Ministry of Agriculture and Forestry

Ministry of The Environment

Forest Research Institute

TEMPLATE for:

Submission of information on forest management reference levels by FINLAND

as requested by the Cancún decisions, i.e. „Consideration of further commitments for Annex I Parties under the Kyoto Protocol, Draft conclusions proposed by the Chair", contained in FCCC/KP/AWG/2010/L.8, and its Addendum: Draft decision [-/CMP.6], Land use, land-use change and forestry, contained in FCCC/KP/AWG/2010/L.8/Add.2

1. Forest management reference level value

The forest management reference level for Finland for the commitment period 2013-2020 is -20.1 Mt CO_2 eq. with removals from harvested wood products using the first order decay functions (A). The value is -19.3 Mt CO_2 eq. with assuming instant oxidation from HWP (B). The values are averages of the projected forest management and harvested wood products emissions and removals for the period 2013-2020. The policies in place and implemented no later than December 2009 were taken into account (FCCC/KP/AWG/2010/L.8/Add.2 para 11).

Finland has revised the values of the reference levels submitted earlier. The carbon stock changes in living biomass, dead organic matter and soils were recalculated due to the several changes in the greenhouse gas inventory. Since the 2009 submission, Finland has implemented new national biomass models for trees, as well as new biomass conversion factors for biomass growth and drain. The litter input data for soil model were recalculated due to the changes in biomass estimation. The weather data applied in the soil carbon model Yasso were revised due to the recommendation of the ERT. The scenario behind the reference levels were the same as for the earlier reference level.

Table 1. Values of proposed reference levels for forest management including HWP with first order decay function and (A) and HWP with instant oxidation (B) (million tonnes CO_2 eq.)

Reference levels	
(A)	**(B)**
-20.1	-19.3

2. General description

The reference levels were constructed from the projected emissions and removals as an average of the emissions and removals in 2013-2020. The projections of carbon stock changes were based on a scenario of the development of the forest resources in 2006-2055. Finnish Forest Research Institute calculated the scenario for the preparation of the national climate and energy strategy in 2008 and for the National Forest Programme 2015 (Uusivuori et al. 2008a, Uusivuori et al. 2008b). The Long-term Climate and Energy Strategy was approved by the Government and given to the Parliament 6th November 2008 as a

Government Report (Pitkän aikavälin ilmasto- ja energiastrategia 2008). The National Forest Programme was approved by the Government as a Government Resolution 27 March 2008 (NFP 2015).

SF-GTM forest sector model and the MELA forestry model were used to produce the scenario based on the national forest inventory data. The outputs of the models were employed to calculate the projections of carbons stock changes. The domestic policies included in the scenario were consonant with the climate and energy policies adopted in 2008 (Pitkän aikavälin ilmasto- ja energiastrategia 2008).

Projections of emissions from GHG sources N-fertilization and biomass burning were estimated based on the emissions reported in the GHG inventory. For the projection of CO_2 emissions/removals from harvested wood products the data from FAOSTAT, national forestry statistics and the Long-term Climate and Energy Strategy were used.

All elements mentioned in footnote 1 of paragraph 4 of the decision -/CMP.6 on LULUCF were taken into account in the construction of the forest management reference level:

(a) **Removals or emissions from forest management as shown in greenhouse gas inventories and relevant historical data**. To estimate the projected emissions and removals from forest management the same methods (models, conversion and emission factors) were used as in the greenhouse gas inventory. In the starting point of the scenario, which was year 2006, the 10^{th} National forest inventory data (NFI) were used for forest resources (volume of growing stock, increment of growing stock). The same data were also used in the greenhouse gas inventory. The same source categories and gases, excluding emissions from wild fires, were included in the reference levels. Possible emissions from force majeure are included in the historical emissions but in the projection the emissions were not predicted.

(b) **Age-class structure.** The initial age-class structure of the scenario was based on the latest NFI data in 2006 and during the model simulation the age of forest stands was kept up-to-date (see Section 5).

(c) **Forest management activities already undertaken.** The latest NFI data were used to represent the initial state of forests to develop by the forestry model simulator; thereby the effects of the activities already undertaken were taken into account.

(d) **Projected forest management activities under a business as usual scenario.** The estimated harvest demand was based on the SF-GTM forest sector model, in which the production of forest industry, the demand of products, roundwood supply and forest resources were combined. The roundwood demand was an input to the forest model which estimated the final harvest removals. The forest management schedules were simulated according to the forest management regimes given in the Forest Management Practice Recommendations. The increase in the energy wood harvesting is a policy included in the scenario and it is in accordance with the Finland's climate and energy policy adopted in 2008 (see section 6. Polices included).

(e) **Continuity with the treatment of forest management in the first commitment period.** The information on forest management is provided in the same way as in the first commitment period except for HWP.

(f) **The need to exclude removals from accounting in accordance with decision 16/CMP.1, paragraph 1.** The projections included in this submission follow the general principles that govern the treatment of land use, land-use change and forestry activities.

3. Pools and gases

Table 2. Carbon pools and greenhouse gas sources included in the reference level.

