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Submission of information on forest management reference levels by Denmark

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Foreword

This report supports the submission on forest management reference levels for Denmark 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

The report is based on the data from the Danish National Forest Inventory (NFI), performed for the Ministry of Environment and the SINKS projects in relation to Article 3.4 of the Kyoto protocol for the Ministry of Climate and Energy and projects related to updating Danish forest data and data on harvested wood products.

Forest & Landscape, University of Copenhagen, have compiled the report based on data from the NFI combined with other relevant data, generated in the research, in other statistics and the general Forest Monitoring for the Ministry of Environment. The report refers to the previous report on Acquiring and updating Danish forest data for use in UNFCCC (Johannsen et al. 2010).

Frederiksberg, February 28th 2011

Johannsen, V.K, Nord-Larsen, T., Suadicani, K.

Summary

Projections for Denmark are provided by University of Copenhagen, Forest and Landscape, based on analyses of the National Forest Inventory for the calculation of CO_2-emissions/removals from LULULF, and data from UNECE for the calculation of CO_2-emissions/removals from Harvested Wood Products.

The reported values are annual emissions/removals calculated as averages of the projected FM data series for the period 2013-2020, taking account of policies implemented before April 2009. The Reference level A of 359 Gg CO2eq include the emissions/removals from HWP using the first order decay functions whereas Reference level B of 243 Gg CO2eq assumes instant oxidation.

The methods and considerations behind the Reference level are provided in the report.

CONTENTS

Introduction

Danish forest inventory methods have changed significantly since the first forest census in 1881. In 2002, the previous questionnaire based forest census was replaced with a sample based forest inventory. This has had significant impact on the methods involved in calculating Danish CO_2 emissions and has created a need for the development of methods for consistent estimation of forest carbon pools. The sections on forests in the National Inventory Reports have since 2008 been mainly based on the National Forest Inventory data.

1 Forest management reference level value

The reported values are annual emissions/removals calculated as averages of the projected FM data series for the period 2013-2020, taking account of policies implemented before April 2009. The Reference level A include the emissions/removals from HWP using the first order decay functions whereas Reference level B assumes instant oxidation (provided for transparency reasons only).

Table 1.1. Value of proposed reference levels (Gg CO2eq). (A) with emissions/removals from HWP using the first order decay functions; (B) assuming instant oxidation (provided for transparency reasons only).

Reference level A	Reference level B
Gg CO2eq	Gg CO2eq
359	243

2 General description

Projections for Denmark are provided by University of Copenhagen, Forest and Landscape, based on analyses of the National Forest Inventory for the calculation of CO_2-emissions/removals from LULULF, and data from UNECE for the calculation of CO_2-emissions/removals from Harvested Wood Products. When constructing the forest management reference level, all elements mentioned in footnote 1 of paragraph 4 of the decision -/CMP.6 on LULUCF were taken into account. Although a more in-depth description is provided in subsequent sections, a short summary is given here:

(a) Removals or emissions from forest management as shown in greenhouse gas inventories and relevant historical data are estimated utilising the same data as for reporting on the removals or emissions from forest management.

(b) Age-class structure is included in the construction of the reference level as part of the underlying data for the estimation of removals and emissions (see section 5 “Description of construction of reference levels”).

(c, d and e) Forest management activities already undertaken are reflected in the reference level by utilising updated data from the National Forest Inventory. The reference level thus reflects both business as usual and continuity of the treatment of forest management in the first commitment period. The relevant data for the calculation of CO_2-emissions/removals from HWP 2013-2020 is found as projections based on data from the last 20 years (see section 5.4 Harvesting rates and 5,5 Harvested Wood Products). No specific policies or legislative provisions have been adopted of influence for these activities (see section 6, “Policies included”). Accounting principles and consistent data capture will ensure continuity in the reporting across reporting periods.

(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

The pools included to set the reference level include the living biomass - above and below ground and the dead organic matter - containing both dead wood and litter (Table 3.1). These pools are measured by the NFI and estimations of the pools are being used already in the reporting for Denmark.

No changes are expected from the soil carbon pool within the reference period. Effects of fertilization, drainage and liming are not included in the reference level as no significant effects of these are expected in the reference period. Biomass burning is not used in forest management in Denmark.

Table 3.1. C pools and GHG 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	N2O	N2O	CO2	CO2	CH4	N2O
yes	yes	yes	yes	no	no	no	no	no	no	no	no

4 Approaches, methods and models used

Data used in the estimation comes from three main sources:

1. National Forest Inventory (NFI) conducted by Forest and Landscape for The Danish Forest and Nature Agency, Ministry of Environment. The NFI started in 2002 and is a continuous forest inventory with partial replacement. The rotation is 5 years (Nord-Larsen et al 2008, 2010).

2. Forest Census 1990 and 2000, conducted by Statistics Denmark in cooperation with The Danish Forest and Nature Agency and Forest and Landscape (Danmarks Statistik 1994, Larsen & Johannsen 2002),

3. Mapping of the forest area based on satellite images in 1990 and 2005, with support from The Ministry of Climate and Energy (SINKS SatMon Project).

4.1.1 Carbon stock 1990 - 2010:

Based on the mapped forest area in 1990 and in 2005 a calculation of carbon stored in both forest established before 1990 (Kyoto Protocol Article 3.4) and in afforestation since 1990 (Kyoto Protocol Article 3.3) was performed. The forest areas in 1990 as well as in 2005 have been mapped to be larger than previously estimated in relation to the forest census in 1990 and 2000.

The calculation of carbon stocks in 1990 and in 2000 were based on the species and age distribution reported in the 1990 and 2000 forest census as an expression of the total forest land allocation to species and ages. Based on the average carbon stock in different species and age classes measured in the NFI in 2004-2010, the total standing carbon stock was calculated. For each of the years 1990 - 2000 carbon stock was calculated as the moving average, corrected for the small scale deforestation which was detected.

Since the NFI was initiated in 2002 the first full cycle of measurements was completed in 2006. Under the assumption that changes occur gradually, these measurements are representative of 2004, corresponding to the period midpoint. Calculation of carbon stock in the period 2001-2003 is based on NFI in 2004 and carbon stock as calculated for 2000. For 2004-2010 carbon stock is calculated solely on the basis of the NFI using additional information about the total forest area from satellite image mapping.

For 2009 and 2010 carbon stock at the period midpoints can only be calculated using data from 3 and 1 years, respectively (i.e. data collected in 2008-2010 and 2010). As the data include a limited sample of the plots included in a full 5-year measurement circle, estimates have a larger uncertainty resulting in relatively large year-to-year variation. To obtain reasonable estimates of carbon stocks on 2009 and 2010 estimates were obtained using linear regression. Estimates of carbon stocks from data collected in individual years from 2002 to 2010 were regressed against the measurement years using weighted regression (Figure 4.1). Individual weights were calculated as the number of measured sample plots relative to the number of forest covered plots (based on an evaluation of aerial photographs.

Finally, the estimated regression model is used to estimate carbon stocks for 2009 and 2010. When full 5-year measurements are available for 2009 and 2010 these will be used in place of the regression based estimates.

