Carbon Sequestration in Harvested Wood Products (HWP)

Data for 2014-Reporting to the UNFCCC – Final draft

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**Executive summary**

Carbon emissions from harvested wood products (HWP) must be accounted for by parties under the Kyoto Protocol linked to the United Nations Framework Convention on Climate Change (UNFCCC) for the second commitment period (2013-2020). This report explains the basis of the Danish reporting of HWP for 2014. The reporting of HWP was first conducted for 2013. Thus for that year an elaborate background report was prepared on methods, data correction and validation. This report of 2013 will be used for reference for this and coming reporting years.

Carbon in the HWP pool is accounted for based on the semi-finished wood product categories: sawnwood, wood-based panels and paper and paper products with default half-lives of 35, 25 and 2 years, respectively, stipulated by the Intergovernmental Panel on Climate Change (IPCC). HWP originating from imported wood must be excluded from the accounting. HWP originating from deforestation activities must be accounted for on the basis of instantaneous oxidation.

For calculating carbon stocks in HWP, Denmark has applied the default first order decay (FOD) model stipulated by the IPCC, with the default half-lives (IPCC Tier 2 methodology). Activity data has been collected from international databases as well as from surveying the Danish wood industry (IPCC Tier 2 and 3 methodologies). Carbon conversion factors have been derived from national forest inventory data (IPCC Tier 3 methodology).

A questionnaire was sent out to the Danish wood industry in April 2015 in order to survey the production of the sector regarding sawnwood and wood-based panels (Questionnaire on the production of the Danish wood industry).

In 2015 a method to estimate the production of non-responding companies regarding the Questionnaire was developed. The method relies on the data from the responding companies and the size distribution of the companies in the sector. Furthermore a new method to estimate the share of HWP originating from deforestation has been implemented. Both methods have only been employed for 2014 and not backwards in time.

According to the Questionnaire the production of sawnwood in 2014 was estimated at 415,220 m$^3$. The estimated volume of the non-responding companies accounted for 13,108 m$^3$ – or 3% of the total production. i.e. the responding companies covered an estimated 97% of the total production of sawnwood in Denmark. The production of wood-based panels was about 367,000 m$^3$ – this originates from only 1 company, which is the only relevant company in the sector, i.e. the Questionnaire covers 100% of the production of wood-based panels.

As of 2014 the HWP pool originating from domestic harvest and domestic consumption consisted of about 4,97 Mio. ton carbon (67% from sawnwood and 33% from wood-based panels – the paper pool was insignificant). The total inflow of carbon to the HWP pool in 2014 is reported to 154,433 ton carbon – 70,424 ton from sawnwood, 84,009 ton from wood-based panels and 0 ton from paper. The outflow from the pool is reported to 111,049 ton carbon in 2014 - 65,421 ton from sawnwood, 45,538 ton carbon from
wood-based panels and 90 ton from paper. Thus there has been a net carbon sequestration in HWP of about 43.384 ton carbon in 2014.

The corrected Forest Management Reference Level (FMRL) has projected the inflow in 2014 to 131.450 ton carbon (60.469 ton from sawnwood, 70.981 ton from wood-based panels and 0 ton from paper) and the outflow to about 110.463 ton carbon in 2013 (65.287 ton from sawnwood, 45.086 ton from wood-based panels and 90 ton from paper). The projected net sequestration is 20.987 ton carbon.

The subprojects regarding mapping of the Danish wood flows and estimating HWP in the Danish building stock has only progressed slightly – this has primarily consisted of identifying and contacting relevant parties regarding the subjects. This has been somewhat successful in that a dialogue was initiated. These projects are fundamental in the validation procedure regarding the data for HWP reporting.
Preface
This report has been prepared in relation to the Danish reporting of carbon in harvested wood products (HWP) for 2013 under the Kyoto Protocol, which is linked to the United Nations Framework Convention on Climate Change (UNFCCC). HWP is included in the section of the Kyoto Protocol dealing with landuse, landuse change and forestry (LULUCF) under articles 3.3 and 3.4. The report preparation has been carried out by the Department of Geosciences and Natural Resource Management (IGN) at the University of Copenhagen on behalf of the Danish Energy Agency (Danish Ministry of Climate, Energy and Building).

In order to secure a proper reporting for the second commitment period of the Kyoto Protocol (2013-2020) the Danish Energy Agency initiated several projects all aiming at enhancing knowledge and collecting data for the documentation of carbon emissions/sequestration (SINKS 2). Among these a specific project was assigned to deal with the reporting of HWP (Project 8a): “Collection of validated data for reporting the changes in carbon sequestration in harvested wood products in 2014-2020”. This project builds on Project 8b: “Development of methods and routines for collection of validated data for the use of estimating the amount of stored carbon in harvested wood products (HWP-data)”, which was carried out in 2014 (see Schou et al., 2015). The present report documents the work carried out under project 8a, which will be repeated for the reporting period of 2014-2020.