Change in C pool included in the reference level						GHG sources included in the reference level					
Above-ground biomass	Below-ground biomass	Litter	Dead wood	Soil		Fertilization	Drainage of soils	Liming	Biomass burning		
				mineral	organic	N_2O	N_2O	CO_2	CO_2	CH_4	N_2O
yes	yes	yes	yes	yes	yes	yes	no	no	yes	yes	yes

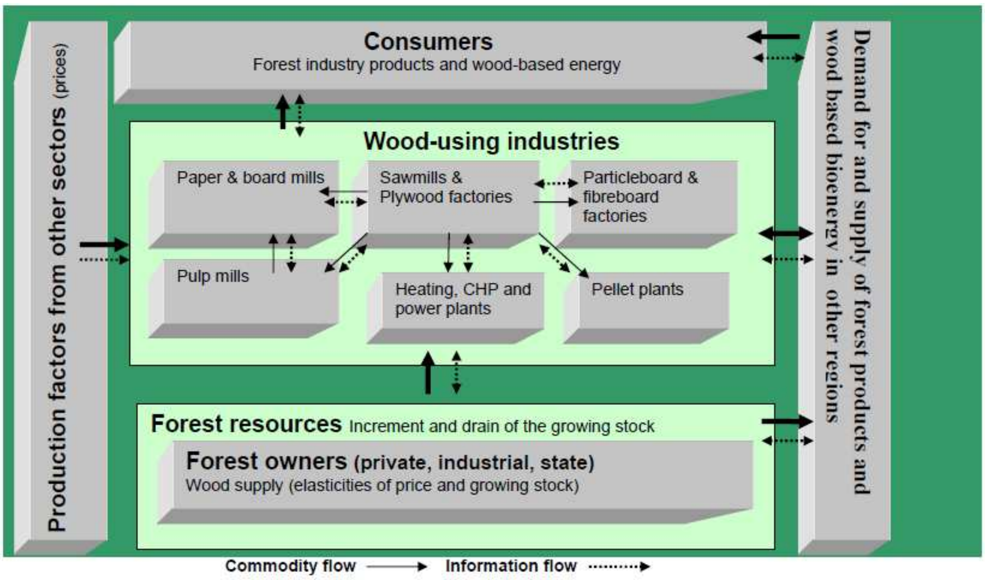
The carbon pools and greenhouse gas sources in the reference level were corresponding to greenhouse gas inventory submitted in 2010. The N_2O emissions from drainage of soils are not included in the reference level as they are not reported in the GHG inventory either. Liming on forest lands do not occur in Finland, therefore the emissions were not estimated. Emissions from biomass burning cover emissions from controlled burnings and wildfires. The estimates of tree biomass include above-ground and below-ground biomass. The estimates for litter, dead wood and soils organic matter are also given as an aggregate estimate.

4. Approaches, methods and models used

4.1 Scenario models

The SF-GTM forest sector model and the MELA forestry model were used for the forest scenario (Kallio 2008, Salminen & Hirvelä 2008).

SF-GTM model is a partial equilibrium model depicting Finland's forestry sector; forestry, forest industry and the forest product market. Regional demand of forest products, production of forest industry, supply of roundwood and the development of growing stock are incorporated into the model (Fig. 1). The production of forest industry is defined by products and plants, and the inputs from forestry by timber assortments. The model is based on the GTM model (Global Trade Model) developed in IIASA. (Ronnila 1995).



Source: Maarit Kallio, Finnish Forest Research Institute

Figure. 1. Forest sector model SF-GTM. A general model structure for one region.

MELA is a forestry model consisting of two parts 1) a forest simulator based on individual tree growth and development models, and 2) an optimization package based on linear programming. MELA simulates alternative management schedules according to the given simulation instructions. The comparison and the selection of the alternatives are based on the linear optimization. The source information to MELA is the forest resource information based on the national forest inventory. The methods in MELA are based on the general assumption that natural processes and development of forest resources in forest stands can be predicted. MELA utilized the roundwood demand and stump prices information produced by the SF-GTM model. The results are the volume and the development of the growing stock, the growth and the estimates of cutting possibilities separately (Redsven 2005).

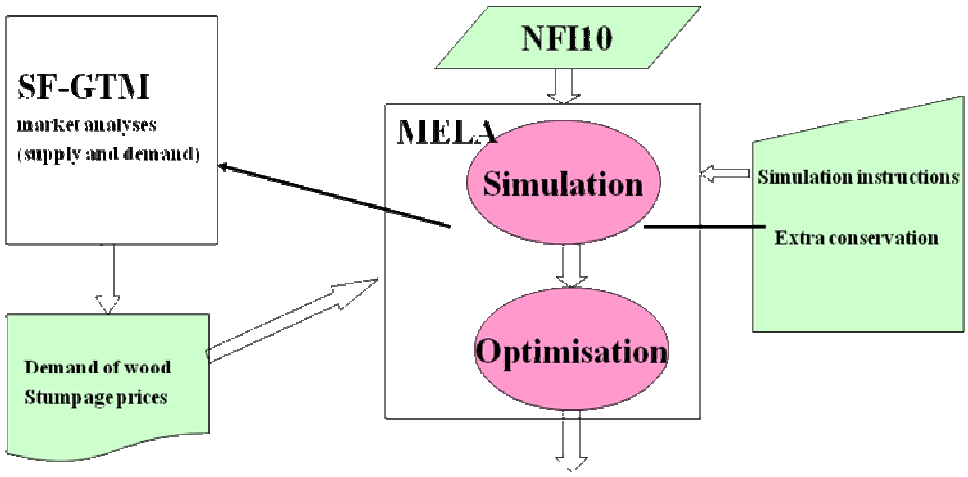


Figure 2. The framework of the SF-GTM and the MELA models for the alternative calculations of the National Forest Programme 2015 (Salminen & Hirvelä 2008). The extra conservation activity was not included in the scenario applied to construct the reference level. The 10^{th} national forest inventory data (NFI10) from years 2004-2006 were the forest resource input to the MELA model.

Assumptions for SF-GTM and MELA models:

- The initial state of forest area, volume of growing stock and increment of growing stock based on the 10^{th} national forest inventory data measured 2004-2006. The development of forest resources was predicted 2006 onwards.
- Natural processes (ingrowth, increment, and mortality) were simulated by individual tree models.
- NFI sample plots were classified into two categories: forest available for wood supply and forest not available for wood supply (protected forests).
- To the forests available for wood supply were simulated alternative forest management activities according to the Forest Management Practice Recommendations (2006).
- SF-GTM model's equilibrium stumpage prices were used in the MELA model for determining the delivery prices (raw wood prices at the road side) as the sum of stumpage prices and average logging costs. The delivery prices were used to calculate the gross revenues from different treatment and development options in MELA. The net revenues were received as the difference of gross revenues and logging and silvicultural costs.