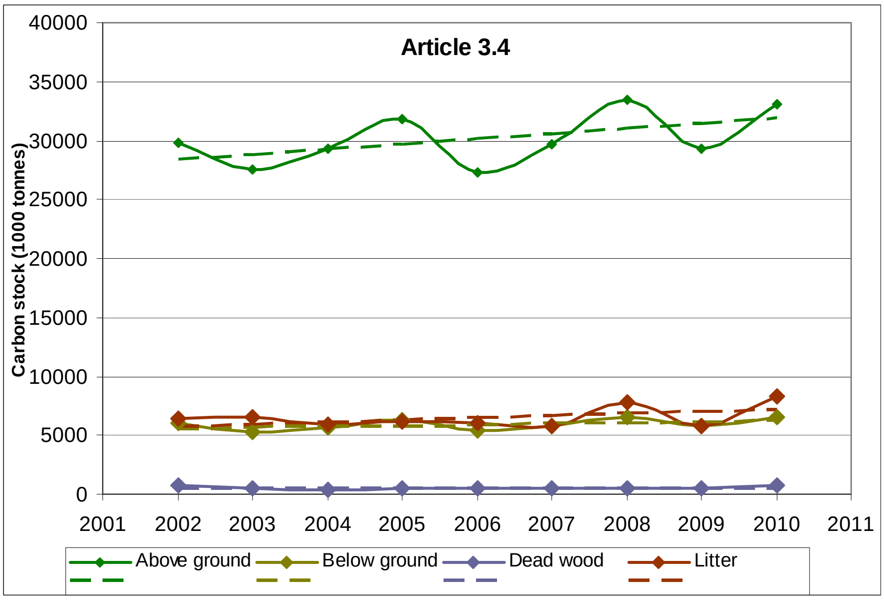

Figure 4.1. Prediction models for carbon stock estimates in 2009 and 2010.

4.1.2 Projections 2011-2020

The prognosis for carbon stock during the period 2011 - 2020 is based on the NFI data on carbon stock in species and age classes. Forecasts are based on the present allocation to age classes and species specific models for probabilities of rejuvenation of each management class. It assumes a constant distribution of species (no species change), but a calculation of percentage of area rejuvenated each year with the same species. For each year, these calculations are combined with NFI data for carbon stocks in each management class. Evolution of the total carbon pool can then be calculated. The probabilities for rejuvenation is estimated based on the forest census data from 1990 and 2000 (Nord-Larsen & Heding 2002).

The projections are performed similarly for forests established before and after 1990. An annual afforestation of 1900 ha is assumed, with a species distribution similar to the distribution observed in the NFI, except for a constant area with Christmas trees.

The forecast for the period 2011- 2020 shows a decrease in the forest carbon stock. This is due to the current high proportion of old trees, which face rejuvenation. Hereby large old trees felled and replaced by regeneration. The result is that the total carbon stock decreases. Changes in forest management, may affect the development of forests. Thus, a postponement of cutting of old trees will postpone the decline in carbon storage. Conversely, increased logging (e.g. due to increased demand, increased price or similar) may lead to a sharper decline in carbon stock.

The design of the Danish NFI allows for estimation of increment and harvest volumes due to the presence of permanent sample plots that are remeasured every 5 years. As the NFI was initiated in 2002, the first rotation was completed in 2006 and the first full cycle of remeasuring permanent sample plots will be completed in 2011. This will allow future projections to be based on representative measurements in the Danish forests and the development in carbon stock on the permanent plots to be utilised directly in the prognoses.

For further details on the methods we refer to the publication "Revised: Acquiring and updating Danish forest data for use in UNFCCC" (Johannsen et al. 2010).

4.1.3 Projecting harvest volumes 2010-2020 based on NFI data and models

The projection of harvest volume and its distribution to forest product assortments is based on a model developed for projecting potential forest fuel resources in Denmark (Nord-Larsen and Heding 2002, Nord-Larsen and Talbot 2004, Nord-Larsen and Suadicani 2010). The basic model uses information on the present forest area distribution to tree species, age classes and site conditions and a set of forest growth and stem taper functions (Figure 4.2). The area distributions are calculated using NFI data for the full 5-year measurement rotation 2006-2010.

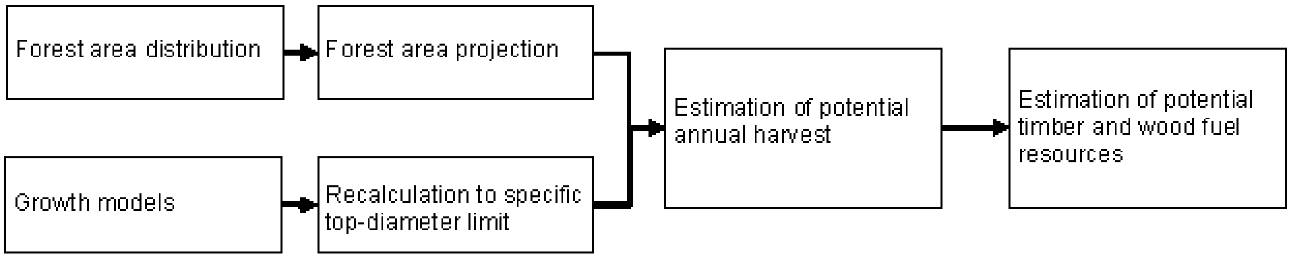

Figure 4.2. Basic model for projecting potential forest resources.

The model for projecting harvest volumes using four basic steps:

1. Using the current distribution of forest area to species and age-classes and geographical regions, the forest area is projected for one period using the probabilities of rejuvenation described above and an annual afforestation of 1900 ha. It is assumed that rejuvenated areas are established with the same species as previously occupied the area.

2. Using the current distribution of forest area to species and age-classes and the species-specific, regional average production class (a measure of site quality corresponding to the potential average volume production expressed in cubic meters at the optimal rotation age) volume growth is estimated using mathematical forms of species specific yield tables. Thinning volume is calculated based on the estimated volume per hectare at the beginning and end of the projection period and an estimate of total production during the period. Final harvest volume is based on the estimated area of rejuvenation and estimated volume per hectare at mid-period.

3. Using species specific stem-taper and volume functions the estimated total thinning and harvest volumes are converted to harvest volumes at road-side using a specific top-diameter limit. The top diameter limit does not apply to harvesting of whole trees for bioenergy. A critical harvesting diameter (CHD) is applied to distinguish between whole tree harvesting of fuelwood and harvesting of stemwood for timber assortments. CHD is defined as the thinning diameter, above which profits from harvesting of stem wood for timber assortments exceed that of harvesting whole trees for fuelwood. Consequently, whole-tree harvesting of fuelwood is only carried out in stands where thinning diameters do not exceed CHD. As such, CHD and the top diameter limit implicitly express different price relations between the timber assortments and fuelwood.

4. The total thinning and harvest volume is distributed to different assortments using species specific stem taper functions and a theoretical model for estimating the distribution to merchantable volume assortments. The potential fuelwood volume above the top diameter limit is calculated as the difference between mean tree above ground and merchantable timber volume. Contrary to the volume functions for hardwoods, the volume functions for softwoods do not include the volume of branches. Branch volume is estimated from a model describing the relation between the total biomass of the tree and the biomass of the stem based on the height and diameter of the mean basal area tree.

Based on the estimated harvest volumes, harvested CO2 equivalents are calculated using species specific basic densities and assuming that carbon makes up 50 pct. of the biomass.

4.1.4 Projecting harvest volumes 2010-2020 based on harvest statistics

Projections of the annual harvest for the period 2010-2020 are used for prognosis of the annual inflow of HWP. The base period is the mean annual harvest 2005-2009 and annual inflow of HWP in the same period. Because the annual harvest in the base period is built on data from Statistics Denmark (2011) some adjustments on the prognosticated annual harvest must be done in order to make the comparisons reasonable.

