SLOVENIAN NATIONAL FORESTRY ACCOUNTING PLAN, INCLUDING FOREST REFERENCE LEVELS – DRAFT

Ljubljana, 31 December 2018

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The Slovenian National Forestry Accounting Plan, containing forest reference levels, has been drawn up in collaboration with the **Ministry of Agriculture, Forestry and Food, the Slovenian Forest Service and the Slovenian Forestry Institute**, and submitted pursuant to Article 8 of Regulation (EU) 2018/841 of the European Parliament and of the Council of 30 May 2018 on the inclusion of greenhouse gas emissions and removals from land use, land use change and forestry in the 2030 climate and energy framework, and amending Regulation (EU) No 525/2013 and Decision No 529/2013/EU.

The National Forestry Accounting Plan contains all the elements set out in Section B of Annex IV and will be published in the Slovenian language on the Ministry of Agriculture, Forestry and Food website (http://www.mkgp.gov.si/si/delovna_podrocja/gozdarstvo/).

GENERAL DESCRIPTION

The forest reference level is based on the criteria set out in Section A of Annex IV (Article 8(4)) and on the **continuation of sustainable forest management practice as documented in the period from 2000 to 2009** using the best and latest available data and with regard to dynamic age-related forest characteristics in forests (Article 8(5) of the Regulation).

In the description of the documentary information on sustainable forest management practice and intensity and on the national policies adopted, and as part of the requirement to elucidate the relevant circumstances, particular regard is paid to national forest development programmes, action plans, the reports issued by the Slovenian Forest Service, national forest inventories, and the measures and initiatives associated with forest management.

Forest development

Management is based on the principles of sustainability, environmental protection and variety of purpose, taking into account the ecological, production-related and social functions of forests. Any forest owner has the right and duty to manage their forest land; as part of its remit, the Slovenian Forest Service provides guidance in this regard. In collaboration with forest owners, it selects trees for harvesting, taking into account the National Forest Programme, the Forests Act (*Zakon o gozdovih*) and its implementing regulations, and forest management and forest cultivation plans.

National Forest Development Programme

Up until 2007, the basic forestry document in Slovenia was the National Forest Development Programme (UL RS, No 14/96), which had its basis in Articles 6 and 7 of the Forests Act (UL RS, Nos 30/93, 56/99 – ZON, 67/02, 110/02 – ZGO-1, 115/06 – ORZG40, 110/07, 106/10, 63/13, 101/13 – ZDavNepr, 17/14, 24/15, 9/16 – ZGGLRS and 77/16). In 1996 this document determined the national sustainable forest management policy, guidelines for conserving and developing forests, and the conditions for the exploitation or multi-purpose use of forests. The Forest Development Programme (PRG) proceeded from Slovenia's international obligations as set out in Chapter 11 of Agenda 21, which was adopted at the United Nations Conference on Environment and Development (UNCED) in Rio de Janeiro in 1992: to prepare a national forestry action plan for the management, conservation and sustainable development of forests that was integrated with other land uses. The PRG also took account of the provisions of the Alpine Convention and the resolutions adopted at the Ministerial Conferences on the Protection of Forests in Europe (Strasbourg 1991, Helsinki 1993) and the Convention on Biological Diversity (Rio de Janeiro 1992).

The PRG established the foundations for the conservation and development of all forests and their functions, taking into account the natural laws of forest ecosystems, the public interest, the material possibilities of the country, and the needs and interests of forest owners. It formulated a development strategy in specific fields of forest management, and also formulated expert guidance for cooperation with activities that intersected with forestry. It also established the organisational, staff-related and material bases for realising the strategy of sustainable, environment-friendly and multi-purpose management of forests and forested areas.

As far as wood production was concerned, the PRG found that it was being insufficiently exploited. Forest increment and yield analyses showed that the average production capacity of Slovenian forest habitats was 8 m³/ha, while the actual increment was 4.9 m³/ha. Only 61 % of the production potential of Slovenian forest sites was being exploited prior to the publication of the PRG. The forest management plans for 1971-1980, 1981-1990 and 1991-2000 provided the source of data on allowable cut.

Owing to careful management, there was a persistent increase in growing stock and increment in Slovenian forests right up to 1990. In 1990 growing stock stood at 194 m³/ha, which was an 80 % increase on 1956 and an 87 % increase on 1947. In a little less than five decades, large quantities of growing stock had accumulated in Slovenian forests, and current annual increment doubled.

The PRG drew attention to the fact that the age and diameter structure of Slovenian forests was below the optimal level. In the period prior to the publication of the PRG, the composition was as follows: 11 % young stands and 45 % growing stands, with a shortfall of adult stands (23 %), particularly older (6 %) and selection stands (3%). In Slovenian forests, the proportion of thick trees in particular, which is an indicator of quality and high-value increment, as well as biodiversity and the mechanical stability of forests, was too low.

In the chapter on the sustainable forest management strategy, the PRG stated that, owing to the fact that forests accounted for a relatively high proportion of Slovenia's total surface area (53 %), there no longer seemed to be a requirement to plan for an increase in forest cover; instead, efforts should be focused on caring for existing forests and on better exploiting their growth potential (in quantitative and, above all, qualitative terms). According to the PRG, in guiding forest development featuring explicit ecological and social functions and the simultaneous and coordinated use of forests, stands had to contain the **highest quantity of growing stock possible**, except in extreme growing conditions and in protected forests, where structural diversity was given explicit precedence.

Guiding forest development from the point of view of cultivation had to be based on the principles of sustainability, environmental protection and variety of purpose. Management systems across small areas are suited to this type of work with forests, allowing flexible adjustments to be made to natural growing conditions and the natural development tendencies of forests. Here it was particularly important to preserve the natural population of forest trees, preserve and establish natural diversity, and **strengthen forest growing stock** (which thereby strengthened the ecological and economic stability of forests). Under the policies set out in the PRG, an increase in Slovenian forest growing stock would be achieved by means of an **accumulation of increment**. The scale of wood harvesting and the trends in the strengthening of the wood production potential of forests are set out in Article 4.8 (Harvesting of forest products).

With the assumption of prudent forest care, the forest management plans in the 1991-2000 period envisaged the annual harvesting of 3 018 000 m³ (1 732 000 m³ of coniferous and 1 286 000 m³ of deciduous trees) or an average of 2.8 m³ per hectare in all Slovenian forests. According to the policies set out in the PRG, this moderate harvesting intensity (66 % of increment for coniferous trees and 50 % of increment for deciduous trees) should continue into the future to enable an increase in the growing stock of more than one third (approximately 36 %) and an increase in increment of one quarter (approximately 26 %) over the next **30 years**. According to estimates, **by 2020 growing stock was to rise to an average of 262 m³/ha** and annual increment was to rise to **6.2 m³/ha**. At the same time, the maximum allowable annual cut would therefore once again increase, following a period (1981-2000) in which there had been a considerable reduction (19 %) as a result of increased ecological problems and 'forest dieback'. In three decades, the harvest would increase evenly to 3.6 m³/ha per year. In quantitative terms, this would lead to 84 % exploitation of forest habitats, as well as to a strengthening in their ecological functions. The long-term objective was to increase Slovenian growing stock to an average of at least half that again of the current level (**optimal growing stock should reach 300 m³/ha**), with the ratio between coniferous and deciduous trees changing even more greatly in favour of the latter.

Summary of forest management areas' forest management plans 2001-2010
(Source: Veselič, Matijašić): When the regional forest management plans were being drawn

up for the **2001-2010** period, due regard was given to the planned allowable cut as derived from the PRG guidelines, i.e. 67 % of increment for coniferous and 55 % of increment for deciduous trees. Prior to 2001, growing stock amounted to 266 703 825 m^3 (or 235 m^3/ha) and annual increment to 6 742 066 m^3 (or 5.9 m^3/ha). The slightly higher allowable cut set out in the 2001-2010 regional forest management plans was justified by the **latest data on forests, which indicated that growing stock and increment were at levels higher than those that had formed the basis for Slovenian policy as set out in the PRG**.

Taking into account the data on the measurements of growing stock for the requirements of the forest management plans produced by forest management units in recent years, the average per-hectare growing stock in Slovenian forests grew from 192 m^3/ha (according to figures from the previous regional forest management plans that provided the basis for the PRG in Slovenia) to 234 m^3/ha, i.e. an increase of 22 %. The growing stock level which, according to the PRG, would not be achieved until 2020, would therefore be achieved before that.

The allowable cut set out in the 2001-2010 regional forest management plans ensured, even if it were to be realised in full, that Slovenian forests and their stock would develop in a positive direction. Alongside this, growing stock and forest increment would, in a few decades, reach the framework of values regarded as optimal (model) for commercial forests (excluding protected forests and forest reserves) and, with an approximately balanced ratio between the development stages of stands, 300-330 m^3/ha of growing stock and 7.2-8 m^3/ha of increment, which would, if the overall surface area of forests were maintained, give a **harvest of between 6 and 7 million m^3 (gross)**.

Slovenian Forest Service 2004 annual report

Growing stock stood at **252 m^3/ha** in **2004**, i.e. only 10 m^3/ha away from the 2020 target of 262 m^3/ha, and 50 m^3/ha away from the optimal figure of 300 m^3/ha. The Forest Service does point out that the allowable cut has risen in the forest management plans since it was established in 1994. The allowable cut in Slovenian forests as determined in units' forest management plans therefore increased from 3 147 770 m^3 (1994) to 4 170 345 m^3 (2004), which exceeded the allowable cut set out in the 2001-2010 regional forest management plans by 69 289 m^3 (or 1.7 %). The difference between the quantity of harvesting actually conducted and the allowable cut determined in the forest management plans is, to a large degree, the result of economic decisions made by forest owners: *'According to previous rough analyses, harvesting in state-owned forests in all recent years has taken place approximately to the level of planned or allowable cut, while harvesting in private forests has only reached approximately two thirds of the allowable cut. There are several reasons why harvesting has not been carried out in private forests. Undoubtedly the most important reason is the lack of cost-effectiveness in harvesting wood from stands containing thinner trees or in felling thin trees. In these cases, forest owners do not opt for harvesting.'*

According to the PRG (1996), one difficulty with the management of private forests was the fragmented nature of forest estates, which was evident not only in the small average size of a private forest estate (at 2.3 ha, among the smallest in Europe), but also in the fact that forest owners' forest estates were generally divided up into several spatially separate parcels. The form of the estate was also often unsuitable (e.g. very long and narrow parcels). The highly fragmented nature of private forest estates (there were around 300 000 owners or co-owners in 1996) makes it difficult to carry out specialist forestry work in private forests and to make best use of wood and of forest potential; however, it also means that private forests are diverse in terms of plant species and structure. Forests have little significance in economic terms for many owners of small forest estates, who are therefore insufficiently interested in cultivating high-quality forests. Moreover, they are generally poorly professionally qualified to carry out forestry work. One further disadvantage of having fragmented estates is that the Forestry Service has to work with a large number of owners, which makes their advice less effective. The PRG gave two warnings: that the average stock had to be further increased,

and that the age and diameter structure of Slovenian forests had to be balanced. The 2007 National Forest Programme shifted the emphasis towards ensuring sustainability and resolving the issue of diameter structure.

