# Annex 3

# Economic and Financial Analysis

*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)"*

## Contents

## A. Introduction

The economic and financial analysis of the project "Enhancing the resilience of Serbian forests and the carbon storage potential of the country to support and boost the decarbonization process through adaptation and mitigation investments" ("the project") aims to identify the net incremental financial and economic benefits generated by the project's investment. The project aims to reduce national net emissions by increasing **carbon removals from the forestry sector (8.4 $MtCO_2e$ (20Y))** via increasing forest cover, enhancing degraded coppice stands into high forest, creating offsetting and insetting mechanisms and reducing barriers to the private sector's access to finance for decarbonization. The project's sequestration will reduce the cost of decarbonization going forward in Serbia; in the absence of these activities, the future cost of decarbonization would be much higher.

Direct beneficiaries of the project include 729,064 people (or 11% of the national population in 2021) in the country. Indirect beneficiaries include 2.84 million people. Indirect positive impacts are expected in terms of increased carbon stocking, reduced emissions from fuelwood use, in public nurseries and increased market opportunities for Serbia's population.

The analyses and conclusions of the individual models show that the project exhibits efficiency in the achievement of its mitigation targets. Overall, the economic activities stimulated by the project investment are financially profitable for the private sector and the beneficiary households. The models show positive financial parameters, with 20-year IRR higher than the financial discount rate of 7% used as a relevant cost of capital for private investment decision.[1] The forestry investments demonstrate high net ecosystem services production with a low financial value of economic benefits deriving from ecosystem services. The project's efforts on policy and regulatory framework will reduce the incentives for unsustainable practices (e.g., illegal logging) and strengthen the economic opportunities related to the forestry and energy sectors.

On the economic side of the analysis, at aggregate level and accounting for all relevant economic and ecosystem benefits (including the valuation of CO2e explained in section D below), the project shows very solid parameters, with a 20-year Economic IRR of **15.0%** (higher than the social discount rate), with **US$ 78. 4 million** NPV, and a 40-year Economic IRR equivalent to **17.6%** with US$ 227.5 million NPV.[2] . The project yields a positive stream of returns under the cost and benefit sensitivity analysis, including specific sensitivity to labor and seedlings costs and under fluctuating carbon price scenarios.

## B. Project Benefits

The project will be implemented via three interconnected components (plus project management):

1. **National level upscaling of sustainable and climate adaptive silviculture and carbon finance framework**
2. **Improving energy security and livelihood from climate resilient forest ecosystem and GHG emissions reductions from increased carbon sinks and decarbonization opportunities**
3. **Engaging Private sector in climate adaptive silviculture and decarbonization investments.**

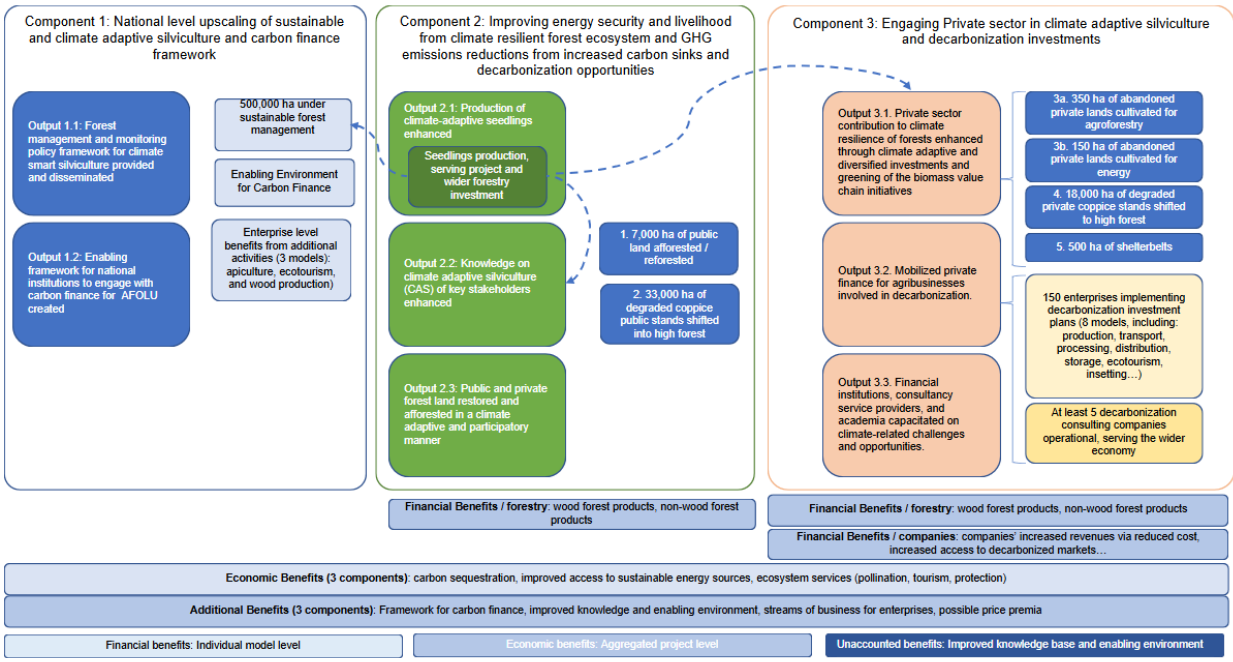
In this document, Section C outlines the structure of the analysis, Section D lays out the main assumptions and Section E describes the financial and economic benefits generated by the project.

[1] See section D, key parameters.
[2] The two different periods are used to capture the full deployment of benefits deriving from forestry investment.

## C. Overview and Structure of the Analyses

The analysis structure mirrors that of the project. It is based on models for three main clusters of activities financed by the project. Figure 1 provides an overview of the Economic and Financial analysis, how it maps to each of the project components and activities and benefits (both accounted and unaccounted).

**Figure 1: Overview of Economic and Financial Analysis**




The detailed structure of the analyses is as follows:

- **Carbon sequestration through forestry investment:** improved ecosystem service provision (CO2e sequestration) – resulting from the direct investment under component 1, from the overall improved governance on forests, and from sustainable coppicing supported by the project. The analyses focus on the following forestry investment:
  - Afforestation/reforestation on public land
  - Conversion of degraded coppice into high stand forests on public and private land
  - Unfarmed land restoration on degraded private land (for fuelwood and agroforestry)
  - Insetting / building shelterbelts on private land

  The forestry investment stimulates additional benefits such as household savings from increased availability of non-wood forest products, increased hedonistic value of forests and landscapes with a potential expansion of ecotourism activities, increased opportunity for apiculture and beekeeping activities related to greater forest coverage and enhanced capacity at national level to achieve forestry-related NDC targets.

- **Decarbonization investments:** removing constraints to access to finance for Serbian firms, particularly in the agrifood sector, to invest in decarbonization including in energy efficient technologies. The analysis has focused on decarbonization investments in different agricultural value chain activities such as:
  - Agro-processing
  - Urban agrifood retail
  - Cold storage
  - Transport and logistics (trucks and tractors)

We include the individual model and highlight their benefits in the EFA as indicative benefits that the project could trigger. We also include the benefits from this stream in the overall aggregates, but model for scenarios where 0%, 50%, 75% or 100% of the loans are disbursed by the banks to private companies.

- **Additional benefits from greater availability of scarce commodities and around decarbonization**: the project activities will unlock additional benefits from:
  - Greater availability of efficient fuelwood, and more efficient use of household energy, especially in rural communities[3]
  - Increased demand from the private sector for consulting services on decarbonization

- **Additional benefits to the wider ecosystem,** these benefits will accrue from[4]:
  - Flood protection
  - Pollination
  - Non-wood forest products
  - Ecotourism

To measure the achievement of the project's objective of mobilizing investments to accelerate the adoption of afforestation / coppice conversion / restoration of degraded lands conducive to carbon sequestration and investment in decarbonization, besides creating economic development and employment opportunities, traditional financial models are a useful but not a sufficient tool. For the quantification of the potential financial and economic benefits of the project's investment (both grant GCF resources and co-financing), the models developed for the analysis helped guide the project's cost structure and co-financing requirements, the investment-specific concessionality levels, and to identify the possible success factors and complementary actions required.

A caveat is necessary here. The project aims to generate potential additional benefits such as the support to define a framework for carbon finance, an improved knowledge base, and an improved enabling environment for decarbonization, of which the specific aspects and regulations are to be defined during implementation. However, once fully operational, the project supported carbon finance framework would generate potential new streams of business, and possible premia from decarbonized processes and products. Given the unpredictability of the regulatory frameworks, these benefits remain unquantified and are not included in the overall benefits.

Serbia has been enhancing its policies and enabling environment for decarbonization and investment in its green agenda through international capital markets.[5] Serbia issued a EUR 1 billion green bond with seven year securities with a 1% coupon rate and 1.26% yield) in 2021 to finance and refinance areas such as energy efficiency, protection of the environment, biodiversity and sustainable agriculture, renewable energy, sustainable water and circular economy among other areas.[6] There has been strong interest in the bond issuance, which has been oversubscribed three times as of December 2022.[7] At time of design, about 87.9% of the bond values are committed (Green Bond Reporting, December 2022)[8], and "the issuer also committed to allocating the funds during 2023 fully". Interventions and investment supported by the project are additional to the scope of the green bond, representing a full additionality to the areas covered by the bond, and an additional support to the achievement of national targets.

3 The number of beneficiaries due to the increased fuelwood availability could be difficult to monitor and accomplish, due to the dynamic nature of the fuelwood market and multiplicity of factors affecting it (external and internal).

4 The EFA took into account the economic value of ecosystem services. The financial value is accounted for only for Ecotourism, Non-Wood Forest Products, and Apiculture. Being the ecosystem services unlikely to represent a financial Benefit, the analysis has taken a conservative approach and preferred the risk to underestimate the overall Economic benefits, especially when it comes to quantifying benefits from flood protection, natural hazards and biodiversity.

5 Republic of Serbia, Green Bond Framework. August 2021. https://javnidug.gov.rs/static/uploads/1438_Serbia%20Green%20Bond%20Framework_vf.pdf

6 https://www.greenfinanceplatform.org/policies-and-regulations/serbia-issued-sovereign-green-bond, and https://javnidug.gov.rs/static/uploads/GREEN%20BOND%20REPORT.pdf

7 Republic of Serbia, Green Bond Reporting, December 2022. https://javnidug.gov.rs/static/uploads/GREEN%20BOND%20REPORT.pdf

8 https://javnidug.gov.rs/static/uploads/externalreviwer-20221229-serbia2.pdf

Forest management is included in the Bond's Sector 6 "Protection of Environment, Biodiversity and Sustainable Agriculture (PEBSA). This sector comprises sustainable forest management, environmental protection, biodiversity preservation and sustainable agriculture. Specifically on sustainable forest management, the investment represented 1.95 percent of the funds allocated so far, equivalent to about EUR 17 million.

## D. Key Assumptions

The model parameters are based on information gathered during the project design (up to May 2023), include interviews with industry associations and financial institutions, information from the donor agencies operating in Serbia, market analyses, data from the Statistics Agency of Serbia and global databases, and the design team's estimates based on similar projects. Price information gathered includes costs of labor (skilled and unskilled rural wages), capital costs (equipment, machinery, tools), inputs, and transport costs to market. We made certain conservative assumptions for inputs and outputs, taking into account possible risks and scenarios. A list of prices used in the economic and financial analysis is available in the "Prices" spreadsheet of the EFA document (Annex 3).

- **Model Characteristics.** All models aim to identify incremental costs and revenues related to the introduction of new technologies or practices and associated to the investments. For forestry, the models assume the investments will take place from year 2 to year 6 (as activities evolve from nursery establishment to tree planting and need additional investment), while for the other activities investment is generally limited to the first or second year (procurement of equipment, tools, machineries, civil works).

- **Adoption / success rate**. Aggregated benefit cash flows are calculated taking into account variable adoption rates, generally between 80 and 90 percent, reflecting the relative scarcity of entrepreneurial skills, adjusted to the models. In some cases, with specific capital-intensive technologies, the models also assume a success rate or learning curve rate for firms at the aggregate level. This allows a conservative representation of the financial and economic benefits projections, including the carbon emissions generated.

- **Impact of climate patterns**. Climate change impacts have been embedded on the models used for the EFA, aligned to the project's climate scenario (annex 2) and in line with RCP4.5 described in Section 2 of the Feasibility Study. The main climate change related stressors to forestry include generalized temperature and water stress recurrence. The consequences of these stressors were taken into account for the selection of the practices proposed by the project on forestry investment. In particular, aiming to increase the survival rates, this included the use of climate adapted tree species, under an adapted composition of different species per hectare (in order to increase the resilience of the new forests), and 15 percent replanting of seedlings in the second year after planting. All models account for climate patterns by adjusting the yield, harvest potential or returns to the major climate related stressors. Such climate related stressors are assumed resulting in a projected fluctuation of the incremental benefits throughout the project implementation and capitalization period. The technologies and practices supported by the project are more suitable to the climate change context and generate higher incremental benefits in the local context, despite their higher costs than BAU practices in the country. In addition to the baseline scenario for Serbia under RCP 4.5, the models also run a sensitivity analysis for RCP 8.5. The results for this analysis are included on page 27 of this annex.

- **Lending Terms.[9]** When required, essentially for the activities that envisage a contribution from the private sector to the investment costs, the analysis has used the maturity and interest rates prevailing in the Serbian financial sector (this includes both working capital and investment loans with above 1 year duration, with average interest rates between 4.5% and 7% percent for loans in Serbian dinar and US$). All loans are expected to be repaid in equal instalments over a five-year period. The loans were assumed to have a one-year grace period. Interest on the entire amount outstanding would be paid during the grace period.

[9] The source for these assumptions is the Central Bank of Serbia.

- **Financial Discount Rate.** The financial discount rate has been set at 7%, corresponding to the average interest rates for short-medium term loans (relevant to the private businesses and consumption patterns of the context)[10] and their trends in the last years (Source: CBA compendium of interest rates).

- **Economic Discount Rate.** The social discount rate at 6% reflects the society intention to give value to future benefits (i.e., increased ecosystem services) renouncing to part of the current consumption.[11] The discount rate is used as selection criterion to consider viability for the project's investments with an IRR above the opportunity cost of capital.

- **Analysis period**. All financial models were analyzed considering two-time horizons: 10 years for the financial prospects under market conditions, 20 years for the capitalization period of the investment in carbon sequestration. An additional horizon of 40 years was considered for all models, and in particular to integrate a more comprehensive deployment of ecosystem benefits from the forestry investment. More details on the production and financial parameters used in the models are found in the EFA spreadsheet.

- **For the economic analysis**, the following assumptions have been considered:
  - **Shadow exchange rate** (SER), estimated at 1.0 US$ = 111.6 RSD (conversion factor: 1.09). The sheet "Shadow Price Factors" in the EFA spreadsheet contains the assumptions and data for the shadow exchange rate and price factors for key commodities.
  - **Price conversion factors**,[12] varying between 0.80 and 0.83, with a standard of 0.83 (accounting for VAT, the main tax transfer in the project sphere of intervention), and labor conversion factor of 0.91.
  - **Valuation of ecosystem services.**
    - **(i)** For **CO2e sequestration potential,** the analysis considered the shadow price of **USD 40/tCO2-eq** as the lower end of the range of social value of carbon estimated to stay consistent with achieving the temperature goal of the Paris Agreement as identified by the High-Level Commission on Carbon Prices (World Bank, 2017)[13]. A more recent study (World Bank, 2023)[14] provides a review of carbon pricing applied by individual initiatives (government, international community), showing values varying between less than 10 (30 percent of the initiatives) to over US$ 30/tCO2-eq (20 percent of the initiatives). Further, as of 2022, voluntary market prices for carbon ranged between $5 and $20 for REDD+ / forestry related credits.[15] Thus, the analysis uses two additional benchmarks to test for sensitivity: (1) the carbon value exchanged in the EU ETS as of 2020, equivalent to US$ 19 per tCO2-eq and (2) a low carbon price of US$ 10 / tCO2-eq. The analysis was also updated to reflect the average ETS price for 2022 (US$ 80 / t CO2-eq).
    - **(ii)** For the **ecosystem services**, only the harvesting of wild fruits and beekeeping activities have been directly accounted for in the Financial and Economic analyses. Other relevant ecosystem services such as pollination, flood protection and tourism (as hedonistic valuation of improved landscape) were not directly included in the individual financial models as no specific economic values were found for Serbia. For these services, proxy values from other countries with similar contexts were added in the final aggregation of economic results (Ecosystem Services Valuation Database (ESVD).[16]

[10] See section on EE stoves.
[11] Ref: EIB, March 2013. The paper quotes also European Commission recommendation for social discount of 5.5% for Cohesion countries and 3.5% for other EU countries.
[12] Details on prices and their conversion factors are presented in the respective spreadsheets of the EFA.
[13] World Bank, 2017. Guidance note on shadow price of carbon in economic analysis.
[14] World Bank. 2023. State and Trends of Carbon Pricing 2023. http://hdl.handle.net/10986/39796
[15] https://www.abatable.com/blog/carbon-credits-pricing
[16] https://www.esvd.net/.

## E. Analyses

The Economic and Financial Analysis is organized around four types of models, those related to (1) investing in forestry through the project's activities, (2) investing in decarbonization, particularly in the agrifood sector, (3) enhancing the supply of scarce commodities (e.g., fuelwood) and (4) quantifying the value of incremental ecosystem benefits generated by the project's activities that are not captured in the individual models.

## E.1 Forestry Investment

The project's proposed forestry investments aim to increase the actual carbon sequestration in the country by effective afforestation, reforestation, forest enrichment and reconversion of degraded forests in selected areas of Serbia. Financial benefits take into account incremental revenues of forest owners (public and private) from fuelwood harvesting (for local and commercial sales)[17] as well as non-wood forest product harvesting. Economic benefits consider net incremental ecosystem services such as non-wood forest products, pollination, flood protection, tourism, and carbon sequestration. The valuation of the incremental carbon sequestration is taken into account in the economic analysis only, while the incremental financial benefits from the increasing non-wood forest product harvest are analyzed separately (accounted as a separate entrepreneurial activity associated to the increased coverage and improved conditions of the forests). Non-wood forest products (NWFPs) and fuelwood are embedded in all forestry models, where applicable. In addition, two additional illustrative financial models are added on ecotourism and apiculture as revenue generating activities. The benefits from these models are not included in the overall economic benefits from the project.