The project is supported by an advisory committee consisting of representatives from the Danish Nature Agency (Danish Ministry of Environment), Statistics Denmark, the Danish Wood and Furniture Industry, the Danish Forest Association, the Danish Energy Agency (Ministry of Climate, Energy and Building), the Danish Centres of Building and the Department of Geosciences and Natural Resource Management (University of Copenhagen).
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**Abbreviations**

AR = Afforestation/Reforestation  
C = Carbon  
CMP = Conference of the Parties serving as meeting of the Parties  
COP = Conference of the Parties  
D = Deforestation  
FAO = Food and Agricultural Organization of the United Nations  
FM = Forest Management  
FMRL = Forest Management Reference Level  
FOD = First order decay  
FWP = Finished wood products  
HWP = Harvested wood products  
IPCC = Intergovernmental Panel on Climate Change  
IRW = Industrial roundwood  
JFSQ = Joint Forest Sector Questionnaire  
KP = Kyoto Protocol  
NFI = National Forest Inventory  
SFWP = Semi finished wood products  
SD = Statistics Denmark  
UNFCCC = United Nations Framework Convention on Climate Change
1 Introduction

The reporting of HWP was first conducted for 2013. Thus for that year an elaborate background report was prepared on methods, data correction and validation. This report of 2013 will be used for reference for this and coming reporting years (see Schou et al., 2015).

1.1 The background of HWP reporting under the Kyoto Protocol

In 1998 Denmark signed the Kyoto Protocol (KP), which stipulates internationally binding reduction targets regarding the emissions of greenhouse gases (UNFCCC, 2014). As carbon dioxide (CO₂) is an important greenhouse gas, parties must keep track of the national flow of carbon in order to account for emissions (/sequestration) of CO₂. Denmark has elected accounting on an annual basis.

At the 17th conference of the parties (COP17) to the UNFCCC in Durban it was decided that emissions from HWP should be accounted for from 2013 onwards (UNFCCC, 2012).

The following terms were agreed upon through Decision2/CMP.7:

- Imported HWP should not be accounted for.
- Definition of default half-lives (mean life times) for the HWP categories: Sawedwood, wood-based panels and paper.
- HWP originating from deforestation should be accounted for on the basis of instantaneous oxidation.
- Rejected HWP in solid waste disposals and HWP used for energy production should be accounted for on the basis of instantaneous oxidation.
- Each country using a projected forest management reference level could decide upon whether or not to include HWP produced prior to the start of the second commitment period (2013-2020).
- Accounting for HWP originating from afforestation and reforestation under article 3.3 and from forest management under article 3.4 should be treated separately.

1.1.1 Accounting of emissions - Forest Management Reference Level

For the accounting of emissions a Forest Management Reference Level (FMRL) is constructed according to Decision 2, CMP.7 – paragraph 16 (UNFCCC, 2012). The FMRL specifies the expected average annual net emissions (emissions ÷ sequestration) originating from forest management (FM) for the second commitment period. The actual (reported) annual net emissions for the period will then be compared to the FMRL (IPCC, 2014 – page 2.93). FM under article 3.4 is defined as taking place in areas with forests which also contained forests on 31. December 1989 and thus do not qualify for afforestation and reforestation under article 3.3, and is a system of practices for stewardship and use of forest land aimed at fulfilling relevant ecological (including biological diversity), economic and social functions of the forest in a sustainable manner (Decision 16/CMP.1 (UNFCCC, 2006) and Decision 2/CMP.6 (UNFCCC, 2011)).

The FMRL may be described by a “business as usual” scenario, where the emissions are forecasted on the basis of the expected harvest level in the commitment period. The HWP contribution to the original FMRL

1 Conference of the Parties serving as the meeting of the Parties to the Kyoto Protocol on its seventh session
reported in 2011 was calculated with a baseline period from 2005-2009, which at that time was the five most recent years, where relevant data was available (Johannsen et al., 2011).

It was decided in 2014, that due to major changes in the data material used for the annual HWP reporting a revision of the original FMRL was needed, aligning the data used to calculate the FMRL to that used in the reporting. This is referred to as a technical correction – a value which must be added to the FMRL at the time of accounting. The revision of FMRL also includes a change in the reference period. It was decided to change the reference period from 2005-2009 to 2008-2012, in order to provide a more accurate FMRL using the most recent data.

1.2 Description of HWP

1.2.1 Description of the HWP pool
Products flow into the common pool of HWP in use from the domestic wood industry and from imported wood. After a certain period of use, they leave the pool as discarded products. Only semi-finished wood products (SFWP), i.e. sawnwood, wood-based panels and paper, are accounted for. Thus finished products (e.g. furniture, floors, beams, books etc.) do not enter in the estimations.

Decision 2/CMP.7 stipulates that only HWP produced and consumed domestically may be included in the HWP pool of the reporting country. I.e. the HWP-carbon must originate from trees harvested and used in the reporting country\(^2\). This means that the domestic production must be divided into two parts: One part produced from domestically harvested wood, and one part produced from imported roundwood. Furthermore the share produced from domestically harvested wood must be divided into domestically used HWP and exported HWP, as it is only the former that may be accounted for.

Because of the huge amount of data involved in the estimation, there are many potential sources of errors that may influence the final result. Even small errors in the data can lead to significant errors in the result, especially if subtraction operations are performed on the data, which is the case, when estimating the net inflow to the HWP pool.

2 Methods and Materials

2.1 Choice of guidelines for reporting HWP
Presently two set of guidelines for estimating the carbon stock in the HWP pool exist. The 2006 IPCC Guidelines for National Greenhouse Gas Inventories (2006 IPCC Guidelines) (IPCC, 2006) and the 2013 Revised Supplementary Methods and Good Practice Guidance Arising from the Kyoto Protocol (2013 KP Supplement) (IPCC, 2014)The 2013 KP Supplement is developed in accordance with Decision 2/CMP.7 (and 2/CMP.8 – UNFCCC, 2012), and as it is the latest set of guidelines, this reporting has been prepared on the basis of the 2013 KP Supplement. Only when this guideline refers specifically to methods employed by the 2006 IPCC Guidelines these have been used.