Based on an evaluation of satellite images and the observed forest area estimated from the NFI (Nielsen et al. 2010) it is evident that the forest area in 2000 in the harvest forecast 2000-2009 is underestimated. The consequence is that the annual increment and the annual harvest also is underestimated. Depending on the method the forest area in year 2000 now can be estimated to 545 000-562 000 ha while only 486 000 ha was included in the harvest forecast. Therefore the annual harvest should be adjusted by a correction factor (562 000/486 000). In the original report the mean annual harvest 2000-2009 was estimated to 2 717 051 m^3, and this is corrected to 3 150 000 m^3.

The adjusted harvest forecast 2000-2009 estimated the mean annual harvest to 3 150 000 m^3, while the mean registered harvest in 2000-2009 was estimated to 2 339 560 m^3 (Statistics Denmark 2011). The difference may have several reasons:

1. The current harvest reported by Statistics Denmark might be underestimated. A large proportion of forest estates in Denmark are relatively small (<5 ha). For such forest owners, the main source of income is not the forest and they may be underrepresented in the forest owner database used for extracting respondents for the annual harvest survey by Statistics Denmark. Also, such forest owners may lack the forest mensuration skills necessary for estimating harvested volumes and may - to some extend - consider the limited volumes harvested, often for personal use, as insignificant and not worth reporting.

2. The potential forest volumes may not be realized. The economical incentive for forest owners to thin and harvest their forest may not always be present, especially at small forest estates where the main source of income is not forest operations. In this case, other values may be the main consideration including hunting possibilities and preservation of biological or aesthetic values.

The reason for the difference is basically unknown, but it is expected that the difference will also be found when comparing the registered harvest and the prognosticated harvest in 2010-2019. When comparing the harvest forecast with the registered harvest this aspect should therefore be accounted for. The prognosticated annual harvest should be therefore be reduced with 26% (1-2 339 560/3 150 000) to adjust the prognosticated harvest to the level of the registered harvest. As the mean annual harvest 2010 -2019 is estimated to 3 545 108 m^3 the corrected annual harvest 2010-2019 is calculated to 2 635 632 m^3.

As mentioned the basis of the projection of the inflow of HWP is the mean annual harvest in 2005-2009. The registered annual harvest in this period is 2.530.020 m^3 meaning that the mean inflow of HWP in 2010-2019 will be 4% higher than the mean annual inflow of HWP in 2005-2009.

This is an acceptable result although most experts assume a decrease in the production of HWP in the coming years. The consequence is conversion of lower qualities of industrial roundwood to energy wood and an increased export of industrial roundwood out of Denmark, but this aspect is not included in the selected projection method.

Production import and export of industrial roundwood for the period 1999-2008 are given in Table 4.1. The steep increase in export of industrial roundwood is clear as well as the decreasing import of industrial roundwood. The result is a decreased consumption of industrial roundwood in Denmark, which must result in a decreased production of HWP.

The production, import and export data for industrial roundwood is also used for the calculation of the inflow of HWP produced only from domestic roundwood (Rüter 2011).

Table 4.1. Data for Industrial Roundwood based on UNECE for the period 1999 - 2008

Year	Production	Imports	Exports
	m3	m3	m3
1999	1.236.000	664.000	289.000
2000	2.492.000	530.000	876.000
2001	996.000	448.000	726.000
2002	789.042	457.129	238.920
2003	810.390	582.203	248.746
2004	568.000	490.672	306.247
2005	1.681.600	848.121	644.710
2006	1.196.000	399.152	545.458
2007	1.460.000	332.523	841.526
2008	1.680.000	335.947	1.141.798

5 Description of construction of reference levels

5.1 Area under forest management

Table 5.1. Estimated total forest area, forest area established before 1990, deforestation* and afforestation in 1990-2010. Estimated areas are based on the interpretation of maps produced form satellite images.

Year	Total area included in the reporting	Forest area established before 1990	Afforestation	Deforestation
1990	540.498	539.788	711	884
1991	540.581	538.903	1.677	394
1992	542.382	538.509	3.873	728
1993	542.899	537.781	5.119	2
1994	545.310	537.779	7.531	547
1995	547.027	537.232	9.795	2
1996	548.462	537.231	11.232	203
1997	550.460	537.028	13.432	2
1998	551.826	537.026	14.800	2
1999	555.935	537.024	18.910	1.248
2000	557.367	535.777	21.590	734
2001	559.001	535.043	23.959	685
2002	559.624	534.358	25.266	54
2003	561.057	534.304	26.754	459
2004	561.986	533.845	28.141	329
2005	564.910	533.517	31.393	82
2006	567.829	533.435	34.394	114
2007	569.898	533.321	36.577	114
2008	573.206	533.207	39.998	114
2009	576.513	533.093	43.420	114
2010	579.820	532.979	46.841	114

* Deforestation is given as the area for each year. The deforestation area is in the subsequent years included in the reporting for other land use classes - e.g. settlements or cropland.

5.2 Emissions and removals from forest management

5.2.1 Historical emissions and removals from forest management

The time series since 1990 is consistent with the 2010 national GHG inventory. The National Inventory Report (Nielsen et al. 2010) also contains further information on the estimation of the time series based on updated and new information on forest area in 1990 and the development until 2005.

Table 5.2. Estimated forest area, live biomass carbon, carbon in dead wood and soil carbon (in forest floor and in mineral soil). Estimates of forest area are in hectares and estimates of carbon are given in Gg C. Full data are given in appendix 4 and 5.

		Gg C	1990	1996	2000	2005	2010	2015	2020
Forests established before 1990	Area		539.788	537.231	535.777	533.517	532.979	532.979	532.979
	Live biomass	Above ground	29.313	30.656	31.559	30.486	31.935	30.264	29.948
		Below ground	4.721	4.936	5.080	5.792	6.279	6.006	5.978
	Dead wood		466	500	522	495	564	545	542
	Forest floor		7.292	7.177	7.103	6.398	7.215	6.778	6.778
	Mineral soil		59.131	58.851	58.692	71.555	71.478	71.509	71.509
	Total		113.975	115.017	115.767	114.726	117.471	115.103	114.755
Forests established after 1990	Area		711	11.232	21.590	31.393	46.841	56.341	65.841
	Live biomass	Above ground	0	30	95	625	957	1.907	2.695
		Below ground	0	5	16	135	198	376	524
	Dead wood		0	1	3	70	157	137	155
	Forest floor		0	1	2	39	102	164	286
	Minearl soil		78	1.230	2.365	12.009	16.367	12.610	13.651
	Total		1.226	4.991	8.679	12.878	17.781	15.196	17.312
Deforestation	Area		884	203	734	82	109	0	0
	Live biomass	Above ground	-48	-12	-43	-6	-7	0	0
		Below ground	-8	-2	-7	-1	-1	0	0
	Dead wood		-1	0	-1	0	0	0	0
	Forest floor		-12	-3	-10	-1	-2	0	0
	Minearl soil		-97	-22	-80	-15	-16	0	0
	Total		-231	-56	-197	-24	-26	0	0

The average CO_2 emission from forest established before 1990 in the period 2013 - 2020 is 243 Gg CO_2 equalling 66 Gg C. This is based on the principles described in Johannsen et al. 2010.

If the same analyses are applied but with a postponement of regeneration of 20 years for broadleaved and 5 years for conifers - reflecting a lower probability of regeneration at a given age - the average CO_2 emission from forest established before 1990 in the period 2013 - 2020 is -185 Gg CO_2 equalling -50 Gg C.