The analysis has considered **six simplified forest investment models**, consistent with the project activities (and related forest investment costs – Annex 3). The models are based on different conditions on the ground during the design (Annex 2, with detailed programme description). The six models present common features:

> **a.** They have a mixed composition of tree species in the target areas and the proportion between species, representing the most suitable mix to respond to the changing climate conditions and pattern and to enhance the resilience of forests by diversifying its composition (table 1).
> **b.** They involve the public procurement of seedlings from public nurseries, including those jointly supported by the project and by the Government (in this way, the project will also support the country capacity to produce climate adaptive seedlings and satisfy its future demand). All investment will be carried out under the supervision of the Department of Forests, in collaboration with other local institutions, and the participation of locally recruited manpower.[18]

Key differences between the models are the seedling density, the composition of tree species (depending on the scope of the investment) and the need or not for fencing to protect from animal intrusion (the main reason for needing to fence; the Feasibility Study on Forestry provides further details on the rationale for fencing).

**The forestry investment models include:**

**1. Afforestation / reforestation in public land: 7,000 ha of newly established forest.** This investment includes about **2,300 seedling per ha** density of Pinus, Quercus, Carpinus and wild fruit trees (including 15 percent additional seedlings in the second year of investment to enhance the survival rate), for an overall extension of **7,000 ha**. It requires fencing only in Vojvodina region (1,300 ha) to protect the growing trees from animal intrusions.

**2. Degraded coppice stands on state-owned land shifted into high forest.** This investment envisages about **690 seedling per ha** density of Quercus and wild fruit trees (including 15 percent seedlings in the second year of

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17 For the financial analysis, the increased value of forest mass is accounted for in the forestry models at the moment of Wood harvesting and sale. In the Economic overall value of increased forest mass cover is taken into account as incremental CO2e sequestered by the forests.

18 The project will need to mobilize about 560,000 person days, equivalent to over 2,500 forest full time annual jobs over the 7 years of project implementation.

investment to enhance the survival rate), for an overall extension of **33,000 ha**. No fencing is envisaged, due to the limited risk of animal intrusions.

**3. Unfarmed private lands are cultivated with wooden species**. This investment, fully located in Vojvodina, has two alternative aims:

> **3.a. Fuelwood for energy use**. The investment comprises a density of **10,000 seedlings per ha** of a combination of Willow and Poplar, used for production of fuelwood, for an area estimated in **150 ha**. The investment, feasible in Vojvodina, requires fencing.
>
> **3.b. Agro-forestry**. The investment comprises a density of **1,725 seedlings per ha** in a combination of Quercus (10%) and wild fruit trees (90%), used for agroforestry, in an area estimated in **350 ha**. The investment requires fencing, as located in Vojvodina.

**4. Degraded coppice stands on private land shifted into high forest**. This investment envisages about **690 seedlings per ha** density of Quercus (70%) and wild fruit trees (30%), including 15 percent seedlings in the second year of investment to enhance the survival rate. The overall extension of the investment is **18,000 ha**. No fencing is envisaged, due to the limited risk of animal intrusions.

**5. Shelterbelts (insetting)**. The investment envisages a density of **2,875 seedlings per ha** (including 15% replating on year 2), with a combination of Quercus, wild fruit trees and Willow or Poplar. The ideal location of the investment is in degraded treeless agricultural landscapes of Vojvodina region and requires fencing to avoid damages from animal intrusion.

Overall, forestry investment will cover a **total of 59,000 ha** in sites identified for their vulnerability and degradation, and suitability of forestry investment (including regarding clarity of tenure rights on land). To satisfy the demand of seedlings, the project will invest in two nurseries (starting between year 1 and 2 of the project). The investment will be phased in a way that cover 5 percent of the targeted hectares in Year 2, 15 in Year 3; 20 percent in Year 4; and 30 percent in years 5 and 6 (this is consistent with the organization of forestry investment in the EFA spreadsheets).

**Table 1** summarizes the forestry models' peculiarities and the expected wood harvest flow. **Table 2** summarizes the average cost of forestry investment, by activity, and disaggregated by source (government, GCF, private co-financing).

**Table 1. Forestry Investment – Tree species per investment model and related benefits**

| Foresty Investment and Tree species | Proportion of Tree Species | Second thinning wood harvest (at 20th year) | Harvesting of commercial timber starts at | Quantity of wood harvested (commercial timber) | Type of Product Generated (Value Chain from inputs to final products) |
|---|---|---|---|---|---|
| | % | m3 / ha | year | m3 / ha | |
| **(1) Afforestation / reforestation in public land** | 7000 ha | | | | |
| Pinus | 25% | 3-5 | 30-35 | 30-35 | Fuelwood, Paper, Construction |
| Quercus (Oak) | 25% | 5 | 30-35 | 25-30 | Fuelwood |
| Carpinus | 25% | 2 | 30-40 | 20-25 | Fuelwood |
| Fruit trees / shrub | 25% | 2 | 30-40 | 20-25 | Fuelwood |
| Willow / Poplar | | | | | |
| **(2) Degraded coppice stands on state-owned land shifted into high forest** | 33000 ha | | | | |
| Pinus | | | | | |
| Quercus (Oak) | 70% | 5 | 30-35 | 25-30 | Fuelwood |
| Carpinus* | | 4 | 30-40 | 20-25 | Fuelwood* |
| Fruit trees / shrub | 30% | 2 | 30-40 | 20-25 | Fuelwood |
| Willow / Poplar | | | | | |
| **(3.a) Unfarmed private lands cultivated with wooden species for energy use** | 150 ha | | | | |
| Pinus | | | | | |
| Quercus (Oak) | | | | | |
| Carpinus | | | | | |
| Fruit trees / shrub | | | | | |
| Willow / Poplar | 100% | 0 | 3 (five cicles in 15 yrs) | 60 | Fuel / biomass |
| **(3.b) Unfarmed private lands cultivated with wooden species for agroforestry** | 350 ha | | | | |
| Pinus | | | | | |
| Quercus (Oak) | 10% | 5 | 30-35 | 20-25 | Fuelwood |
| Carpinus* | | | | | Fuelwood* |
| Fruit trees / shrub | 90% | 2 | 30-40 | 15-20 (lower density) | Fuelwood |
| Willow / Poplar | | | | | |
| **(4) Degraded coppice stands on private land shifted into high forest** | 18000 ha | | | | |
| Pinus | | | | | |
| Quercus (Oak) | 70% | 5 | 30-35 | 25-30 | Fuelwood |
| Carpinus* | | 4 | 30-40 | 20-25 | Fuelwood* |
| Fruit trees / shrub | 30% | 2 | 30-40 | 20-25 | Fuelwood |
| Willow / Poplar | | | | | |
| **(5) Shelterbelts established in private land** | 500 ha | | | | |
| Pinus | | | | | |
| Quercus (Oak) | 10% | 0 | 0 | 0 | |
| Carpinus | | 0 | 0 | 0 | |
| Fruit trees / shrub | 40% | 0 | 0 | 0 | |
| Willow / Poplar / Robinia | 50% | 0 | 0 | 0 | |

*: Part of dominant Carpinus trees (30m3/ha) are logged in Y1 to make space for new trees

**Table 2: Forestry investment, average per hectare by activity and source**

| | Average USD/ha | GCF share (%) | Government co-financing (%) | Private (%) |
|---|---|---|---|---|
| Afforestation / Reforestation (public) | 2,298 | 37% | 63% | |
| Coppice Conv (public) | 759 | 10% | 90% | |
| Coppice Conv (private) | 761 | 10% | 85% | 5% |
| Land Rest (agroforestry) | 4,940 | 18% | 77% | 5% |
| Shelterbelts | 1,268 | 44% | 51% | 5% |

**Financial benefits** generated by the forest investment include: **a. wood products** (with fuelwood used as benchmark value), and **b. non-wood forest products** (including fruits from wild fruit trees). Additional **economic benefits** (not valued for the financial assessment of the investment) include **c. carbon sequestration** (according to the tree species, and with a social value defined in the economic analysis section), **d. pollination**, **e.** eco**tourism**, and **f. flood protection** (with a social value defined in according to proxy values form the Ecosystem Services Valuation Database (ESVD) and detailed in “FO.Benefit streams” TAB of the EFA spreadsheet. The types of benefits are summarized in **Table 3**. Specifically for Shelterbelts, besides being a demonstrated practice to enhance soil protection (avoiding aeolian erosion control), increased biodiversity, pollination services as well as (re)establish more suitable habitats and migration routes for wildlife, the benefit also include the potential utilization as insetting investment due to the carbon sequestration.

Table 3. OVERVIEW OF BENEFITS FROM FORESTRY INVESTMENT INCLUDED IN THE EFA

| Benefits | Financial value | Economic value | Applicable to: |
|---|---|---|---|
| **Wood Forest Products** | Yes | Yes | All forestry investments, according to the tree species |
| **Non-wood Forest Products** | Yes | Yes | All forestry investments, proportionately to fruit trees / shrubs |
| **Carbon sequestration** | No | Yes | All forestry investment according to tree species |
| **Other ecosystem benefits:** | | | |
| Pollination (from year 5 of the investment) | No | Yes | All forestry investments, according to the reference values from the Ecosystem Services Valuation Database (ESVD) and detailed in "FO.Benefit streams" TAB of the EFA spreadsheet) |
| Tourism (from year 7 of the investment) | No | Yes | |
| Flood protection (from year 7 of the investment) | No | Yes | |

**a. Wood products,** fuelwood is used as benchmark value, being the product with the lowest technical sophistication and the highest opportunity for commercialization for the forest owners participating in the project. The expected harvested quantities depend on the tree species and are summarized in **Table 1**. For wood price valuation, the analysis considered the latest available information (FAO, 2023)[19]. The average firewood prices in the heating season 2022/2023 (between 58 € per stacked m3 in Southern Serbia and 95.6 € per stacked m3 in Belgrade region / Vojvodina)[20]. Such difference in firewood purchase prices between the two regions depends on the availability of forest and the proximity to markets, making availability of wood in Southern Serbia significantly larger than in Belgrade region. The prevailing firewood price in Western Serbia and Central Serbia ranges from €70 to €72 per stacked cubic meter. For the analysis, a conservative benchmark corresponding to the Western and Central Serbia market (around 78 US$/m3) is considered as a reference for the analysis. Prices of wood at harvest (non-stacked) are assumed 30% lower due to different humidity content and weight compared to purchased firewood and set at an average 60 US$/m3.

**b. Non-wood forest products** (NWFP), including fruits from wild fruit trees such raspberries, blackberries, mulberries, as well as wild pears, apples and plums. Under the three types of investment described above, these wild fruits are expected to generate the limited yet positive harvest opportunities (**TABLE 4**). The financial prices are based on the prevailing wholesale prices in the country, deducting the cost of harvest.[21]

Table 4. FRUIT TREES HARVEST

| | Unit | FIN. Price US$/kg | Y1-Y5 | Y6-Y10 | Y11-Y20 | Y21-40 |
|---|---|---|---|---|---|---|
| Raspberries, blackberries, mulberries | kg/ha | 1.35 | - | 75 | 75 | 75 |
| Pear | kg/ha | 0.61 | - | 125 | 125 | 125 |
| Apple | kg/ha | 0.41 | - | 125 | 125 | 125 |
| Plum | kg/ha | 0.33 | - | 125 | 125 | 125 |

**Investment costs** for the forestry investment comprise labor, seedlings, transportation, equipment and contingencies. The values utilized in the analysis are based on the prevailing costs of forestry investment carried out by the project partners, including the Department of Forests and the Public Enterprises charged of the land preparation, planting and weeding (Public Enterprise "Srbijasume" for Central Serbia and PE Vojvodinasume for Vojvodina region).

**Financing** (further elements on concessionality are provided at the end of the analysis). The costs are shared between GCF financing and co-financing from the mentioned local partners. The GCF contribution represents an

[19] FAO, 2023. Prof. Dr Branko Glavonjić. Inventory of wood energy consumption and GHG emissions from wood fuels in Serbia. Produced within the FAO project TCP/SRB/3801/C1.

[20] In July 2021, FAO reported that the average firewood prices in the heating season 2020/2021 amounted to 50.8 € per stacked m3 in Vojvodina, and 33.3 € per stacked m3 in Eastern Serbia. The current prices correspond to a slightly less than 90% increase. Source: FAO, 2021. Prof. Dr Branko Glavonjić. Inventory of wood energy consumption and GHG emissions from wood fuels in Vojvodina and East Serbia, Produced within the FAO project TCP/SRB/3801/C1.

[21] https://www.selinawamucii.com/insights/prices/serbia/raspberries-blackberries-mulberries-and-log/, https://www.selinawamucii.com/insights/prices/serbia/pears/#import-prices, https://www.selinawamucii.com/insights/prices/serbia/apples/, https://www.selinawamucii.com/insights/prices/serbia/plums-and-sloes/

average of 35 percent of the total investment cost,[22] with complementary co-financing from the Department of Forests and the Public Enterprises. The GCF contribution is the necessary condition to ensure that the forestry investment is carried out in the most degraded and remote areas, and are comprising the required technical assistance to ensure the transfer of capacities for climate adaptive forestry investment and their systematic utilization in forestry investment in the country.

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**Financial analysis of forestry investment**. The financial analyses take into account the results of the six forestry investment models and reflects their respective net incremental benefits, compounding all investment costs, and the incremental revenues deriving from the sale of wood and non-wood forest products.

**Climate change impact on forestry investment**. In line with the climate scenario, all forestry models systematically integrate the expected impact of climate change on forest growth, represented as a variable benefits depending on the estimated climate change related risks (i.e., a ~20 percent drop of benefits every 4 to 5 years and sporadic increases of benefits). A sensitivity analysis for extreme climate related events beyond prediction was also carried out (including natural hazards that generate unexpected increase of costs of seedlings or reduced benefits from the survival rates of trees).

Under the above assumptions, the models were tested according to different options of investment financing.

**No GCF project financing scenario**. At first, the analysis assessed the financial performance of forest investment under the assumption that the landowner (either a public institution, or an individual/ private entity) would pay for the full amount of investment required (land preparation, seedlings, planting, equipment…). This scenario was tested to assess the financial performance of forestry investment in absence of any sort of public financial support. The detailed presentation of the financial performance of the forestry investment shows that under the current conditions of the financial market, **in the absence of GCF financing** and more in general in absence of public financing, **none of the forestry investment model is financially profitable** even under a 20 or 40 years' time horizons. This scenario confirms that no forestry investment would be feasible in the absence of concessional financing.

A summary of the internal rate of return (IRR) and the net present value (NPV) of the six forest models, both from the perspective of one individual hectare as well as for the entire project investment phased according to the capacity to meet the respective target hectares is presented in the table below (**TABLE 5**), and the corresponding details are available in the "FIN_FO.Models (all)" spreadsheet of the EFA.

[22] Details in the project cost tables.

**Table 5. Prospect of financial performance of the individual forestry models (No GCF financing)**

| | 10 year results IRR | NPV | 20 year results IRR | NPV | 40 year results IRR | NPV |
|---|---|---|---|---|---|---|
| **(1) AFFORESTATION (public land) (7,000 ha)** | | | | | | |
| 1ha model | -22.8% | (1,625) | -3.0% | (1,261) | 3.0% | (944) |
| **Aggregated** | #NUM! | (9,600,195) | -6.3% | (7,472,552) | 2.6% | (5,327,893) |
| **2. COPPICE CONVERSION in Public Land (33,000 ha)** | | | | | | |
| 1ha model | -20.8% | (330) | -1.7% | (241) | 3.7% | (166) |
| **BASE** | #NUM! | (9,345,402) | -4.9% | (6,892,449) | 3.4% | (4,470,540) |
| **(3.a) UNFARMED LAND RESTORATION for energy use (150 ha)** | | | | | | |
| 1ha model | -23.4% | (9,190) | -8.9% | (8,567) | -1.1% | (7,818) |
| **BASE** | #NUM! | (1,157,049) | -12.0% | (1,030,008) | -1.7% | (926,202) |
| **(3.b) UNFARMED RESTORATION for agroforestry (350 ha)** | | | | | | |
| 1ha model | -17.8% | (3,635) | 0.4% | (2,306) | 4.9% | (1,270) |
| **BASE** | #NUM! | (1,125,945) | -2.5% | (735,703) | 4.6% | (374,982) |
| **(4) COPPICE CONVERSION: Private (18,000 ha)** | | | | | | |
| 1ha model | -20.8% | (330) | -1.7% | (241) | 3.7% | (166) |
| **BASE** | #NUM! | (5,097,492) | -4.9% | (3,759,518) | 3.4% | (2,438,476) |
| **(5) SHELTERBELTS: Private (500 ha)** | | | | | | |
| 1ha model | -27.9% | (4,736) | -6.8% | (4,145) | 0.1% | (3,682) |
| **BASE** | #NUM! | (1,937,658) | -10.6% | (1,689,885) | -0.4% | (1,459,881) |

Source: "FIN_FO.Models (all)"

**Cost-sharing scenarios**. While for investment in public land the analysis has always considered full project funding, for forest investment in private land the analysis was performed with different financing scenarios, between a minimal self-financing from private owners (including a sensitivity analysis on the price of fuelwood as the major source of income and as presenting a growing price in the last seasons)[23] to a loan financing of the forestry investment at prevailing market terms. These have allowed to assess a range of appropriate levels of concessionality for the investment. The scenarios, and their results, are reported in the following paragraphs.