2007 National Forest Programme

The existing PRG was updated and upgraded by means of a basic strategic forests and forestry document: the National Forest Programme (NGP), adopted by resolution (UL RS, No 111/07). The NGP defined forests as a permanent resource for preserving the health of the Slovenian population, and stated that forests, along with sustainable management and wood use, environmental protection and biodiversity, fostered economic development and provided jobs. It defined the importance of wood and highlighted the fact that although the general benefits of forests were more important, the economic importance of wood was not negligible and that, **in future, more trees could be harvested in Slovenian forests without affecting their sustainable preservation and development**.

In Slovenia, wood is a traditionally important source of energy responsible for heating more than 30 % of all dwellings. The market for all forms of wood-based fuel is developing rapidly in Slovenia and, as modern technologies become established, the demand for wood for energy has also increased. Wood used for fuel still most commonly comes in the form of logs, although the use of wood chips and pellets has increased rapidly in recent years. By introducing a **system of co-financing** of initial investments in modern central heating boilers and supporting promotional projects, **the state has also contributed significantly** to this trend.

The NGP, published in 2007, reported that Slovenian forests' growing stock and increment had been rising for more than 50 years. The average growing stock of all forests exceeded 257 m³/ha, and had already reached 280 m³/ha in commercial forests (multi-purpose and special-purpose forests in which commercial wood activities are permitted). Through planned forest management, the situation outlined in the NGP came close to the **newly established optimal average growing stock level**, i.e. **320-330 m³/ha**. Chapter 6.3.2 ('Forests and climate change') contains Objective 1, which is to 'ensure a CO_2 sink in forests', and Policy 1, which runs as follows: *'**To achieve optimal growing stock** from the economic, environmental and social aspects, with sufficient accumulation of annual increment (at least 1 000 000 m³/year) relative to the sink that Slovenia is able to establish under Article 3.4 of the Kyoto Protocol (1.3 Mt CO_2/year).'* Moderate and selective accumulation of increment was prescribed for achieving this, and a warning issued regarding the imbalance of the age/diameter structure and on harvesting in private forests, where, despite the upward trend, only 60 % of possible wood was being felled on average. These discrepancies arose because of the high costs of forest management, which were primarily the result of the low density of forest access routes, the high felling and harvesting costs resulting from the fragmented nature of forest estates, and the protracted stagnation of prices for forest wood assortments.

The role of wood as an important renewable natural resource that had always contributed to the development of industry and the Slovenian economy as a whole, particularly in rural areas, was acknowledged in 2007. Therefore, if wood processing was to be secured, value added to the domestic environment and the economy further developed, it was important to integrate forestry and woodworking. As wood is the most energy-saving raw material and forests and permanent incorporated wood are important factors in carbon-binding (carbon sinks), this also contributes to the rational use of energy and to a clean environment.

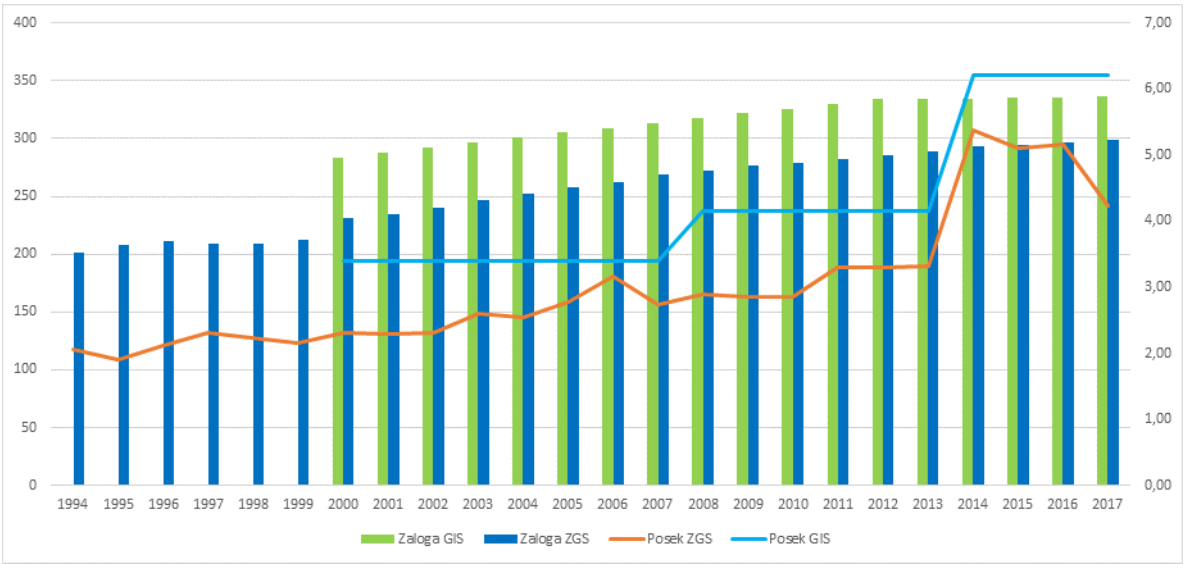

Figure 1: Growing stock and harvesting based on the assessments of the Slovenian Forest Service (ZGS) and the Slovenian Forestry Institute (GIS)

Zaloga GIS	GIS stock
Zaloga ZGS	ZGS stock
Posek ZGS	ZGS harvest
Posek GIS	GIS harvest

Slovenian Forest Service 2008 report

In its 2008 report, the Forest Service stated that, based on growing stock of **270 m^3/ha**, harvesting increased to 4 930 176 m^3 (or by 57 %) in 2008 relative to 1994 and by 2.9 % relative to 2006, and it refuted claims that it was neglecting the wood production function at the expense of other forest functions.

Slovenian Forest Service 2009 report

In its 2009 report, the Forest Service announced growing stock of **276 m^3/ha**, that harvesting had increased by 63 % relative to 1994, and that harvesting in state-owned forests in all recent years had been performed roughly to the planned level or that of the allowable cut, while **recorded** harvesting in private forests was lower than the allowable cut, even if the otherwise rough estimates of unrecorded and unauthorised harvesting were taken into account.

2010 National Renewable Energy Action Plan

The National Renewable Energy Action Plan (AN OVE) for 2010-2020, adopted by the Slovenian government, defines wood biomass as the most important renewable energy source in the country. In the plan the government makes a commitment to provide an appropriate support environment in which the renewable energy targets can be achieved; this includes the replacement of heating oil with wood biomass and other renewable energy sources. Under the AN OVE and supported by the Ministry of the Economy, the Eco Fund and the Office of the Government of the Republic of Slovenia for Local Self-Government and Regional Policy, there were public calls for tenders for the co-financing of individual wood biomass heating systems in 2009 and 2010, public calls for tenders for the co-financing of district heating using wood biomass in 2009, 2010 and 2011, financial incentives as part of cohesion policy, and subsidies for district heating systems using wood biomass and geothermal energy. The AN OVE also expressed support for establishing a wood biomass market as one of the key elements of the support environment up to 2020, and highlighted the poor state of infrastructure in relation to forest roads and the unregulated system of

sawing roundwood, including the separation of poor-quality wood for use in the production of renewable energy sources from high-quality wood suitable for the manufacture of wood products. **Improving forest management is a priority sustainable economic development measure based on forest biomass as an important natural renewable source.**

An awareness of the importance of the sustainable use of forest biomass will, above all, encourage the use of wood for the manufacture of products, mostly in construction, and indirectly make it possible to use larger quantities of poorer-quality wood for conversion into a renewable energy source.

'GOZD in les – razvojna priložnost Slovenije'
('FORESTS and wood – Slovenia's development opportunity')

With the aim of analysing the situation in Slovenian forestry and searching for future solutions and policies, a meeting took place on 2 March 2010. It was organised by the Slovenian National Council and the Slovenian Forest and Timber Technology Platform, or the Commission for Agriculture, Forestry and Food. The resolutions produced in the presentations on wood use and the challenges facing the wood industry, and analyses of the management of private forests, the paper industry and the formation and potential of wood as a biofuel were as follows:

- to systematically label semi-finished products, products and services in relation to their impact on greenhouse gas emissions and on the environment throughout their entire lifecycle;
- to promote the gradual use of wood in construction, the manufacturing industry, agriculture and energy: good wood for products, poor wood for processing and cellulose, and ligneous residues for energy sources;
- to define wood as a strategic raw material and forestry and the wood processing industry as important sectors;
- to strengthen the wood and wood products market, and to integrate the manufacturing, processing and sales processes;
- to put education and training systems in place, and to organise an accelerator service to promote and guide wood production and processing.