Similar analyses could be performed for increased harvesting resulting in lower carbon pools and higher emissions. There is no available data to support these analyses. Hence, the basic scenario is utilised in the estimation of the reference level.

The average CO_2 emission from forest established after 1990 in the period 2013 - 2020 is -681 Gg CO_2, equalling -186 Gg C.

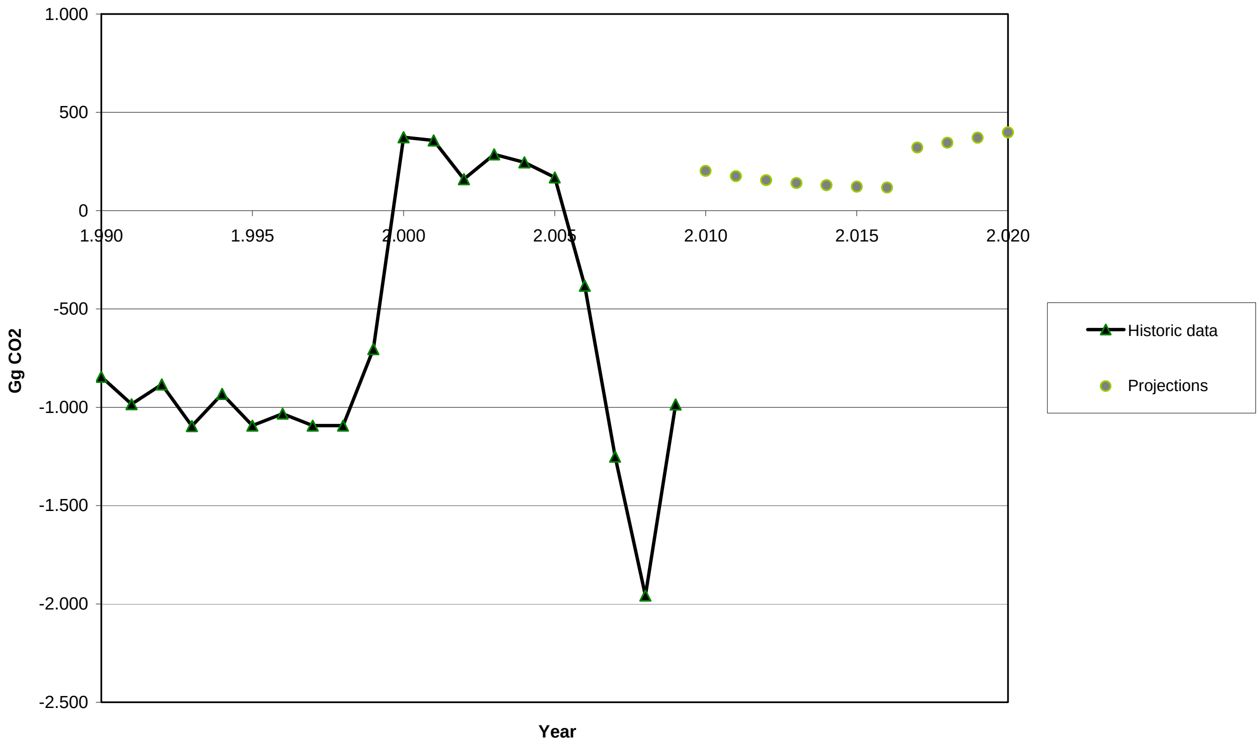

Figure 5.1. Figures of CO_2 sequestration for area of forests established before 1990. Line discontinued in 2010.

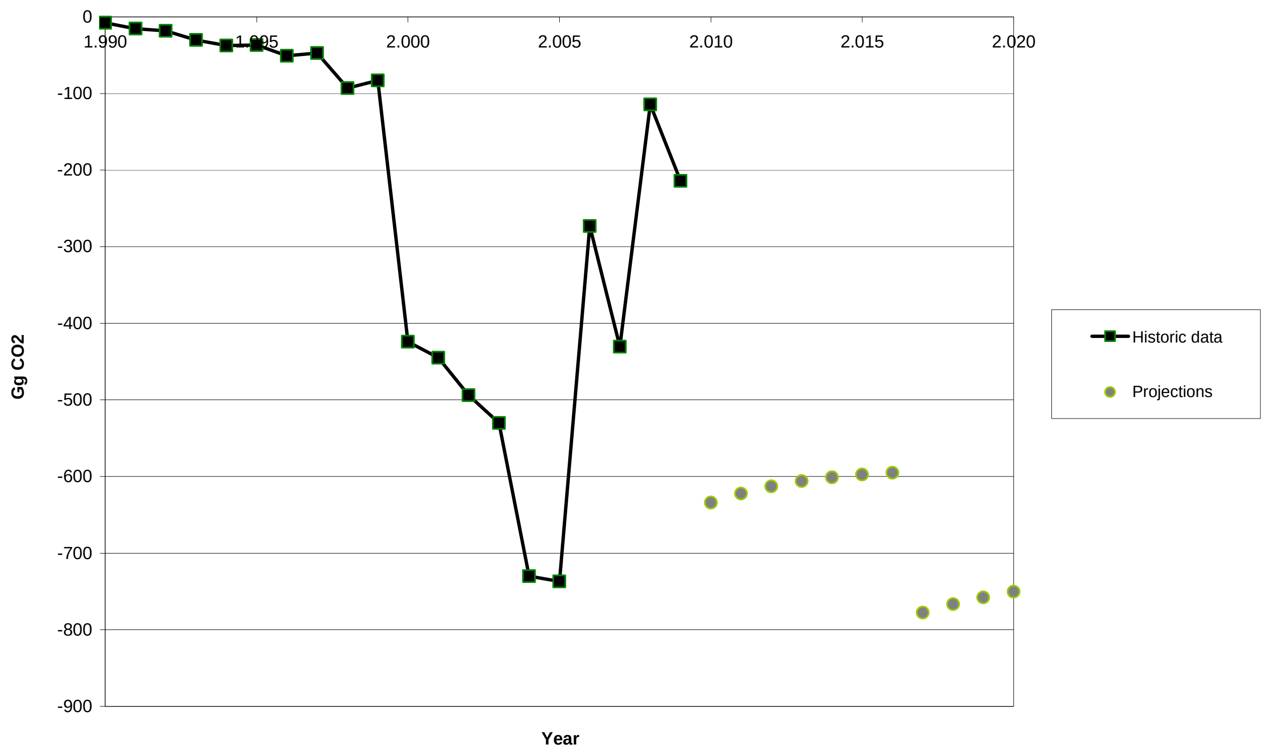

Figure 5.2. Figures of CO_2 sequestration for afforestation (carbon pool in mineral soils and forest floors is assumed constant in these areas and not included in the calculations). Line discontinued in 2010.

5.2.2 Relation between Article 3.3. and Article 3.4

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

Forest established before 1990 - Article 3.4

For the area of forests established before 1990 there is an increase in carbon stock for the period 1990 to 2000. There is some deforestation, but still the total carbon stock is increasing. From 2010 to 2020 the forests established before 1990 is expected to be a source of emissions due to the effect of the age structure of the forest area.

Afforestation - Article 3.3

In the afforestation a steady increase in carbon stock is found. The species composition is based on the information from the 2000 Forest Census for the period 1990-2000. Subsequently the NFI provides information on the afforestation area and the carbon pools in these areas - up till 2008. The estimates for the carbon pools in the afforestation are similar to previous estimates, with a slight increase due to the new knowledge on species composition and average carbon stock in those areas based on the NFI data. The estimation is based on a combination of georeferenced sample plots from the NFI and satellite based forest maps, supporting identification of plots from afforestation.