**Scenario A: 10% investment contribution from the private landowners**. This scenario is tested to assess the solidity of the forestry models to a potential contribution from the private landowners. The scenario implies that the private owners would: **i.** contribute to 10% of the overall forestry investment, **ii**. bear the full cost of wood harvesting needed to clear the land before land preparation, and **iii.** benefit from the full amount of wood harvested (accounted for at fuelwood prices). Three additional sub-scenarios were produced, to test the sensitivity of the assumptions to fuelwood price reductions (**Table 6**, below summarizes the results, reported in FIN_FO.Models (private-Base); (private-sens.1); and (private-sens.2)).

- *Results*. For unfarmed land restoration for (3.a) fuelwood production and (3.b) agroforestry, as well as (4) coppice conversion, the results show that even if the investment is potentially profitable under a 10 year horizon, the payback period (ie, the time required for the private owner to start benefitting of a positive financial stream) is ranging between six and eight years, with a consequent risk of making the investment decision unattractive for the private owner (further constrained by the general practice of full concessionality, and the likely high transaction cost unaccounted for in the analysis). This is valid also for (4) degraded coppice conversion, that has a 244 US$ on 40-year basis NPV. For (5) shelterbelts, the investment is only profitable under a 20-year horizon, and with an unattractive payback period of 11 years.

[23] See above "wood products", where it is reported that fuelwood prices increased by about 90% between 2020/21 and 2022/23 (Source: FAO, 2021; FAO, 2023 cited above).

- *Fuelwood price fluctuation sensitivity*. Similar results are found when testing the sensitivity to fuelwood price reduction, with the exception of unfarmed land restoration for (3.a) fuelwood production. Under a 20% fuelwood price reduction assumption, such model appears as not profitable, with payback period likely over 20 years, making the investment fully unattractive for private investors.

**Table 6. Financial analysis of private forestry investment under Scenario A (90% concessionality)**

| 90% concessionality | base fuelwood price | | | 10% reduced fuelwood price | | | 20% reduced fuelwood price | | |
|---|---|---|---|---|---|---|---|---|---|
| | 10 Years | 20 Years | 40 Years | 10 Years | 20 Years | 40 Years | 10 Years | 20 Years | 40 Years |
| **3.a Land restoration / energy:** | | % on fuelwood revenues: | | | % on fuelwood revenues: | | | % on fuelwood revenues: | |
| - investment cost per private owner (USD): | 898 | | 50% | 898 | | 55% | 898 | | 62% |
| - fuelwood harvesting cost on Y1 (USD): | 1,332 | | | 1,332 | | | 1,332 | | |
| + revenue from Y1 fuelwood harvest Y1 (USD): | 1,811 | | | 1,629 | | | 1,448 | | |
| IRR (%) | 32% | 34% | 34% | 9% | 13% | 15% | -14% | -11% | -4% |
| NPV (USD) | 936 | 1,558 | 2,308 | 94 | 360 | 769 | -748 | -838 | -769 |
| Payback (Year) | Y6 | | | Y6 | | | n/a | | |
| **3.b Land restoration / agroforestry:** | | % on fuelwood revenues: | | | % on fuelwood revenues: | | | % on fuelwood revenues: | |
| - investment cost per private owner (USD): | 511 | | 28% | 511 | | 31% | 511 | | 35% |
| - fuelwood harvesting cost on Y1 (USD): | 1,332 | | | 1,332 | | | 1,332 | | |
| + revenue from Y1 fuelwood harvest Y1 (USD): | 1,811 | | | 1,629 | | | 1,448 | | |
| IRR (%) | 49% | 54% | 54% | 25% | 33% | 33% | 16% | 25% | 26% |
| NPV (USD) | 617 | 1,946 | 2,982 | 453 | 1,779 | 2,802 | 289 | 1,612 | 2,621 |
| Payback (Year) | Y6 | | | Y6 | | | Y7 | | |
| **4. Coppice conversion:** | | % on fuelwood revenues: | | | % on fuelwood revenues: | | | % on fuelwood revenues: | |
| - investment cost per private owner (USD): | 49 | | 14% | 49 | | 15% | 49 | | 17% |
| - fuelwood harvesting cost on Y1 (USD): | 266 | | | 266 | | | 266 | | |
| + revenue from Y1 fuelwood harvest Y1 (USD): | 362 | | | 326 | | | 290 | | |
| IRR (%) | #NUM! | #NUM! | #DIV/0! | #NUM! | #NUM! | #NUM! | 13% | 23% | 24% |
| NPV (USD) | 80 | 169 | 244 | 47 | 135 | 206 | 14 | 101 | 169 |
| Payback (Year) | Y1 | | | Y1 | | | Y8 | | |
| **5. Shelterbelts** | | % on fuelwood revenues: | | | % on fuelwood revenues: | | | % on fuelwood revenues: | |
| - investment cost per private owner (USD): | 545 | | n/a | 545 | | n/a | 545 | | n/a |
| - fuelwood harvesting cost on Y1 (USD): | - | | | - | | | - | | |
| + revenue from Y1 fuelwood harvest Y1 (USD): | - | | | - | | | - | | |
| IRR (%) | 0% | 13% | 15% | 0% | 13% | 15% | 0% | 13% | 15% |
| NPV (USD) | -199 | 407 | 924 | -199 | 405 | 915 | -199 | 403 | 907 |
| Payback (Year) | Y11 | | | Y11 | | | Y11 | | |

**Scenario B**: **5% investment contribution from the private landowners**. This scenario is tested as it is the closest to the prevailing practice in Serbia, where the full investment cost is covered by the public sector (i.e., under full concessionality) as forestry investment are considered not profitable from a purely financial viewpoint. Similar to Scenario A, this also implies a contribution from private owners for 5% of the overall forestry investment, with all cost of wood harvesting under private owner responsibility, and the full benefits from the wood harvested for the private owners. Three additional sub-scenarios tested the sensitivity of the models to fuelwood price reductions were added to this one (**Table 7**, below summarizes the results, reported in detail in FIN_FO.Models (private-sens.3); (private-sens.4); and (private-sens.5)).

- *Results*. Expectedly, this scenario presents more solid financial performance than the above. For all investment models, the financial performance is sufficiently attractive for private investors, and presents a more acceptable payback period that could encourage private operators to undertake the investment.
- *Fuelwood price fluctuation sensitivity*. The results seem largely confirmed under potential price reductions, with the exception of unfarmed land restoration for (3.a) fuelwood production.
- *Seedlings and Labour cost price fluctuation sensitivity*. The results were also tested to seedlings and labour price raise, and show robust results to an increase of 50% of labour cost and twofold increase of seedlings price. The results present negligible differences with the base cost (tested on the private-sens. 3 scenario described above), summarized in Table 20 in Appendix 3. **Sensitivity of models to Seedlings and Labour cost increase**).
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### Table 7. Financial analysis of private forestry investment under Scenario B (95% concessionality)

| 95% concessionality | base fuelwood price 10 Years | 20 Years | 40 Years | 10% reduced fuelwood price 10 Years | 20 Years | 40 Years | 20% reduced fuelwood price 10 Years | 20 Years | 40 Years |
|---|---|---|---|---|---|---|---|---|---|
| **3.a Land restoration / energy:** | | % on fuelwood revenues: | | | % on fuelwood revenues: | | | % on fuelwood revenues: | |
| - investment cost per private owner (USD): | 449 | | 25% | 449 | | 28% | 449 | | 31% |
| - fuelwood harvesting cost on Y1 (USD): | 1,332 | | | 1,332 | | | 1,332 | | |
| + revenue from Y1 fuelwood harvest Y1 (USD): | 1,811 | | | 1,629 | | | 1,448 | | |
| IRR (%) | 182% | 182% | 182% | 30% | 31% | 31% | -7% | -7% | 0% |
| NPV (USD) | 1,355 | 1,978 | 2,728 | 513 | 780 | 1,189 | -329 | -418 | -350 |
| Payback (Year) | Y6 | | | Y6 | | | Y30 | | |
| **3.b Land restoration / agroforestry:** | | % on fuelwood revenues: | | | % on fuelwood revenues: | | | % on fuelwood revenues: | |
| - investment cost per private owner (USD): | 256 | | 14% | 256 | | 16% | 256 | | 18% |
| - fuelwood harvesting cost on Y1 (USD): | 1,332 | | | 1,332 | | | 1,332 | | |
| + revenue from Y1 fuelwood harvest Y1 (USD): | 1,811 | | | 1,629 | | | 1,448 | | |
| IRR (%) | #NUM! | #NUM! | #NUM! | 128% | 129% | 129% | 32% | 39% | 39% |
| NPV (USD) | 856 | 2,185 | 3,221 | 692 | 2,018 | 3,041 | 527 | 1,851 | 2,860 |
| Payback (Year) | Y1 | | | Y6 | | | Y6 | | |
| **4. Coppice conversion:** | | % on fuelwood revenues: | | | % on fuelwood revenues: | | | % on fuelwood revenues: | |
| - investment cost per private owner (USD): | 25 | | 7% | 25 | | 8% | 25 | | 8% |
| - fuelwood harvesting cost on Y1 (USD): | 266 | | | 266 | | | 266 | | |
| + revenue from Y1 fuelwood harvest Y1 (USD): | 362 | | | 326 | | | 290 | | |
| IRR (%) | #NUM! | #NUM! | #NUM! | #NUM! | #NUM! | #NUM! | 36% | 42% | 43% |
| NPV (USD) | 103 | 192 | 267 | 70 | 158 | 229 | 37 | 124 | 192 |
| Payback (Year) | Y1 | | | Y1 | | | Y6 | | |
| **5. Shelterbelts** | | % on fuelwood revenues: | | | % on fuelwood revenues: | | | % on fuelwood revenues: | |
| - investment cost per private owner (USD): | 273 | | n/a | 273 | | n/a | 273 | | n/a |
| - fuelwood harvesting cost on Y1 (USD): | - | | | - | | | - | | |
| + revenue from Y1 fuelwood harvest Y1 (USD): | - | | | - | | | - | | |
| IRR (%) | 10% | 21% | 22% | 10% | 21% | 22% | 10% | 21% | 22% |
| NPV (USD) | 56 | 661 | 1,179 | 56 | 660 | 1,170 | 56 | 658 | 1,161 |
| Payback (Year) | Y8 | | | Y8 | | | Y8 | | |

**Scenario C: forestry investment financed by a commercial loan**. This scenario was tested to simulate the potential attractiveness of private owners for forestry investments financed by a loan at commercial rate, and no concessional project financing. This scenario was performed under the prevailing loan commercial terms of a five year duration and two sub-scenarios for the interest rate of 7% and of 4.5%. As for the previous scenario the full set of incremental revenues from harvested wood and non-wood forest products are entirely enjoyed by the private owners.

- *Results*. Specific performance of the models is summarized in **Table 8** and **Table 9**, and suggest that none of the models presents positive financial performance even in the span of 20 years, and is positive only for models 3.b and 4 under the 40-year horizon. Details are presented in FIN_FO.Models loans @ 7% and @ 4.5% TABs of the EFA spreadsheet.

### Table 8. Financial performance of forestry models financed by a 7% interest loan

| Forestry Investment financed by a loan<br>7% interest rate | 10 year results IRR | NPV | 20 year results IRR | NPV | 40 year results IRR | NPV | |
|---|---|---|---|---|---|---|---|
| **(3.a) UNFARMED LAND RESTORATION for energy use (150 ha)** | | | | | | | **Payback:** |
| 1ha model | <-30% | -6,609 | -9.0% | -5,986 | -0.4% | -5,236 | n/a |
| **BASE** | <-30% | -853,573 | -12.8% | -726,532 | -1.0% | -622,726 | Years |
| **(3.b) UNFARMED LAND RESTORATION for agroforestry (350 ha)** | | | | | | | **Payback:** |
| 1ha model | -26.2% | -4,592 | -1.9% | -3,237 | 3.9% | -2,097 | 24 |
| **BASE** | <-30% | -1,388,567 | -5.8% | -998,324 | 3.6% | -603,666 | Years |
| **(4) COPPICE CONVERSION: Private (18,000 ha)** | | | | | | | **Payback:** |
| 1ha model | -31.1% | -469 | -4.1% | -370 | 3.0% | -269 | 30 |
| **BASE** | <-30% | -7,052,548 | -9.4% | -5,714,574 | 2.7% | -3,922,912 | Years |
| **(5) SHELTERBELTS: Private (500 ha)** | | | | | | | **Payback:** |
| 1ha model | -37.2% | -5,280 | -8.6% | -4,675 | -0.2% | -4,157 | n/a |
| **BASE** | <-30% | -2,151,034 | -13.7% | -1,903,261 | -0.8% | -1,647,608 | Years |

**Table 9. Financial performance of forestry models financed by a 4.5% interest loan**

| Forestry Investment financed by a loan 4.5% interest rate | 10 year results IRR | 10 year results NPV | 20 year results IRR | 20 year results NPV | 40 year results IRR | 40 year results NPV | |
|---|---|---|---|---|---|---|---|
| **(3.a) UNFARMED LAND RESTORATION for energy use (150 ha)** | | | | | | | **Payback:** |
| 1ha model | <-30% | -6,247 | -8.7% | -5,625 | -0.1% | -4,875 | n/a |
| **BASE** | <-30% | -811,105 | -12.4% | -684,064 | -0.7% | -580,258 | Years |
| **(3.b) UNFARMED LAND RESTORATION for agroforestry (350 ha)** | | | | | | | **Payback:** |
| 1ha model | -25.9% | -4,414 | -1.6% | -3,058 | 4.1% | -1,918 | 23 |
| **BASE** | <-30% | -1,339,480 | -5.5% | -949,237 | 3.8% | -554,579 | Years |
| **(4) COPPICE CONVERSION: Private (18,000 ha)** | | | | | | | **Payback:** |
| 1ha model | <-30% | -451 | -3.9% | -353 | 3.2% | -252 | 30 |
| **BASE** | <-30% | -6,809,281 | -9.1% | -5,471,307 | 2.8% | -3,679,644 | Years |
| **(5) SHELTERBELTS: Private (500 ha)** | | | | | | | **Payback:** |
| 1ha model | -36.9% | -5,089 | -8.4% | -4,484 | -0.1% | -3,966 | n/a |
| **BASE** | <-30% | -2,076,221 | -13.5% | -1,828,448 | -0.6% | -1,572,796 | Years |

**Findings**. The financial performance of the forestry sector is overall very low, and presents a limited attractiveness for private sector investment. Despite the positive net incremental revenues flow from the initial wood harvesting to clear the land, the non-wood forest products likely available after the fifth year from planting, the investment for private owners remains barely profitable even with a high concessionality (including 90-95 percent of the costs fully covered by the project / public sector), and even in this case the financial flow starts to become positive only after 6-10 years. The low level of financial profitability suggests that public resources are required for forestry investment (as the benefits will largely be only of economic nature). The results also suggest that a possible interest of the private sector is only feasible under a high degree of concessional financing[24].

- The scenarios analysed are helpful also to determine the threshold of possible contribution from private owners to participate in the project. Taking into account the negative financial performance of investment not sufficiently supported by public funds, the analysis narrows down the options for private sector participation to a scenario with a minimum 90% concessionality (described respectively in scenario A). This option is further narrowed down to the highest level of concessionality of 95% (described in Scenario B), due to the high sensitivity to prices and cost fluctuations shown by the models, which translates into an additional incentive to ensure the actual investment decision on the large scale envisaged by the project.
- Under this scenario, the overall investment from the private owners ranges from 25 US$ / ha for the coppice conversion to 450 US$ / ha for land restoration for fuelwood production. With the exception for the Shelterbelts (not generating fuelwood), such amounts can be covered by the revenues deriving from the sale of fuelwood harvested in the first year of investment.

**Additional benefits:** A set of benefits remain unaccounted (employment generation, spillover effects, access to markets). Specifically, on **employment generation**, forestry investments are highly labor intensive. In the case of the project, the labor required to implement the 59,000 ha of forest investment is over 560,000 person days over a span of 6 years, corresponding to about 2,570 full time equivalent jobs. Labor also represents a resource (and potential investment). Throughout the project, local labor will be contracted and will be trained upfront and on the job, ultimately increasing local capacities to manage forest and enhancing the sustainability of the forest investment.

[24] Different is the case of a valuation of shelterbelts as an insetting investment, upon condition that the owner is able to sell the carbon credits generated by the forest within a certain time period.

**Sources of benefits and input intensity**: The models highlight that the sources of benefits are distributed across type of investment in forestry. Investments to convert degraded coppice stands on state-owned and private lands to high forest represent more than 55% of total benefits. Together with afforestation, and again due to the large area targeted for degraded coppice conversion, investments in coppice stands on state-owned lands are the most labor intensive activities.

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**Economic analysis of forestry models**. The economic benefits associated with forest investment are composed of **i)** the valuation of carbon sequestration, and **ii)** the valuation of other ecosystem services (pollination, tourism, flood protection). For carbon sequestration, the analysis has taken into account the valuation of the incremental carbon sequestration taking into account the above and below ground incremental biomass associated by the forest investment, at a standard value of 40 US$ / tCO2e. **TABLE 10** summarizes the expected tonnes of CO2e sequestered for each tree species. These values have been applied to the models in order to compute the respective tree species composition's contributions.

**Table 10. CO2e sequestration, for all Forestry Models**

| tCO2e/ha | Y1-4 | Y5-9 | Y10-14 | Y15-19 | Y20-29 | Y30-39 | Y40 |
|---|---|---|---|---|---|---|---|
| Pinus | 0.4 | 2.6 | 8.0 | 14.0 | 20.0 | 30.0 | 43.2 |
| Quercus (Oak) | 0.7 | 3.4 | 13.7 | 23.0 | 34.0 | 50.0 | 68.3 |
| Carpinus | 0.4 | 2.0 | 6.9 | 12.0 | 18.0 | 30.0 | 40.5 |
| Fruit trees / shrub | 0.1 | 0.6 | 2.4 | 4.0 | 6.0 | 9.0 | 12.2 |
| Willow / Poplar | 0.6 | 16.1 | 32.1 | 48.2 | 64.2 | 64.2 | 64.2 |

Overall, the **economic returns** of the forestry interventions are largely positive. All six forestry investment generate positive Economic-IRR and Economic-NPV under the base scenario (which incorporates already the expected **impact of climate change**), under a 20-year horizon and a 40 year horizon (the analysis show that only the case of unfarmed land restoration (investment 3.a and 3.b the 10-year horizon is sufficient to produce positive economic returns). **TABLE 11** provides an overview of the economic performance of the individual forestry models under the base scenario of a 40 US$/t CO2e social value of carbon, the forestry models.