\(^2\)Note that this means wood from Danish forests used by mills and industries in Denmark.
2.2 Definitions
For clarity this section outlines the definition of some key terms used in the reporting in accordance with the 2013 KP supplement and the Joint Forest Sector Questionnaire (JFSQ) (FAO et al., 2014).

The term “roundwood” is used to define wood in the rough – i.e. all roundwood, independent of the further use. “Industrial roundwood” is defined as roundwood used for production of sawnwood, wood-based panels and paper – but not fuelwood (firewood and wood chips). Industrial roundwood encompasses timber and lumber defined as wood for sawmilling, pallet wood defined as wood for the production of pallets, pulpwood defined as wood for the production of pulp for paper production and other industrial roundwood for other purposes. “Sawnwood” is defined as the product resulting from the sawing of roundwood (e.g. sawn timber and boards), while “wood-based panels” is an aggregate category of products resulting from the processing of shredded roundwood or residual wood materials (e.g. particleboards). The term “conifer” defines coniferous species, while “non-conifer” defines species, which are not conifers – in this report it is considered analogue to broadleaved species.

2.3 General description of reporting of HWP
The estimation of carbon in the HWP pool is based on the three semi-finished wood product categories: (1) sawnwood, (2) wood-based panels, and (3) paper and paperboard (also referred to as HWP categories) – see 2013 KP Supplement (IPCC, 2014).

2.3.1 Tiers
Three tiers of methods may be used when calculating carbon stocks in HWP according to the 2013 KP supplement (IPCC, 2014):

- **Tier 1**: This method assumes that the HWP carbon stock is constant over time, i.e. that the inflow to the pool equals the outflow from the pool. This is equivalent to assuming instantaneous oxidation of HWP resulting in zero annual net-emissions from the pool, as the annual stock change is zero.
- **Tier 2**: This method employs standard (default) IPCC models/parameters and standard activity data from international databases (e.g. data from FAO-STAT) to estimate the HWP carbon stock. The method may be used “provided that verifiable and transparent activity data are available” (IPCC, 2014 – page 2.119).
- **Tier 3**: This method employs country specific methods and country specific activity data. As for Tier 3 activity data must be verifiable and transparent and methodologies must be “at least as detailed and accurate” as for Tier 2 (IPCC, 2014 – page 2.123)

In this reporting a combination of Tier 2 and 3 methods, as the standard IPCC method for estimating the HWP carbon stock is used in combination with country specific activity data as well as data from international databases.

2.3.2 Method for calculating carbon stocks in HWP
A first order decay (FOD, i.e. exponential decay) function is used to estimate the carbon stock and the annual changes for each of the SFWP categories in accordance with 2013 KP Supplement Equation 2.8.5 (IPCC, 2014 – page 2.120):
\[
C_{i+1} = e^{-k} \times C_i + \left[ \frac{1 - e^{-k}}{k} \right] \times \text{Inflow}_i
\]

\[\Delta C_i = C_{i+1} - C_i\] (1)

Where:

- \(C_i\) is the carbon stock for the given HWP category at the beginning of year \(i\) (variables are written with index \(i\), as the equation is used in the discrete form)
- \(k\) is the decay constant depending on the HWP category - \(k = \ln(2)/T_{1/2}\), where \(T_{1/2}\) is the half-life
- \(\text{Inflow}_i\) is the inflow to the given HWP category during year \(i\)
- \(\Delta C_i\) is the change in carbon stock during year \(i\).

The calculations start at year 1900 equal to time, \(i = 0\), according to the 2006 IPCC Guidelines. This method of estimating the carbon stock in HWP is referred to as the “flux-data method” (cf. IPCC, 2006).

2.3.2.1 Estimation of initial carbon stock

The use of Equation 2.8.5 depends on the estimation of an initial carbon stock at year \(i = 0\). In the 2013 KP Supplement the initial stock is estimated by Equation 2.8.6 (IPCC, 2014 – page 2.121):

\[
C_{t_0} = \frac{\text{Inflow}_{\text{average}}}{k} = \text{Inflow}_{\text{average}} \times \tau
\]

\[
\text{Inflow}_{\text{average}} = \frac{\sum_{i=t_0}^{t_4} \text{Inflow}_i}{t_4 - t_0} = \frac{\sum_{i=t_0}^{t_4} \text{Inflow}_i}{5 \text{ years}}
\] (2)

Where:

- \(C_{t_0}\) is the HWP carbon stock for a given HWP category at year 0
- \(\text{Inflow}_{\text{average}}\) is the average inflow over the first 5 years of the considered time period \((t_0 - t_4)\)
- \(\tau\) is the mean lifetime depending on the HWP category

2.3.2.2 Estimation of historic inflow 1900-1961

For Denmark historic data is only available back to 1961. The historic inflow to the HWP pool back to 1900 is estimated by Equation 12.6 from the 2006 IPCC Guidelines (IPCC, 2006 – page 12.18):

\[
V_t = V_{1961} \times e^{[U \times (t - 1961)]}
\] (3)

Where:

- \(V_t\) is the annual inflow to the given HWP category at time \(t\)
- \(V_{1961}\) is the annual inflow to the given HWP category in year 1961
- \(U\) is the estimated continuous rate of change in industrial roundwood consumption for the world region, which the given country belongs to
2.3.2.3 Allocation of HWP to activities

The treatment of HWP depends on the activity of origin. Decision 2/CMP.7 stipulates that HWP originating from deforestation (D) activities must be accounted for on the basis of instantaneous oxidation (this is also the case for HWP in solid waste disposal sites). I.e. only HWP originating from activities classified as Forest Management (FM) and afforestation (AR) may be included in the pool.