Summary of 2011-2020 regional forest management plans

The summary of the 2011-2020 regional plans states that the planned allowable cut is determined on the basis of the state of forest stands, the ratios between different development stages, and the objectives and cultivation conditions within specific forest management classes. According to the summary, the planned allowable cut will be 65 488 284 m^3 over the next decade at the national level. It goes on to state that, according to figures from the regional plans, Slovenian forest growing stock stands at 281 m^3/ha, and that the recalculated figures for 2010 indicate growing stock of **310 m^3/ha**. However, there are differences between regions in terms of the growing stock of thick trees. Stocks are highest in the Dinaric region (Kočevje and Postojna forest management areas), in the Alps (Kranj, Nazarje and Slovenj Gradec forest management areas) and in Pohorje (Maribor and Slovenj Gradec forest management areas), where more intensive renewal of forest stands is planned for the future. The youngest forests in terms of development are those situated in the Karst, Murska Sobota, Celje and Tolmin forest management areas, where an emphasis will remain on the accumulation and care of growing stock.

The average annual increment of Slovenian forests is 7 m^3/ha (7.8 m^3/ha according to estimates for 2010). The **PRG plan has been achieved** *(Forest increment and yield analyses show that the average production capacity of Slovenian forest sites was 8 m^3/ha [Table 1], while the actual increment was 4.9 m^3/ha. Therefore, only 61 % of the production potential of Slovenian forest habitats was exploited)*.

Allowable cut for the future regulatory period (2011-2020) is 56 m^3/ha, or 6.55 million m^3 per year. Harvesting intensity is slightly higher in state-owned forests than in private and other forests: an average of 86 % of increment or 21 % of growing stock. Of the key problems faced by forest management in the previous decade (2001-2010), the ZGS highlighted those of ensuring that the planned measures, such as harvesting, cultivation and protection work, were carried out, and the fact that some private forests were poorly served by forest access routes. It also pointed out that the goal of forest management was to increase wood production, which is why the basic strategic wood management policies and priorities were aimed chiefly at increasing exploitation of the production potential of forest habitats and opening forests up by means of access routes.

Support for forest management

Several reports, summaries, action plans and programmes set out the reasons for the low intensity of management by private owners. The Forests Act (in force since 1993), one of the first laws passed in independent Slovenia, reset the forest management methods to be employed in the country. One change was that inexperienced and poorly equipped forest owners became responsible for managing their own forests. The forest management factors that limited the possibility of more intensive management included:

1. the closed nature of private forests;
2. the fact that the Denationalisation Act (*Zakon o denacionalizaciji*) returned large, previously state-managed areas of land to private owners;
3. the change to the socio-economic relations between forest estate owners, with the proportion of farmer-owners falling further; in general, forest owners' economic dependence on forests fell, which in turn led to a fall in their readiness to carry out forestry work;
4. a forestry policy, supported by the PRG, which emphasised the accumulation of growing stock through a policy in which allowable cut would reach up to 60 % of the increment;
5. a significant increase in the nature conservation and social and environmental roles of forests, which also often overlooked the importance of wood;
6. the collapse or decline of timber plants;
7. the small size of forest estates, with the majority of owners owning a forest area of less than one hectare in size that was frequently divided into several spatially separate units;
8. joint ownership, which also hindered management. Management is, in principle, more difficult for more than a quarter of forest owners in Slovenia because they own their forest estate jointly with another. This also makes the work of the forestry service more demanding, as they have to consistently take account of the fact that joint owners have the right to manage their forest together. There is a safeguard in the case of urgent work, e.g. the remediation of an epicentre of bark beetle infestation. If the forest owner is not known or is not reachable for objective reasons, or if the joint owners cannot agree on who will represent them, the Forestry Service becomes the custodian in special cases, when a decision needs to be issued.

Financial incentives

Since **1994** and pursuant to the Rules on the Financing and Co-Financing of Investments in Forests from the Central Government Budget (UL RS, No 58/94) and subsequent instruments (Rules on the Financing and Co-Financing of Investments in Forests, UL RS, Nos 71/04, 95/04, 37/05, 87/05, 73/08, 63/10, 54/14, 60/15 and 86/16), forest owners have been entitled to financial incentives relating to the ecological and social importance of forests (which in turn necessitates restrictions on management). Among the other provisions made in 1994 was an increase of 30 % in the proportion of co-financing from the national budget for owners of forests with permanent residence in economically deprived areas and in areas on the border with Italy, Austria, Hungary and Croatia, which are regarded as areas with

particular development problems. However, the co-financing could, in fact, reach maximum of 100 % of the value of the work performed (Rules Amending the Order on the Financing and Co-Financing of Investments in Forests from the Central Government Budget, UL RS, No 83/2002). As part of the implementation of the Single Programming Document for the Republic of Slovenia 2004-2006, Slovenian central government budget funds and EU funds were earmarked, and are still being earmarked, for the co-financing of the following measure: 'Investments in forests to improve their economic and ecological value'.

Best forest owners

Since 1998, owners of private forests have also been supported and encouraged to manage their forests through the 'Najbolj skrbni lastniki gozda' ('Best forest owners') awards. The following criteria or work-related assessments are taken into account when the selection is made: maintenance of forest access routes, forest paths and parcels boundaries; the level of care given to the forest; the level of initiative shown in rectifying storm damage; compliance with the professional instructions of the Forest Service; the quality of the work carried out in the forest; the maintenance of good forest order; the rehabilitation of damage after felling and harvesting; adherence to the explicit functions of the forest and the needs of forest animals (e.g. the preservation of trunk hollows, fertile tree and shrub varieties, and anthills); general ecological awareness; and the taking of a nature conservation approach. The organisation and selection of the 14 best forest owners, one in each regional unit, is performed by the Slovenian Forest Service.

'LesEnSvet 2004-2005'

Support for the use of wood as a raw material is also provided via the LesEnSvet advisory network, which contains advisers from the Chamber of Agriculture and Forestry of Slovenia, energy advisers (EnSvet network) and foresters employed by the Slovenian Forest Service. The network is organised informally and operates as part of four institutions: the Slovenian Forest Service, the Chamber of Agriculture and Forestry of Slovenia, the Construction Institute at the Ministry of the Environment and Spatial Planning, and the Slovenian Forestry Institute. The operations of the network in 2004 and 2005 were secured as part of the regular activities of these institutions and with the help of three international projects:

- ALPENERGYWOOD (INTERREG III.B), the Slovenian partner for which was the Slovenian Forestry Institute (GIS) (until May 2006)
- The supply and use of bioenergy with the simultaneous provision of sustainable forest management (FAO), coordinated by the Slovenian Forest Service (until March 2005)
- 'Removing Barriers to the Increased Use of Biomass as Energy Sources (GEF)', carried out by the Ministry of the Environment and Spatial Planning (until June 2006).

Rural Development Programme 2007-2013

One of the most important elements in the provision of incentives to private forest owners to manage forests properly was the Rural Development Programme 2007-2013, which contained Measure 122 'Improving the economic value of forests'. This Common Agricultural Policy measure co-financed investments in up-to-date machinery and equipment for forestry work (felling and harvesting of wood) and investments in the construction and reconstruction of forest roads and tracks. The beneficiaries included owners or co-owners of private forests, associations of forest-owning legal entities, individuals and municipalities. Support was given to members of an agricultural holding engaged in wood processing in accordance with the applicable legislation for investments in initial wood processing under Measure 123 'Adding value to agricultural and forestry products'. The programme was extended into the new period (2014-2020).

Decree on Green Public Procurement

The purpose of the Decree on Green Public Procurement (UL RS, Nos 102/11, 18/12 and 24/12) is to minimise negative environmental impact by means of the public procurement of

more environmentally friendly goods, services and works, improve the environmental characteristics of existing products and services, encourage the development of environmental innovations and a circular economy, and provide a model of good practice to the private sector and consumers. The decree provides that wood or wood-based materials must account for at least 70 % by volume of the materials used for the manufacture of furniture, at least 10 % in the reuse of building wood in wooden wall panels, and at least 30 % by volume of materials or wood-based materials in buildings (excluding interior fittings, ground floor panels and the structures lying beneath them), unless a regulation or the purpose of use prohibits or prevents this.

2012 'Les je lep' Action Plan

In **2012** the Action Plan for Increasing the Competitiveness of the Forest-Wood Chain in Slovenia up to 2020 was published. Its slogan for promotional purposes was 'Les je lep' ('Wood is beautiful'). This was an operational document aimed at increasing the competitiveness of the entire value chain for forests and wood, and was adopted by the Slovenian government at its 20th regular session on 27 June 2012. The document defines wood as a national strategic raw material which still had great unexploited potential. In 2011, 3.9 million m^3 of wood was harvested, although 5.5 million m^3 could have been harvested under forest management plans. In coming years, the allowable cut could even increase to 6.5 million m^3 annually. Slovenian companies engaged in the production of sawn wood and veneer processed 76 %
of domestically produced logs in 2010. The action plan once again places the Slovenian wood-processing industry among the country's most strategically important and promising economic sectors, with sufficient quantities of domestic raw materials available for this purpose. There are two important measures here.

Measure 2.1.1 Encouraging an increase in harvesting, particularly in private forests, with the aim of improving the marketing of forest wood assortments and initiating an organisation of producers for the performance of work in forests. The aim of the measure is to increase the percentage of harvest relative to the allowable cut, and to introduce forest care activities chiefly in private forests, in accordance with the forest management plans in force. Under this measure, Activities 2.1.1.a and 2.1.1.d are important:

- Activity 2.1.1.a: Encouraging the establishment of organisations of forest wood assortment producers by means of forest production organisation activities, the purchase and sale of forest wood assortments from private forests, and integration into production chains through primary processing, using the following two indicators: the harvest relative to the allowable cut, the quantity and economic effect of the purchase and sale of forest wood assortments from private forests, and the share of planned cultivation work performed; the quantity and economic effect of the purchase and sale of forest wood assortments via the organised purchase of wood and integration into production chains through the primary processing of wood. Deadline for start of implementation from 2014.
- Activity 2.1.1.d: Encouraging forest owners to increase harvesting in accordance with the forest management plans in force with the aim of activating owners who do not make use of the allowable cut, and encouraging them to harvest and carry out necessary cultivation works in accordance with forest management plans. Encouraging investments in forests and the integration of forest owners for departmental forest management. Indicators: harvest relative to the allowable cut, volume, share of planned cultivation work performed, value of investments in forests deriving from the integration of forest owners. Deadline for start of implementation of works from 2012.