**Sensitivity analysis**. For each model, a sensitivity analysis has been applied to assess the impact of climate and other variables on costs. The results show that even with decreases of benefits or equivalent increases in costs of inputs, overall, the analysis shows positive results for the 20 and 40-year horizon (the results are presented in the same **Table 11**).

The overall project-supported forestry investments were tested also against variations of the price of carbon, as the largest source of economic benefits. Besides the base scenario, two alternative prices of carbon were taken into account:

a. 19 US$/t CO2e, corresponding to the 2021 average value under the ETS, and
b. 10 US$/t CO2e as the lowest benchmark of the public initiatives (reference: WB, 2021). Even with a significant drop of the value of carbon, the investment presents positive economic returns, significantly above the social discount rate under both a 20-year and 40-year horizon (**TABLE 12**).

As a conclusion, **all forestry investments are largely solid from an economic standpoint**.

**Table 11. Summary of Economic performance of forestry models**

| | ECON Price per Unit (SD) |
|---|---|
| WB social price of carbon | 40 |

| | (1) AFFORESTATION (public land) (7,000 ha) | 10 year results | | 20 year results | | 40 year results | |
|---|---|---|---|---|---|---|---|
| | | Econ-IRR | Econ-NPV | Econ-IRR | Econ-NPV | Econ-IRR | Econ-NPV |
| | 1ha model | -4% | (804.59) | 13.3% | 1,969.11 | 16% | 6,395.15 |
| Base scenario | BASE | #NUM! | (7,508,235) | 10.9% | 5,369,325 | 16.0% | 32,915,714 |
| Sensitivity Analysis | Costs: +10% | #NUM! | (8,408,659) | 9.8% | 4,468,901 | 15.2% | 32,015,290 |
| | Costs: +20% | #NUM! | (9,309,083) | 8.9% | 3,568,477 | 14.5% | 31,114,866 |
| | Costs: +30% | #NUM! | (10,209,507) | 8.1% | 2,668,053 | 13.9% | 30,214,442 |
| | Benefits: -10% | #NUM! | (7,644,235) | 9.8% | 4,062,637 | 15.2% | 29,104,809 |
| | Benefits: -20% | #NUM! | (7,757,569) | 8.9% | 2,973,731 | 14.5% | 25,929,055 |
| | Benefits: -30% | #NUM! | (7,853,467) | 8.1% | 2,052,348 | 13.9% | 23,241,879 |

| | 2. COPPICE CONVERSION in Public Land (33,000 ha) Detailed Results | 10 year results | | 20 year results | | 40 year results | |
|---|---|---|---|---|---|---|---|
| | | Econ-IRR | Econ-NPV | Econ-IRR | Econ-NPV | Econ-IRR | Econ-NPV |
| | 1ha model | 18% | 139.61 | 31% | 1,290.36 | 32% | 2,793.72 |
| Base scenario | BASE | -11.9% | (1,850,424) | 30.2% | 23,908,088 | 31.9% | 69,639,598 |
| Sensitivity Analysis | Costs: +10% | -17.6% | (2,969,718) | 26.2% | 22,788,794 | 28.4% | 68,520,305 |
| | Costs: +20% | -21.7% | (4,089,011) | 23.3% | 21,669,501 | 25.8% | 67,401,011 |
| | Costs: +30% | -25.0% | (5,208,305) | 21.0% | 20,550,207 | 23.8% | 66,281,718 |
| | Benefits: -10% | -17.6% | (2,699,743) | 26.2% | 20,717,086 | 28.4% | 62,291,186 |
| | Benefits: -20% | -21.7% | (3,407,509) | 23.3% | 18,057,917 | 25.8% | 56,167,509 |
| | Benefits: -30% | -25.0% | (4,006,388) | 21.0% | 15,807,852 | 23.8% | 50,985,937 |

| | (3.a) UNFARMED LAND RESTORATION for energy use (150 ha) Detailed Results | 10 year results | | 20 year results | | 40 year results | |
|---|---|---|---|---|---|---|---|
| | | Econ-IRR | Econ-NPV | Econ-IRR | Econ-NPV | Econ-IRR | Econ-NPV |
| | 1ha model | 23% | 4,219.28 | 29% | 15,087.50 | 30% | 28,469.66 |
| Base scenario | BASE | 7.4% | 19,416 | 28.8% | 1,406,920 | 30.0% | 3,291,568 |
| Sensitivity Analysis | Costs: +10% | 3.6% | (36,480) | 26.2% | 1,351,023 | 27.6% | 3,235,672 |
| | Costs: +20% | 0.5% | (92,376) | 24.1% | 1,295,127 | 25.7% | 3,179,775 |
| | Costs: +30% | -2.3% | (148,273) | 22.2% | 1,239,231 | 24.1% | 3,123,879 |
| | Benefits: -10% | 3.6% | (33,164) | 26.2% | 1,228,203 | 27.6% | 2,941,520 |
| | Benefits: -20% | 0.5% | (76,980) | 24.1% | 1,079,273 | 25.7% | 2,649,813 |
| | Benefits: -30% | -2.3% | (114,056) | 22.2% | 953,255 | 24.1% | 2,402,984 |

| | (3.b) UNFARMED LAND RESTORATION for agroforestry (350 ha) Detailed Results | 10 year results | | 20 year results | | 40 year results | |
|---|---|---|---|---|---|---|---|
| | | Econ-IRR | Econ-NPV | Econ-IRR | Econ-NPV | Econ-IRR | Econ-NPV |
| | 1ha model | 44% | 750.38 | 52% | 3,417.70 | 52% | 6,675.23 |
| Base scenario | BASE | 20.7% | 27,888 | 51.2% | 717,980 | 51.7% | 1,782,050 |
| Sensitivity Analysis | Costs: +10% | 0.8% | (16,823) | 34.4% | 673,269 | 35.6% | 1,737,339 |
| | Costs: +20% | -8.4% | (61,535) | 27.5% | 628,558 | 29.2% | 1,692,627 |
| | Costs: +30% | -14.2% | (106,246) | 23.2% | 583,846 | 25.3% | 1,647,916 |
| | Benefits: -10% | 0.8% | (15,294) | 34.4% | 612,063 | 35.6% | 1,579,399 |
| | Benefits: -20% | -8.4% | (51,279) | 27.5% | 523,798 | 29.2% | 1,410,523 |
| | Benefits: -30% | -14.2% | (81,728) | 23.2% | 449,113 | 25.3% | 1,267,628 |

| | (4) COPPICE CONVERSION: Private (18,000 ha) Detailed Results | 10 year results | | 20 year results | | 40 year results | |
|---|---|---|---|---|---|---|---|
| | | Econ-IRR | Econ-NPV | Econ-IRR | Econ-NPV | Econ-IRR | Econ-NPV |
| | 1ha model | 18% | 139.61 | 31% | 1,290.36 | 32% | 2,793.72 |
| Base scenario | BASE | -11.9% | (1,009,322) | 30.2% | 13,040,775 | 31.9% | 37,985,235 |
| Sensitivity Analysis | Costs: +10% | -17.6% | (1,619,846) | 26.2% | 12,430,251 | 28.4% | 37,374,712 |
| | Costs: +20% | -21.7% | (2,230,370) | 23.3% | 11,819,728 | 25.8% | 36,764,188 |
| | Costs: +30% | -25.0% | (2,840,893) | 21.0% | 11,209,204 | 23.8% | 36,153,664 |
| | Benefits: -10% | -17.6% | (1,472,587) | 26.2% | 11,300,229 | 28.4% | 33,977,011 |
| | Benefits: -20% | -21.7% | (1,858,641) | 23.3% | 9,849,773 | 25.8% | 30,636,823 |
| | Benefits: -30% | -25.0% | (2,185,303) | 21.0% | 8,622,465 | 23.8% | 27,810,511 |

| | (5) SHELTERBELTS: Private (500 ha) Detailed Results | 10 year results | | 20 year results | | 40 year results | |
|---|---|---|---|---|---|---|---|
| | | Econ-IRR | Econ-NPV | Econ-IRR | Econ-NPV | Econ-IRR | Econ-NPV |
| | 1ha model | 9% | 282.39 | 21% | 5,406.21 | 22% | 12,066.85 |
| Base scenario | BASE | -13.6% | (393,640) | 19.3% | 1,447,338 | 22.1% | 4,590,309 |
| Sensitivity Analysis | Costs: +10% | -15.6% | (463,358) | 18.0% | 1,377,621 | 21.1% | 4,520,591 |
| | Costs: +20% | -17.4% | (533,075) | 16.9% | 1,307,903 | 20.1% | 4,450,874 |
| | Costs: +30% | -19.0% | (602,792) | 15.8% | 1,238,186 | 19.3% | 4,381,157 |
| | Benefits: -10% | -15.6% | (421,234) | 18.0% | 1,252,383 | 21.1% | 4,109,628 |
| | Benefits: -20% | -17.4% | (444,229) | 16.9% | 1,089,920 | 20.1% | 3,709,062 |
| | Benefits: -30% | -19.0% | (463,686) | 15.8% | 952,451 | 19.3% | 3,370,120 |

*Source: EFA Spreadsheet, ECON_FO.Models*

### Table 12. Summary of Economic performance of the project forestry investments

| | ECON Price per Unit (SD) | |
|---|---|---|
| WB social price of carbon | 40.00 | BASE |

| | All Forestry Investment | | | | | | |
|---|---|---|---|---|---|---|---|
| | Detailed Results | 10 year results | | 20 year results | | 40 year results | |
| | | Econ-IRR | Econ-NPV | Econ-IRR | Econ-NPV | Econ-IRR | Econ-NPV |
| Base scenario | BASE | 22.8% | 8,858,956 | 40.0% | 92,907,116 | 40.6% | 219,035,616 |
| Sensitivity Analysis | Costs: +10% | 16.1% | 6,058,390 | 35.5% | 90,106,550 | 36.3% | 216,235,050 |
| | Costs: +20% | 10.9% | 3,257,824 | 31.9% | 87,305,984 | 33.0% | 213,434,484 |
| | Costs: +30% | 6.6% | 457,257 | 29.1% | 84,505,418 | 30.4% | 210,633,918 |
| | Benefits: -10% | 16.1% | 5,507,627 | 35.5% | 81,915,046 | 36.3% | 196,577,319 |
| | Benefits: -20% | 10.9% | 2,714,853 | 31.9% | 72,754,987 | 33.0% | 177,862,070 |
| | Benefits: -30% | 6.6% | 351,736 | 29.1% | 65,004,168 | 30.4% | 162,026,091 |

| Forestry Investment Model | hectares | 10 year results | | 20 year results | | 40 year results | |
|---|---|---|---|---|---|---|---|
| | | Econ-IRR | Econ-NPV | Econ-IRR | Econ-NPV | Econ-IRR | Econ-NPV |
| 1. Aff/Ref (public) | 7,000 | #NUM! | (7,508,235) | 11% | 5,369,325 | 16% | 32,915,714 |
| 2. Coppice conv. (public) | 33,000 | -12% | (1,850,424) | 30% | 23,908,088 | 32% | 69,639,598 |
| 3.a Land Rest. (energy) | 150 | 7% | 19,416 | 29% | 1,406,920 | 30% | 3,291,568 |
| 3.b Land Rest. (agrof.) | 350 | 21% | 27,888 | 51% | 717,980 | 52% | 1,782,050 |
| 4. Coppice conv. (private) | 18,000 | -12% | (1,009,322) | 30% | 13,040,775 | 32% | 37,985,235 |
| 5. Shelterbelts | 500 | -14% | (393,640) | 19% | 1,447,338 | 22% | 4,590,309 |

| | ECON Price per Unit (SD) | |
|---|---|---|
| WB social price of carbon | 19.00 | ETS |

| | All Forestry Investment | | | | | | |
|---|---|---|---|---|---|---|---|
| | Detailed Results | 10 year results | | 20 year results | | 40 year results | |
| | | Econ-IRR | Econ-NPV | Econ-IRR | Econ-NPV | Econ-IRR | Econ-NPV |
| Base scenario | BASE | #NUM! | (12,629,977) | 17.5% | 30,465,479 | 20.7% | 101,014,835 |
| Sensitivity Analysis | Costs: +10% | #NUM! | (15,430,544) | 15.6% | 27,664,913 | 19.1% | 98,214,269 |
| | Costs: +20% | #NUM! | (18,231,110) | 14.0% | 24,864,347 | 17.9% | 95,413,703 |
| | Costs: +30% | #NUM! | (21,031,676) | 12.7% | 22,063,781 | 16.8% | 92,613,137 |
| | Benefits: -10% | #NUM! | (14,027,767) | 15.6% | 25,149,921 | 19.1% | 89,285,699 |
| | Benefits: -20% | #NUM! | (15,192,591) | 14.0% | 20,720,289 | 17.9% | 79,511,419 |
| | Benefits: -30% | #NUM! | (16,178,212) | 12.7% | 16,972,139 | 16.8% | 71,240,875 |

| Forestry Investment Model | hectares | 10 year results | | 20 year results | | 40 year results | |
|---|---|---|---|---|---|---|---|
| | | Econ-IRR | Econ-NPV | Econ-IRR | Econ-NPV | Econ-IRR | Econ-NPV |
| 1. Aff/Ref (public) | 7,000 | #NUM! | (8,119,617) | 7% | 527,234 | 13% | 17,180,594 |
| 2. Coppice conv. (public) | 33,000 | -21% | (2,547,130) | 26% | 17,997,402 | 28% | 50,419,134 |
| 3.a Land Rest. (energy) | 150 | 2% | (56,636) | 24% | 942,338 | 26% | 2,140,775 |
| 3.b Land Rest. (agrof.) | 350 | 14% | 15,133 | 46% | 610,184 | 47% | 1,430,979 |
| 4. Coppice conv. (private) | 18,000 | -21% | (1,389,343) | 26% | 9,816,765 | 28% | 27,501,346 |
| 5. Shelterbelts | 500 | -25% | (532,385) | 13% | 571,556 | 17% | 2,342,008 |

| | ECON Price per Unit (SD) | |
|---|---|---|
| WB social price of carbon | 10 | Low |

| | All Forestry Investment | | | | | | |
|---|---|---|---|---|---|---|---|
| | Detailed Results | 10 year results | | 20 year results | | 40 year results | |
| | | Econ-IRR | Econ-NPV | Econ-IRR | Econ-NPV | Econ-IRR | Econ-NPV |
| Base scenario | BASE | #NUM! | (13,450,974) | 15.6% | 23,854,788 | 19.0% | 79,933,562 |
| Sensitivity Analysis | Costs: +10% | #NUM! | (16,251,541) | 13.8% | 21,054,222 | 17.5% | 77,132,996 |
| | Costs: +20% | #NUM! | (19,052,107) | 12.3% | 18,253,656 | 16.3% | 74,332,430 |
| | Costs: +30% | #NUM! | (21,852,673) | 11.0% | 15,453,089 | 15.3% | 71,531,864 |
| | Benefits: -10% | #NUM! | (14,774,128) | 13.8% | 19,140,201 | 17.5% | 70,120,905 |
| | Benefits: -20% | #NUM! | (15,876,756) | 12.3% | 15,211,380 | 16.3% | 61,943,691 |
| | Benefits: -30% | #NUM! | (16,809,748) | 11.0% | 11,886,992 | 15.3% | 55,024,510 |

| Forestry Investment Model | hectares | 10 year results | | 20 year results | | 40 year results | |
|---|---|---|---|---|---|---|---|
| | | Econ-IRR | Econ-NPV | Econ-IRR | Econ-NPV | Econ-IRR | Econ-NPV |
| 1. Aff/Ref (public) | 7,000 | #NUM! | (8,381,637) | 4% | (1,547,947) | 11% | 10,436,971 |
| 2. Coppice conv. (public) | 33,000 | #NUM! | (2,845,718) | 24% | 15,464,251 | 26% | 42,181,792 |
| 3.a Land Rest. (energy) | 150 | -1% | (89,230) | 22% | 743,231 | 23% | 1,647,578 |
| 3.b Land Rest. (agrof.) | 350 | 11% | 9,666 | 44% | 563,986 | 45% | 1,280,519 |
| 4. Coppice conv. (private) | 18,000 | #NUM! | (1,552,210) | 24% | 8,435,046 | 26% | 23,008,250 |
| 5. Shelterbelts | 500 | #NUM! | (591,847) | 9% | 196,220 | 13% | 1,378,451 |

Source: ECON_Aggregated (DET)

In addition to the financial and economic benefits considered above, we analyzed the potential two additional revenue-generating activities on forested areas: ecotourism and apiculture. While the benefits from these models are not included in the aggregate benefits from the project, they serve to illustrate potential kinds of additional financial returns. Note that the aggregate benefits from the project include ecosystem benefits from ecotourism and pollination (but not from the models).

1. **Ecotourism**

The project's activities in forest areas can support ecotourism and enhance revenues. Globally, ecotourism makes up 5-7% of tourism revenues and it has been expanding at more than 10% annually, according to the World Tourism Organization. Expanding ecotourism in Serbia would involve investing in energy efficient buildings, capitalizing on the country's forest areas, encouraging community participation in sustainable tourism, agriculture, and forest management and protection. It would bring financial benefits relative to current alternatives, including excessive fuelwood extraction. Financial benefits would include higher revenue from tourists (surveys show that tourists are willing to pay higher prices for sustainable tourism), revenue from nature walks/local activities in forests, lower costs (through energy savings from energy efficiency) and revenue from selling locally sourced goods in the premises. Costs include marketing and repaying the interest on the loan (at market prevailing loan terms) to upgrade the facilities.