Assumptions for forest industry operation environment:

- The volume of imported round wood decrease after 2009, because Russian's import duty for roundwood come into force. After 2015 roundwood and chips are imported about 8 Mm^3 and the import of saw logs stops.
- Export prices of final forest industry products return to the average level of 2000-2006 prices by 2015. Prices of sawn goods and wood-based panels decrease 2%, the price of paper increases 1% and the price of wood pulp decrease 0.5%.
- The prices of electricity and heating power increase by 2% in 2008-2015.

MELA model produced volume estimates for years 2006, 2016, 2026 etc and increments and drain estimates for 10 years periods 2006-2015, 2016-2025, 2026-2035 etc (Table 3). The area of forest land and poorly productive forest land stayed constant over time being 22.825 million ha of which 1.864 million ha were protected areas.

Table 3. Increment, harvest removals and drain estimates according to the scenario. The mid-years, in which the estimates were dated, are in the parentheses.

	2006–2015 (2010)	**2016–2025 (2020)**	**2026–2035 (2030)**
	Million m^3/year		
Increment	97.7	96.8	104.2
Cutting removals	62.8	66.2	66.2
Cutting drain (removals + waste wood)	69.7	69.4	68.6
Natural mortality	12.4	7.5	7.3
Total drain	82.1	76.8	75.9
	2006	**2016**	**2026**
	Million m^3		
Volume of growing stock	21800	23300	25300

Under the given assumptions MELA directed the cuttings to such forests whereupon the increment of growing stock decreased during the first period 2006-2015. The figures given in Table 3 are only for commercial roundwood and other harvested parts of a tree but a stem are excluded. The energy wood harvesting by collecting logging residues was not included in the MELA harvesting alternatives (see Section 4.3). Natural mortality peaks during the first ten year period due to fact that self-thinning models and model of random mortality operated on overstocked stands. During the following periods natural mortality reduces due to fact that quantity of overstocked stands was also reduced.

The forest area of MELA was not consistent with the KP forest management area, since the scenario was made for nationally defined forest land and poorly productive forest land. The area under forest management was 21.904 million ha in 2006 (NIR 2010) and projected area of 21.688 million ha in 2020 compared to the area of 22.825 million ha MELA used. The model did not take into account the changes in forest area due to deforestation, afforestation and reforestation. Therefore the mean estimates per hectare for volume, increment and drain were used in the calculations.

4.2 Projection on carbon stock changes in biomass

The projection of carbon stock change in tree biomass was calculated using the same method as in GHG inventory, a difference between gains (increment) and losses (drain) (NIR 2010). The biomass conversion factors were recalculated for the 2011 submission and those conversion factors were used (Table 4).

All calculations were made by tree species groups, soil types, South and North Finland. Steps of the calculation were:

1. Volume increments were calculated as mean increments m^3/ha and converted to biomass, carbon and CO_2. The increments of afforested/reforested areas were subtracted from total increment.
2. Natural drain (mortality) per hectare and harvest drain per hectare were calculated and converted to biomass, carbon and CO_2. The harvest drain due to deforestation was subtracted from harvest drain. The biomass removed from deforested areas estimated for 2011 GHG inventory were used.
3. Mean values were multiplied by the area under forest management (see Section 5a).
4. The difference of gains and losses in living biomass is the net sink of tree biomass.

5. The separate CO_2 balance projections for South Finland and North Finland were calculated. The values between mid-years (see Table 3) were interpolated. The projection for whole Finland was a sum of the two regional projections (Table 5).

Table 4. Biomass conversion factors for increment and drain.

	Increment		Drain			
			Natural drain		Harvest drain	
	Mineral soil	Peatland	Mineral soil	Peatland	Mineral soil	Peatland
South Finland	Mg C/m^3					
Pine	0.5798	0.5918	0.6436	0.6159	0.6217	0.6292
Spruce	0.6772	0.7364	0.7836	0.8712	0.7289	0.7766
Broadleaved	0.8058	0.8166	0.9150	0.9574	0.8447	0.8760
North Finland						
Pine	0.6228	0.6392	0.6237	0.6719	0.6331	0.6439
Spruce	0.8109	0.8461	0.8787	1.0049	0.8108	0.8514
Broadleaved	0.8748	0.8000	0.9126	0.8766	0.9070	0.8567

4.3 Projections on carbon stock changes in litter, dead wood and soil

The methodology of estimation of carbon stock changes in soil, litter and dead wood on mineral soils and drained organic soils is the same as in the GHG inventory (NIR 2010, NIR 2011). This method combines forest inventory data, biomass models, litter turnover rates and dynamic soil carbon model. For managed forests, the Yasso model (Liski et al. 2005) was applied, see section 7.2.3.1 in the NIR (2011) for details. Projections for dead organic matter and soils are given in Table 5.

Litter input

Litter input estimation for period of 1972 to 2008 was based on the data and methods presented in the NIR (2011), and similar principles were applied for future projections. MELA forest projection model provided estimates for future tree stocks starting from 2006 with interval of 10 years (Table 3). These stocks were then converted to biomass with BEFs (biomass expansion factors) currently applied in the national greenhouse gas inventory (NIR 2011). The litter input to the soils from living trees was estimated with turnover rates that are applied in the GHG inventory (NIR 2011).

