figure 2: NEXT screenshot-overview of the results (cumulated and annual) at 3 different years.

NEXT indicators*

* Indicators from the strategies implemented in the present analysis

Cumulated emissions - Emissions expected by:	**2030**		**2043**		**2050**	
Reference scenario:	190,578	tCO2-e	500,266	tCO2-e	643,200	tCO2-e
Target scenario:	-982,241	tCO2-e	-4,812,090	tCO2-e	-6,939,255	tCO2-e
Mitigation potential:	-1,172,818 ▼	tCO2-e	-5,312,356 ▼	tCO2-e	-7,582,454 ▼	tCO2-e
Carbon stock changes (balance):	-1,164,898 ▼	tCO2	-5,287,276 ▼	tCO2	-7,548,134 ▼	tCO2
Total emissions changes, excluded carbon stock (balance):	-7,920 ▼	tCO2-e	-25,080 ▼	tCO2-e	-34,320 ▼	tCO2-e
Annual emissions - Emissions expected by:	**2030**		**2043**		**2050**	
Reference scenario:	23,822	tCO2-e	23,822	tCO2-e	0	tCO2-e
Target scenario:	-295,102	tCO2-e	-299,076	tCO2-e	-158,565	tCO2-e
Forest cover (balance, cumulated area):	520,463	ha	548,370	ha	561,251	ha

Table 5 summarizes the climate change mitigation impact of the different implemented activities, including the decarbonization of the private sector.

Table 3 Overview of the calculated GHG emission reductions per activity over the lifetime of the project from 2023 to 2050, in $tCO_{2eq.}$

	Emission reduction from forestry sector

Comp. [7]	Land use before the project	Land use after the project	ha	Carbon sequestered/avoided
1	Degraded Forest	Forest under improved climate-adaptive management	500,000	-1,483,561
2	Former forested areas currently set aside	Newly established natural forests	7,000	-1,646,856
2	Abandoned and degraded public coppicing stands converted to high forests	High forests	33,000	-2,746,638
3	Abandoned and degraded private coppicing stands converted to high forests	High forests	18,000	-1,498,166
3	Bordering Agricultural land	Shelterbelt / windbreaks	500	-98,927
3	Degraded Agricultural land	Restored land with agro-forestry an short rotation forestry	500	-108,308
1/2/3	Total carbon sink from forestry activities			-7,582,454[8]
total Emission reduction accounted for the project				**Carbon sequestered/avoided [tCO_{2eq}]**
3	Avoided emission through decarbonisation of private sector			-833,333
1/2/3	Emissions sink from forestry activities			-7,582,454
Total GHG emissions reductions				-8,415,787

A. The Low Carbon Development Strategy and the Forestry sector

The strategy declares as its general objective to reduce total GHG emissions by 33% by 2030 and by at least 65% by 2050 (compared to 1990 levels). In order to achieve this, one of the most crucial goals is to increase the carbon sink of the forests by 17% by 2030 and by 22% by 2050 (compared to 2010 levels). This means that the Net GHG Emissions in LULUCF Sector are expected to increase from -4.5 mln tCO_{2eq} in 2015 to -6.6 mln tCO_{2eq}. in 2030, i.e. by an additional -2 mln $tCO_{2eq.}$ (see specific objective 3 of table 15 "Key performance indicators at the level of the Vision and of the general and specific objectives", Low Carbon Development Strategy, 2019).