The model assumes that small 5-room facilities with a capacity of 10 guests located in rural forested areas are the ecotourism sites and fetch a 10% premium as compared to regular tourist hotels. Each regular tourist site is occupied 10 nights out of 30 each month. We also conservatively estimate that each ecotourist site is occupied by 12 nights each month (or 144 nights each year) and is thus attracting more tourists than a regular tourist site would. The model also assumes that each facility takes out a loan to finance the investments, with a **lending interest rate of 7% and a loan duration of 5 years**.

For an individual facility, a 10-year analysis with these loan terms yields an **NPV of $8,038 and an IRR of 23.6%.** The payback period for the loan at these terms is 3.4 years, lower than the loan duration of 5 years.

We assume that within the project investment area and associated with the project forestry investment, about 100 such facilities could be set up. For these, a 20-year analysis with the same loan terms gives an **NPV of $1.55 million and IRR of 27.6%**.

2. **Apiculture and Pollination Services**

Supporting apiculture activities through the project's forestry interventions will lead to additional revenues for producers in the form of revenues from the sale of honey, wax, propolis, pollen and new bee colonies. Investment costs will include the purchase of beehouses, bee families, equipment (refractometer, honey extractor, wax extractor etc.). Operational costs will include maintaining the beehouses, medicines and veterinary services and provision of labor. A financial analysis of the investment in beekeeping shows that both a medium sized (50-bee family) and small sized (30-bee family) apiculture venture is profitable over the 20-year period. Further, assuming that apiculturists take out an investment loan to finance their activities (7% interest rate, 5-year repayment period), **an individual small bee farm shows an IRR of 43% and NPV of $9498 while the medium bee farm shows an IRR of 37% and NPV of $14,588.** In both cases, the payback period is between 5.5 and 6.5 years.

## E.2. Decarbonization Investments

Using outdated and depreciated agricultural equipment translates into higher cost of production (due to higher energy use) and higher emissions.[25] This is particularly relevant in Serbia. For example, 86% of tractors are 20 or more years old and the majority of buildings were built before 2011, when Serbia even put in place regulations

[25] https://iopscience.iop.org/article/10.1088/1757-899X/977/1/012011/pdf

around Energy Efficiency of buildings. Therefore, investments in energy efficient technologies in Serbia, with a focus on agrifood value chains, will help in sequestering carbon while reducing costs from reduced energy use and in some cases also translate into efficiency gains from newer technologies. These efficiency gains are stimulated by the Platform supported by Component 3 of the project (activity 3.2.1).

The models in this section quantify the financial benefits from **four** types of investments, facilitated through technical assistance and loans of the amount of US$ 50 million provided by financial institutions under **Component 3** of the project. Beyond the financial returns from investing in decarbonization, economic benefits include greater carbon sequestered from investing in more energy efficient technologies, which are quantified as part of the economic returns. It is important to note that in the agrifood sector for the Serbian context there is no benchmark figure readily available for abatement costs, or the cost of an intervention that will reduce CO2 emissions by 1 tonne. Thus, we do not consider or compare the efficiency of decarbonization loan activities in reducing emissions in the analyses.

In each of the following investments, firms take out loans for investment in decarbonization. All loans are considered investment loans at **interest rates of 7% annually and a repayment period of 5 years**. For each investment, we report, as applicable, the net present value (NPV), internal rate of return (IRR) over a 10- or 20-year horizon and an indicative repayment period.[26]
It is important to note that these models are indicative; their benefits are not included in the overall aggregates attributed to the project.

### 1. Agro-Processing

Agro-processing companies in Serbia would save on energy costs by switching from conventional equipment to energy efficient equipment, particularly with respect to (a) steam boilers and (b) field machinery such as combine harvesters. However, given the current energy price situation and other variables, these models are not viable in the short term from a financial perspective. In the long term, depending on energy price dynamics and other variable costs, these models may turn profitable and are presented with this perspective.

**a. Steam Boilers:** The agrifood industry uses steam for various purposes, the most important are heating, drying, and distillation. The first model analyzes the energy efficient boiler that uses natural gas for steam production. Steam boilers with the capacity to produce 1000 kg of steam per hour is used for the analysis (average capacity level for food industry). The analysis conducted for the steam boiler that uses natural gas.[27] The introduction of a steam boiler technology is combined with training on how to operate it. Financial benefits include more efficient energy consumption (natural gas) for steam production and lower cost per unit of energy (since new boilers utilize less natural gas). Economic benefits include reduced GHG emissions. The application of energy efficient steam boilers is limited to about 2% of all agribusiness enterprises in Serbia or 115 agrifood enterprises.

The model is profitable from a financial perspective, for an individual agrifood firm, giving an **IRR of 23.9% and NPV of $18,279 over the 10-year period and an IRR of 31.9% and NPV of $66,535 over the 20-year period.** Assuming the loans associated with the project finance the decarbonization investment of **1% of agrifood enterprises in Serbia (150 firms), at the aggregate level, the investment will generate an IRR of 31.9% and an NPV of $6.6 million.** The payback period for the loan is 17 years, longer than the repayment period prescribed by financial institutions, raising potential questions of default in the current scenario. However, as highlighted above, this may change with market conditions in the future.

**b. Field Machinery:** The second model analyzes the investment of agribusinesses to energy efficient Combine Harvesters. Financial benefits of switching from a traditional to an efficient Combine Harvester include lower input costs due to fuel savings, higher revenues from reduced post-harvest losses and thus greater sales, reduced labor

26 The payback period is the time period (generally in years) in which a return is required from an investment or the amount of time it takes for the positive cash flow to exceed the initial investment, without concern for the time value of money. Source: Renewable and Sustainable Energy Reviews 2018.

[27] According to experts' estimation, the share of food industry firms that use boilers with natural gas is 50% and the rest are using fuel oil and other energy sources.

costs and rental income from renting the harvester to neighboring farmers for additional activities. Costs include maintenance and insurance. The approximate cost of one combine harvester in Serbia is approximately $192,908.[28] **Given the high price of combine harvesters, the model is not financially profitable over a 10-year or a 20-year period at a 7% interest rate for the conversion of 5 harvesters. It yields an IRR of 3% over a 10-year horizon for an individual firm at market interest rates without additional incentives or subsidies, such as those provided under EBRD's Energy Efficiency Credit Lines in Eastern Europe.[29]**

### 2. Urban Agrifood Retail

The majority of buildings in Serbia are energy inefficient, leading to high energy consumption for heating and cooling.[30] For the average supermarket (over 2000 $m^2$) in urban areas in Serbia to switch to energy efficient buildings, including better building design (with overhangs), LED lights, doors on cabinets, heat recuperation equipment, purchase of low emitting refrigerators and cooling systems will lead to significant cost savings between 23% and 80%, mainly in the form of energy costs. There will be additional savings from shorter value chains and additional sales revenues (greater space, less food loss and fresh products).

This model analyzes the economic and financial benefits from retrofitting large food retail stores (hypermarkets and supermarkets) into energy efficient structures. The energy efficient conversion would include food retail actors adopting more efficient building structures with improved insulation, LED Lights, doors on cabinets, heat recuperation equipment and heat pumps. Financial benefits accrue from energy savings (lower consumption) from heating, cooling, electricity and ventilation and higher revenues from shorter value chains, less food loss and waste, higher amount of storage due to efficient stores and greater sales. The costs includes the cost of the technology (and associated interest payments on the loan). Economic benefits accrue from reduced GHG emissions relative to older buildings and greater availability of fresh food in Serbia.

For an individual supermarket, the model gives an I**RR of and NPV of 31% and $4.2 million over a 10-year period and an IRR of 35.3% and NPV of $10.2 million over a 20-year period**. Given the potential high retail revenues and ensuing cash flow of supermarkets, the loan payback period is two years. The model assumes that Financial Institutions provide loans to 5% of supermarkets in Serbia or 6 stores. Over a 20-year horizon and a 7% interest rate, the model yields an **NPV of $61 million and IRR of 35.28%.**

### 3. Cold Storage

In Serbia, two types of Cold Storage are prevalent: (1) Cold Storage (up to -20 degrees Celsius), mainly used for frozen raspberries and (2) ULO cold stores for fresh food, mainly used for apples. For Serbian companies in cold storage, switching to energy efficient electrical systems (compressors, lighting), setting chillers, refrigerants and insulation equipment, and electric lighting systems will bring financial benefits in the form of costs savings from reduced energy use, greater volume of goods stored (due to newer design), reduced food loss and waste and thus greater sales in both domestic and foreign markets. Effective use of racks and cooler organization could increase available cooler space by 50% or more. Economic benefits accrue from reduced GHG reductions and greater export potential.

Through the project's activities, firms would obtain loans to replace conventional cold storage (chillers, freezers and controlled atmosphere using Freon or Ammonia) with energy efficient cold storage for preserving fresh fruits (berries, apricots, peaches, raspberries, etc.) and vegetables. **A 20-year model with 7% lending rate shows that converting 20% of all average-sized (2,000 MT) cold rooms or 45 facilities would lead to an NPV of $2.4 million or 16.86% and an indicative average payback period of 2 years.**

### 4. Transport and Logistics (tractors and trucks)

Switching to energy efficient trucks (freight vehicles) and tractors from those using conventional fuels in the agrifood sector will generate financial benefits in the form of fuel savings, higher revenue (due to greater productivity from new tractors or lesser food loss/higher volume from freight) as well as a nominal revenue from the sale of the old vehicle. To convert 0.15% of the existing fleet of tractors and trucks to energy efficient ones and to convert firms to

[28] https://ebrdgeff.com/projects/serbian-farmer-boosts-his-production-with-a-new-combine-harvester/
[29] https://ebrdgeff.com/ebrd-and-unicredit-boost-energy-efficiency-in-serbia/
[30] DAI / Global Cold Chain Alliance report for Serbia

electric trucks, **a 20-year model with a 7% loan shows an NPV of $7.1 million and a 13.7% IRR and a payback duration of 2.2 years.**

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***Economic Benefits from Decarbonization Loans***

Table 13 summarizes the economic returns from the four decarbonization loan models at the individual firm level as well as aggregated over the full loan amount of US$ 50 million. Within the US$ 50 million, the number of units/firms financed in the aggregate scenario are a function of the profitability of the individual unit financial model, their carbon sequestration potential/emission factors and expected demand. However, it is important to note that the actual composition and amount of individual loans may vary based on actual market demand and macroeconomic conditions.

The economic returns include the carbon sequestration benefits of switching to energy efficient technologies.

**Table 13: Summary of Economic Performance of Decarbonization Loan Models (at Carbon Price of US$ 40 / tCO2 eq)**

| (1) AGROPROCESSING (STEAM BOILER) | | 10 year results | | 20 year results | | 40 year results | |
|---|---|---|---|---|---|---|---|
| | | Econ-IRR | Econ-NPV | Econ-IRR | Econ-NPV | Econ-IRR | Econ-NPV |
| Base scenario | 1 Unit | 81.2% | $37,014 | 83.1% | $91,536 | 83% | $133,627 |
| | Aggregate | 88.6% | $3,980,442 | 90.7% | $9,998,118 | 90.7% | $14,645,681 |
| Sensitivity Analysis (1 UNIT) | Costs: +10% | 22.9% | $19,867 | 31.1% | $75,805 | 31.5% | $124,898 |
| | Costs: +20% | 5.8% | ($341) | 18.0% | $48,798 | 19.3% | $91,975 |
| | Costs: +30% | -4.9% | ($20,549) | 10.5% | $21,791 | 12.9% | $59,051 |
| | Benefits: -10% | 25.4% | $20,092 | 33.2% | $72,124 | 33.5% | $117,774 |
| | Benefits: -20% | 6.1% | $110 | 18.3% | $41,435 | 19.5% | $77,726 |
| | Benefits: -30% | -7.5% | ($19,872) | 8.9% | $10,747 | 11.5% | $37,678 |
| Sensitivity Analysis (AGGREGATE) | Costs: +10% | 56.1% | $3,540,423 | 60.4% | $9,973,326 | 60.4% | $15,619,052 |
| | Costs: +20% | 33.4% | $2,386,581 | 40.7% | $8,037,584 | 40.8% | $13,002,901 |
| | Costs: +30% | 18.5% | $1,232,740 | 28.9% | $6,101,843 | 29.4% | $10,386,751 |
| | Benefits: -10% | 59.3% | $3,354,535 | 63.3% | $9,338,146 | 63.3% | $14,587,914 |
| | Benefits: -20% | 33.8% | $2,014,807 | 41.0% | $6,767,225 | 41.2% | $10,940,627 |
| | Benefits: -30% | 14.8% | $675,078 | 26.2% | $4,196,304 | 26.8% | $7,293,339 |
| *Only 50% of loans disbursed* | | 88.6% | $2,155,638 | 90.7% | $5,617,805 | 90.7% | $8,654,893 |

| (2) URBAN AGRIFOOD RETAIL | | 10 year results | | 20 year results | | 40 year results | |
|---|---|---|---|---|---|---|---|
| | | Econ-IRR | Econ-NPV | Econ-IRR | Econ-NPV | Econ-IRR | Econ-NPV |
| Base scenario | 1 Unit | -9.8% | ($2,041,404) | 5.0% | ($319,082) | 8.2% | $1,203,861 |
| | Aggregate | 14.0% | $985,768 | 14.0% | $7,186,129 | 26.6% | $12,668,723 |
| Sensitivity Analysis (1 UNIT) | Costs: +10% | -11.9% | ($2,381,874) | 3.9% | ($686,467) | 7.4% | $813,054 |
| | Costs: +20% | -13.8% | ($2,722,344) | 2.9% | ($1,053,852) | 6.7% | $422,248 |
| | Costs: +30% | -15.7% | ($3,062,814) | 1.9% | ($1,421,237) | 6.1% | $31,441 |
| | Benefits: -10% | #NUM! | ($4,926,053) | -15.1% | ($4,890,115) | -6.5% | ($4,837,080) |
| | Benefits: -20% | #NUM! | ($7,810,702) | #NUM! | ($9,461,147) | #NUM! | ($10,878,021) |
| | Benefits: -30% | #NUM! | ($10,695,351) | #NUM! | ($14,032,180) | #NUM! | ($16,918,961) |
| Sensitivity Analysis (AGGREGATE) | Costs: +10% | 12.1% | $1,486,827 | 23.5% | $11,659,270 | 24.4% | $20,656,399 |
| | Costs: +20% | 6.8% | $227,063 | 19.9% | $10,238,016 | 21.1% | $19,094,615 |
| | Costs: +30% | 2.4% | ($1,032,701) | 17.0% | $8,816,762 | 18.5% | $17,532,832 |
| | Benefits: -10% | #NUM! | ($9,354,461) | -10.8% | ($9,138,829) | -3.6% | ($8,820,621) |
| | Benefits: -20% | #NUM! | ($21,455,513) | #NUM! | ($31,358,183) | #NUM! | ($39,859,423) |
| | Benefits: -30% | #NUM! | ($33,556,564) | #NUM! | ($53,577,536) | #NUM! | ($70,898,225) |
| *Only 50% of loans disbursed* | | -9.9% | ($6,646,931) | 4.9% | ($1,080,755) | 8.2% | $3,841,267 |

| (3) COLD STORAGE | | 10 year results | | 20 year results | | 40 year results | |
|---|---|---|---|---|---|---|---|
| | | Econ-IRR | Econ-NPV | Econ-IRR | Econ-NPV | Econ-IRR | Econ-NPV |
| Base scenario | 1 Unit | 11.6% | $11,800 | 17.9% | $54,774 | 18.7% | $87,719 |
| | Aggregate | 12.0% | $821,752 | 18.5% | $3,873,927 | 19.3% | $6,214,024 |
| Sensitivity Analysis (1 UNIT) | Costs: +10% | 11.4% | $14,438 | 17.7% | $63,901 | 18.6% | $106,936 |
| | Costs: +20% | 11.2% | $13,866 | 17.6% | $63,326 | 18.4% | $106,360 |
| | Costs: +30% | 10.9% | $13,294 | 17.4% | $62,752 | 18.3% | $105,783 |
| | Benefits: -10% | -7.8% | ($30,068) | 3.9% | ($9,474) | 7.1% | $8,439 |
| | Benefits: -20% | #NUM! | ($75,145) | #NUM! | ($83,424) | #NUM! | ($90,634) |
| | Benefits: -30% | #NUM! | ($120,223) | #NUM! | ($157,373) | #NUM! | ($189,708) |
| Sensitivity Analysis (AGGREGATE) | Costs: +10% | 11.4% | $649,707 | 17.7% | $2,875,527 | 18.6% | $4,812,131 |
| | Costs: +20% | 11.2% | $623,965 | 17.6% | $2,849,677 | 18.4% | $4,786,187 |
| | Costs: +30% | 10.9% | $598,222 | 17.4% | $2,823,826 | 18.3% | $4,760,243 |
| | Benefits: -10% | -7.8% | ($1,353,040) | 3.9% | ($426,342) | 7.1% | $379,766 |
| | Benefits: -20% | #NUM! | ($3,381,530) | #NUM! | ($3,754,062) | #NUM! | ($4,078,543) |
| | Benefits: -30% | #NUM! | ($5,410,020) | #NUM! | ($7,081,782) | #NUM! | ($8,536,852) |
| *Only 50% of loans disbursed* | | 11.6% | $337,725 | 17.9% | $1,450,689 | 18.7% | $2,419,038 |

| (4) TRANSPORT & LOGISTICS (ENERGY EFFICIENT TRUCKS & TRACTORS; ELECTRIC TRUCKS) | | 10 year results | | 20 year results | | 40 year results | |
|---|---|---|---|---|---|---|---|
| | | Econ-IRR | Econ-NPV | Econ-IRR | Econ-NPV | Econ-IRR | Econ-NPV |
| Base scenario | 1 Unit | 32.0% | $59,746 | 35.9% | $143,233 | 36.1% | $218,005 |
| | Aggregate | 29.7% | $7,175,334 | 34.2% | $18,115,086 | 34.4% | $27,609,855 |
| Sensitivity Analysis (1 UNIT) | Costs: +10% | 24.3% | $50,183 | 29.4% | $141,362 | 29.8% | $223,780 |
| | Costs: +20% | #NUM! | ($721,100) | #NUM! | ($1,039,818) | #NUM! | ($1,281,790) |
| | Costs: +30% | #NUM! | ($1,236,833) | #NUM! | ($1,948,818) | #NUM! | ($2,510,340) |
| | Benefits: -10% | #NUM! | ($671,241) | #NUM! | ($1,153,590) | #NUM! | ($1,551,183) |
| | Benefits: -20% | #VALUE! | #VALUE! | #VALUE! | #VALUE! | #VALUE! | #VALUE! |
| | Benefits: -30% | #VALUE! | #VALUE! | #VALUE! | #VALUE! | #VALUE! | #VALUE! |
| Sensitivity Analysis (AGGREGATE) | Costs: +10% | 22.4% | $5,937,001 | 28.1% | $17,917,654 | 28.5% | $29,774,239 |
| | Costs: +20% | 8.8% | $1,122,612 | 17.7% | $10,636,894 | 18.9% | $20,396,798 |
| | Costs: +30% | 10.8% | $2,012,188 | 19.2% | $12,821,559 | 20.3% | $23,589,831 |
| | Benefits: -10% | 8.5% | $917,443 | 17.3% | $9,466,957 | 18.5% | $18,175,360 |
| | Benefits: -20% | -20.2% | ($8,916,504) | -2.0% | ($6,264,499) | 4.3% | ($2,800,961) |
| | Benefits: -30% | #NUM! | ($13,046,487) | -13.5% | ($12,530,531) | -1.9% | ($11,206,807) |
| *Only 50% of loans disbursed* | | 29.7% | $3,950,782 | 34.2% | $10,256,626 | 34.4% | $16,458,352 |

Source: EFA Spreadsheet, "1-Decarb Loans Sensitivity"

**The four decarbonization loan models generate positive Economic IRR and Economic NPV** under a base scenario with carbon price at US$ 40 / tCO2 eq, under a 10-, 20- and 40-year time horizon. Each model incorporates the impact of climate change. The table also highlights a sensitivity analysis both at the firm/unit level and at the aggregate level. The results show that even with increases of operating costs or lower benefits, the models yield positive results for the majority of cases. For each model, we also conducted a sensitivity analysis testing the returns if only a proportion of the loans are disbursed. The returns for the aggregate models remain positive in the case where only 50% of the envisioned loan amount ends up being disbursed by financial institutions, due to market risks or exogenous shocks. Additional tables summarizing the economic returns with lower prices of carbon (US$ 19 / tCO2e and US$ 10/tCO2e) are included in the EFA spreadsheet.