Future litter input from loggings and natural mortality were also estimated based on the MELA projections. MELA system provides estimates for natural mortality and loggings with 10 years intervals (Table 3). The biomass of natural mortality and harvesting residues were estimated with BEFs that were applied in the GHG inventory (NIR 2011). The national bioenergy targets were taken into account during the soil carbon simulations. The policy objective of 12 mill m^3 of bioenergy use by 2015 was estimated with linear interpolation from 2008 to 2015. The origin of bioenergy was assumed to remain as it was 2008 (division into stumps, harvesting residues and stems), also regional uses were assumed to be proportional to the situation of 2008. Litter input of ground vegetation was estimated in the same way as in the GHG inventory (NIR 2011).

Mineral soils

Yasso soil model was applied on mineral soils (NIR 2010). The initialization and the application of the model followed principles of GHG inventory, also mean weather of 1971-2009 was applied as proposed by the ERT of UNFCCC (NIR 2011). For parameter values and model description, see section 7.2.3.1 in the NIR (2011) and the appendix 7c in the NIR (2011).

Organic soils/peatlands
On drained organic soils emission were estimated also similarly as in GHG inventory (NIR 2010 and NIR 2011). Emissions of peat decomposition were estimated separately according to the fertility classes, thereafter below ground litter input was deducted from the decomposition flux to obtain net gas exchange for these lands. In order to upscale emissions to the national level the area of drained organic forest lands were multiplied with net emission factors.

4.4. Projections of emissions from GHG sources

N-fertilization

The N_2O emissions from N fertilization were included in the reference level. The value used for years 2009-2020 was assumed to be at the level of average of 2004-2008. This corresponds the amount of 3062 metric tonnes of nitrogen annually applied to forest. The method of GHG inventory was used (NIR 2010).

Biomass burning

CO_2, CH_4 and N_2O emissions from controlled burnings and forest fires were included in the reference level. Controlled burnings are conducted after clear cuttings when cutting residues are expected to hamper the planting. Cutting residues are classified in the litter pool and calculated as an instant oxidation after felling, therefore the CO_2 emissions are not reported to avoid double-counting. For controlled burnings the emissions for 2009-2020 were estimated as a constant value being the average of the emissions of years 2004-2008 (NIR 2010). Thereby the area burned 2009-2020 is 645 ha per year and total emissions 1 Gg CO_2 eq per year.

The forest area burned in wild fires in 2009-2020 was assumed to be in the level of the average of the previous five years 2004-2008 (766 ha). The biomass burned in fires was estimated from national forest inventory data for years 1990-2008 (NIR 2010). For years 2009-2020 the mean volume estimates for forest land produced by the MELA model were used. Mean volumes were converted to biomass by the conversion factors calculated from the 10^{th} National forest inventory data (NIR 2010).

4.5 Projected carbon stock changes and emissions from GHG sources

The net sink of forest management is at its lowest level in the beginning of the period of projections (Table 5). That low level if sink corresponds to the changes in the increment of the growing stock and the cutting removals of the MELA scenario. In these calculations was assumed that all cutting residue harvesting will be occurred on mineral soil forests, because at the moment there is no data available of the distribution by soil types. It is expected cutting residues will also be harvested on peatlands. Due to that assumption the decrease in the sink of mineral soils is remarkable. The volume of growing stock increased in MELA scenario (Table 3) which means the increased litter fall into the soil. Since the assumption energy wood is not harvested on peatlands, the increased litter production is shown as decrease in emissions of forest peatlands.

Table 5. Projected carbon stock changes and emissions from other GHG sources included in the reference level.

	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
	Gg CO_2 eq.											
Biomass	-18 663	-18 453	-18 868	-19 283	-19 698	-20 113	-20 528	-20 943	-21 358	-21 773	-22 188	-22 603
Gains	-119 888	-119 678	-119 468	-119 259	-119 049	-118 839	-118 629	-118 419	-118 209	-117 999	-117 789	-117 579
Losses	101 226	101 226	100 601	99 976	99 351	98 726	98 101	97 476	96 851	96 226	95 601	94 976
SOM+DOMmin	-5 198	-5 489	-4 637	-4 079	-3 662	-2 572	-1 396	-616	-236	-215	-505	-964
SOM+DOMpeat	7 126	5 624	4 551	4 275	3 998	3 722	3 446	3 170	2 944	2 717	2 490	2 264
N-fertilization	19	19	19	19	19	19	19	19	19	19	19	19
Controlled burning	1	1	1	1	1	1	1	1	1	1	1	1
Wildfires	29	29	29	30	30	30	30	30	31	31	31	31
FM, all gases	-16 687	-18 270	-18 905	-19 038	-19 312	-18 913	-18 428	-18 339	-18 600	-19 221	-20 152	-21 252

Table 6. Historical emissions and removals from forest management (NIR 2011).

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
	Gg CO_2 eq.																		
Biomass	-27648	-42559	-35979	-33472	-24401	-22903	-30621	-24858	-22569	-25239	-26342	-31240	-32755	-34113	-34643	-38880	-42625	-33876	-39371
SOM+DOMmin	-8320	-7771	-7075	-6968	-7317	-8316	-9393	-10464	-10595	-10447	-10558	-10036	-9267	-8562	-7716	-6975	-7116	-6734	-6468
SOM+DOMpeat	12780	12737	12009	11391	10774	10337	10207	9595	8998	8723	8521	8392	8144	8054	8032	8102	8198	7924	7822
N-fertilization	27	20	9	3	12	6	8	13	13	10	10	11	12	11	12	11	18	17	35
Controlled burnings	4	2	2	1	2	2	1	1	1	2	1	3	2	1	0	1	1	1	1
Forest fires	12	6	31	0	23	16	14	35	3	19	12	6	18	23	11	15	51	19	27
FM, all gases	-23145	-37565	-31003	-29044	-20908	-20858	-29784	-25678	-24150	-26934	-28357	-32864	-33846	-34586	-34304	-37726	-41473	-32650	-37954

5. Description of construction of reference levels

I. Description of how each of the following elements were considered or treated in the construction of the forest management reference level, taking into account the principles in decision 16/CMP.1

(a) Area under forest management

A constant forest area of 22.825 million ha was used for the MELA simulations for the whole time series. That area was not used to estimate total emissions/removals from forest management but to calculate mean values per hectare from MELA outputs. The area under forest management from 2009 to 2020 was projected from the area reported in GHG inventory (NIR 2010) for forest management in 2008 (Table 7). Time series 1990-2008 is the same as reported in the NIR 2010. All forests in Finland are managed and under forest management activity, so new forest land was not expected to come into the accounting outside reported FM area. An average of years 2004-2008 deforested areas were calculated separately for South Finland and North Finland, and for mineral soils and organic soils (Table 8) and assumed as average annual deforestation area in 2009-2020. That annual deforestation areas was subtracted from the FM area of the year 2008.