Deforestation - Article 3.3

Deforestation amount to 6,300 ha during the period 1990 - 2005. The carbon pools of the areas deforested are estimated based on the area of the deforestation and the average carbon pools for the year in question.

5.3 Forest characteristics and related management

5.3.1 Age class structure

The data from the NFI constitutes the base for the projection for the period until 2020. Based on the analysis the Danish forest (of Article 3.4) will be a source of CO_2-emissions in the period until 2020. This is primarily due to the age distribution especially for the common species beech and oak (Figure 3). The large areas with mature trees (more than 25% of the area and 36 % of the biomass in beech is more than 100 years old, Nord-Larsen et al., 2010) indicate pronounced fellings in the coming years, which is expected under a business as usual scenario to lead to increased emissions of CO_2 from the forest.

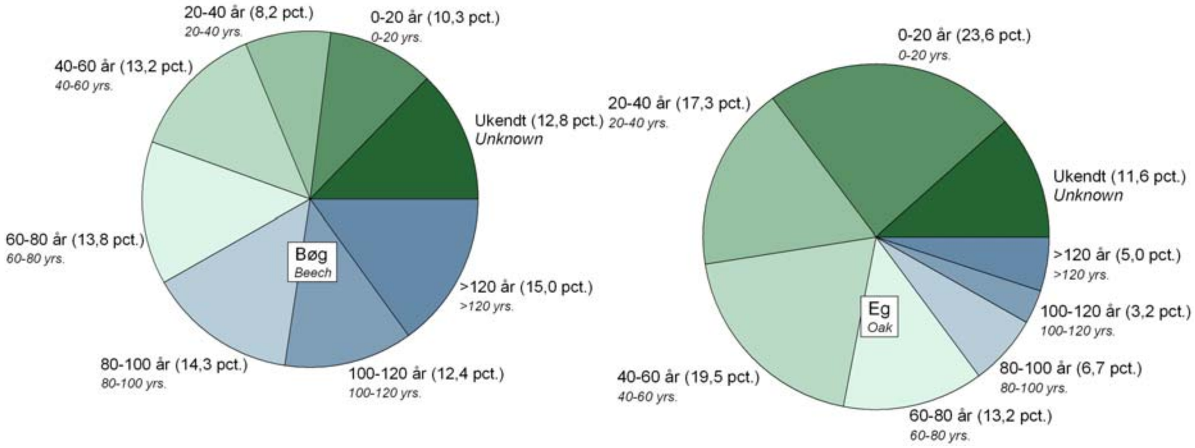

Figure 5.3. Age-class distribution for the two most common broadleaved forest tree species in Denmark, beech and oak (from Nord-Larsen et al., 2010). Ages indicate the midpoints of twenty-year classes.

5.3.2 Increment

In the 2000 forest census, annual volume increment was projected at 4.6 mio. m^3 per year. The estimate was based on largely the same models as used in the prognosis presented here. In the present projections, increment is estimated at 4.6-4.7 mio. m^3 per year or 7.9-8.4 m^3 per ha and year (Table 5.3). Projected increment exceeds annual harvest volume reported by Statistics Denmark, which is relatively stable around 2.2 mio. m^3 per year. This would indicate an increase in volume per hectare and is consistent with the relatively large growing stock in Danish forests (196 m^3/ha) compared to the general level estimated from common yield tables in Denmark. For comparison, the model predicted growing stock based solely on yield tables was 156 m^3/ha in the 2000 forest census (Larsen and Johannsen, 2002).

However, it is striking that projected increment is nearly double the current harvest reported by Statistics Denmark. The reason may be that forest growth models overestimate forest growth. The forest growth models are based on the idealized case of experimental stands that are thinned at regular intervals and generally maintained with the expertise of professional foresters. Many forest stands may be treated less than optimal and may therefore have reduced growth relative to the model predictions. In the application of the models, it has been attempted to alleviate this problem by using localized estimates of growth potential and canopy cover, but this may not fully compensate for the difference between observed stand growth and model predictions. Further to this end, underlying yield tables were mainly developed during the first half of the 20^{th} century. As forest practises have changed since the development of the tables, models may be expected to represent current forest management practises poorly. Another reason may be that the growing stock is increasing more than expected.

Table 5.3. Projected increment 2008-2020.

Periode	Annual growth	Annual growth
	m^3/ha	m^3
2008-2009	8,4	4.769.167
2009-2010	8,4	4.736.089
2010-2011	8,3	4.709.041
2011-2012	8,2	4.684.012
2012-2013	8,1	4.657.736
2013-2014	8,1	4.629.777
2014-2015	8,0	4.597.267
2015-2016	7,9	4.567.603
2016-2017	7,8	4.542.856
2017-2018	7,8	4.511.436
2018-2019	7,7	4.484.096
2019-2020	7,7	4.482.573
2020-2021	7,6	4.477.278
2021-2022	7,6	4.478.526
2022-2023	7,6	4.477.559
2023-2024	7,5	4.474.086
2024-2025	7,5	4.474.456
2025-2026	7,5	4.473.936
2026-2027	7,5	4.478.576
2027-2028	7,4	4.474.756

5.3.3 Rotation length

Age structure as described in 5.3.1 is a reflection of the current rotation length and possibly a postponement of regeneration of parts of the area with broadleaved stands. The rotation length is expected to be as observed in the period 1990 - 2000 - as this is the best available information currently. In the prognosis the transition probabilities reflect the rotation length. For more information see Johannsen et al (2010) and Nord-Larsen & Heding (2002).

The design of the Danish NFI allows for evaluation of the rotation length due to the presence of permanent sample plots that are remeasured every 5-years. As the NFI was initiated in 2002, the first rotation was completed in 2006 and the first full cycle of remeasuring permanent sample plots will be completed in 2011. This will allow future analyses to be based on representative measurements in the Danish forests.

5.3.4 Information on forest management activities under “business as usual”

No management activities under business as usual are expected to substantially change increment and harvesting levels post 2009. However, there is some uncertainty as to the combination of the different models available for prognosis. The prognosis of forest management and its effect on the overall carbon pools in the forests is based on the assumption of a stable rotation length and probability of regeneration - which is based on data for the period 1990 - 2000. This management may not have been implemented in practical forestry for the last 5-10 years (reflected in the large proportion of old forest stands). If price structure on the wood market does not change significantly in period 2008-2013 the assumptions and models for regeneration of forest stands may not hold. This could lead to a stable or increasing carbon stock of the forests. However, there are no data available to substantiate other predictions. As the NFI was initiated in 2002, the first rotation was completed in 2006 and the first full cycle of remeasuring permanent sample plots will be completed in 2011. This will allow future reporting to be based on representative measurements in the Danish forests. This can provide data for evaluation of the models used for prognosis, but will not be available before 2012.

5.4 Harvesting rates

5.4.1 Historical harvesting rates

The estimation of annual harvest in the Danish forests is based on questionnaires sent out, analysed and published by Statistics Denmark (Statistics Denmark, 2011)

Table 5.4. Harvest in the Danish Forests 1990-2009 (Statistics Denmark, 2011).