**Table 14** highlights the economic returns for the aggregated decarbonization loans. It highlights that the decarbonization investments, facilitated by commercial loans at market interest rates, generate positive economic returns over a 10- and 20-year period. For a 10-year horizon, the Economic IRR for the decarbonization loans is **25.4%**. The results remain positive under lower prices of carbon (19 and 10US$/tCO2e), underscoring their robustness. Further, sensitivity analysis accounting for only half the amount of the loans being disbursed also yields positive returns.

**Table 14: Summary of Economic Returns from Aggregated Decarbonization Loans (under three carbon price scenarios)**

| ECON Price per Unit (SD) | |
|---|---|
| WB social price of carbon | 40 |

| DECARBONIZATION LOANS (AGGREGATE) | | 10 year results | | 20 year results | | 40 year results | |
|---|---|---|---|---|---|---|---|
| | | Econ-IRR | Econ-NPV | Econ-IRR | Econ-NPV | Econ-IRR | Econ-NPV |
| Base scenario | Aggregate | 25.4% | $14,230,899 | 31.2% | $43,480,521 | 31.5% | $70,497,718 |
| Sensitivity Analysis (AGGREGATE) | Costs: +10% | 20.2% | $11,613,958 | 27.4% | $42,425,777 | 27.9% | $70,861,820 |
| | Costs: +20% | 10.9% | $4,360,222 | 20.5% | $31,762,171 | 21.5% | $57,280,501 |
| | Costs: +30% | 9.1% | $2,810,450 | 19.3% | $30,563,989 | 20.4% | $56,269,656 |
| | Benefits: -10% | -2.7% | ($6,435,523) | 10.9% | $9,239,932 | 13.2% | $24,322,420 |
| | Benefits: -20% | #NUM! | ($31,738,740) | #NUM! | ($34,609,519) | #NUM! | ($35,798,300) |
| | Benefits: -30% | #NUM! | ($51,337,992) | #NUM! | ($68,993,546) | #NUM! | ($83,348,546) |
| *Only 50% of loans disbursed* | | 5.7% | ($202,786) | 15.5% | $16,244,365 | 16.8% | $31,373,550 |

| ECON Price per Unit (SD) | |
|---|---|
| Price of carbon (low) | 10 |

| DECARBONIZATION LOANS (AGGREGATE) | | 10 year results | | 20 year results | | 40 year results | |
|---|---|---|---|---|---|---|---|
| | | Econ-IRR | Econ-NPV | Econ-IRR | Econ-NPV | Econ-IRR | Econ-NPV |
| Base scenario | Aggregate | 18.8% | $9,533,602 | 25.9% | $35,404,328 | 26.5% | $59,632,347 |
| Sensitivity Analysis (AGGREGATE) | Costs: +10% | 13.9% | $6,569,843 | 22.6% | $33,756,217 | 23.3% | $59,189,186 |
| | Costs: +20% | 7.6% | $1,445,353 | 18.1% | $26,598,358 | 19.4% | $50,275,975 |
| | Costs: +30% | 3.5% | ($2,253,146) | 15.4% | $21,806,855 | 17.0% | $44,505,382 |
| | Benefits: -10% | -9.9% | ($11,580,808) | 6.2% | $381,260 | 9.6% | $12,383,789 |
| | Benefits: -20% | #NUM! | ($34,855,949) | #NUM! | ($40,151,557) | #NUM! | ($43,334,818) |
| | Benefits: -30% | #NUM! | ($56,705,098) | #NUM! | ($78,318,017) | #NUM! | ($95,910,807) |
| *Only 50% of loans disbursed* | | 2.5% | ($2,570,556) | 13.1% | $12,181,445 | 14.8% | $25,911,102 |

Source: EFA Spreadsheet, “1-Decarb Loans Sensitivity”

## E.3. Additional Benefits: Wood Availability, Household Energy, Decarbonization Consulting

**Three** additional models show the *additional* economic benefits of the project activities. These models are not intended to make a case to invest in the system but rather highlight that the project’s activities can enhance grain availability and wood availability in the country, in the context where both commodities are scarce due to global production shifts and geopolitical tensions in the region.

**1. <u>Wood production</u>**

The project's activities, particularly through regulatory measures and awareness campaigns, will lead to greater availability of wood for fuel in Serbia, and in particular for the most vulnerable households and potentially for exports in the future.

First, a simple model using population and poverty projections for Serbia highlights that **11% more people – mostly those under the poverty line or at risk of poverty – will use fuelwood over the next 10 years.** The project will unlock more efficient wood for this group.

Second, an analysis of fuelwood exports globally, from the EU and from Serbia highlight that fuelwood exports have been rising over the last five years. However, **while EU exports of fuelwood have grown by 6% from 2020 to 2021 alone, Serbia’s exports have declined by 16%** (in part due to rising domestic consumption). The increased availability of fuelwood may also translate into greater exports.

2. **<u>Household Energy expenditure</u>: households shift from sustainable and more efficient fuelwood compared to inefficient fuelwood**

As households shift from inefficient fuelwood consumption to more efficient consumption – through greater awareness and regulations around drying, this will translate into financial savings from fuelwood at the household level.

The improved efficiency of wood biomass used for fuel will reduce the total energy expenditures of the rural poor and those at risk of high poverty. Improved efficiency through the project could lead to lower energy expenditures on average up between 16% and 24%. A caveat to add is that the variability in wood fuel prices will also depend on trends in the prices of other fuels. Conservative estimates around current and projected fuelwood prices (around US$ 60 / m3 of stacked wood) show annual financial savings from fuelwood of nearly **US$ 32 for each household.** These savings will free up household resources for other expenditures. The forestry models show that about 15,668 households would benefit from more efficient fuelwood. The project will have a positive impact on households that will be expected to face **a lower unit cost for energy produced by fuelwood.** This lower unit cost of energy will enhance affordability of energy for the poorest segments of the population. The carbon sequestration benefits from using more efficient fuelwood (and a lower amount of it) are important but are not taken into account here since they are accounted for in the project's forestry investment models.

3. **<u>Consulting to firms on decarbonization and carbon accounting</u>**

Serbia's accession to the EU regulations and the project's Component 3 activities will lead to greater demand for carbon accounting and decarbonization strategy consulting for the economy, including for agribusinesses. Specialized service providers will technically assist firms to measure GHG emissions, develop their baselines, set up internal monitoring, reporting and verification (MRV) systems, ensure compliance with different ESG standards and certifications. However, expert interviews highlight that there is limited capacity for the provision of these specialized consulting services / providers in the country. The project activity will provide capacity development to these service providers to enhance their capacity to serve agribusiness firms and firms in other sectors with respect to their decarbonization strategy formulation and activities.

The provision of consultancy services to agribusinesses on carbon accounting can bring financial benefits in the form of additional revenues and price premia (through lower costs and attracting new business streams). Additional costs to the Service Providers would include the consulting resources, operating costs, start-up costs, and human resources to develop and maintain internal systems. Additional economic Benefits such as greater information/awareness about decarbonization and spillovers to other firms and are not quantified.

The project's technical assistance on decarbonization will mean that a portion of their investment will be grant-funded. Even though the model is profitable, making the financial case for firms paying for consulting services, survey data show that awareness around sustainability compliance is low. The project's provision of these services will help overcome this information asymmetry as well as build capacity for decarbonization in the medium term. The aggregate economic model – for 5 Such service providers --- is profitable at the 10- and **20-year horizons, with an E-IRR of 16.6% and 22%.**

## E.4. Additional Economic Benefits: Ecosystem Valuation

Reforestation enhances biodiversity, slows land degradation and improves vegetative cover. These rehabilitation actions are associated with several ecosystem services such as providing habitat for animals such as bees, areas suitable for recreational activities and primary production of food products.

The analysis has taken into account five types of benefits associated with reforestation: pollination, direct and indirect protection from natural hazards, tourism, non-wood forest products (NWFP) and flood protection. For the first four types of benefits, we use the Ecosystem Services Valuation Database (ESVD), an open-source database that collates information from over 950 studies on the economic benefits of ecosystems and biodiversity.[31] Information from the database were narrowed down by relevant countries in Europe and relevant ecosystems. To narrow the list of countries, only Serbia's direct neighbors or other countries in Southeastern Europe were taken into account: Italy, Austria, Czech Republic, Slovakia, Hungary, Romania, Bulgaria, North Macedonia, Kosovo, Croatia, Bosnia and Herzegovina, and Montenegro. Further filters to the data points by ecosystem activities of interest were applied. For flood protection, the analysis built on the estimates published by Ivetic and Plavsic (2021) for Serbia.[32]

The analysis considered values to a common set of units for the Serbia context (2021 US$ in real terms). First, converting the annual per hectare value from the database into RSD using the exchange rate from the relevant year in which the estimate originates. Second, adjusting it using a deflator and convert it into US$ at the 2021 exchange rate. Then, multiplying the per-hectare value by the number of hectares it would potentially apply to under the project's activities. For example, the total number of hectares covered by new forests under the project is 7,000 ha. Pollination would take place on 100% of this area. The benefits per hectare are integrated in the forestry models according to their respective eligibility factor and computed in the aggregated economic benefits. **Table 15** reports the quantified benefits from this approach at years 10, 20 and 40. The analysis assumes that the production of ecosystem services is phased according to the incremental forestry investment supported by the project. As such, relevant ecosystem services are integrated in the economic analysis as follows:

**Table 15. Ecosystem Benefits for Serbia, by type of ecosystem service**

| Ecosystem benefit | Annual Benefits (US$ / Ha) | Relevant Forest Investment | Total eligible Area (Ha) | % of Total Eligible Area Covered by Ecosystem Service | Annual Benefits for the first 10 years for the total Area (US$) | Annual Benefits for the first 20 years for the total Area (US$) | Annual Benefits for the first 40 years for the total Area (US$) |
|---|---|---|---|---|---|---|---|
| Pollination | 57.00 | Afforestation / reforestation | 7,000 | 100% | 243,789 | 640,595 | 838,997 |
| | | Degraded coppice converted in high stand forests | 51,000 | 20% | | | |
| | | Shelterbelts | 500 | 100% | | | |
| | | Unfarmed land restoration | 500 | 100% | | | |
| | | Sustainable Forest Management | 500,000 | 15% | 2,287,125 | 3,281,063 | 3,457,406 |
| Tourism | 77.09 | (All) | (ref. EFA spreadsheet) | 10% | 9,120 | 72,607 | 106,456 |
| | | Sustainable Forest Management | 500,000 | 5% | 645,629 | 1,286,439 | 1,462,301 |
| Flood Protection | 19.01 | Shelterbelts in Vojvodina | 500 | 100% | 618 | 4,919 | 7,212 |
| | | Sustainable Forest Management | 500,000 | 5% | 159,209 | 317,229 | 350,596 |

## F. Aggregated Results

**Aggregated results: economic benefits from forestry investment**. The aggregated project net incremental benefits take into account the results of the forestry investment on 59,000 ha under the six different models, the sustainable management of the 500,000 ha of forests under Climate adaptive Sylviculture[33], as well as include a conservative valuation of the economic values of wood, non-wood forest products, and other ecosystem services (pollination, tourism, flood protection).

[31] https://www.esvd.net/

[32] (PDF) PRIMER VREDNOVANJA EKOSISTEMA U FUNKCIJI ZAŠTITE OD POPLAVA NA SLIVU REKE TAMNAVE (researchgate.net)

[33] These include ecosystem services valuation such as carbon sequestration (as estimated in annex 22), increased pollination services (for an assumed 15% of the forest area under improved management), as well as tourism and flood protection (for 5% of the area).

The aggregated economic analysis was done taking into account the overall project costs (, and under the three main scenarios of carbon pricing (a base case with a value of 40US$/tCO2e, and two other cases – with 10US$ as the lowest benchmark, and as 80US$ according to the 2022 average ETS price). Several additional sensitivity tests were added to the analysis, to reflect the impact of climate change on costs and benefits and the respective economic performances.

Under a time horizon of 20 years, the forestry investment generates an Economic IRR of 13.3 percent, largely above the social discount rate of 6 percent, and an economic NPV of 53.13 m US$. This result confirms the validity of the investment under an economic viewpoint even under 20 years horizon. Under the time horizon of 40 years, the forestry investment maximize their benefits and the economic performance are even more solid, with an E-IRR of 15.0 percent and a NPV of US$ 78.4 million US$ (**Table 16**).

**Sensitivity analysis: costs and benefits**. The sensitivity to increase of costs or decrease of benefits shows also solid results: the economic NPV is negative only in case of twofold costs or a reduction of about 50 percent of the benefits. As a result, it can be concluded that the project represents a significantly solid investment even under drastic changes in the cost or benefits.

**Sensitivity analysis: carbon pricing**. Carbon sequestration represents one of the major ecosystem benefits generated by the project. The net incremental benefits show expectedly a tangible variation to the change of carbon pricing yet remaining substantially positive in the 20 and 40 year horizon. Even considering a low 10US$/tCO2e (as the lowest range in the carbon pricing initiatives considered as a potential benchmark), the E-IRR is 10.3 percent and NPV 25.8m US$, or 14.0 percent and 103.7 US$ respectively under 40 years horizon.

**Sensitivity analysis: RCP 8.5**. As mentioned above, the baseline scenario for this analysis is consistent with RCP 4.5 In addition, we have run a sensitivity analysis accounting for RCP 8.5 where the project benefits would change in line with climate change effects. Even considering this climate scenario, the 20-year IRR is 12.6% and NPV is $51.6 million and the 40-year IRR is 15.4% and NPC pf $155 million.