HWP originating from deforestation is excluded from the pool by determining the fraction of the feedstock (roundwood for production of HWP) originating from deforestation by 2013 KP Supplement Equation 2.8.3 (IPCC, 2014 – page 2.116):

\[
\hat{f}_{j,i} = \frac{\text{harvest}_{j,i}}{\text{harvest}_{\text{total},i}}
\]

(4)

Where:

\( f_{j,i} \) is the share of the harvest originating from activity \( j \) in year \( i \)

\( \text{harvest}_{j,i} \) is the harvest originating from activity \( j \) in year \( i \)

\( \text{harvest}_{\text{total},i} \) is the total harvest from all activities in year \( i \)

As no data on harvest originating specifically from afforestation activities exits, it is assumed, in accordance with 2013 KP supplement good practices (IPCC, 2014 – page 2.118), that the contribution to the HWP pool is zero. Anyway taking into account the average age, species composition and growth rates of afforested areas in Denmark the production of industrial roundwood presently, must be expected to be minimal.

On deforestation activities the harvest is estimated from information on the standing volume on deforested lands according to the Danish National Forest Inventory (NFI – cf. Johannsen et al., 2013), in accordance with 2013 KP supplement good practices (IPCC, 2014 – page 2.117). Standing volume is converted to harvested volume of industrial roundwood by multiplying with factors to correct for the share of merchantable volume and the share of roundwood used for industrial roundwood (an assumed ratio of merchantable to total volume of 0.87 is used).

2.3.2.4 Estimation of share of HWP from domestic harvest

To estimate the share of HWP originating from domestic harvest 2013 KP Supplement Equation 2.8.1 (IPCC, 2014 – page 2.115) is used for the categories sawnwood and wood-based panels:

\[
\hat{f}_{\text{IRW},i} = \frac{\text{IRW}_{\text{P},i}-\text{IRW}_{\text{EX},i}}{\text{IRW}_{\text{P},i}+\text{IRW}_{\text{IM},i}-\text{IRW}_{\text{EX},i}}
\]

(5)

Where:

\( f_{\text{IRW},i} \) is the ratio of domestically harvested and consumed industrial roundwood (feedstock) to the total domestic consumption of industrial roundwood in year \( i \)

\( \text{IRW}_{\text{P},i} \) is the production of roundwood in year \( i \)

\( \text{IRW}_{\text{IM},i} \) is the import of roundwood in year \( i \)
$IRW_{EX,i}$ is the export of roundwood in year $i$

In this reporting $f_{IRW,i}$ is estimated separately for sawnwood (for conifer and non-conifer) and wood-based panels based on the determined roundwood consumption for each of the categories\(^3\).

For paper the estimation is done by multiplying Equation 2.8.1 with 2013 KP Supplement Equation 2.8.2 (cf. IPCC, 2014 – page 2.115):

$$f_{PULP,i} = \frac{PULP_{P,i}-PULP_{EX,i}}{PULP_{P,i}+PULP_{IM,i}-PULP_{EX,i}}$$ (6)

Where:

$f_{PULP,i}$ is the ratio of domestically harvested and consumed pulpwood to the total domestic consumption of pulpwood in year $i$

$PULP_{P,i}$ is the production of pulpwood in year $i$

$PULP_{IM,i}$ is the import of pulpwood in year $i$

$PULP_{EX,i}$ is the export of pulpwood in year $i$

The ratios from 1900-1960 are assumed constant, in line with section 2.4.1.3, and estimated by the average ratios for 1961-1964.

Thus the amount of HWP domestically harvested and domestically consumed for a given activity $j$ is estimated by Equation 7:

$$HWP_{j,i} = (HWP_{P,i} - HWP_{E,i}) \times f_{DP,i} \times f_{j,i}$$ (7)

Where:

$HWP_{P,i}$ is the production of HWP for activity $j$ in year $i$

$HWP_{P,i}$ is the total production of HWP for activity $j$ in year $i$

$HWP_{E,i}$ is the total export of HWP for activity $j$ in year $i$

$f_{DP,i}$ is the share of HWP originating from domestic harvest

$f_{j,i}$ is the share of HWP associated with activity $j$

2.3.3 Forest Management Reference Level - correction

The estimation of the FMRL and the corrected reference level, FMRL$\text{corr}$, is based on a projection representing a “business as usual scenario”. The projected inflow to the HWP pool in the second commitment period 2013-2020 is based on the ratio of the annual projected harvest for the period to the average historic harvest 2008-2012 (IPCC, 2014 – page 2.130):

\(^3\) This estimation method does not take into account the origin of the wood scrap wood used in production of wood-based panels.
\[ HWP_{\text{projected},i} = HWP_{\text{average}~2008-2012} \times \frac{\text{Harvest}_{\text{projected},i}}{\text{Harvest}_{\text{average}~2008-2012}} \]  \hspace{1cm} (8)

Where:

- \( HWP_{\text{projected},i} \) is the projected production of HWP in year \( i \)
- \( HWP_{\text{average}~2008-2012} \) is the average historic production of HWP for years 2008-2012
- \( \text{Harvest}_{\text{projected},i} \) is the projected harvest in year \( i \)
- \( \text{Harvest}_{\text{average}~2008-2012} \) is the average historic harvest for years 2008-2012

The technical correction is calculated by 2013 KP Supplement Equation 2.7.1 (IPCC, 2014 – page 2.98) as:

\[ \text{Technical Correction} = \Delta FMRL_{\text{corr}} - FMRL \]  \hspace{1cm} (9)

Where:

- \( \text{Technical Correction} \) is the correction in terms of the absolute difference between the original FMRL and the corrected FMRL – i.e. the difference in the projected net-emissions from the HWP pool.