Table 7. Area of forest management.

	1990	1995	2000	2005	2008	2015	2020
	1000 ha						
Mineral soil	16172	16144	16100	16037	15999	15912	15849
Peatland	5920	5915	5902	5882	5874	5854	5839
Total	22092	22059	22002	21920	21873	21765	21688

Table 8. Deforestation area for years 2009-2020.

	South Finland	North Finland
	ha/year	
Mineral soil	9557	3002
Peatland	1667	1218

(b) Emissions and removals from forest management

1) Historical emissions and removals from forest management

The emissions and removal from biomass, dead organic matter and soil organic matter were recalculated due to the new biomass conversion factors and other changes made for 2011 GHG inventory (see Section 4, Table 6). The MELA scenario predicts forest resources and harvesting rates 2006 onwards. The estimates of volume and increment of growing stock in 2006 based on the results of the 10^{th} National forest inventory which were also used in the GHG inventory to estimate gains in living biomass and biomass for tree compartments.

2) The relationship between forest management and forest land remaining forest land as shown in GHG inventories and relevant historical data, including information provided under Article 3.3., and, if applicable, Article 3.4 forest management of the Kyoto Protocol and under forest land remaining forest land under the Convention

The relationships between forest land, forest land remaining forest land and area under forest management are described in the NIR 2010 and NIR 2011. The forest land definition under the Convention reporting differs in the minimum area compared to the Kyoto Protocol reporting. That causes some slightly different emissions and removals between these two reportings. Under Article 3.3 the emission from the AR activities was 0.2 M t CO_2 eq. and emissions from deforestation 3.6 M t CO_2 eq. for 2008 and 2009 (NIR 2011).

Table 9. Historical emissions and removals from Forest land (FL) (NIR 2011).

	1990	1995	2000	2005	2006	2007	2008
	Million tonnes CO_2						
FL remaining FL	-21.7	-19.7	-26.9	-34.9	-38.5	-29.6	-34.8
Lands converted to FL	0.5	0.5	0.4	0.3	0.3	0.3	0.3
FL total	-21.2	-19.1	-26.5	-34.6	-38.2	-29.3	-34.6

(c) Forest characteristics and related management

1) Age class structure

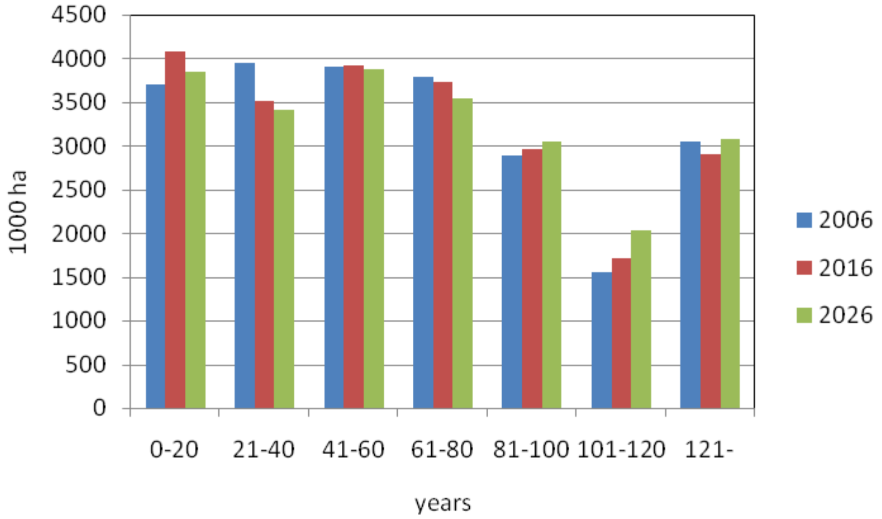


Figure. 3 The age-class structure of forests according to the MELA scenario.

In Figure 3 the age-class structure is presented for whole Finland. It differs between South Finland and North Finland. The area of forests over 120 years does not decrease by 2020 because they are mainly the protected areas in North Finland where the fellings are prohibited. The age distribution in 2006 is based on the 10th National forest inventory from years 2004-2006. The 2006 distribution was the bases for MELA scenario and thus for the distributions for years 2016 and 2026.

2) Increment

Table 9. Increment of growing stock in NFI6-NFI10 (inventory years in parenthesis) and predicted increments for 2010, 2020 and 2030 (million m^3 per year).