**Table 16. Aggregated forestry benefits (with all project costs)**

| | | 10 year results | | 20 year results | | 40 year results | |
|---|---|---|---|---|---|---|---|
| | | IRR | NPV | IRR | NPV | IRR | NPV |
| All aggregated forestry benefits including all project costs | Base scenario | -12.0% | (30,909,143) | 13.3% | 53,139,018 | 16.5% | 179,267,518 |
| | Increase of costs by 10% | -0.14 | (37,686,519) | 12.0% | 46,361,642 | 15.4% | 172,490,142 |
| | Increase of costs by 20% | -0.17 | (44,463,895) | 10.8% | 39,584,266 | 14.5% | 165,712,766 |
| | Increase of costs by 30% | -0.18 | (51,241,271) | 9.8% | 32,806,890 | 13.8% | 158,935,390 |
| | Decrease of benefits by 10% | -0.14 | (34,260,472) | 12.0% | 42,146,947 | 15.4% | 156,809,220 |
| | Decrease of benefits by 20% | -0.17 | (37,053,246) | 10.8% | 32,986,888 | 14.5% | 138,093,971 |
| | Decrease of benefits by 30% | -0.18 | (39,416,362) | 9.8% | 25,236,069 | 13.8% | 122,257,992 |

| | | 10 year results | | 20 year results | | 40 year results | |
|---|---|---|---|---|---|---|---|
| | | IRR | NPV | IRR | NPV | IRR | NPV |
| All aggregated forestry benefits including all project costs (CO2e=80US$/t) | (CO2e=80US$/t) | -9.7% | (29,023,411) | 15.6% | 80,756,725 | 18.6% | 271,198,924 |
| | Increase of costs by 10% | -0.12 | (35,977,101) | 14.2% | 73,803,034 | 17.5% | 264,245,233 |
| | Increase of costs by 20% | -0.14 | (42,930,791) | 13.0% | 66,849,344 | 16.6% | 257,291,543 |
| | Increase of costs by 30% | -0.16 | (49,884,482) | 12.0% | 59,895,654 | 15.8% | 250,337,853 |
| | Decrease of benefits by 10% | -0.12 | (32,706,455) | 14.2% | 67,093,668 | 17.5% | 240,222,939 |
| | Decrease of benefits by 20% | -0.14 | (35,775,659) | 13.0% | 55,707,787 | 16.6% | 214,409,619 |
| | Decrease of benefits by 30% | -0.16 | (38,372,678) | 12.0% | 46,073,580 | 15.8% | 192,567,579 |

| | | 10 year results | | 20 year results | | 40 year results | |
|---|---|---|---|---|---|---|---|
| | | IRR | NPV | IRR | NPV | IRR | NPV |
| All aggregated forestry benefits including all project costs (CO2e=10US$/t) | (CO2e=10US$/t) | -14.6% | (33,645,800) | 10.9% | 31,103,380 | 14.1% | 108,996,606 |
| | Increase of costs by 10% | -0.17 | (40,423,176) | 9.6% | 24,326,004 | 13.1% | 102,219,230 |
| | Increase of costs by 20% | -0.19 | (47,200,552) | 8.4% | 17,548,628 | 12.2% | 95,441,854 |
| | Increase of costs by 30% | -0.21 | (53,977,928) | 7.4% | 10,771,252 | 11.4% | 88,664,478 |
| | Decrease of benefits by 10% | -0.17 | (36,748,342) | 9.6% | 22,114,549 | 13.1% | 92,926,572 |
| | Decrease of benefits by 20% | -0.19 | (39,333,793) | 8.4% | 14,623,857 | 12.2% | 79,534,878 |
| | Decrease of benefits by 30% | -0.21 | (41,521,483) | 7.4% | 8,285,578 | 11.4% | 68,203,444 |

Source: EFA Spreadsheet, ECON_Aggregate (SUM)

**Aggregated results: all project-generated benefits**. An additional aggregation was done to take into account the net incremental benefits expectedly generated by the leveraged private finance of the project (estimated in US$ 50 million worth of decarbonization loans supported by Component 3 activities). Such benefits are composed of the reduction in carbon emissions deriving from the agribusiness companies implementing their decarbonization strategies via loan financed technological shifts and improvements. The models are described above, and include steam boiler, urban agrifood retail, cold storage, and improved transport (energy efficient trucks & tractors and electric trucks) as representative examples of the potential decarbonization investments. As additional element, the incremental corporate taxes generated by the decarbonization investment were also aggregated, resulting in an incremental discounted value of US$ 5.1 million for the 20 years horizon, and US$ 13.9 million for the 40 years horizon.

The project aggregated net incremental benefits take into account the full estimated costs of the investment (represented by the 50m US$ leveraged loans, plus an additional estimated 20 percent of self-financed investment) for a combination of enterprises investing in the technologies mentioned above. The economic benefits take into account the valuation of the efficiency gains for the companies (fully described in the financial analysis section) and a valuation of the reduced carbon emissions, under the three carbon pricing scenarios (a base case with a value of 40US$/tCO2e, and two other cases – with 10US$ as the lowest benchmark, and as 80US$ according to the 2022 average ETS price). Also in this case, various tests to assess the sensitivity of the aggregation to the increase of costs or decrease of benefits were performed. An additional test was done in case only half of the actual loans would materialize.

Under the base carbon price scenario, the project presents positive economic performance in the 20 year horizon, with an Economic-IRR of 15.0 percent, significantly above the social discount rate, and a NPV of 78.4 m US$, and even more solid results for a 40 years horizon (E-IRR of 17.6 percent with 227.5 m US$ NPV - Table 17).

**Sensitivity analysis: costs and benefits**. Under the base scenario, only an increase of costs of over 50 percent or a reduction of benefits of above 15% would cause a negative economic performance. Even in case only half of the loan materialize the project represents a valuable investment.

**Sensitivity analysis: lower disbursement of decarbonization loans.** As an additional sensitivity analysis, the models consider scenarios where a smaller proportion of the envisioned loans for decarbonization are disbursed by the financial institutions to private firms. Specifically, the analysis takes into account scenarios where 0%, 50% and 75% of the loans are disbursed. Under these scenarios, the model yields positive rates of return for the 20- and 40-year horizons.

**Sensitivity analysis: carbon pricing**. Even for this case, as the carbon sequestration or decrease in carbon emission represent the majority of the economic benefits, the aggregated economic performance depend largely on the carbon pricing. Again, the performance substantially larger than the social discount rate for both 20 and 40 years horizon. Even if the financial performance of the models is positive under various sensitivity scenarios, with a carbon pricing of 10US$/t, the aggregated economic levels are below the social discount rate in case of a reduction of benefits over 5 percent (where carbon is among the benefits).

Overall, the project presents a substantial performance and solidity of each individual models as well as an aggregate solidity.

**Table 17. Aggregated project benefits (with all project costs)**

All aggregated economic benefits including all project costs (CO2e=40US$/t)

| | 10 year results | | 20 year results | | 40 year results | |
|---|---|---|---|---|---|---|
| | IRR | NPV | IRR | NPV | IRR | NPV |
| (CO2e=40US$/t) | -6.4% | (28,156,115) | 15.0% | 78,441,519 | 17.6% | 227,522,945 |
| Increase of costs by 10% | -8.5% | (34,933,491) | 13.8% | 71,664,143 | 16.7% | 220,745,569 |
| Increase of costs by 20% | -10.4% | (41,710,867) | 12.7% | 64,886,767 | 15.8% | 213,968,193 |
| Increase of costs by 30% | -12.1% | (48,488,243) | 11.7% | 58,109,391 | 15.0% | 207,190,817 |
| Decrease of benefits by 10% | -8.7% | (32,117,879) | 13.7% | 63,819,991 | 16.5% | 197,993,274 |
| Decrease of benefits by 20% | -11.3% | (36,079,644) | 12.2% | 49,198,463 | 15.4% | 168,463,604 |
| Decrease of benefits by 30% | -14.2% | (40,041,408) | 10.6% | 34,576,935 | 14.2% | 138,933,933 |
| If 75% of loans are disbursed | -8.4% | (30,467,680) | 14.3% | 68,756,279 | 17.1% | 211,073,730 |
| If 50% of loans are disbursed | -10.7% | (32,779,245) | 13.4% | 59,071,039 | 16.5% | 194,624,515 |
| If 0% of loans are disbursed | -16.9% | (37,402,375) | 11.5% | 39,700,558 | 15.2% | 161,726,085 |

In EFA document

All aggregated economic benefits including all project costs (CO2e=80US$/t)

| | 10 year results | | 20 year results | | 40 year results | |
|---|---|---|---|---|---|---|
| | IRR | NPV | IRR | NPV | IRR | NPV |
| (CO2e=80US$/t) | -2.0% | (18,988,798) | 18.2% | 117,836,760 | 20.5% | 334,974,515 |
| Increase of costs by 10% | -4.2% | (25,766,174) | 16.9% | 111,059,384 | 19.4% | 328,197,139 |
| Increase of costs by 20% | -6.2% | (32,543,550) | 15.8% | 104,282,008 | 18.5% | 321,419,763 |
| Increase of costs by 30% | -8.1% | (39,320,926) | 14.7% | 97,504,632 | 17.6% | 314,642,387 |
| Decrease of benefits by 10% | -4.5% | (23,867,294) | 16.8% | 99,275,708 | 19.3% | 294,699,688 |
| Decrease of benefits by 20% | -7.2% | (28,745,791) | 15.2% | 80,714,656 | 18.0% | 254,424,860 |
| Decrease of benefits by 30% | -10.2% | (33,624,287) | 13.5% | 62,153,604 | 16.7% | 214,150,033 |
| If 75% of loans are disbursed | -4.2% | (22,679,974) | 17.4% | 105,647,922 | 19.9% | 315,086,045 |
| If 50% of loans are disbursed | -6.8% | (26,371,149) | 16.4% | 93,459,084 | 19.2% | 295,197,575 |
| If 0% of loans are disbursed | -13.4% | (33,753,499) | 14.3% | 69,081,409 | 17.7% | 255,420,634 |

In EFA document

All aggregated economic benefits including all project costs (CO2e=10US$/t)

| | 10 year results | | 20 year results | | 40 year results | |
|---|---|---|---|---|---|---|
| | IRR | NPV | IRR | NPV | IRR | NPV |
| (CO2e=10US$/t) | -10.0% | (35,031,602) | 12.2% | 48,895,088 | 15.0% | 146,934,267 |
| Increase of costs by 10% | -12.1% | (41,808,978) | 11.1% | 42,117,712 | 14.1% | 140,156,891 |
| Increase of costs by 20% | -13.9% | (48,586,354) | 10.0% | 35,340,336 | 13.3% | 133,379,515 |
| Increase of costs by 30% | -15.6% | (55,363,730) | 9.1% | 28,562,960 | 12.6% | 126,602,139 |
| Decrease of benefits by 10% | -12.3% | (38,305,818) | 11.0% | 37,228,203 | 14.0% | 125,463,464 |
| Decrease of benefits by 20% | -14.7% | (41,580,033) | 9.6% | 25,561,318 | 13.0% | 103,992,661 |
| Decrease of benefits by 30% | -17.5% | (44,854,249) | 8.1% | 13,894,434 | 11.8% | 82,521,859 |
| If 75% of loans are disbursed | -11.9% | (36,308,459) | 11.5% | 41,087,546 | 14.5% | 133,064,493 |
| If 50% of loans are disbursed | -14.1% | (37,585,317) | 10.7% | 33,280,004 | 13.9% | 119,194,720 |
| If 0% of loans are disbursed | -19.9% | (40,139,032) | 8.8% | 17,664,920 | 12.7% | 91,455,173 |

Source: ECON_Aggregate (SUM)

## Appendix 1: Table of Contents of the EFA Spreadsheet

| | | | | Relevance | | |
|---|---|---|---|---|---|---|
| **Models:** | **C1** | **C2** | **C3** | **Fin** | **Econ** | **Agg.** |
| **I Introduction and parameters** | | | | | | |
| Coefficients | | x | x | x | x | |
| Prices | | x | x | x | x | |
| Shadow prices | | x | x | x | x | |
| FO.Plan | | x | x | | | |
| FO.Costs | | x | x | | | |
| FO.Benefits (Wood) | | x | x | x | x | |
| FO.Benefits stream | | x | x | x | x | |
| GHG accounting | x | x | x | | x | x |
| **II Aggregation of benefits** | | | | | | |
| ECON_Aggregate (SUM) | | x | x | | x | |
| ECON_Aggregate (DET) | | x | x | | x | |
| CONCESSIONALITY SENS | | x | x | | x | x |
| Decarb Loans - Aggregate (DET) | | | x | x | x | x |
| Decarb Loans-Sensitivity | | | x | x | x | |
| **III Forestry TABs:** | | | | | | |
| FIN_FO.Models (all) | | x | x | x | | |
| ECON_Aggregated (Forestry) | | x | x | | x | x |
| FIN_FO.Models (private-BASE) | | | x | x | | |
| FIN_FO.Models (private-sens.1) | | | x | x | | |
| FIN_FO.Models (private-sens.2) | | | x | x | | |
| FIN_FO.Models (private-sens.3) | | | x | x | | |
| FIN_FO.Models (private-sens.4) | | | x | x | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| | FIN_FO.Models (private-sens.5) | | x | x | | |
| | FIN_FO.Models (loans@0.07) | | x | x | | |
| | FIN_FO.Models (loans@0.045) | | x | x | | |
| | FIN_FO.Models (SUM_sens) | | x | x | | |
| **IV** | **Decarbonization TABs:** | | | | | |
| | 1a-Steam Boiler-FIN | | x | x | | |
| | 1a-Steam Boiler-ECO | | x | | x | x |
| | 1b-Field Machinery-FIN | | x | x | | |
| | 1b-Field Machinery-ECO | | x | | x | x |
| | 2- Urban Agrifood Retail-FIN | | x | x | | |
| | 2- Urban Agrifood Retail-ECO | | x | | x | x |
| | 3-Cold Storage-FIN | | x | x | | |
| | 3-Cold Storage-ECO | | x | | x | x |
| | 4-Transport - FIN | | x | x | | |
| | 4-Transport - ECO | | x | | x | x |
| **V** | **Other Benefits (accounted)** | | | | | |
| | 7-Consulting on Carbon SP-FIN | | x | x | | |
| | 7-Consulting on Carbon SP-ECO | | x | | x | x |
| | 6- Household Energy | | x | x | x | x |
| **VI** | **Additional Models (accounted separately in ECON Aggregate)** | | | | | |
| | 5- Wood Production | x | | x | | |
| | 8-Ecotourism | x | | x | | |
| | 9-Apiculture | x | | x | | |

## Appendix 2: Carbon pricing

This Appendix on carbon pricing describes the perspectives of different actors on carbon pricing and market, including:

(a) global actors, think tanks, academia and experts – setting or providing evidence on the social price of carbon to achieve the Paris Agreement goals;

(b) global / regional bodies, setting measurement, reporting and verification mechanisms (MRV), and setting standards for emission reductions investments and related methodologies (e.g., CDM, on forestry)

(c) Governments, and their practices for incentives and disincentives – setting subsidies and taxation (fiscal policies) and mechanisms for carbon exchange (e.g., EU ETS);

(d) private sector actors, and parallel carbon exchange markets.

For the specific case of Serbia, the appendix sketches the pre-conditions (assumptions) that allow the establishment of a possible future national ETS, the obstacles (of legislative, regulatory framework, capacity, or similar natures), and the actions required. It also provides a summary of the evidence to define the ideal pricing of carbon to be utilized for the economic valuation of the project investments (ie, through forestry and related value chains), and possible alternative pricing (using other countries, and existing mechanisms as benchmark).

### *I.* Current State of Carbon Pricing

Various reports provide ranges for the carbon pricing necessary to achieve the Paris Goals, between US$ 30 and 100 per ton of CO2. Despite this range, about half of emissions covered by existing national or regional initiatives are priced below US$ 10 per ton of CO2.

**What is Needed (three estimates):**

- To achieve the temperature targets and goals agreed upon by 196 countries under the Paris Agreement on Climate Change,[34] the High-Level Commission on Carbon Prices (2017) suggested that carbon prices would need to be in the US$ 40 – US$ 80/tCO2e range by 2020 and US$ 50–US$ 100/tCO2e range by 2030.
- Less than 5% of GHG emissions were covered by a carbon price within the High-Level Commission's identified range (World Bank 2020).
- Another study reinforces this: only 3.76% of global emissions are currently covered by a US$ 40-80 price.[35]
- Economists at the International Monetary Fund (IMF) suggest that major emitters (China, US, India, EU, Canada, UK) would need a carbon price of US$ 75/t by 2030 to achieve sufficient emissions reductions.36
- The International Energy Agency's (IEA) Sustainable Development Scenario states that a carbon price ranging between US$ 75/tCO2 and US$ 100/tCO2 is needed stay on track with a Paris-compatible trajectory.
- Most companies participating in the Carbon Pricing Corridors Initiative (CDP 2018), identified US$ 30 –US$ 50/tCO2e in the short-term as the carbon price corridor needed to achieve goals in line with the Paris Agreement.

**Current Initiatives and Key Figures:**

- As of 2020, 61 carbon pricing initiatives were in place or scheduled for implementation, consisting of 31 ETSs and 30 carbon taxes, covering 12 gigatons of carbon dioxide equivalent (GtCO2e) or about 22 percent of global GHG emissions (World Bank 2020).

34 Paris Agreement Full Text: https://unfccc.int/sites/default/files/english_paris_agreement.pdf
35 ESG Investor, ""Carbon Pricing too Low to meet Paris Agreement Goals" https://www.esginvestor.net/carbon-pricing-too-low-to-meet-paris-agreement-goals/
36 IMF, 2021. "Proposal for an International Carbon Price Floor Among Large Emitters." June 18, 2021. https://www.imf.org/en/Publications/staff-climate-notes/Issues/2021/06/15/Proposal-for-an-International-Carbon-Price-Floor-Among-Large-Emitters-460468

- In 2019, governments raised more than US$ 45 billion in revenues from carbon pricing. More than half of these revenues went into environmental or developmental projects (World Bank 2020).

**Global Carbon Prices in 2019-20:**

- In 2019, the IMF calculated the global average carbon price as US$ 2/tCO2.
- According to the World Bank (2020), globally, carbon prices range between less than US$ 1 and US$ 119/tCO2e, with about half of the emissions covered by existing initiatives priced at below US$ 10/tCO2e. They do not provide a median value due to the differences in contexts.

## II. Stakeholder Perspectives

### *a. National / Regional Government Rationales*

For governments, carbon pricing is *a key* instrument to reduce emissions. In most cases, it can also be a source of revenue, which is particularly important in the presence of fiscal constraints. However, countries adopt a range of perspectives on carbon pricing levels and tools (fiscal, subsidies or taxation) to implement this pricing, depending on their economic environment, existing emissions and industrial composition, international and national commitments, and regulatory setups.

For instance, in addition to participating in the EU ETS, many EU member states impose their own carbon tax in addition to participating in the EU ETS. For instance, in Sweden, companies pay a price of approximately $119/ton of carbon emissions (World Bank 2020). But outside of Europe – where carbon prices are among the highest -- most carbon pricing systems charge less than $20/tCO2, and many charge less than $5.