Not reaching the forestry targets would have drastic impacts on the climate change efforts of Serbia, as following explained: Total GHG emissions in Serbia (with LULUCF sink) were 56.7 mln tCO_{2eq}. in 2015 and, as outlined in the low carbon strategy of the country, this value is targeted to be reduced by 2030 to 47.82 mln tCO_{2eq}. The carbon sink of the forest on the other hand was -4.5 mln tCO_{2eq} in 2015 and is targeted to reach -6.6 mln tCO_{2eq} in 2030. However, in a BAU/baseline scenario the LULUCF sink is expected to reach

[7] Component of the project that the emission reduction activity is referring to.
[8] Calculated with NEXT, see figure 2

only -5.1 mln tCO_{2eq} by 2030, which means that the other sectors would have to further decrease the emissions by 1,526 kt CO2eq to balance the missing additional sink. This would represent a further increase of 22% of the overall GHG reduction efforts, resulting in a significant increase in the additional investment costs required for the implementation of the Strategies' low carbon development pathways, which already correspond to Euro 6,5b by 2030 (about 7.0b US$). In comparison, the investments foreseen in the forestry sector by the same strategy are relatively low, with EUR 92mln.

The GHG emission reduction from the forestry activities of the project are expected to increase carbon removals and avoid carbon loss of the Serbian forest by -7.4 mln tCO_{2eq} over the project lifetime of 27 Years. The implementation of the project would correspond to a reduction of -1.17 mln tCO_{2eq} by year 2030, i.e. at the completion of the project, meaning that, on the basis of the official data published by the Republic of Serbia in the frame of the low carbon development strategy, the project is expected to contribute significantly to the national targets to increase the carbon sink of 17% by 2030 (compared to 2010). The impact of the project will last in time. By year 2050, i.e. 27 years after the expected start of the project, the project is expected to lead to a carbon removal mainly from forestry activities of about 7,4 million tCO_{2eq}, further contributing to the targeted national carbon sink increase of +22% by 2050 (compared to 2010).

4. Conclusion

It is estimated that approximately 8.4 mln tCO_{2eq} will be avoided over 27 Years of the project. Most of the GHG emissions are avoided through the implementation of the forestry activities in component 2 and 3.

Considering all investments costs of the project, the cost per tCO_{2eq} avoided is approximately USD 10.3. The cost is in line with other crosscutting projects related to forestry/ sustainable landscape management approved by the GCF, e.g. in Benin (US$ 19.6[9]), LAO PDR (US$ 17.7[10]) and others.

[9] https://www.greenclimate.fund/project/fp187
[10] https://www.greenclimate.fund/project/fp200

5. References

[1] Cleaner Production Centre of Serbia (CPCS), 2019. Manual for the implementation of Low Carbon strategies in the Serbian food industry as a contribution to Circular Economy https://www.greenindustryplatform.org/sites/default/files/learning-resources/action//niskougljenicne%20strategije%20ENG%20WEB.pdf

[2] Hochbichler, E. and Trailovic Z. (2016.). Silvicultural recommendations for the strategic-operative management of coppice stands in the state forest enterprise "Srbijašume". Final report; Institute of Silviculture. BOKU Vienna.

[3] Intergovernmental Panel on Climate Change (IPCC). 2006. Intergovernmental Panel on Climate Change – IPCC. IPCC, 2006. IPCC Guidelines for National Greenhouse Gas Inventories, Prepared by the National Greenhouse Gas Inventories Programme, 4: Forest land.

[4] Marschall, J. (1975): Yield tables for forest inventory. Österr. Agrarverlag. 199 S.

[5]Republic of Serbia, 2019. Low Carbon Development Strategy https://balkangreenenergynews.com/wp-content/uploads/2020/01/Low-Carbon-Development-Strategy-with-Action-plan-Serbia_eng.pdf

[6] Schiettecatte et al., 2002a. The Nationally Determined Contribution Expert Tool (NEXT): a comprehensive greenhouse gas accounting tool to support annual environmental Impact assessment over a 30-year time series in the Agriculture, Forestry and Other land use sector. *Frontiers in climate* https://www.frontiersin.org/articles/10.3389/fclim.2022.906142/full

[7] Schiettecatte et a., 2022b. Technical guidance of the Nationally Determined Contribution Expert Tool (NEXT). https://www.fao.org/documents/card/fr/c/cc0568en/

[8] Sopp, L. 1974: Fatömegzàmitàsi Tàblàzatok [wood cubing tables]. Mezögazdasàgi Kiadò. Budapest