Measure 2.1.2 To increase the openness of forests (construction/reconstruction of forest roads/tracks) and improve forest owners' level of equipment for carrying out work in forests, with Activity 2.1.2.a: Encouraging investments in the purchase of new machinery for wood cutting and harvesting in forests and in improvements to the openness of forests through forest infrastructure.

Legal measures

While forest land can be freely traded, there are certain restrictions that must be adhered to, the aim of which is to combine forest parcels and thereby make forest management easier. The first important restriction is that parcels of forest land smaller than five hectares in size may not be divided. The second is the pre-emptive right of purchase. The first person with pre-emptive right of purchase when a forest is being sold is the joint owner, followed by owners of neighbouring land and then the tenant. The pre-emptive right then passes to the owners of nearby land. Owing to the way forests are managed and a number of special features characteristic of forest land, it makes sense to combine smaller forest estates with larger ones so that the management process is simplified. The state and municipalities also have a pre-emptive right of purchase when a protected forest or special-purpose forest is being sold. The state also has a pre-emptive right of purchase when a forest of a total size of more than 30 hectares is being sold. The Agricultural Land Act (*Zakon o kmetijskih zemljiščih*) and Forests Act are used to determine a pre-emptive right.

CRITERIA/COMPLIANCE

The forest reference level shall be consistent with the goal of achieving a balance between anthropogenic emissions by sources and removals by sinks of greenhouse gases in the second half of this century. Over the long term, removals in forests will be ensured by means of:

- the balancing of the ratio between different development stages;
- the renewal of exhausted forests;
- the more rapid renewal of storm-damaged forests and those areas where natural renewal is too difficult or too slow;
- increasing the share of deciduous trees in their natural habitats or rotating them with Norway spruce;
- greater investments in forests (access routes);
- more active management in private forests;
- increased use of wood as a renewable raw material, and similar measures,

The enhancement of the potential removals by ageing forest stocks that may otherwise show progressively declining sinks shall be reflected in active forest management or the restoration of exhausted and thinned-out forests. A large proportion of the restoration has also come about in response to natural weather events (ice storm and wind damage) and bark beetle infestation.

The forest reference level proposed in this national plan:

a) ensures that the mere presence of carbon stocks is excluded from accounting;
b) ensures a robust and credible accounting system that ensures that emissions and removals resulting from biomass use are properly accounted for;
c) includes the carbon pool of harvested wood products, thereby providing a comparison between assuming instantaneous oxidation and applying the first-order decay function and half-life values;
d) assumes a constant ratio between solid and energy use of forest biomass as documented in the period from 2000 to 2009;
e) is consistent with the objective of contributing to the conservation of biodiversity and the sustainable use of natural resources, as set out in the EU forest strategy, Member States' national forest policies, and the EU biodiversity strategy;
f) is consistent with the national projections of anthropogenic greenhouse gas emissions by sources and removals by sinks reported under Regulation (EU) No 525/2013;
g) is consistent with greenhouse gas inventories and relevant historical data and is based on transparent, complete, consistent, comparable and accurate information.

CARBON POOLS

The National Forestry Accounting Plan contains an identification of carbon pools and greenhouse gases included in the forest reference level, the reasons for omitting a carbon pool from the forest reference level determination, and a demonstration of the consistency between the carbon pools included in the forest reference level.

Carbon pools included:

- above-ground biomass;
- below-ground biomass;
- dead wood;
- harvested wood products (HWP);
- greenhouse gases from forest

fires. Carbon pools excluded, with

reasons:

- litter (n/a);
- soil organic carbon (re-measurements not yet conducted).

METHODOLOGY

This chapter sets out the approaches, methods and models, including quantitative data, used for determining the forest reference level, including the latest measurements and the national inventory reports.

Stratification of forest area

Forest area

A forest area is defined in the Forests Act (UL RS, No 77/16) as land containing forest trees in the form of a stand that reaches a height of at least 5 m and covers an area of at least 0.25 hectares. A forest is also at least 0.25 hectares of land overgrown with forest trees that has not been used for agricultural purposes for the last 20 years, where the forest trees can reach a height of at least 5 m and at least 75 % of the land is covered by forest trees, and riverside forest corridors and windbreaks wider than the height of one adult tree and covering an area of at least 0.25 hectares.

The area covered by forests is defined in forest management plans, which are drawn up for the entire area covered by forest in Slovenia. These plans are produced for a ten-year period, with 10 % of plans being updated every year. Forest surface area changes annually in accordance with the changes in forest surface area as established in the plans drawn up in a specific year.

Forest surface area for 2018 is defined as the forest surface area under the applicable plans drawn up between 2009 and 2018, corrected in line with the change to the national border with Croatia as decided by the court of arbitration (No/PCA Case No 2012-04) and the adopted Act on Keeping Records on the National Border with the Republic of Croatia (UL RS, No 69/17).

Stratification

The Forests Act prescribes environment-friendly, multi-purpose and sustainable management across the entire forested area of Slovenia. Environment-friendly forest management is based on an adherence to the natural dynamics of forest development and the natural restoration of all tree species crucial for an individual forest site. It is therefore vital to understand and stratify forests with regard to their potential natural vegetation in order to realise the concept of environment-friendly forest management. The natural vegetation is defined by means of 74 forest habitat types, hierarchically arranged into 19 groups (Kutner et al., 2012).

Forest types differ between themselves in terms of production capacity, the development dynamics of forest stands, the natural tree species composition of forests and the natural restoration strategy, and are defined with the aid of phytocoenological maps. Forest types are the basis for a definition of forest management classes (FMC) at the level of forest management units, and regional forest management classes (RFMC) at the level of regional forest management plans (RFMP).

The management method is defined for each unit and RFMC, as follows:

- forest cultivation system;
- production and restoration period;
- target tree species composition;
- target growing stock;
- level of harvesting and scope of cultivation work;
- guidelines for the cultivation and protection of forests and the multi-purpose use of forests.

Table 1: Stratification of forests

FMP	Description	Group of forest sites (Kutnar et al. 2018)
FMP1	Riparian forest and fluvial forest	1, 2
FMP2	Sessile oak – hornbeam forests	3, 4
FMP3	Central European submontane beech forest	6, 8, 13
FMP4	Illyrian beech forest	5, 7, 10
FMP5	Illyrian fir beech forest	9
FMP6	Other thermophilous deciduous forests	11, 12, 14
FMP7	Spruce and fir forest	15, 16
FMP8	Protected forest and forest reserves	chiefly 17, 18, 19

Regional forest management classes can be combined into 19 forest types at the national level. For the purposes of this report, we have combined the forest-type groups into seven forest management strata based on similarities in their management method; these strata differ between themselves in terms of state of the forest, development dynamics and forest restoration, the productivity of forest sites and the forest management strategies employed. For individual FMPs, we have formed the BAU level in line with the definition of the management method and the requirements of the regulation for preparation of the LULUCF report.

Protected forests with low activity intensity and forest reserves with no activity also comprise a category. Despite the fact that forest management plans are produced for all forests in Slovenia, practically no management takes place in protected forests or special-purpose forests in which activities are not permitted (forest reserves). While individual interventions involving harvesting are possible in protected forests, these are restricted to the remediation of forests in response to extreme events. We have not taken these forests into account when calculating the surface area of Managed Forest Land (MFL). The data below therefore applies to MFL and not to all forests in Slovenia; the figures can therefore differ from the official figures published in international statistical reports.

Forest management is determined by forest management plans in which, **regardless of ownership**, the maximum allowable cut is defined at the department/section level. While a manager of a state-owned forest is bound by the requirement to follow FMP policies, an FMP constitutes, for private owners, the upper limit of possible forest use. There are more than 460 000 forest owners in Slovenia; they own 76 % of the country's forests. Twenty-one per cent of forests are state-owned and 3 % are owned by municipalities. The largest single forest owner is the Roman Catholic Church, while there are two other typical groups of private owners as determined by the management method employed ('Clustering-based typology and analysis of private small-scale forest owners in Slovenia' in *Forest Policy and Economics*; Vol. 80, July 2017, pp. 116-124). As outlined in the general description, Slovenia has provided support to owners with the aim of increasing forest management since 1994, and continues to do so.

Definition of management method

The basic data on forest stocks (growing stock, increment, harvesting) at the national level comes from the NFI (for 2000, 2007, 2012 and 2018). The NFI is based on 750 plots, which is insufficient for establishing the situation and determining the BAU level for individual FMPs. More detailed data on the structure of forests by diameter class for individual FMPs is therefore derived from forest inventory data for the purpose of forest management planning. These come from the FMPs in force, which are produced for a ten-year period and cover the

entire forested area of Slovenia.

As approximately 10 % of the unit forest management plans are updated every year, the data shows the situation with a time lag of five years. We have eliminated this lag in the data by harmonising the data from the forest inventory with the national-level data from the NFI using the ratio method.

We have followed the same logic when determining the harvesting structure and level. The national harvesting level was defined for the 2000-2009 period on the basis of the NFI data, while the harvesting structure by diameter level at the FMP level, and together at the MFL level, is taken from the cut inventory for the same period. The cut inventory is maintained by the Slovenian Forest Service, which is responsible, under the Forests Act, for monitoring the state of forests, as well as for all other activities. It is difficult to gain an insight into all activities because of the large number of owners and co-owners and the variety of ways in which allowable cut is performed. Therefore, the only possible correct assessment of harvesting is given under the NFI. Here as well, we have harmonised the more detailed data on harvest volume and structure from the cut inventories with the national-level data from the NFI using the ratio method.

FMPs follow the division of MFLs into eight layers, which differ between themselves in terms of state of the forest, development dynamics and forest restoration, the productivity of forest sites and the forest management strategies employed. Common to all types is the preparation of a stand and the forest cultivation methods, such as staking (protection against a tree being eaten by herbivorous wild animals), the removal of climbing plants or soil preparation. Natural renewal takes precedence over artificial renewal using seedlings. Supplementary planting has been introduced in certain areas – for example, where natural renewal has not proceeded in accordance with plans or in order to enhance the tree species diversity or to plant fruit-bearing species. **In Slovenian forests, hives are not removed.**

The basis for determining a BAU level is the state of forests in 2000 and biomass removal in the period between 2000 and 2009. Biomass removal for determining FRL is based on actual biomass removal between 2000 and 2009, and is expressed as a percentage of the growing stock classes at the start of the BAU determination period (growing stock 2000) by individual diameter class. An additional basis is provided by the following legal documents: the National Forest Development Programme (1996) and the subsequent National Forest Programme (2007), the forest management plans of forest management areas (2001-2010), and the data derived from the ten-year forest management plans of forest management units in force between 2000 and 2009.