Equation 2.7.1 is applied, as only a CMP-decision may change a country’s officially reported FMRL. A recalculation alone cannot do this (cf. IPCC, 2014 – page 2.98).

For accounting purposes it is important to note that the calculated FMRL includes emissions from the historic pool of HWP, i.e. emissions from products placed in the pool before the start of the second commitment period (inherited emissions) – this is to ensure consistency with the annual reporting, which also includes inherited emissions. Emissions from the first commitment period are included as instantaneous oxidation under art. 3.3 and 3.4.

### 2.4 Data

#### 2.4.1 Model parameters

##### 2.4.1.1 Emissions factors - half-life

For applying Equation 2.8.5 IPCC default values on half-lives (Tier 2) are used (IPCC, 2014 – page 2.123):

- Paper = 2 years
- Wood-based panels = 25 years
- Sawnwood = 35 years

##### 2.4.1.2 Carbon conversion factors

For the conversion of wood volume or weight into carbon the following conversion factors, including both IPCC default values (Tier 2) and country-specific values (Tier 3), are used:

- Paper = 0.386 Mg C/Mg (IPCC default)
- Wood-based panels = 0.269 Mg C/m³ (IPCC default)
• Sawnwood, conifer = 0,235 Mg C/m³ (Country-specific)
• Sawnwood, non-con. = 0,286 Mg C/m³ (Country-specific)

To estimate conversion factors for sawnwood, data from the NFI (Nord-Larsen et al., 2014) on live above ground biomass and standing volume of tree species in the forests is used in Equation 10:

\[
\text{Density}_{C,f} = \frac{\text{Biomass}_f \times \text{Prop}_C}{\text{Standing volume}_f}
\]  

(10)

Where:

\(\text{Density}_{C,f}\) is the carbon density for species \(f\)

\(\text{Biomass}_f\) is the live above ground biomass for species \(f\)

\(\text{Prop}_C\) is the proportions of carbon in the biomass - a value of 0,5 is used.

\(\text{Standing volume}_f\) is the standing volume for species \(f\)

As the historic sawnwood production before 2011 is only known on the basis of species groups (conifer and non-conifer), densities are converted to this level by using the average proportion of species in the sawnwood production for 2011-2013 as stated by Equation 11 (see also Section 2.4.2.1):

\[
\text{Density}_{C,S,k} = \sum_{i=1}^{k} \text{Density}_{C,f} \times \text{Share}_{\text{prod 2011-2013},f}
\]  

(11)

Where:

\(\text{Density}_{C,S,k}\) is the carbon density for species group \(S\) consisting of \(k\) species

\(\text{Share}_{\text{prod 2011-2013},f}\) is the share of the sawnwood production for species \(f\)

This is the carbon density of fresh wood. As wood volume decreases under drying this yields a conservative estimate of the carbon content in sawnwood. The estimation is based on carbon density functions developed for Danish conditions for norway spruce (\textit{Picea abies} (L.) Karst.), sitka spruce (\textit{Picea sitchensis} (Bong.) Carr.), silver fir (\textit{Abies alba} Mill.), beech (\textit{Fagus sylvatica} L.), larch (\textit{Larix} sp.), douglas fir (\textit{Pseudotsuga menziesii} Mirb. Franco) and grand fir (\textit{Abies grandis} Dougl. Lindley). For other species the function of the most similar species is applied.

Table 1 and Table 2 show the data on the calculation of carbon conversion factors.
Table 1. Conversion factors for sawnwood based on volume and biomass estimations from the Danish National Forest Inventory and an assumed carbon fraction of 0.5 based on IPCC (2014).

<table>
<thead>
<tr>
<th>Species/species group</th>
<th>Total standing volume [1.000 m³]</th>
<th>Total biomass content [1.000 Mg]</th>
<th>Carbon fraction</th>
<th>Conversion factor [Mg C/m³]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beech</td>
<td>33.334</td>
<td>19.924</td>
<td>0.5</td>
<td>0.30</td>
</tr>
<tr>
<td>Oak</td>
<td>12.423</td>
<td>7.149</td>
<td>0.5</td>
<td>0.29</td>
</tr>
<tr>
<td>Maple</td>
<td>6.404</td>
<td>2.599</td>
<td>0.5</td>
<td>0.20</td>
</tr>
<tr>
<td>Ash</td>
<td>5.111</td>
<td>2.888</td>
<td>0.5</td>
<td>0.28</td>
</tr>
<tr>
<td>Birch</td>
<td>4.928</td>
<td>2.626</td>
<td>0.5</td>
<td>0.27</td>
</tr>
<tr>
<td>Other broadleaved</td>
<td>9.214</td>
<td>4.441</td>
<td>0.5</td>
<td>0.24</td>
</tr>
<tr>
<td>Norway spruce</td>
<td>22.696</td>
<td>10.700</td>
<td>0.5</td>
<td>0.24</td>
</tr>
<tr>
<td>Sitka spruce</td>
<td>7.862</td>
<td>3.745</td>
<td>0.5</td>
<td>0.24</td>
</tr>
<tr>
<td>Silver fir</td>
<td>5.424</td>
<td>2.599</td>
<td>0.5</td>
<td>0.24</td>
</tr>
<tr>
<td>Pine</td>
<td>8.688</td>
<td>5.369</td>
<td>0.5</td>
<td>0.31</td>
</tr>
<tr>
<td>Nordmann fir</td>
<td>1.379</td>
<td>737</td>
<td>0.5</td>
<td>0.27</td>
</tr>
<tr>
<td>Noble fir</td>
<td>1.992</td>
<td>1.018</td>
<td>0.5</td>
<td>0.26</td>
</tr>
<tr>
<td>Other conifer</td>
<td>8.733</td>
<td>3.972</td>
<td>0.5</td>
<td>0.23</td>
</tr>
</tbody>
</table>