National forest inventory					MELA scenario		
NFI6 (1971-1976)	NFI7 (1977-1984)	NFI8 (1986-1994)	NFI9 (1996-2003)	NFI10 (2004-2008)	2010	2020	2030
57.4	68.4	77.7	86.8	99.5	97.7	96.8	104.2

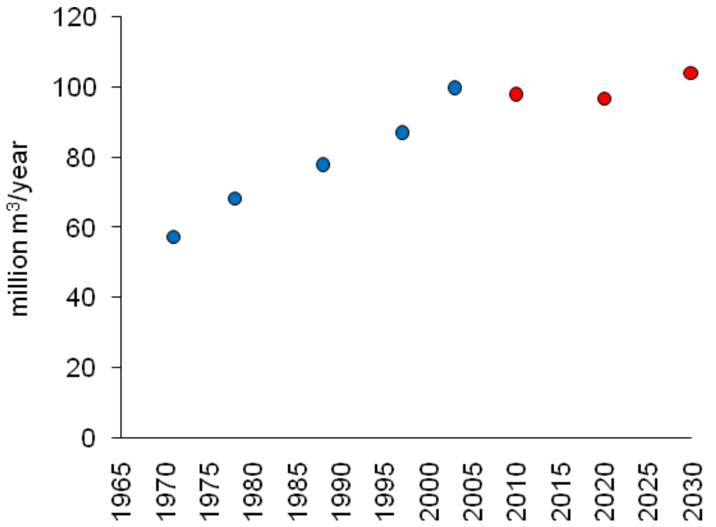


Figure 4. Increment of growing stock according to NFI6-NFI10 (blue dots) and for years 2010, 2020 and 2030 according to the MELA scenario (red dots).

3) Rotation length

The Forest Management Practice Recommendations gives two criteria to define the maturity of a forest stand, the mean diameter of a stand and the stand age (Table 9). For peatland forests only the diameter was used.

Table 9. The mean diameters to define the maturity of a forest stand and the rotation lengths by tree species and geographical regions on mineral soils and peatlands. Source: Forest Management Practice Recommendations (2006), Forest Management Practice Recommendations for peatlands (2007).

Tree species	Site fertility/site type	**North Finland**	**Central Finland**	**South Finland**
Regeneration by mean diameter, cm				
Scots pine	Herb rich and mesic	23-27	24-28	26-32
	Sub-xeric	22-26	23-27	25-30
	Xeric	21-25	22-25	22-26
Norway spruce	Herb rich	23-26	26-30	28-32
	Mesic	22-25	25-28	26-30

Silver birch	Herb rich	21-23	27-30	28-32
	Mesic	21-23	26-28	27-30
Downy birch	Mineral soils	19-21	22-25	23-27
	Peatlands	18	21-23	23-25
Regeneration by age, yr				
Scots pine	Herb rich and mesic	90-120	80-100	70-90
	Sub-xeric	100-130	90-110	80-100
	Xeric	120-150	100-130	90-120
Norway spruce	Herb rich	100-130	70-90	70-90
	Mesic	110-130	80-100	70-90
Birch sp.	All sites	50-60	60-70	60-70

4) Information on forest management activities under "business as usual"

The forest management activities the MELA simulated to forest stands were in accordance with the Forest Management Practice Recommendations (2006) which are commonly in use in Finland. The regeneration activities MELA simulated to NFI sample plots were regeneration felling, soil preparation, seeding or planting, silvicultural thinning in young stands and clearing of ditches. Regeneration was possible if the above mentioned threshold values for diameter or age were reached. Thinning was possible if the threshold values for basal area given in the Management Practice Recommendations were reached.

The harvesting of logging residues and stumps is an activity that increase the losses of biomass but does not show in the harvesting statistics (logging removals). Forest chips are divided into stemwood, logging residues and stumps and roots (Table 10). In Figure 5 is shown the increasing consumption of forest chips since 2000.

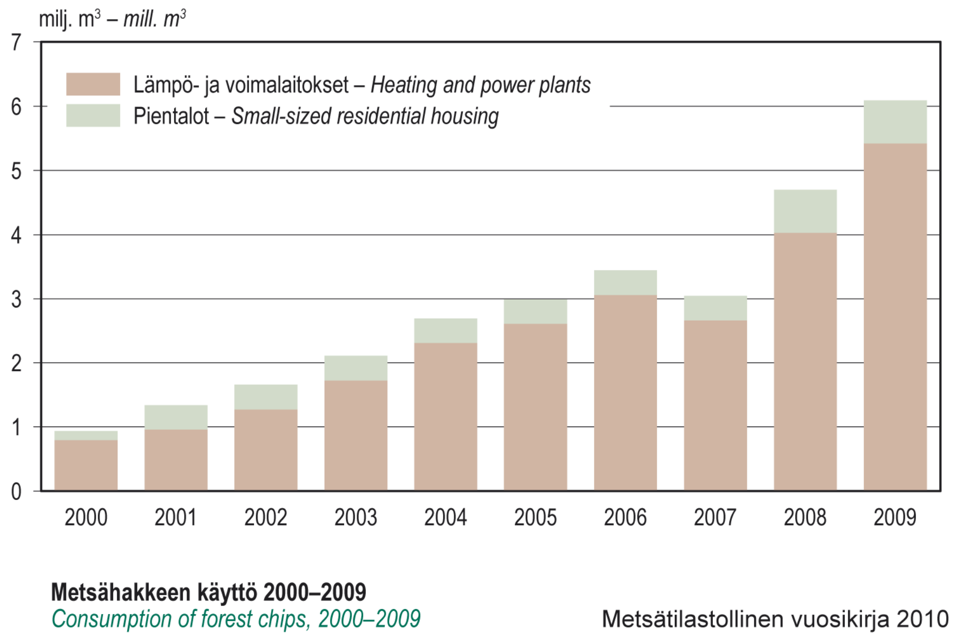


Figure 5. Consumption of forest chips for energy. Source: Finnish Statistical Yearbook of Forestry 2010.

Table 10. Consumption of forest chips in 2000-2009. Source: Finnish Statistical Yearbook of Forestry 2010.

	Stemwood	Logging residues	Stumps and roots	Other	Total
	1000 m^3				
2000	465	378	5	87	935
2001	754	556	17	12	1 339
2002	819	794	44	-	1 657
2003	915	1 111	84	-	2 109
2004	1 071	1 480	144	-	2 695
2005	1 132	1 485	376	-	2 993
2006	1 256	1 735	458	-	3 448
2007	1 208	1 527	313	-	3 048
2008	1 797	2 332	573	-	4 703
2009	3 320	1 938	834	-	6 092

(d) Harvesting rates

1) Historical harvesting rates

The logging removals and the total drain statistics compiled by the Finnish Forest Research Institute were used for the projections and for the GHG inventory (2010). The historical removals and drain were used to estimate the litter input to the soil (see Section 4.3).