Biomass removal for determining the FRL is based on:

- a continuation of the sustainable management method, as recorded in the 2000-2009 forest management plans, with due regard to the diameter (age) structure;
- consideration of the best data from the permanent sample plots for the purposes of forest management planning and from the national forest inventories (NFI 2000, 2007, 2012, 2018);
- consideration of the dynamics of the increment and increased harvesting of thick trees;
- non-interference in the intensification of forest management as part of sustainable, multi-functional and environment-friendly forest management, an increase in wood use and the provision of increased sinks;
- actual harvesting between 2000 and 2009, expressed as a percentage of the growing stock at the start of the BAU determination period (growing stock 2000) by individual diameter class.

The harvesting performed between 2000 and 2009 was defined on the basis of PRG, NGP and NFI data, while the structure of the harvest by diameter class was taken from the cut

inventories for the same period (2000-2009). The prescribed maximum allowable cut (thinning and final cut) by individual FMP and diameter class constitutes the BAU level for the 2000-2009 period. **While a manager of a state-owned forest is bound by the requirement to follow FMP policies, an FMP constitutes, for private owners, the upper limit of possible forest use.**

As the allowable cut prescribed in the FMP was not realised in full because of the lack of activity on the part of private owners, which meant that the BAU level could not be met in full in these forests, we used the intensity of harvest (percentage of the growing stock) by FMP and diameter class for state-owned forests as the BAU level for the 2000-2009 period (Table 2).

Table 2: Determination of the BAU level for an individual FMP (state-owned forests)

Index/dbh class	Harvest relative to growing stock by diameter class (%)					
	10-19 cm	20-29 cm	30-39 cm	40-49 cm	50 cm and over	Total
FMP1	9.02	14.44	18.94	19.27	18.95	16.46
FMP2	10.20	12.85	15.91	17.44	25.00	16.04
FMP3	10.15	11.02	12.41	14.99	23.50	14.79
FMP4	8.75	11.01	12.62	13.27	17.28	13.01
FMP5	11.82	10.12	11.97	15.02	22.79	16.29
FMP6	4.68	4.81	6.83	8.82	13.73	7.01
FMP7	14.88	13.37	12.48	13.77	19.98	15.43
FMP8	0.85	1.36	2.02	2.91	3.44	2.13
MFL (all forests)	8.90	9.61	11.31	13.64	20.62	13.67

To provide assistance to private forest owners and encourage forest management, Slovenia has adopted/supported the following:

- LesEnSvet advisory network;
- Rural Development Programme 2007-2013;
- 'Les je lep' Action Plan;
- Decree on Green Public Procurement;
- 'Čar lesa' ('Wonder of Wood') exhibition (since 2009), etc.

The results of the measures are evident above all in the opening-up of forests and in investments in resources. In response to the introduction of co-financing for the construction and reconstruction of forest roads under the Rural Development Programme 2007-2013, considerably more forest roads were constructed and reconstructed in 2008 than in previous years (Figure 2). A total of 23.4 km of forest roads were constructed, two and a half times the figure for the previous year, while 25.5 km were reconstructed, or 2.7 times the figure for the previous year (ZGS Report: 2008). In 2010, despite the co-financing available for the construction and reconstruction of forest roads under the Rural Development Programme 2007-2013, which had revived forest road construction in 2008 and 2009, only a modest figure for construction and reconstruction was achieved: 12.3 km of construction (45 % of the figure for 2009) and 15 km of reconstruction (58 % of the figure for 2009). The economic crisis clearly had an impact on the level of investment in forestry (ZGS Report: 2010). The conditions for forest roads deteriorated still further in 2011; a mere 2.5 km of construction and 2.7 km of reconstruction.

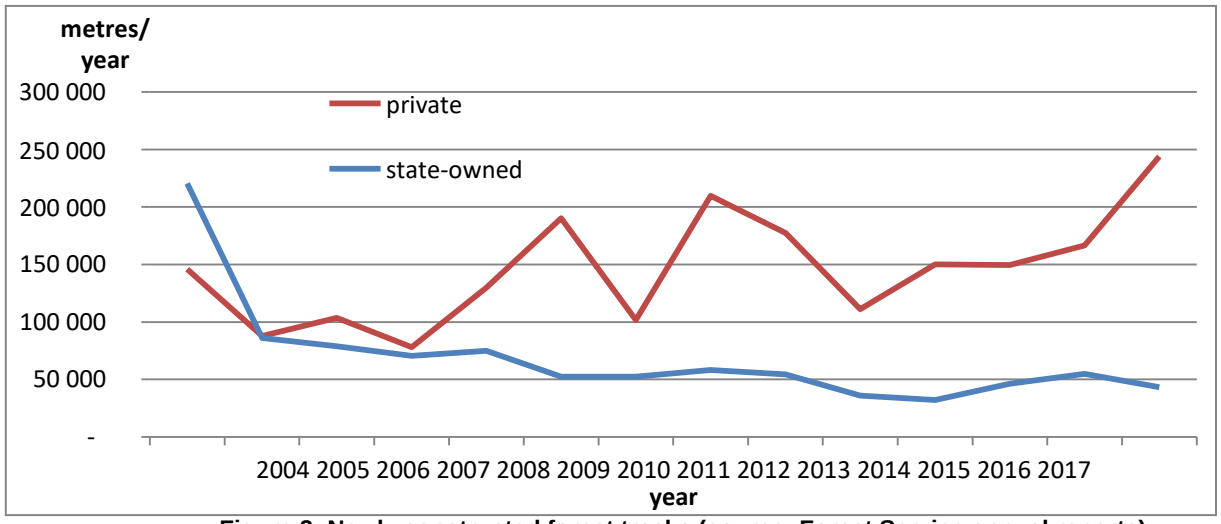

Figure 2: Newly constructed forest tracks (source: Forest Service annual reports)

Newly constructed tracks in private and state-owned forests The impact of the PRP 2007-2013 is clear, with a decline in 2010, most likely as a result of the economic crisis.

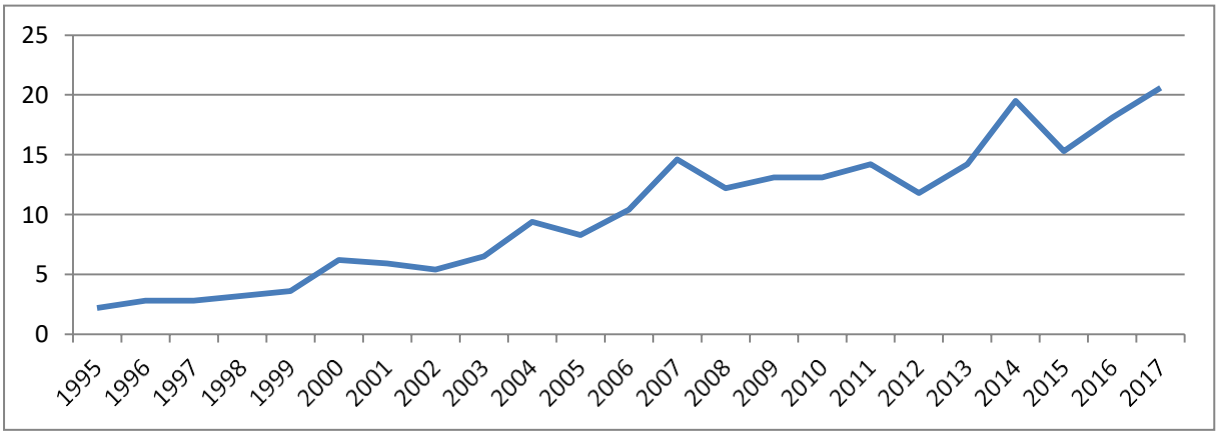

Figure 3: Gross investment in fixed assets in forests – equipment and buildings (in EUR millions/year) (source: Statistical Office of the Republic of Slovenia)

A comparison between the diameter structure and the model shows a large surplus of the thickest trees (dbh > 50 cm) totalling 25 million m^3. The surplus is also evident in the 40-49.9 cm dbh class (4.6 million m^3), while the medium dbh class (20-39.9 cm) had a deficit of 50.5 million and the first dbh class (10-19.9 cm) had a deficit of 19 million m^3.

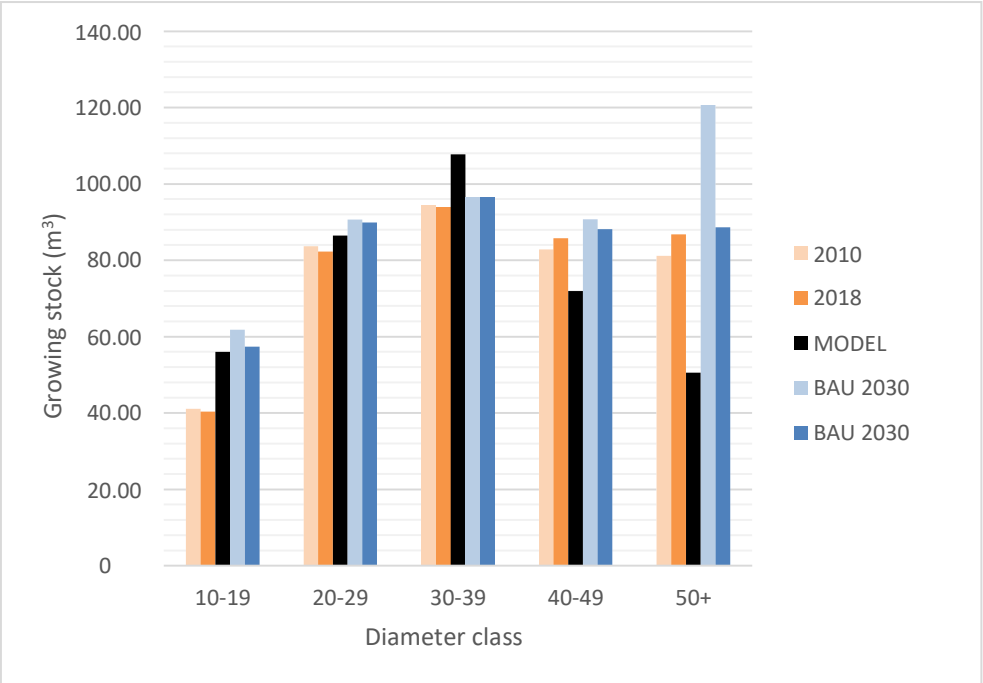

Figure 4: Comparison between the growing stock by actual structure in 2010 and 2018 and the modelled BAU and corrected BAU levels (both for 2030) enabling sustainable management.