Table 2. Weighted carbon conversion factors for conifer and non-conifer sawnwood based on species shares reported in the questionnaire regarding the production of sawnwood.

<table>
<thead>
<tr>
<th>Tree species/group</th>
<th>Year</th>
<th>Average</th>
<th>Conversion factor - weighted [Mg C/m³]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-conifer</td>
<td>1,00</td>
<td>1,00</td>
<td>1,00</td>
</tr>
<tr>
<td>Maple</td>
<td>0,02</td>
<td>0,02</td>
<td>0,02</td>
</tr>
<tr>
<td>Ash</td>
<td>0,12</td>
<td>0,10</td>
<td>0,10</td>
</tr>
<tr>
<td>Ash/maple</td>
<td>0,00</td>
<td>0,00</td>
<td>0,00</td>
</tr>
<tr>
<td>Beech</td>
<td>0,54</td>
<td>0,53</td>
<td>0,54</td>
</tr>
<tr>
<td>Oak</td>
<td>0,22</td>
<td>0,24</td>
<td>0,24</td>
</tr>
<tr>
<td>Broadleaves/oth.broad.</td>
<td>0,10</td>
<td>0,10</td>
<td>0,09</td>
</tr>
<tr>
<td>Conifer</td>
<td>1,00</td>
<td>1,00</td>
<td>1,00</td>
</tr>
<tr>
<td>Spruce/fir</td>
<td>0,95</td>
<td>0,96</td>
<td>0,94</td>
</tr>
<tr>
<td>Other conifer</td>
<td>0,05</td>
<td>0,04</td>
<td>0,06</td>
</tr>
</tbody>
</table>

4 Primarily Quercus robur L. and Quercus petrea (Mattuschka) Liebl.
5 Acer pseudoplatanus L.
6 Fraxinus excelsior L.
7 Primarily Betula pubescens Ehrh. and Betula pendula Roth.
8 Primarily Pinus sylvestris L., Pinus contorta Doug., Pinus mugo Turra and Pinus nigra Arnold
9 Abies nordmanniana (Stev.) Spach.
10 Abies procera Rend.
2.4.1.3 **Regional roundwood consumption rates**
The growth rate, $U$, estimated for the region of Europe is applied (IPCC, 2006), i.e. $U = 0.0148$.

2.4.2 **Activity data – sources**
In Denmark historical data on production, import and export of roundwood and SFWP are available from two sources: FAO-STAT – for the period 1961-2013, and Statistics Denmark – for the period 1988-2014. Statistics Denmark has data going further back than 1988, but these are only available through written publications and thus have not been used in this reporting.

2.4.2.1 **Questionnaire on the production of the Danish wood industry**
In order to improve the data foundation and quality for the reporting a questionnaire was first sent out to the Danish wood industry in June 2014. The questionnaire is referred to as the Questionnaire on the production of the Danish wood industry. The objective was to obtain production figures for the years 2011, 2012 and 2013 for the individual companies in order to estimate the total production of sawnwood and wood-based panels. These figures were used for reporting the inflow to the pools of sawnwood and wood-based panels for the 2013-reporting. The Questionnaire is also described in Schou et al. (2015).

For the 2014-reporting, the Questionnaire was again sent out to the industry in April 2015 to obtain production figures for 2014 for sawnwood and wood-based panels.

In 2015 a method to estimate the production of non-responding companies has been developed to obtain a more complete and correct figure of the total national production. For 2013 only the volumes of the reporting companies were used.

The production of sawmills, that had not answered the questionnaire, was estimated based on the assumption that the known sawmills in each strata (size class – see Table 3) was representative for the non-responding sawmills. In the strata non-responding sawmills were expected to have the same per employee production as the responding sawmills in the strata. For the small sawmills and sawmills without employees, non-responding sawmills were expected to have a production similar to the mean production in the strata. Sawmills without production was included in the estimation as the proportion of sawmills without production was also expected to represent the whole strata.

The results from the Questionnaire are outlined in Section 3.1.

2.4.3 **Overview of activity data sources and corrections**
Data on inflow to the HWP pool is applied from three sources: FAO-STAT, Statistics Denmark and the Questionnaire on the production of the Danish wood industry:

- From 1961-1989: Data from FAO-STAT – corrected
- From 1990-2010: Data from Statistics Denmark – corrected
- From 2011-2014: Data from Questionnaire – not corrected

The corrections are explained in detail in Schou et al. (2015).
2.4.3.1 HWP originating from deforestation

The area of deforestation used for estimating the amount of HWP carbon originating from deforestation activities has been corrected in 2014 by the application of national mappings of tree height and biomass. By overlaying the area originally designated as deforestation with the mappings of the mean tree height of the given deforestation areas is it possible to estimate their aboveground biomass – and thus the areas’ potential for producing HWP. Currently this correction procedure has only been implemented for 2014 and not backwards in time.