Year	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Total	2.018	1.914	1.916	1.778	1.852	1.926	1.876	1.818	1.710	1.715	3.672
Timber	1.612	1.452	1.430	1.237	1.297	1.365	1.249	1.192	1.164	1.159	2.972
Firewood	305	351	364	408	394	399	425	419	363	358	421
Wood chips	100	111	121	134	162	162	203	206	184	199	279
Fuel-wood as wood chips											
Fuel-wood as round wood											

Year	2001	2002	2003	2004	2005	2006	2007	2008	2009
Total	1.793	1.607	1.808	1.867	2.962	2.349	2.550	2.371	2.418
Timber	1.108	877	900	917	1.682	1.194	1.455	1.315	1.013
Firewood	425	405	438	428	472	409	377	309	351
Wood chips	260	325							
Fuel-wood as wood chips			326	372	420	468	501	564	799
Fuel-wood as round wood			143	150	389	279	217	183	254

5.4.2 Assumed future harvesting rates

Nord-Larsen and Suadicani have estimated the mean annual harvest 2010-2019 to 3.545.108 m^3/year and the mean annual harvest 2020-2029 to 3.692.741 m^3/year. Based on some additional calculations of the original data the harvested volume has been estimated for the individual years (Table 5.5). Somehow the annual increment and the annual harvest have a tendency to increase when calculated in one year periods instead of calculated in 10 years periods. Therefore the annual harvest has been levelled to fit the mean annual harvest 2010-2019 according to Nord-Larsen and Suadicani (2010).

Projections of the annual harvest for the period 2010-2020 are used for prognosis of the annual inflow of HWP. The base period is the mean annual harvest 2005-2009 and annual inflow of HWP in the same period. Because the annual harvest in the base period build on data from Statistics Danmark (2011) some adjustments on the prognosed annual harvest must be done in order to make comparisons reasonable (See page 10-12).

Table 5.5. Projected harvest volumes 2010-2020 (Nord-Larsen and Suadcani 2010, adjusted).

Year	Annual harvest m^3	Year	Annual harvest m^3
2010	2.720.814	2019	2.581.716
2011	2.689.385	2020	2.571.686
2012	2.668.072	2021	2.569.833
2013	2.660.793	2022	2.577.334
2014	2.643.369	2023	2.575.536
2015	2.613.314	2024	2.578.360
2016	2.608.123	2025	2.578.164
2017	2.594.933	2026	2.596.272
2018	2.575.800	2027	2.604.953

When comparing projected harvest volumes to current harvest volumes reported by Statistics Denmark differences may have several reasons:

2. The current harvest reported by Statistics Denmark might be underestimated. A large proportion of forest estates in Denmark are relatively small (<5 ha). For such forest owners, the main source of income is not the forest and they may be underrepresented in the forest owner database used for extracting respondents for the annual harvest survey by Statistics Denmark. Also, such forest owners may lack the forest mensuration skills necessary for estimating harvested volumes and may to some extend consider the limited volumes harvested, often for personal use, as insignificant and not worth reporting.

2. The potential forest volumes may not be realized. The economical incentive for forest owners to thin and harvest their forest may not always be present, especially at small forest estates where the main source of income is not forest operations. In this case, other values may be the main consideration including hunting possibilities and preservation of biological or aesthetic values.

5.5 Harvested wood products

5.5.1 Background

In §27 it is stated that:

"Emissions from harvested wood products removed from forests which are accounted for by a Party under article 3 shall only be accounted for by that Party. Accounting shall be on the basis of first order decay functions with default half lives of two years for paper, 25 years for wood panels and 35 years for saw wood. Alternatively, for domestically produced and consumed harvested wood products only, a Party may use country specific data to replace the default half lives specified above, or to account for such products in accordance with the definitions and estimation methodologies in the most recently adopted IPCC Guidelines and any subsequent clarification agreed by the Conference of the Parties, provided that verifiable and transparent data are available."

5.5.2 Data for the calculations

The calculations are based UNECE data from 1964-2009. Data was found for the production, import and export of (1) sawnwood (coniferous and non-coniferous), (2) wood based panels (divided into seven different assortments), and (3) paper and paperboards. As the afforestation in the period 2013-2020 is at maximum 30 years old - the potential harvest will be used for energy wood (chips and firewood) and will not be included in the calculations of HWP.

5.5.3 Projections used in the prognosis

All calculations are done according to Rüter (2011). All historic data is based on UNECE (2011). The projected inflow of HWP 2010-2020 is based on Nord-Larsen and Suadcani (2010 adjusted). For details about the adjustments see page 10-12.

5.5.4 Results

The contribution of HWP to the reference level of Denmark amounts to 0,116 Mt CO2. It was calculated using the C-HWP-Model, which estimates delayed emissions on the basis of the annual stock change of semi-finished wood products as outlined in the 2006 GL (Rüter, 2011). The estimation uses the product categories, half lives and methodologies as suggested in para 27, page 31 of FCCC/KP/AWG/2010/CRP.4/Rev.4. The activity data (production and trade of sawnwood, wood based panels and paper and paperboard) is derived from the TIMBER database (UNECE 2011) (time series 1964-2009). In order to achieve accurate results, the HWP numbers have been calculated applying the sub-categories of sawnwood, wood based panels and paper and paperboard as specified in Table 5.6. Sawnwood includes the Items 1632 and 1633, wood based panels comprising of Items 1634, 1640, 1646, 1647, 1648, 1649 and 1650, and paper and paperboard corresponds to Item 1876. Following conversion factors have been used:

Table 5.6. Conversion factors of considered commodities*.

Classification		Description of commodity	Air dry density	C conv. factor	Source
FAO	UNECE		[g/cm³]	[Gg C/1000m³]	
1866	1.2.C	Industrial roundwood, coniferous	0,450	2,250E-01	Kollmann (1982), (oak, beech)
1867	1.2.NC	Industrial roundwood, non-coniferous	0,670	3,350E-01	Kollmann (1982), (oak, beech)
1632	5.C	Sawnwood, coniferous	0,450	2,250E-01	Kollmann (1982), (oak, beech)
1633	5.NC	Sawnwood, non-coniferous	0,670	3,350E-01	Kollmann (1982), (oak, beech)
1634	6.1	Veneer sheets	0,590	2,950E-01	IPCC (2003)
1640	6.2	Plywood	0,480	2,402E-01	IPCC (2003)
1646	6.3	Particle board	0,630	2,898E-01	Hasch (2002), Barbu (2011)
1647	6.4.1	Hardboard	0,850	4,165E-01	Kollmann (1982), Barbu (2011)
1648	6.4.2	Medium density fibreboard	0,725	3,190E-01	Hasch (2002), Barbu (2011)
1649	6.4.x	Fibreboard, compressed	0,788	3,504E-01	(50 % hardboard / 50 % medium density fibreboard)
1650	6.4.3	Other board (Insulating board)	0,270	1,148E-01	Kollmann (1982), Barbu (2011)
1876	10	Paper and paperboard	0,900**	4,500E-01**	IPCC (2006)

* Items 1866 and 1867 are needed for methodological reasons only (see following section), ** in [g/g] and [Gg C/1000t]

In order to only estimate emissions from HWP removed from forests which are accounted for by Denmark under Article 3, in a first step, the annual share of carbon in HWP coming from domestic forests has been calculated. Following equations were used as industrial roundwood is assumed to serve as raw material for the production of HWP.

$$ratio_{INDRW\ consumption\ from\ dom\ harvest} = \frac{(Production_{INDRW} - Export_{INDRW})}{(Production_{INDRW} + Import_{INDRW} - Export_{INDRW})}$$

$$Production_{HWP\ from\ dom\ harvest} = Production_{HWP} \cdot ratio_{INDRW\ consumption\ from\ domestic\ harvest}$$

The ratio (Equation 1) was calculated both for coniferous and non-coniferous industrial roundwood (*INDRW*, Items 1866 and 1867). For coniferous sawnwood and paper and paperboard, the ratio for coniferous industrial roundwood was applied. For non-coniferous sawnwood the ratio for non-coniferous industrial roundwood was applied. For the other HWP, the ratio of the annual mass weighted average of coniferous and non-coniferous industrial roundwood was applied.