The current distribution of growing stock is the result of the long-term tendency of forestry policy and forest management to increase growing stock and the productive capacities of Slovenian forests, as well as improvements to their structure and species diversity. Harvesting was therefore mainly focused on minimum care and cultivation measures, and less on the final cut. Based on the current state of forests, the harvest should be close to the increment in future; this will lead to a short-term equalisation of increment and loss, or to a reduction in the carbon sink from the atmosphere.

The modelled distribution of biomass by diameter class (Figure 4) gives an average growing stock of 330 m^3/ha. Under the model, the level of growing stock is equalised with the average optimal growing stock defined in the NGP. The actual growing stock for Slovenian forests as reported in FRA 2010 is 332 m^3/ha, which indicates the urgency of reducing, as quickly as possible, the gap between increment and harvest, not only from the point of view of highest yield by increment, but also from that of ensuring all forest functions and maintaining sustainable forms of management.

Forestry policy from 1950 on focused on the accumulation of growing stock (the harvest was always lower than the increment). The lowest harvest volumes were planned between 1991 and 2000. This was also the period following independence and of changes to the socio-economic world of forestry. One of the outcomes was an expressly lower level of realisation of allowable cut. The gap gradually reduced between 2001 and 2010, one reason for which was the fact that management incentives had been introduced.

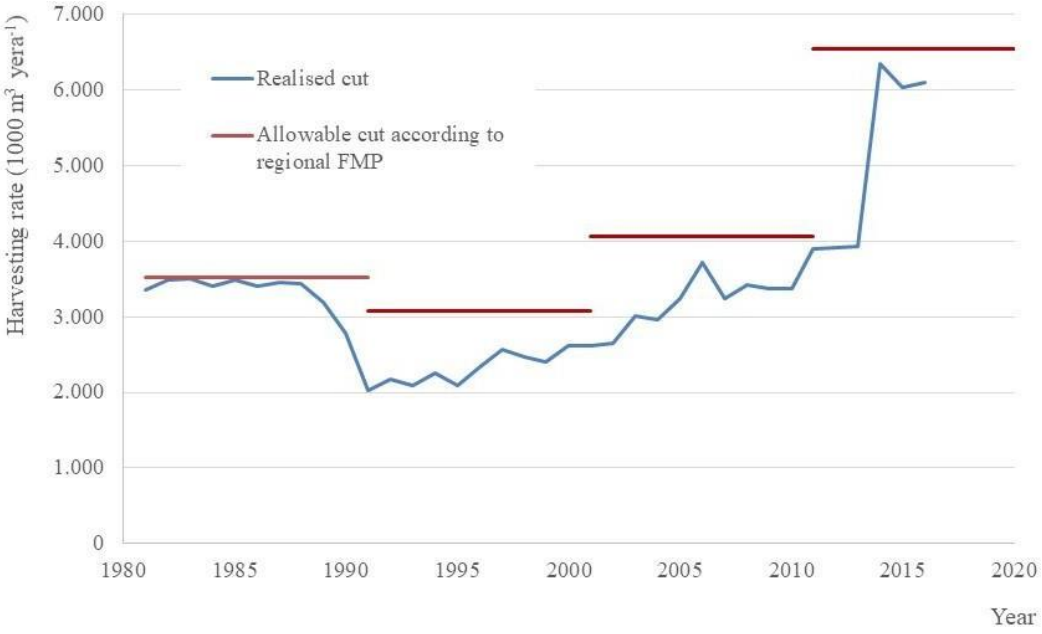

Figure 5: Comparison between allowable and realised cut 1981-2020

The total allowable cut in the management plans has grown in the 2011-2020 period/followed the guidelines contained in the NGP (2007), i.e. the harvesting of 75 % of the increment. The level of the harvest was determined with a view to sustainability, and by the actual condition of stands, the targets and guidelines contained in the NGP, and the measures outlined in the Rural Development Programme 2007-2013. The allowable cut was also higher because of the assumption that the cut realised in the 2011-2020 period would increase gradually and that the final cut would be realised throughout this entire period. A comparison between the planned and realised cut in the last six years indicates that this assumption has proved to be realistic. There are several factors influencing the higher realisation of the prescribed cut:

- a clear change in policy from the NGP of 2007;
- forestry policy interventions, e.g. promotion of forest-wood chains and the revival of sawmill activities and the wood industry;
- the establishment of a state-owned forestry company;
- investments in private forest owners (education and training, promotion of wood, co-financing of equipment purchases, incentives to integrate, etc.);
- the increase in sanitation harvests in 2014, 2015 and 2016 (as a result of the ice storm, wind damage and bark beetle infestations).

All measures were realised by a larger number of business entities, and there was a revival of the wood market and increased investment in the wood industry. All the measures pursue the main national objective: of replacing energy-intensive raw materials with wood.

Since 2008, when the NGP was adopted, there have been significant changes in the way the harvest is determined and in the management method. Forest regeneration and care have been installed as priorities before the accumulation of growing stock in the coming decades. **From this aspect, the harvest level in the reference period of 2000-2009 had to be adjusted to the management method from the end of this period.** There are two main reasons why changes were necessary:

1. an imbalance in the diameter class structure;
2. an increased threat of sanitation harvesting.

Under the unpredictable socio-economic conditions occasioned by independence, the long period of accumulation of growing stock caused major changes in the structure of forests and the ageing of stands, as well as the accumulation of the growing stock of thick trees. Older stands are usually more susceptible to natural disturbances, which increases the risk of a

reduction in adherence to planning requirements and a reduction in the carbon sink.

An analysis of sanitation harvests in the 1995-2016 period shows that sanitation harvests accounted for 30 % of the total harvest (this includes increased forest care in response to extreme weather events). If the structure of Slovenian forests remains the same or if the share taken by the thickest trees continues to rise, forest stability will decline, leading to greater volumes of sanitation harvesting and a reduction in the role of policy.

Table 3: Corrected national BAU level

Index/dbh class	Harvest relative to growing stock by diameter class (%)					
	10-19 cm	20-29 cm	30-39 cm	40-49 cm	50 cm and over	Total
BAU	8.90	9.61	11.31	13.64	20.62	13.67
Corrected BAU	8.90	9.61	11.31	15.04	44.62	18.55

In order to move towards a stable situation in terms of diameter class, we made a slight correction, as evidenced in the NGP, and one that still ensured a gradual reduction in the proportion of thick trees and the probability of sanitation harvests. Here we have focused the intensity of harvest solely on thick trees (forest renewal), while we have preserved the concepts of thinning (interventions on thin and medium-thick trees).

Modelling

While Slovenia's methodological approach to determining the development of carbon pools based on the available data and on national conditions is specific to itself, it does follow the Commission's technical instructions (Guidance on developing …, 2018) and the provisions of Regulation (EU) No 2018/841, including the criteria and guidelines for the preparation/determination of the forest reference level. This approach includes carbon stock changes in above-ground biomass, below-ground biomass, dead wood and harvested wood products, where the best available data was used. The reference level does not include carbon stock changes in soil or litter as there is currently no reliable data on the basis of which a projection for these two pools could be produced. When the data does become available, it will be included in the reference level and a technical correction made.

The model used to project the development of above-ground biomass, including the assumptions regarding the inclusion of harvesting and natural disturbances, is presented in more detail below. The method by which the changes to carbon stocks in harvested wood products were calculated under the required categories is also described.

The model for projecting carbon stocks in above-ground biomass in managed forests takes account of the harvest intensity by diameter class for state-owned forests. The assumption is made that they show a more realistic picture of the forest management customary in practice during the 2000-2009 period (i.e. 'business-as-usual'). The model takes into account the baseline diameter structure by expanded diameter class in the strata described in Step 1 and the features of the forest management method in the reference period described in Step 2.

The data collected as part of the national forest inventories of 2000, 2007, 2012 and 2018 was used to model the development of growing stock in above-ground biomass by diameter class at the national level. The model includes variables such as growing stock, increment, growth, harvest and mortality; a calculation in the growing stock dynamics up to 2030 was obtained on their basis. The model takes into account the average annual increment in the 2007-2012 period, the average annual growth in the 2000-2012 period, the average annual harvest in the 2000-2009 period, the average annual mortality in the 2000-2012 period, and

the transition periods between the first and fourth diameter classes.

The data on increment, growth, mortality, etc. is available only for the country as a whole, which is why the calculations obtained from this model have not been performed separately for strata but only for the country as a whole. The baseline year of the projection is 2010.