Table 11. Total roundwood removals 1990-2008. Source: Finnish Statistical Yearbook of Forestry 2010 (1000 m^3).

1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
48870	39369	45144	47700	55024	56712	52592	58838	60968	60938
2000	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**
61500	59363	60271	61142	61163	58684	56935	63854	58011	47699

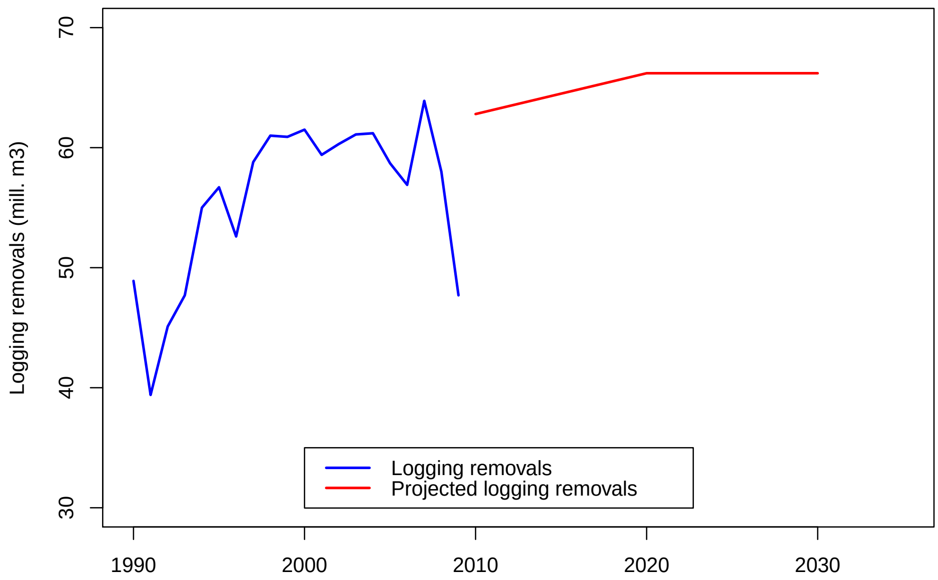


Figure 6. The historical logging removals and the predicted logging removals. The predicted values were interpolated between mid-years, see Table 3.

2) Assumed future harvesting rates

Table 12. Assumed future roundwood removals by tree species and timber assortment classes.

		2010	**2015**	**2020**
		1000 m^3		
Scots pine	Sawlogs	11897	12132	12367
	Pulpwood	15156	15611	16067
	Total	27054	27743	28433
Norway spruce	Sawlogs	13711	13422	13134
	Pulpwood	10311	10629	10946
	Total	24022	24051	24080
Birch sp.	Sawlogs	1290	1479	1669
	Pulpwood	8233	8873	9512
	Total	9523	10352	11181
Other sp.	Sawlogs	252	273	295
	Pulpwood	1937	2063	2190
	Total	2188	2337	2485
Total		62787	64483	66179

(e) Harvested wood products

Emissions and removals from the harvested wood products were calculated from domestically produced and consumed HWP. Wood used for production originated in forests under Kyoto Protocol Article 3. The approach employed was the stock change approach which Finland has used to report carbon stock changes in HWP to the UNFCCC, but the export was excluded (NIR

2010, IPCC 2006, page 12.26). Three product groups, sawnwood, wood-based panels and paper and paperboard were included with half-lives of 35, 25 and 2 years respectively. Default conversion factors for conversion from product units to carbon was used (IPCC 2006):

Sawnwood	0.225 tonne C m^{-3}
Wood-based panels	0.294 tonne C m^{-3}
Paper and paperboard	0.450 tonne C $(air\text{-}dry\ tonne)^{-1}$

The FAOSTAT data and the national forestry statistics were used for years 1961-2009 (Table 13). The growth rate of HWP consumption of 1.51% was used prior to 1961. From 2010 to 2020 the production of sawnwood, wood-based panels, paper and paperboard was set in the accordance with the results of SF-GTM model and MELA scenario. The quantity of exported products was estimated as an average of years 2000-2009 export of goods relative to the production. The production of sawnwood decreased by13% to 2015 compared to 2006 level and still decreased by 4% between 2015 and 2020. The increase in the production of wood-based panels was about 1% from 2006 to 2015 and it continued at the same level by 2020. The paper and paperboard production was also assumed to increase about 1% from 2006 to 2015 and after that the increase was 5%.

The proportion of domestically produced and used industrial roundwood relative to total use of industrial roundwood was used to calculate the quantity of domestic production from the total production figures (Table 13).

In this calculation all harvested wood was allocated to forest management. Therefore the accounting under Article 3 shall be part of the technical correction as suggested in para 15 quarter, page 27 of FCCC/KP/AWG/2010/CRP.4/Rev.4.

Table 13. Production and export of sawnwood, wood-based panels and paper products and emissions and removals of carbon stock changes in HWP.