As a result, this share of HWP produced from domestically harvested timber is presented as a percentage in Table 5.7. The presented approach follows the initial assumption that all forests in Denmark are managed, and in order to simplify matters, it is presumed that all harvest is allocated to forest management. This assumption is to be verified and corrected where necessary.

Table 5.7. Historic time series of amounts and share of accountable carbon Inflow to the HWP pool [in 1000t C and %]

1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980
209	223	301	315	383	388	421	407	400	387	363	337	401	392	443	462	399
86.8%	87.8%	90.7%	91.5%	92.5%	93.1%	93.0%	93.2%	91.9%	85.6%	81.7%	89.0%	90.6%	90.1%	95.9%	96.4%	93.4%

1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
403	360	423	409	378	365	393	376	386	392	391	334	419	373	370	282	273
95.2%	94.9%	94.5%	90.4%	81.2%	79.0%	82.6%	77.7%	81.0%	82.7%	83.0%	81.2%	90.6%	78.5%	74.1%	82.9%	76.8%

1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
231	256	282	195	221	220	174	263	352	245	318	332
65.0%	70.7%	84.9%	55.4%	66.6%	63.0%	52.3%	78.0%	76.2%	67.4%	81.5%	84.9%

The annual carbon Inflow (= carbon in produced HWP) to the HWP pool prior to the year 1964 (first year for which activity data from TIMBER database (UNECE 2011) is available for Denmark) has been calculated from the 5 years average from 1964 to 1968 and was assumed to be the constant carbon pool Inflow for the time period 1900-1963.

In order to provide a projection for the development of the HWP pool consistent with the assumptions on the future harvest, the rates of change of the Projected harvest (EU Submission 2011) as compared to the last 5 years average of historic harvest, for which up-to-date data is available, was calculated (cf. Table 5.8). These projected growth rates as cp. to the average of the years 2005-2009 for Denmark were applied to the same 5 years average of historic carbon Inflow to the HWP pool in order to receive the future Inflow to the HWP pool.

Table 5.8. Projection of carbon Inflow to the HWP pool.

Average of historic harvest (2005-2009) [in 1000m3]	2.530
Average HWP pool Inflow* (2005-2009) [in 1000t C]	302

years	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Projected harvest rate [in 1000m3]	2721	2689	2668	2661	2643	2613	2608	2595	2576	2582	2572
Change as cp to historic harvest (2005-2009) [in %]	7,54%	6,30%	5,46%	5,17%	4,48%	3,29%	3,09%	2,57%	1,81%	2,04%	1,65%
Projected carbon Inflow to HWP pool [in 1000t C]	325	321	318	318	316	312	311	310	307	308	307

*a similar approach was chosen by Kangas and Baudin (2003): ECE/TIM/DP/30

For calculating the pool of HWP in use, three half-lifes for application in the first order decay function have been used as suggested by para 7, page 31 of FCCC/KP/AWG/2010/CRP.4/Rev.4.

- Sawnwood: 35 years
- Wood based panels: 25 years
- Paper and paperboard: 2 years

The projected net-emissions are calculated from the annual stock change estimates following the calculation method provided in IPCC 2006, Vol.4, Ch. 12 (Equation 12.1).

Table 5.9. Historic (up to 2009) and projected net-emissions from HWP pool [in 1000t CO2].

1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
-215	-199	16	-281	-99	-80	255	293	439	331	214	503	391	384	531	208	-82

2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
326	67	70	70	88	99	102	108	119	118	120	125	119	121

5.5.5 Additional remarks

The expected emissions from HWP are mainly caused by the decreasing production in the Danish Forest industry. The use of HWP in Denmark has increased for many years, and therefore one could expect increased carbon sequestration in HWP. Anyway the proposed calculation method only include HWP produced in Denmark, and not HWP imported from other countries. Therefore the result shows emission of CO_2 from HWP.

The use of the projected annual harvest for levelling the inflow of HWP in 2010-2010 is based on the logic that the production of HWP in the country increases if the annual harvest increases. This is not necessarily the case for Denmark. The proportion of wood for energy has increased and 60% of the harvested wood is used for energy purposes. The proportion of industrial roundwood decreases and a larger and larger proportion of the industrial roundwood is exported. Therefore the annual harvest is not a good parameter for levelling the inflow of HWP in Denmark.

5.6 Disturbances in the context of force majeure

Table 5.10. Overview of registered Danish wind falls since 1990 and the relationship with the base year emissions without LULUCF (assuming that most wind falls are conifers)

Year	Wind fall in 1000 m^3	Wind fall in ton CO_2 eq	In percentage of base year emissions (without LULUCF)
13-14. Jan. 1993	157	115.238	0,2
3-4. Dec. 1999	3619	2.656.346	3,8
29-30. Jan. 2000	234	171.756	0,2
8. Jan. 2005	1985	1.456.990	2,1

Denmark has with varying time intervals experienced wind fall. Wind falls tend to reduce the harvest intensity in the remaining part of the forest area which to a degree reduce the overall effect on emissions and removals in a year with a major wind fall. The proposed reference level does not include any natural disturbances.

It is also worth to mention that the transition probability functions do not include the effect of the wind fall in December 1999 as forest owners in January 2000 as part of the forest census was asked to report on the state of the forest before the storm occurred.

Although extend of the individual windthrows may be locally catastrophic, the amount is typically of an order of less than 2 pct of the total standing volume. Hence, such disturbances generally have limited effect on the total forest carbon pool. Further, CO_2 emissions in the year of the disturbance may not be largely effected by catastrophic windthrow because such events would also lead to an increase in the dead wood carbon pool which is included in the RL calculation. Overall the general trend in development of the carbon pools in forest is expected to be of larger influence than individual windthrows when estimating the RL.

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

No factoring out is performed for forests.

6 Policies included

6.1 Pre-2010 domestic policies included

The recent Forest Act was adopted in 2004, and no changes have occurred since. The domestic policies to support afforestation have been included in the prognosis for Article 3.3 by assuming an annual afforestation of 1.900 ha.

The preparations for the Renewable Energy plan and it's expected increase in use of wood for energy in Denmark have not affected the prognosis for the forests. The increased use of wood fuel is expected to be based primarily on imported wood pellets.

6.2 Confirmation of factoring out policies after 2009

The forest management reference levels is based solely on current NFI data, historic data for regeneration of forest areas, and expectation of a status quo on the carbon stocks in different age classes. Prognoses of harvests have been estimated using two different approaches and the result is based solely on these data. No domestic policies have been taken into account when estimating the reference levels.