Development of growing stock

$$GS_{(i)} = GS_{1(i)} + GS_{2(i)} + GS_{3(i)} + GS_{4(i)} + GS_{5(i)}$$

$GS_{(i)}$ – growing stock in year i (m^3)
$GS_{1(i)}$ – growing stock of diameter class 1 in year i (m^3)
$GS_{2(i)}$ – growing stock of diameter class 2 in year i (m^3)
$GS_{3(i)}$ – growing stock of diameter class 3 in year i (m^3)
$GS_{4(i)}$ – growing stock of diameter class 4 in year i (m^3)
$GS_{5(i)}$ – growing stock of diameter class 5 in year i (m^3)
i – years of projection (2010-2030)

Diameter class 1:

$$GS_{1(i)} = GS_{1(i-1)} + GS_{1(i-1)} \times In + Gr - GS_{1(i-1)} \times Ha - \frac{GS_{1(i-1)}}{T_1} - GS_{1(i-1)} \times Mo$$

In – average annual increment 2007-2012 (% of $GS_{1(i)}$)
Gr – average annual growth 2000-2012 (m^3)
Ha – average annual harvest 2000-2009 (% of $GS_{1(i)}$)
Mo – average annual mortality 2000-2012 (% of $GS_{1(i)}$)
T_1 – transitional period of diameter class 1 (45 years)

Diameter class 2:

$$\mathrm{GS}_{2(i)} = \mathrm{GS}_{(2\,i-1)} + \mathrm{GS}_{(2\,i-1)} \times \mathrm{In} - \mathrm{GS}_{2(i-1)} \times \mathrm{Ha} - \frac{\mathrm{GS}_{2(i-1)}}{T_2} - \mathrm{GS}_{2(i-1)} \times Mo + \frac{\mathrm{GS}_{1(i-1)}}{T_1}$$

In – average annual increment 2007-2012 (% of $GS_{2(i)}$)
Ha – average annual harvest 2000-2009 (% of $GS_{2(i)}$)
Mo – average annual mortality 2000-2012 (% of $GS_{2(i)}$)
T_1 – transitional period of diameter class 1 (45 years)
T_2 – transitional period of diameter class 2 (35 years)

Diameter class 3:

$$\mathrm{GS}_{3(i)} = \mathrm{GS}_{(3\,i-1)} + \mathrm{GS}_{(3\,i-1)} \times \mathrm{In} - \mathrm{GS}_{3(i-1)} \times \mathrm{Ha} - \frac{\mathrm{GS}_{3(i-1)}}{T_3} - \mathrm{GS}_{3(i-1)} \times Mo + \frac{\mathrm{GS}_{2(i-1)}}{T_2}$$

In – average annual increment 2007-2012 (% of $GS_{3(i)}$)
Ha – average annual harvest 2000-2009 (% of $GS_{3(i)}$)
Mo – average annual mortality 2000-2012 (% of $GS_{3(i)}$)
T_2 – transitional period of diameter class 1 (35 years)
T_3 – transitional period of diameter class 2 (30 years)

Diameter class 4:

$$\mathrm{GS}_{4(i)} = \mathrm{GS}_{(4\,i-1)} + \mathrm{GS}_{(4\,i-1)} \times \mathrm{In} - \mathrm{GS}_{4(i-1)} \times \mathrm{Ha} - \frac{\mathrm{GS}_{4(i-1)}}{T_4} - \mathrm{GS}_{4(i-1)} \times Mo + \frac{\mathrm{GS}_{3(i-1)}}{T_3}$$

In – average annual increment 2007-2012 (% of $GS_{4(i)}$)
Ha – average annual harvest 2000-2009 (% of $GS_{4(i)}$)
Mo – average annual mortality 2000-2012 (% of $GS_{4(i)}$)
T_3 – transitional period of diameter class 3 (30 years)
T_4 – transitional period of diameter class 4 (30 years)

Diameter class 5:

$$\mathrm{GS}_{5(i)} = \mathrm{GS}_{5(i-1)} + \mathrm{GS}_{5(i-1)} \times \mathrm{In} - \mathrm{GS}_{4(i-1)} \times \mathrm{Ha} - \mathrm{GS}_{4(i-1)} \times Mo + \frac{\mathrm{GS}_{4(i-1)}}{T_4}$$

In – average annual increment 2007-2012 (% of $GS_{5(i)}$)
Ha – average annual harvest 2000-2009 (% of $GS_{5(i)}$)

Mo – average annual mortality 2000-2012 (% of $GS_{5(i)}$)
T_4 – transitional period of diameter class 4 (30 years)

Table 4: Data on the state of forests from the national forest inventory

	2000	2007	2012	2018
Growing stock (m^3/ha)	283.18	313.69	333.94	330.92
Increment (m^3/ha/year)			7.92	7.92*
Harvest (m^3/ha/year)		3.39	4.10	6.03
Growth (m^3)		1.82	1.91	3.02
Mortality (m^3/ha)		7.54	3.86	13.36
Dead wood (m^3/ha)	16.85*	19.75	19.76	23.77

*NB: estimated value

Table 5: Input data for calculating the development of growing stock

Diameter class	10-19 cm	20-29 cm	30-39 cm	40-49 cm	Over 50 cm
Initial growing stock (m^3)	41 200 859	83 895 176	94 518 884	83 076 427	81 382 465
Increment (% of growing stock)	0.0451	0.0307	0.0230	0.0191	0.0140
Harvest (% of growing stock)	0.0890	0.0961	0.1131	0.1504	0.4462
Growth (m^3)	366 574				
Mortality	0.0029	0.0029	0.0029	0.0029	0.0029

Carbon stocks in above-ground biomass were calculated on the basis of the growing stock as calculated for 2010-2030 and parameters such as the biomass expansion factor (BEF), wood density (D) and carbon fraction (CF) (see NIR 2018, p. 233, Table 6.4.3). The emission factors for above-ground biomass were determined from the annual differences in the hectare values of carbon stocks. The annual carbon stock change in above-ground biomass was calculated as the product of the emission factors and the surface area of managed forests. For the calculation of CO_2 emissions, annual carbon stock changes in above-ground biomass was multiplied by a factor of -44/12.

Assumptions regarding below-ground biomass and dead wood

The growing stock of below-ground biomass was calculated on the basis of the ratio between above-ground and below-ground biomass (R). The same coefficients as were used for reporting for the UNFCCC were used for this calculation (see NIR 2018, p. 233, Table 6.4.3). Slovenia uses the default values from the IPCC Guidelines of 2006, except for fir and beech, for which national factors are used. The annual carbon stock changes were calculated using the same procedure as for above-ground biomass.

The calculation of carbon stocks in dead wood is based on data from the national forest inventory. Until 2018, Slovenia had reliable data on dead wood only for 2007 and 2012. Despite the fact that dead wood was recorded in 2000, sampling at that time did not cover all the types recorded from 2007 onwards. As only dead fallen and dead standing trees were recorded in 2000, we estimated the stock of missing types (stumps, snags, coarse woody debris). This data was used to calculate the annual carbon stock changes for 2000-2012. As forests have been subject to a number of natural disturbances since 2012, the reference level included the average value of carbon stocks changes in dead wood for 2000-2012.

Model of diameter structure of forests

Models of the diameter structure of forests by individual stratum and at the national level are determined on the basis of the characteristics of the growth and increment of trees and forest stands, the defined production and restoration period, the target species composition of forests and the target growing stock level. The procedure of determining this is described in detail in Veselič (2000, 2002).

The diameter structure of forests is based on a combination of data collected as part of forest inventories for the requirements of forest management planning and data from the national forest inventory. Data from the national forest inventory collected on a systematic 4 km x 4 km grid does not enable a detailed stratification of forests to be produced at the national level; therefore, data collected for forestry planning needs was used for the stratification of forests under the FMP.

Forest management model (FMP)

The forest management model is based on the intensity of harvest expressed as the share of harvest relative to the growing stock calculated on the basis of the structure of growing stock by diameter class and stratum, and taking into account the continuation of sustainable forest management practice in 2000-2009 and the dynamic aspect of the age or diameter structure of forests. The levels of intensity of harvest in terms of 'business-as-usual' (BAU) were calculated by expanded diameter class and stratum. The modelling process took account of the intensity of the harvest in state-owned forests, as the records on harvest are more reliable for these forests. At the same time, the manager of state-owned forests is obliged to carry out all measures set out in the forest management plans, while the forest management plans for private owners merely constitute an upper limit of allowable forest use and such owners are not obliged to exploit all possible wood potentials. In order to ensure a balanced ratio between diameter classes and sinks in forests over the long term, the factors were corrected in the calculation, particularly those relating to diameter classes 4 and 5 (thick trees).

Climate change and natural disturbances

The effect of climate change was not specifically taken into account in the methodological approach used. Climate change could have an effect on the future growth and composition of forest stands; but although its impact is currently difficult to assess in quantitative terms, the assumption is made that climate conditions will not change in Slovenia in 2021-2030. Natural disturbances were not directly incorporated into the model in the form of a separate module. Only past emissions from forest fires have been included in the reference level, i.e. as an average emissions value for 2000-2009. Despite the fact that forests have been subject to natural disturbances, such as the ice storm of 2014, the bark beetle gradations of 2015 and 2016, and the wind damage of 2017 and 2018, their effects were not taken into account when the projections were being drawn up.

Surface area of managed forest

In the projection of net emissions from managed forests, the assumption is made that total deforestation will be roughly equal to total overgrowth. On this basis, it is assumed that forest surface area will remain constant, starting from the 2010 projection of the reference level. The surface area of managed forest corresponds to the surface area of forests reported, for UNFCCC and EU purposes, as
'forest land that remains forest land'; this ensures compliance between the reported annual emission assessments and the reference level, which is important for subsequent accounting.

Table 6: Surface area of managed forests (FM) taken into account in the FRL projection

	2010	2011	…	…	2030
Surface area of managed forests (kha)	1 004.79	1 004.79	1 004.79	1 004.79	1 004.79

Table 7: Table of past emissions reported as part of GHG inventories

Year	FM	HWP
2000	-4 651	-75
2001	-5 644	-68
2002	-5 691	-84
2003	-5 654	-122
2004	-5 792	-150
2005	-5 829	-173
2006	-5 819	-204
2007	-5 988	-292
2008	-5 180	-217
2009	-5 136	-169
2010	-5 088	-107

Harvested wood products

Projection of HWP inputs and carbon stock changes – General

HWP calculations follow the instructions set out in Chapters 2.3.5 and 2.5.6 of the Guidance on developing and reporting the Forest Reference Levels in accordance with Regulation (EU) 2018/841 (version 25 June 2018) and the IPCC Guidelines (2014). All other elements are the same as for the annual reporting and their methodology is described in Slovenia's National Inventory Report 2018, specifically in the following chapters: PART 1: NATIONAL INVENTORY 1986-2016; 6.10. Harvested wood products, and PART 2: PART II: SUPPLEMENTARY INFORMATION UNDER ARTICLE 7, PARAGRAPH 1; 11 KP-LULUCF; 11.3.1.1.5 Harvested wood products

Projection of HWP inputs

The harvest reference level is calculated from NFI data (2007 and 2012) for all forests, and multiplied by the forest surface area as reported in the NIR. The harvest totalled 3.39 m^3/ha in the 2007 NFI and 4.15 m^3/ha in the 2012 NFI. The average harvest in the 2000-2009 period was, using these assumptions, calculated at 4 356 million m^3/year (Table X). In accordance with the Guidance (2018) and the IPCC Guidelines (2014), the entire harvest derived from FM was used in calculations of the carbon pool of wood products. Wood from deforestation is taken into account on the basis of instantaneous oxidation and does not enter the HWP carbon pool. The removal of wood from deforestation is taken into account in the calculated C inputs into pools under the wood products and carbon stock changes categories. Data on deforestation and wood quantities is derived from the ZGS annual reports.