The economic cost of climate change in Serbia is high (UNDP 2019). From 2000 until today, due to droughts and floods, the economy has incurred losses of US$ 6 billion. These are estimated to grow to US$ 11 billion by 2030, unless Serbia adapts to climate change.[37]

As part of its process to accede to the European Union (EU), Serbia adopted a Climate Change Act in March 2021[38] to address climate goals in accordance with the EU 2030 Framework for Climate and Energy Policies. Under the Act, Serbia has committed to achieving a reduction of greenhouse gas (GHG) emissions of 33% by 2030, in comparison to the 1990s. However, unlike the Paris Agreement, Serbian Act on Climate Change does not explicitly provide exact quantitative restrictions of emission which Serbia must meet. However, the government plans to adopt a Low Carbon Development, to be adopted for a period of at least 10 years, which will lay out these exact pricing mechanisms.[39]

In addition to meeting EU goals and complying with EU Climate Law and the EU Green Deal, from an international compliance standpoint – Serbia must also fulfill its obligations stemming from its membership in the Energy Community and as a signatory to the Sofia Declaration on the Green Agenda for the Western Balkans.[40] Under the latter, Serbia has committed to align with the EU's ETS and "work towards introducing other carbon pricing instruments to promote decarbonization." (Sofia Declaration, 2020).

### Private Sector / Business Case

From a long-term perspective, companies and investors use carbon pricing to analyze the potential impact of climate change policies on their investment portfolios, and reallocating capital toward low-carbon or climate-

37 UNDP 2019. "Study on the Socio-Economic Aspects of Climate Change in Serbia" https://www.klimatskepromene.rs/wp-content/uploads/2020/07/engl-screen-_06-04-2020_DRAFT_-Study-on-the-Socio-economic-Aspects-of-Climate-Change-on-the-Republic-of-Serbia_UNDP.pdf

38 Serbia's Climate Change Act, 2021 http://www.parlament.gov.rs/upload/archive/files/cir/pdf/predlozi_zakona/2021/337-21.pdf

39 https://www.geciclaw.com/climate-change-act-serbia/

40 Sofia Declaration text: https://berlinprocess.info/wp-content/uploads/2021/02/Leaders-Declaration-on-the-Green-Agenda-for-the-WB.pdf

resilient activities. A lack of information on carbon price may create uncertainty for companies/investors and planning for future investments. In the short term, carbon prices affect costs and revenues.

The economic rationale for carbon prices varies by industry and this is evident in existing prices. A survey found that 23% of the approximately 2,600 companies that disclosed information from their internal carbon-pricing programs indicated they are using an internal carbon charge, and another 22 percent plan to do so in the next two years (McKinsey, 2020).[41] Of the top 100 companies globally in the dataset (based on 2019 revenue), those in the energy, materials, and financial industries reported using internal carbon pricing most frequently. Companies in the technology and industrial sectors were the second most frequent reported users of carbon pricing.

Finally, companies also face competitiveness concerns related to carbon pricing. The prices imposed across countries would shape the relative cost of domestic and foreign goods, thereby affecting trade.

**Country and Regional Carbon Pricing in 2019-20**

Table 18 summarizes country-level carbon pricing for countries which have carbon taxes in place. Table 19 highlights country-level carbon pricing for countries that have a cap and trade system in place.

**Table 18: Carbon Taxes, by country (2019)**

| *Country* | *Carbon Price (US$ / tCO2e)* | *Notes* |
|---|---|---|
| Sweden | 119 | |
| Switzerland | 99 | |
| Liechtenstein | 99 | |
| Finland | 68 | Transport Fuels |
| | 58 | Other Fossil Fuels |
| Norway | 3 - 53 | |
| France | 49 | |
| Iceland | 30 | Fossil Fuels |
| | 9 | F-gases |
| Ireland | 28 | Transport fuels |
| | 22 | Other fossil fuels |
| Denmark | 26 | Fossil Fuels |
| | 22 | F-gases |
| Portugal | 26 | |
| Slovenia | 19 | Fossil Fuels |
| Spain | 16 | |
| Latvia | 10 | |
| South Africa | 7 | 80% of GHG covered |
| Argentina | 6 | Most liquid fuels |
| | 1 | Fuel oil, mineral coal and petroleum coke (20% of GHG covered by both) |
| Chile | 5 | 2020; 39% of GHG covered |
| Colombia | 4 | |
| Singapore[42] | 3.72 | 80% of GHG emissions; 2019-2023 |
| Japan[43] | 3 | |

41 https://www.mckinsey.com/business-functions/strategy-and-corporate-finance/our-insights/the-state-of-internal-carbon-pricing

[42] The government intends to increase the tax rate to US$ 7.43 – US$ 11.15 / $tCO_2$ by 2030.

[43] Japan has a Special Taxation for Climate Change Mitigation, by product is as follows: Petroleum/Oil products: JPY 0.76/L LPG, LNG, etc.: JPY 0.78/kg Coal: JPY 0.67/kg

| | | |
|---|---|---|
| Mexico | <1 - 2 | |
| Poland | < 1 (€0.09) | |
| Ukraine | < 1 (€0.37) | 71% of GHG covered |

*Source: World Bank (2020), ADB (2020), OIES 2021*

**Table 19: Carbon Pricing in ETS**

| *Country / Region* | *Carbon Price (US$ / tCO2e)* | *Notes* |
|---|---|---|
| Korea | 33 | 70% of GHG covered |
| Germany | 27 | To become operational in 2021 |
| Montenegro | 26 | Regulation has been adopted but start date of ETS yet to be announced |
| United Kingdom[44] | £22 | |
| Switzerland | 19 | |
| EU | 19 | |
| New Zealand | 14 | |
| Beijing[45] | 12 | Pilot |
| Shanghai | 5 | Pilot |
| Shenzhen | 2 | Pilot |
| Kazakhstan | 1 | 50% of GHG covered |

*Source: World Bank 2020, OECD 2021*

## III. Implications for the Project Economic and Financial Analysis

Serbia is expected to adopt a legislative framework, transposing elements of the EU ETS system in the foreseeable future. Given the adoption of EU ETS elements, the range of carbon pricing considered could include **EU ETS pricing (US$ 19/tCO2 in 2021 and 80US$ in 2022),** neighboring countries and a benchmark from the World Bank of US$ 10/tCO2.

[44] Initial reserve price of £22/tCO2 for ETS. Further, the UK has a range of climate and energy taxes such as the Climate Change Levy and fuel duty, which mean that effective carbon prices range from £109/tCO2 for road transport fuels to an effective subsidy for gas fired heating of £14/tCO2.

[45] In February 2021, China began the operational phase of its national ETS, building on its experience of successfully piloting carbon markets in eight regions. The Chinese national ETS is estimated to cover more than four billion tCO2, accounting for ~40% of national carbon emissions. The national ETS is estimated to have a cap of over 4,000 MtCO2/ year for 2021.

## Appendix 3. Sensitivity of models to Seedlings and Labour cost increase and RCP 8.5

### TABLE 20. PRICE SENSITIVITY FOR FORESTRY MODELS

Sensitivity to Labour cost +50%

| 95% concessionality | base fuelwood price | | | 10% reduced fuelwood price | | | 20% reduced fuelwood price | | |
|---|---|---|---|---|---|---|---|---|---|
| | 10 Years | 20 Years | 40 Years | 10 Years | 20 Years | 40 Years | 10 Years | 20 Years | 40 Years |
| **3.a Land restoration / energy:** | | % on fuelwood revenues: | | | % on fuelwood revenues: | | | % on fuelwood revenues: | |
| - investment cost per private owner (USD): | 473 | | 26% | 473 | | 29% | 473 | | 33% |
| - fuelwood harvesting cost on Y1 (USD): | 1,332 | | | 1,332 | | | 1,332 | | |
| + revenue from Y1 fuelwood harvest Y1 (USD): | 1,811 | | | 1,629 | | | 1,448 | | |
| IRR (%) | 128% | 128% | 128% | 28% | 29% | 29% | -7% | -7% | -1% |
| NPV (USD) | 1,334 | 1,956 | 2,706 | 492 | 758 | 1,167 | -350 | -440 | -371 |
| Payback (Year) | Y6 | | | Y6 | | | Y30 | | |
| **3.b Land restoration / agroforestry:** | | % on fuelwood revenues: | | | % on fuelwood revenues: | | | % on fuelwood revenues: | |
| - investment cost per private owner (USD): | 279 | | 15% | 279 | | 17% | 279 | | 19% |
| - fuelwood harvesting cost on Y1 (USD): | 1,332 | | | 1,332 | | | 1,332 | | |
| + revenue from Y1 fuelwood harvest Y1 (USD): | 1,811 | | | 1,629 | | | 1,448 | | |
| IRR (%) | #NUM! | #NUM! | #DIV/0! | 77% | 80% | 80% | 30% | 37% | 37% |
| NPV (USD) | 834 | 2,163 | 3,199 | 670 | 1,996 | 3,019 | 506 | 1,829 | 2,838 |
| Payback (Year) | Y1 | | | Y6 | | | Y6 | | |
| **4. Coppice conversion:** | | % on fuelwood revenues: | | | % on fuelwood revenues: | | | % on fuelwood revenues: | |
| - investment cost per private owner (USD): | 29 | | 8% | 29 | | 9% | 29 | | 10% |
| - fuelwood harvesting cost on Y1 (USD): | 266 | | | 266 | | | 266 | | |
| + revenue from Y1 fuelwood harvest Y1 (USD): | 362 | | | 326 | | | 290 | | |
| IRR (%) | #NUM! | #NUM! | #NUM! | #NUM! | #NUM! | #NUM! | 29% | 36% | 36% |
| NPV (USD) | 98 | 187 | 262 | 66 | 154 | 225 | 33 | 120 | 188 |
| Payback (Year) | Y1 | | | Y1 | | | Y6 | | |
| **5. Shelterbelts** | | % on fuelwood revenues: | | | % on fuelwood revenues: | | | % on fuelwood revenues: | |
| - investment cost per private owner (USD): | 296 | | n/a | 296 | | n/a | 296 | | n/a |
| - fuelwood harvesting cost on Y1 (USD): | - | | | - | | | - | | |
| + revenue from Y1 fuelwood harvest Y1 (USD): | - | | | - | | | - | | |
| IRR (%) | 9% | 20% | 21% | 9% | 20% | 21% | 9% | 20% | 21% |
| NPV (USD) | 34 | 639 | 1,157 | 34 | 638 | 1,148 | 34 | 636 | 1,139 |
| Payback (Year) | Y8 | | | Y8 | | | Y8 | | |

Sensitivity to Seedlings Price (+100%)

| 95% concessionality | base fuelwood price | | | 10% reduced fuelwood price | | | 20% reduced fuelwood price | | |
|---|---|---|---|---|---|---|---|---|---|
| | 10 Years | 20 Years | 40 Years | 10 Years | 20 Years | 40 Years | 10 Years | 20 Years | 40 Years |
| **3.a Land restoration / energy:** | | % on fuelwood revenues: | | | % on fuelwood revenues: | | | % on fuelwood revenues: | |
| - investment cost per private owner (USD): | 620 | | 34% | 620 | | 38% | 620 | | 43% |
| - fuelwood harvesting cost on Y1 (USD): | 1,332 | | | 1,332 | | | 1,332 | | |
| + revenue from Y1 fuelwood harvest Y1 (USD): | 1,811 | | | 1,629 | | | 1,448 | | |
| IRR (%) | 59% | 59% | 60% | 19% | 21% | 22% | -10% | -9% | -2% |
| NPV (USD) | 1,196 | 1,819 | 2,568 | 354 | 621 | 1,029 | -488 | -577 | -509 |
| Payback (Year) | Y6 | | | Y6 | | | Y30 | | |
| **3.b Land restoration / agroforestry:** | | % on fuelwood revenues: | | | % on fuelwood revenues: | | | % on fuelwood revenues: | |
| - investment cost per private owner (USD): | 281 | | 16% | 281 | | 17% | 281 | | 19% |
| - fuelwood harvesting cost on Y1 (USD): | 1,332 | | | 1,332 | | | 1,332 | | |
| + revenue from Y1 fuelwood harvest Y1 (USD): | 1,811 | | | 1,629 | | | 1,448 | | |
| IRR (%) | #NUM! | #NUM! | #NUM! | 75% | 78% | 78% | 30% | 37% | 37% |
| NPV (USD) | 832 | 2,161 | 3,197 | 668 | 1,994 | 3,017 | 504 | 1,827 | 2,836 |
| Payback (Year) | Y1 | | | Y6 | | | Y6 | | |
| **4. Coppice conversion:** | | % on fuelwood revenues: | | | % on fuelwood revenues: | | | % on fuelwood revenues: | |
| - investment cost per private owner (USD): | 30 | | 8% | 30 | | 9% | 30 | | 10% |
| - fuelwood harvesting cost on Y1 (USD): | 266 | | | 266 | | | 266 | | |
| + revenue from Y1 fuelwood harvest Y1 (USD): | 362 | | | 326 | | | 290 | | |
| IRR (%) | #NUM! | #NUM! | #NUM! | #NUM! | #NUM! | #NUM! | 28% | 35% | 35% |
| NPV (USD) | 98 | 187 | 262 | 65 | 153 | 225 | 32 | 119 | 187 |
| Payback (Year) | Y1 | | | Y1 | | | Y6 | | |
| **5. Shelterbelts** | | % on fuelwood revenues: | | | % on fuelwood revenues: | | | % on fuelwood revenues: | |
| - investment cost per private owner (USD): | 315 | | n/a | 315 | | n/a | 315 | | n/a |
| - fuelwood harvesting cost on Y1 (USD): | - | | | - | | | - | | |
| + revenue from Y1 fuelwood harvest Y1 (USD): | - | | | - | | | - | | |
| IRR (%) | 8% | 19% | 20% | 8% | 19% | 20% | 8% | 19% | 20% |
| NPV (USD) | 16 | 621 | 1,139 | 16 | 620 | 1,130 | 16 | 618 | 1,121 |
| Payback (Year) | Y8 | | | Y8 | | | Y8 | | |

### OVERALL SENSITIVITY TO RCP 8.5

| In EFA document | | All project benefits and all project costs | 10 year results | | 20 year results | | 40 year results | |
|---|---|---|---|---|---|---|---|---|
| | | Aggregated results | IRR | NPV | IRR | NPV | IRR | NPV |
| All aggregated economic benefits including all project costs (CO2e=40US$/t) | RCP 8.5 | (CO2e=40US$/t) | -9.9% | (33,645,909) | 12.6% | 51,632,198 | 15.4% | 155,989,195 |
| | | Increase of costs by 10% | -12.0% | (40,423,285) | 11.4% | 44,854,822 | 14.4% | 149,211,819 |
| | | Increase of costs by 20% | -13.9% | (47,200,661) | 10.4% | 38,077,446 | 13.6% | 142,434,443 |
| | | Increase of costs by 30% | -15.7% | (53,978,037) | 9.4% | 31,300,070 | 12.9% | 135,657,067 |
| | | Decrease of benefits by 10% | -12.3% | (37,058,694) | 11.3% | 39,691,602 | 14.3% | 133,612,900 |
| | | Decrease of benefits by 20% | -14.8% | (40,471,479) | 9.9% | 27,751,006 | 13.3% | 111,236,604 |
| | | Decrease of benefits by 30% | -17.7% | (43,884,264) | 8.3% | 15,810,410 | 12.1% | 88,860,309 |
| | | If only 50% of loans are disbursed | -15.6% | (44,164,941) | 9.9% | 30,910,325 | 13.4% | 126,968,706 |

### TABLE 21: BENEFITS STREAM -- WITH AND WITHOUT GCF CONCESSIONALITY SCENARIOS, BY COMPONENT

***Component 2***

| | Without GCF (no grant) - WITHOUT PROJECT | | | | With GCF (proposed in FP) | | | |
|---|---|---|---|---|---|---|---|---|
| | 20-year | | 40-year | | 20-year | | 40-year | |
| | NPV | IRR | NPV | IRR | NPV | IRR | NPV | IRR |
| AFFORESTATION (public land) | (7,472,552) | -6.3% | (5,327,893) | 2.62% | 5,369,325 | 10.85% | 32,915,714 | 15.95% |
| STATE COPPICE CONVERSION | (6,892,449) | -4.9% | (4,470,540) | 3.37% | 23,908,088 | 30.22% | 69,639,598 | 31.94% |

***Component 3***

| | Without GCF (no grant) - WITHOUT PROJECT | | | | With GCF (proposed in FP) | | | |
|---|---|---|---|---|---|---|---|---|
| | 20-year | | 40-year | | 20-year | | 40-year | |
| | NPV | IRR | NPV | IRR | NPV | IRR | NPV | IRR |
| UNFARMED PRIVATE LANDS FOR ENERGY | (1,030,008) | -12.0% | (926,202) | -1.70% | 1,406,920 | 28.83% | 3,291,568 | 30.00% |
| UNFARMED PRIVATE LANDS FOR AGROFORESTRY | (735,703) | -2.5% | (374,982) | 4.62% | 717,980 | 51.25% | 1,782,050 | 51.69% |
| PRIVATE COPPICE CONVERSION | (3,759,518) | -4.9% | (2,438,476) | 3.37% | 13,040,775 | 30.22% | 37,985,235 | 31.94% |
| SHELTERBELTS | (1,689,885) | -10.6% | (1,459,881) | -0.38% | 1,447,338 | 19.28% | 4,590,309 | 22.13% |
| DECARBONIZATION LOANS * | - | - | - | - | 38,156,074 | 31.20% | 58,827,878 | 31.50% |

* The decarbonization models do not DIRECTLY depend on GCF concessionality since they are facilitated through loans from financial institutions.
As a conservative assumption, we model that the financial institutions would not lend this $50 mllion in the absense of GCF grant acitvities (such as the information / awareness raising). Thus, in the the "without GCF" scenario implies that 0% of the loans are disbursed and hence the models are not applicable.

***AGGREGATE PROJECT BENEFITS IN THE ABSENSE OF DECARBONIZATION LOANS***

| | Without GCF (no grant) - WITHOUT Decarbonization Loans | | | | With GCF (proposed in FP) - Decarbonization Loans | | | |
|---|---|---|---|---|---|---|---|---|
| Overall Project Economic Benefits | 20-year | | 40-year | | 20-year | | 40-year | |
| | NPV | IRR | NPV | IRR | NPV | IRR | NPV | IRR |
| | 11.5% | 39,700,558 | 15.2% | 161,726,085 | 15.03% | 78,441,519 | 17.63% | 227,522,945 |

Source: EFA Spreadsheet, "CONCESSIONALITY SENS"

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