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8 Appendices

8.1 Appendix 1. Density of common Danish tree species

Deciduous	Density g/cm^3	Coniferous	Density g/cm^3
Beech	0,56	Norway spruce	0,38
Oak	0,57	Sitka spruce	0,37
Ash	0,56	Silver fir	0,38
Sychamore	0,49	Pine	0,43
Other deciduous species	0,56	Mountain pine	0,48
		Contorta pine	0,37
		Scots pine	0,43
		Nordmann fir	0,38
		Noble fir	0,38
		Douglasfir	0,41
		Larch sp.	0,45
		Other conifers	0,38

8.2 Appendix 2. Reduction factors for calculating biomass of deadwood for different degrees of structural decay for deciduous and coniferous species.

Structural decay	Reduction factor	
	Deciduous species	Coniferous species
1	0,804	0,895
2	0,607	0,632
3	0,429	0,605
4	0,304	0,447

8.3 Appendix 3. Parameters for the transition probability

Parameters for the transition probabilities - dependent on species and region

Management class	β_0	β_1	β_2	**Earliest regeneration age (region)**	
				Jutland	**Islands**
Beech	-370,7834	9473,0017	0,0597	90	80
Oak	64,8302	-84,7190	0,0303	120	110
Ash	201,6577	-666,4862	0,0567	60	50
Sychamore	29,1421	44,7930	0,0427	60	50
Other broadleaves	29,1421	44,7930	0,0427	50	40
Norway spruce	-531,4614	12937,8018	0,1239	50	40
Sitka spruce	-174,8721	4867,6015	0,1198	50	40
Nordmann fir	92,5424	1	0,2301	5	5
Noble fir	173021,0121	1	0,2657	40	40
Other fir	-9,3377	726,5105	0,0590	60	50
Pine	-270,3996	6832,1561	0,0915	50	40
Other conifers	-9,3377	726,5105	0,0590	50	40
Mountain pine	116449,5854	1	0,2565	50	40

8.4 Appendix 4. Carbon pools 1990 - 2008.

			1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Forests established before 1990	Area		539.788	538.903	538.509	537.781	537.779	537.232	537.231	537.028	537.026	537.024	535.777
	Live biomass	Above ground	29.313	29.513	29.739	29.946	30.193	30.409	30.656	30.892	31.139	31.386	31.559
		Below ground	4.721	4.753	4.789	4.822	4.862	4.896	4.936	4.973	5.013	5.052	5.080
	Dead wood		466	472	477	483	489	494	500	506	512	518	522
	Soil	Forest floor	7.292	7.266	7.248	7.224	7.211	7.190	7.177	7.160	7.147	7.133	7.103
		Mineral soil	77.190	77.063	77.007	76.903	76.902	76.824	76.824	76.795	76.795	76.794	76.616
	Total		113.975	114.031	114.214	114.309	114.593	114.734	115.017	115.248	115.531	115.814	115.767
Forests established after 1990	Area		711	1.677	3.873	5.119	7.531	9.795	11.232	13.432	14.800	18.910	21.590
	Live biomass	Above ground	0	1	3	7	13	22	30	42	52	75	95
		Below ground	0	0	1	1	2	4	5	7	9	13	16
	Dead wood		0	0	0	0	0	1	1	1	2	2	3
	Soil	Forest floor	0	0	0	0	0	0	1	1	1	1	2
		Mineral soil	102	240	554	732	1.077	1.401	1.606	1.921	2.116	2.704	3.087
	Total		1.226	1.584	2.357	2.812	3.663	4.467	4.991	5.777	6.281	7.723	8.679
Deforestation		Area	884	394	728	1,79	547	2	203	2	2	1.248	734
	Live biomass	Above ground	-48	-22	-40	0	-31	0	-12	0	0	-73	-43
		Below ground	-8	-3	-6	0	-5	0	-2	0	0	-12	-7
	Dead wood		-1	0	-1	0	0	0	0	0	0	-1	-1
	Soil	Forest floor	-12	-5	-10	0	-7	0	-3	0	0	-17	-10
		Mineral soil	-126	-56	-104	0	-78	0	-29	0	0	-178	-105
	Total		-231	-105	-192	-3	-146	-3	-56	-3	-3	-333	-197

			2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Forests established before 1990	Area		535.043	534.358	534.304	533.845	533.517	533.435	533.321	533.207	533.093	532.979
	Live biomass	Above ground	31.323	31.092	30.906	30.691	30.486	30.299	30.357	30.612	31.494	31.935
		Below ground	5.220	5.359	5.507	5.649	5.792	5.938	5.969	6.018	6.189	6.279
	Dead wood		517	511	506	501	495	490	505	543	557	564
	Soil	Forest floor	6.611	6.553	6.504	6.450	6.398	6.349	6.325	6.778	7.037	7.215
		Mineral soil	76.511	76.413	76.405	76.340	76.293	76.281	76.265	76.249	76.232	76.216
	Total		120.549	120.229	120.050	119.781	119.542	119.358	119.421	120.199	121.509	122.209
Forests established after 1990	Area		23.959	25.266	26.754	28.141	31.393	34.394	36.577	39.998	43.420	46.841
	Live biomass	Above ground	182	271	371	478	625	774	828	910	920	957
		Below ground	35	55	78	102	135	168	177	192	193	198
	Dead wood		14	25	38	51	70	89	100	121	141	157
	Soil	Forest floor	12	18	24	30	39	48	59	72	86	102
		Mineral soil	3.426	3.613	3.826	4.024	4.489	4.918	5.231	5.720	6.209	6.698
	Total		3.655	3.960	4.304	4.645	5.312	5.963	6.354	6.965	7.490	8.044
Deforestation		Area	685	54	459	329	82	114	114	114	114	114
	Live biomass	Above ground	-50	-5	-33	-24	-6	-7	-7	-7	-7	-7
		Below ground	-8	-1	-6	-4	-1	-1	-1	-1	-1	-1
	Dead wood		-1	0	-1	0	0	0	0	0	0	0
	Soil	Forest floor	-11	-1	-7	-5	-1	-1	-1	-1	-2	-2
		Mineral soil	-98	-8	-66	-47	-12	-16	-16	-16	-16	-16
	Total		-154	-12	-103	-74	-18	-25	-26	-26	-26	-26

8.5 Appendix 5. Carbon pools 2011 - 2020.

			2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Forests established before 1990	Area		532.979	532.979	532.979	532.979	532.979	532.979	532.979	532.979	532.979	532.979
	Live biomass	Above ground	30.426	30.379	30.337	30.299	30.264	30.231	30.199	30.121	30.037	29.948
		Below ground	6.011	6.009	6.008	6.007	6.006	6.005	6.004	5.997	5.988	5.978
	Dead wood		543	543	544	545	545	546	547	546	544	542
	Soil	Forest floor	6.778	6.778	6.778	6.778	6.778	6.778	6.778	6.778	6.778	6.778
		Mineral soil	76.216	76.216	76.216	76.216	76.216	76.216	76.216	76.216	76.216	76.216
Forests established after 1990	Area		116.354	118.254	120.154	122.054	123.954	125.854	127.754	129.654	131.554	133.454
	Live biomass	Above ground	1.354	1.495	1.634	1.771	1.907	2.043	2.177	2.352	2.525	2.695
		Below ground	273	299	325	351	376	402	427	460	492	524
	Dead wood		128	131	133	135	137	140	142	146	151	155
	Soil	Forest floor	92	109	126	144	164	186	210	235	261	286
		Mineral soil	11.778	11.986	12.194	12.402	12.610	12.819	13.027	13.235	13.443	13.651
	Total		13.625	14.020	14.412	14.804	15.196	15.588	15.983	16.428	16.871	17.312
Total			128.892	129.238	129.588	129.942	130.299	130.658	131.021	131.379	131.727	132.066

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