The projection of harvest takes into account the ZGS model in relation to the share of the harvest taken by each diameter class (five classes). The harvest thus calculated forms the basis for projections for carbon pools of wood products (HWP), in accordance with instructions (Guidance 2018).

Taking the EU Guidance (2018) into account, the projection takes into account the ratio between different uses of wood as documented in the reference period between 2000 and 2009. The average production of products documented in the reference period between 2000 and 2009 is the basis for the projection. Production by individual category of HWP is, as per the Guidance, proportionally multiplied by the ratio between the modelled harvested volumes in the projection and the average harvest documented in the period between 2000 and 2009. This approach ensures that the provision stating that the ratio between energy use and wood processing in the projection is the same as in 2000-2009 ('a constant ratio between solid and energy use of forest biomass as documented in the period from 2000 to 2009 shall be assumed'). In this way, the C input quantities in the carbon pool of HWP are proportionate to the increase/reduction in harvest throughout the entire period of the projection.

Table 8: Data for HWP projections

Year	Forest areas in 1 000 ha	Annual harvest (1 000 m^3)	Projection factor	Model HWP C inputs (tC)
2030	1 206.0	7 585.8	1.74	398 442
2029	1 206.0	7 558.0	1.74	396 980
2028	1 206.0	7 530.6	1.73	395 542
2027	1 206.0	7 503.7	1.72	394 128
2026	1 206.0	7 477.2	1.72	392 737
2025	1 206.0	7 451.2	1.71	391 370
2024	1 206.0	7 425.7	1.70	390 028
2023	1 206.0	7 400.6	1.70	388 711
2022	1 206.0	7 376.0	1.69	387 419
2021	1 206.0	7 351.9	1.69	386 153
2020	1 206.0	7 328.3	1.68	384 914
2019	1 206.0	7 305.2	1.68	383 701
2018	1 206.0	7 282.6	1.67	382 516
2017	1 206.0	7 260.6	1.67	381 361
2016	1 206.3	7 239.2	1.66	380 234
2015	1 206.3	7 218.3	1.66	379 139
2014	1 206.4	7 198.1	1.65	378 075
2013	1 206.4	7 178.4	1.65	377 044
2012	1 206.5	7 159.5	1.64	376 047

2011	1 206.5	7 141.2	1.64	375 086
2010	1 206.6	7 123.6	1.64	374 161
Average 2000-2009	**1 203.7**	**4 355.6**	**1.00**	**228 776**

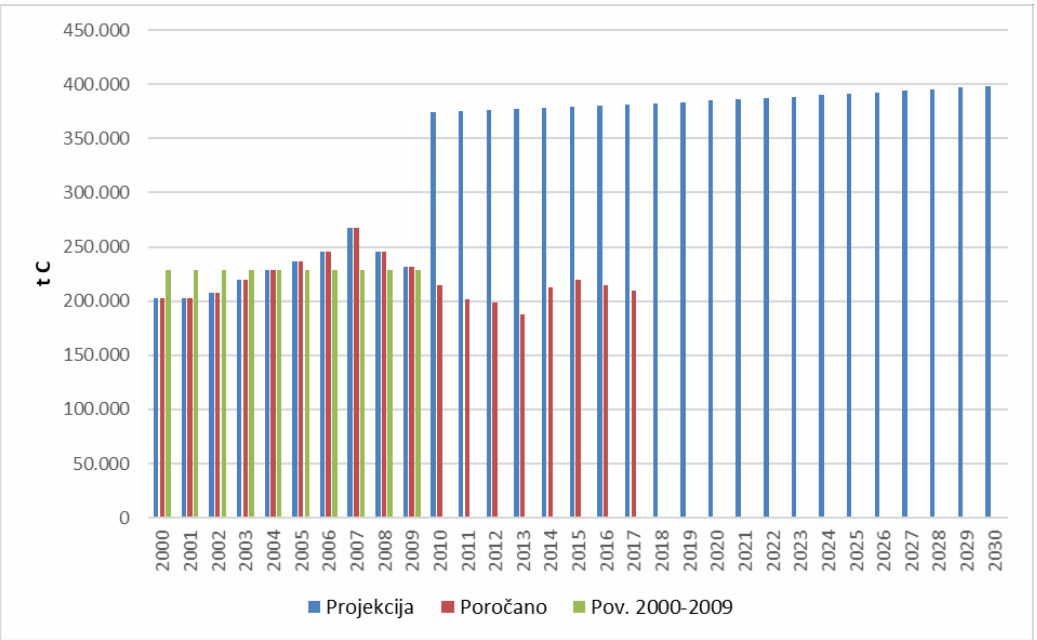

Figure 6: C inputs in HWP stock

Projekcija	Projection
Poročano	Reported
Pov. 2000-2009	Average 2000-2009

Projection and calculation of FRL for 2021-2025 and 2026-2030

The FRL projection was drawn up on the basis of the model approach and with due regard given to the input data (Table 5). With a view to continuing sustainable management methods and instituting BAU corrections in response to the changes instituted by the NGP, the projection envisaged that the harvest volume would increase moderately in the 2010-2030 period. These harvest volumes were taken into account in the projection of the carbon stock change for harvested wood products. Owing to the balancing of the diameter structure and moderate increments, growing stock is expected to increase gradually by 2030. The projection takes into account, in addition to living above-ground and below-ground biomass, the carbon stock changes for dead wood to the level of the average value for 2000-2012, which amounts to -225.28 kt of CO_2, and the average value of the greenhouse gases from forest fires between 2000 and 2009, which amounts to 22.29 kt of CO_2. The reference level takes into account the HWP projection, which is based on data for HWP projections (Table X). This projection shows that the value of the net emissions from HWP was between -470.17 and -524.83 kt of CO_2 (or an average of -495.97 kt of CO_2 between 2021 and 2030). Taking the model for the development of living biomass and these carbon pools or greenhouse gases into account, the FRL projection for total net emissions for forest management shows a moderate increase in sinks by 2030. Under this projection, the average FRL value is therefore **2 582.72 kt of CO_2 equivalent for 2021-2025** and **2 722.09 kt of CO_2 equivalent for 2026-2030** (Figure 7).

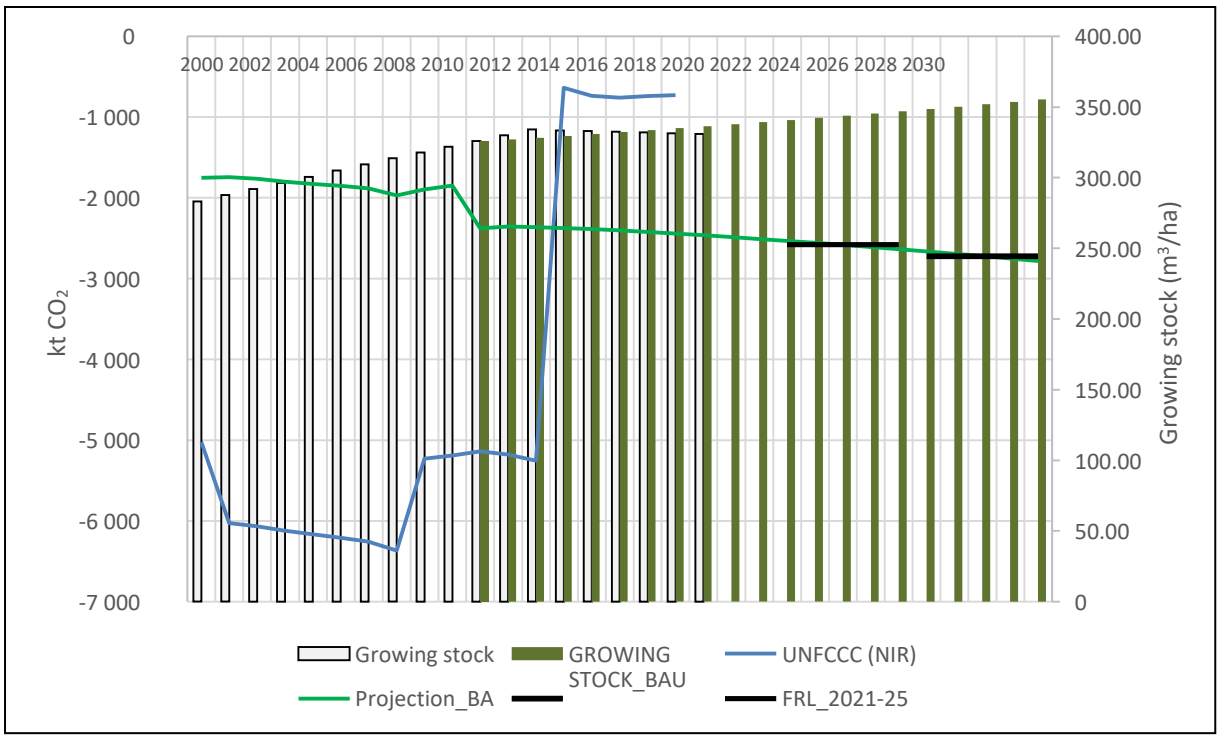

Figure 7: FRL projection and the development of growing stock up to 2030