Using a standard assortment distribution of Norway spruce (the most common species in Denmark, area wise, according to the National Forest Inventory (Nord-Larsen et al., 2014)) on moraine soils (The Danish Forest Association et al., 2003), and a standard yield table for Norway spruce, highest yield class, (Statens Forstlige Forsøgsanstalter, 1990) it is determined that at a mean tree height of approx. 10 m corresponding to a mean diameter (at breast height, DBH) of 10 cm almost no wood for producing sawnwood and wood-based panels is harvested, i.e. only wood for biomass and paper is produced – see Figure 1. Thus a cut-off value of 10 m is introduced, i.e. only areas with a mean tree height > 10 m should be used for estimating the amount of HWP originating from deforestation. The original deforestation area of 834 ha for 2014 is consequently reduced to 139 ha.

It can be added that the DBH-limit for harvesting industrial roundwood is much bigger in non-conifers compared to conifers, because the minimum required top diameter of industrial roundwood is larger. It means that some of the remaining 139 ha should probably also have been rejected, as they are non-conifer areas and below the higher limit of industrial roundwood. Furthermore it is assumed the total amount of carbon in the areas is incorporated into HWP - in reality this would not be so. In conclusion the estimated amount of HWP originating from deforestation is in all likelihood larger than the actual figure. However the reporting of this estimate is in line with the IPCC standards for ‘good practice’, as HWP from FM will then be a conservative estimate.

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11 This source has not been updated recently, but still represents the best (only) general estimates on assortment distributions in Denmark.

12 Paper is disregarded, because no national production of pulp currently exists.
3 Results

3.1 Results from the Questionnaire

Based on an extraction from the Danish company register (CVR) 75 possible sawmills were identified. 52 of the companies were very small without employees except for the owner. Only 4 large sawmills with more than 50 employees were identified. The last 19 sawmills were divided into two groups; the small ones with 2-4 employees (8 sawmills) and the medium-sized sawmills with 5-49 employees (11 sawmills). This is 10 more than identified in 2014, which reflects a less restrictive selection in 2015. An overview is shown in Table 3.

Table 3. Distribution of sawmills. The number of responding sawmills is shown in brackets.

<table>
<thead>
<tr>
<th>Number of sawmills in different sizes.</th>
<th>2012</th>
<th>2013</th>
<th>2014</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very small sawmills (no employees)</td>
<td>41 (11)</td>
<td>41 (11)</td>
<td>52 (17)</td>
</tr>
<tr>
<td>Small Sawmills (2-4 employees)</td>
<td>9 (4)</td>
<td>9 (4)</td>
<td>11 (5)</td>
</tr>
<tr>
<td>Medium/Large sawmills (more than 4 employees)</td>
<td>15 (8)</td>
<td>15 (8)</td>
<td>12 (9)</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>65 (23)</td>
<td>65 (23)</td>
<td>75 (31)</td>
</tr>
</tbody>
</table>

Questionnaires were sent out to identified 75 sawmills. After a few weeks the majority of sawmills that had not answered the questionnaire were contacted by phone and requested to answer. After this second round, 31 sawmills had answered the Questionnaire. This is considered acceptable, as all the large and most of the medium-sized and small sawmills have answered.

The total production of sawnwood in 2014 was estimated to 415.220 m$^3$. 402.112 m$^3$ (97%) are reported in the questionnaires, and 13.108 m$^3$ (3%) was the estimated production of non-responding sawmills. This
The result is in line with the estimated coverage in 2014 for the year of 2013, which was based on revenue shares (see Schou et al., 2015). The production of wood-based panels was 367,000 (see Table 5), which only 1 company accounts for (and thus the coverage in this sector is still 100%).

The same method of including non-respondents has been used when dividing the production to conifer (softwood) and non-conifer (hardwood) sawnwood respectively. Thus the estimated production of conifer in 2014 was 342,972 m³ and the production of non-conifer in 2014 was 72,247 m³.

Table 4 shows the production of sawnwood in 2014 along with the data reported for the years 2012 and 2013. Data from 2012 and 2013 are not completely comparable to the numbers reported in 2014, because the method for estimating the production at non-responding sawmills was not used in the original reporting. Data for 2011 has not been included because too few sawmills had reported production for this year in order to conduct a reasonable estimation.

<table>
<thead>
<tr>
<th>Sawnwood [m³]</th>
<th>2012</th>
<th>2013</th>
<th>2014</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conifer</td>
<td>300,260</td>
<td>299,700</td>
<td>342,972</td>
</tr>
<tr>
<td>Very small sawmills (no employees)</td>
<td>1.301</td>
<td>1.301</td>
<td>1.676</td>
</tr>
<tr>
<td>Small Sawmills (2-4 employees)</td>
<td>2.925</td>
<td>5.398</td>
<td>4.190</td>
</tr>
<tr>
<td>Medium/Large Sawmills (more than 4 employees)</td>
<td>296.034</td>
<td>293.001</td>
<td>337.106</td>
</tr>
<tr>
<td>Non-conifer</td>
<td>68.889</td>
<td>75.543</td>
<td>72.247</td>
</tr>
<tr>
<td>Very small sawmills (no employees)</td>
<td>0</td>
<td>0</td>
<td>46</td>
</tr>
<tr>
<td>Small Sawmills (2-4 employees)</td>
<td>338</td>
<td>495</td>
<td>384</td>
</tr>
<tr>
<td>Medium/Large Sawmills (more than 4 employees)</td>
<td>68.551</td>
<td>75.048</td>
<td>71.818</td>
</tr>
<tr>
<td>Total</td>
<td>369.149</td>
<td>375.243</td>
<td>415.220</td>
</tr>
</tbody>
</table>

Table 5. Production of wood-based panels (only 1 company in the sector). Volume in m³.