	Sawnwood		**Wood-based panels**		**Paper and paperboard**		**Emissions and removals**
	Production	Export	Production	Export	Production	Export	
	million m3				million metric-tonnes		Gg CO_2
1990	7.503	4.176	1.337	0.779	8.968	7.633	-823
1991	6.460	4.267	0.991	0.551	8.777	7.524	253
1992	7.330	4.653	0.938	0.511	9.153	7.860	-109
1993	8.570	6.220	1.224	0.842	9.990	8.593	-45
1994	10.290	7.207	1.369	0.969	10.909	9.502	-553
1995	9.940	7.377	1.444	1.021	10.942	9.228	-330
1996	9.780	7.036	1.565	1.156	10.442	8.529	-686
1997	11.430	7.535	1.675	1.199	12.149	10.161	-1509
1998	12.300	8.227	1.677	1.174	12.703	10.979	-979
1999	12.768	8.292	1.751	1.275	12.947	11.209	-1145
2000	13.420	8.431	1.875	1.381	13.509	11.642	-1638
2001	12.770	8.135	1.796	1.409	12.502	10.875	-732
2002	13.390	8.187	1.863	1.500	12.789	11.452	-794
2003	13.745	8.169	1.929	1.532	13.058	11.734	-1154
2004	13.544	8.226	2.024	1.627	14.036	12.708	-1032

2005	12.269	7.663	1.985	1.556	12.391	11.155	-315
2006	12.227	7.728	2.074	1.623	14.189	12.906	-457
2007	12.477	7.081	2.002	1.543	14.709	13.104	-1641
2008	9.881	5.992	1.715	1.287	13.549	11.852	-441
2009	8.072	5.123	1.066	0.818	13.270	9.690	-2447
2010	8.494	5.218	1.238	0.963	13.425	11.729	183
2011	8.915	5.477	1.411	1.097	13.580	11.865	-77
2012	9.336	5.736	1.583	1.231	13.735	12.000	-300
2013	9.757	5.995	1.755	1.365	13.890	12.135	-496
2014	10.179	6.253	1.928	1.500	14.045	12.271	-671
2015	10.600	6.512	2.100	1.634	14.200	12.406	-834
2016	10.520	6.463	2.100	1.634	14.340	12.528	-838
2017	10.440	6.414	2.100	1.634	14.480	12.651	-834
2018	10.360	6.365	2.100	1.634	14.620	12.773	-824
2019	10.280	6.316	2.100	1.634	14.760	12.895	-809
2020	10.200	6.266	2.100	1.634	14.900	13.018	-790

(f) Disturbances in the context of force majeure

In Finland large scale storm damages can be classified as “force majeure” disturbances. The impacts of these losses are quantified in the following National Forest Inventories. Also special measurements have been conducted to quantify damages. In the GHG inventory these damages can be seen as increased natural losses and dead wood pool and also as decreased tree biomass sink. In the current GHG inventory these damages are included as a part of the NFI measurements, but are not reported separately. Finland’s reference levels are excluding force majeure.

Table 14. Major storms since 1990 that can be classified as “force majeure”.

Date(s)	**Name(s)**	**Quantity of losses, million m^3**
1.11.-16.11.2001	Pyry and Janika	7.3
29.7.-8.8.2010	Asta, Veera, Lahja and Sylvi	8.1

(g) Factoring out in accordance with paragraph 1(h) (i) and 1(h) (ii) of decision 16/CMP.1

There is no IPCC method or any other scientific methods to factor out the effects of elevated carbon dioxide concentrations and the indirect nitrogen deposition or the effects of activities before 1990. Finland use the managed land proxy to factor out the effects described in these paragraphs.

II. Description of any other relevant elements considered or treated in the construction of the forest management reference level, including any additional information related to footnote 1 in paragraph 4 of decision [-/CMP.6]

Policies included

I. Pre-2010 domestic policies included

All current EU-level regulations and national laws concerning forest management have been taken into consideration, if they have been adopted no later than December 2009. Our Forest Act and Act on Financing Sustainable Forest Management were adopted in 1996 and no major changes influencing the reference level have been made since.

Finnish targets for the use of forest resources and the level of carbon sink in forests are given in Finland's National Forest Programme 2015. The latest update was completed in 2008. Target for increased use of wood-based energy is also included in this programme (NFP 2015).

According to NFP 2015, the demand for domestic roundwood is expected to increase sharply due to reduced dependence on imported wood and EU goals for increasing the share of renewables in energy consumption. On average, the forest industry used 71 mill. m3 of roundwood per year in 2002-2006. The volume of annual fellings in Finland is planned to increase 10-15 million m3.

The relevant measures in the Long-term Climate and Energy Strategy (2008) adopted by the Government in November 2008 were included in the reference level, including those promoting the use of bio-energy. The objective is to increase the final consumption of forest chips as energy source from 5.3 TWh in 2007 to 21 TWh in 2020. Small-scale combustion of wood and wood pellets are aimed to be an energy source of 16 TWh (Table 15). Forest chips are also to be used as a raw-material for liquid biofuels. The policies targeted to increase wood consumption and rate of harvesting logging residues and stumps were included in the reference level (Pitkän aikavälin ilmasto- ja energiastrategia 2008).

Table 15. Renewable energy in the WAM scenario in Long-term Climate and Energy Strategy. Source: Finland’s Fifth National Communication under the United Nations Framework Convention on Climate Change (2009).

	2005	2006	2007	2020	
				WM	WAM
Renewable fuels related to industrial production					
Black liquor	36.7	43.3	42.5	38	38
Industrial wood residues	23.1	26.7	26.0	22	22
Total	**59.8**	**70.0**		**60**	**60**
Renewables targeted by policies					
Hydro power	13.6	11.3	14.0	14	14
Recovered fuels and biogas	1.7	1.9	2.0	2	3.5
Forest chips	5.8	7.2	5.3	18	21
Small-scale combustion of wood	13.4	13.6	13.5	12	13
Wood pellets	0.1	0.1	0.2	0.7	3
Heat pumps	1.8	2.4	2.8	3	5
Liquid biofuels	0.0	0.0	0.0	6	6
Wind power and solar energy	0.2	0.1	0.2	1	6
Total	**94.9**	**102.7**	**106.5**	**115**	**128**

II. Confirmation of factoring out policies after 2009

No post 2009 policies are included in establishing the reference level.

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