<table>
<thead>
<tr>
<th>Wood-based panels [m³]</th>
<th>Year</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2012</td>
</tr>
<tr>
<td>Total</td>
<td>340,000</td>
</tr>
</tbody>
</table>

In conclusion the results from the Questionnaires for the year 2014 show a 14 % increase in the production of sawnwood in conifer, which is evenly distributed to the different sawmills - this includes the production from non-responding sawmills in 2014. In hardwood the production has decreased with 5 % from 2013 to 2014, but the production is still higher than in 2012.

3.2 Carbon stock, inflow and outflow

In this section the development of the carbon stock in HWP originating from FM is accounted for – see also Schou et al., 2015. In Section 2.3.2.3 it was explained how HWP originating from deforestation is estimated and thus accounted for on the basis of instantaneous oxidation, and that the amount of HWP carbon from AR activities is assumed to be zero.
3.2.1 Share of HWP from domestic harvest

Figure 2 shows the development of the share of the roundwood feedstock for producing HWP originating from domestic harvest from 2000-2014 (2013 KP Supplement Equation 2.8.1.). Throughout the period the total share has fluctuated between 57% and 94%, around which it has been constant for the last few years. It is evident that sawnwood has had the lowest share, which is due to the import of non-conifer roundwood. In the years 2011-2014 (coinciding with Questionnaire) the highest shares are registered and all values are relatively constant, thus the figures for 2014 are similar to those of 2013.

![Figure 2](image.png)

Figure 2. Fraction of the feedstock for production of HWP coming from domestic harvest from 2000-2014. \( f_{IRW} \) = fraction of industrial roundwood. The domestic contribution for paper is calculated based on two fractions regarding roundwood and pulp.

3.2.2 Deforestation

Figure 3 shows the share of the total harvest originating from deforestation from 2000-2014. The share has fluctuated between 0.4% and 2.1%. From a stable level of around 2% mid-period, the share dropped significantly between 2011 and 2013. The lowest share was reached in 2013 – the figure for 2014 is 1.1%.
3.2.3 Inflow and change of the HWP pool

Figure 4 shows the inflow (in 1.000 Mg, or metric tons\textsuperscript{13}, carbon) to the HWP pool for the different categories for 2000-2014. The inflow has fluctuated between 58 to 155 Gg, which was reached in 2011 and 2014. Except for two years (2005 and 2010) the inflow has been largest for wood-based panels. The years 2011-2014 stand out with a noticeably larger inflow. From 2013 to 2014 the inflow has increased 8%, primarily caused by an increased inflow from sawnwood, which is partly due to the inclusion of production from non-responding companies.

\textsuperscript{13} In general Mg is used, as grams is a SI unit as opposed to tons. In this report “tons” exclusively refer to “metric tons”.
The total changes in the HWP pool from 2000-2014 is shown in Figure 5. For much of the period the pool has been decreasing, however from 2010 the pool has been increasing with a peak of 47 Gg in 2011. In 2014 the pool has increased by 44 Gg, which is 30% higher compared to 2013. Noticeably the pool in sawnwood has started increasing – partly due to an increase in production, and inclusion of production from non-responding companies as mentioned above.

Figure 5. Change in the HWP pool from 2000-2014.

Figure 6 shows the development of the carbon stock for the different HWP categories and the total pool for 1961-2014. In 2014 the total pool was about 5.0 Mio. Mg, of which sawnwood made up about 3.3 Mio. Mg C corresponding to 67% of the total pool, while wood-based panels consisted of about 1.7 Mio. Mg C corresponding to 33% of the total pool. The pool development has shown an increasing trend since 2009.

Figure 6. Development of the carbon stock in the HWP pool for the different categories from 1961-2014.
Table 6 provides an overview of the figures for the HWP pool in 2014, as they will be reported to the UNFCCC. The total net emissions from the pool were +158.971 Mg CO$_2$ equivalents (eq.), i.e. there was a net sequestration of carbon in HWP in 2014 corresponding to this amount of CO$_2$.

Table 6. Figures for 2014-reporting to UNFCCC on HWP from Forest Management (FM) - domestically harvested (DH) and domestically consumed (DC).

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Sawnwood</td>
<td>3,305,883</td>
<td>70,424</td>
<td>65,421</td>
<td>35</td>
<td>5,003</td>
<td>-18,332</td>
</tr>
<tr>
<td>Wood-based panels</td>
<td>1,661,589</td>
<td>84,009</td>
<td>45,538</td>
<td>25</td>
<td>38,471</td>
<td>-140,968</td>
</tr>
<tr>
<td>Paper</td>
<td>217</td>
<td>0</td>
<td>90</td>
<td>2</td>
<td>-90</td>
<td>329</td>
</tr>
<tr>
<td>Total</td>
<td>4,967,689</td>
<td>154,433</td>
<td>111,049</td>
<td></td>
<td>43,384</td>
<td>-158,971</td>
</tr>
</tbody>
</table>

3.2.4 HWP pool development vs. Forest Management Reference Level
Figure 7 shows the reported inflow to the HWP pool for 1990-2014 and the inflow projected by the corrected FMRL. Clearly the FMRL underestimate the inflow – this is even more pronounced for 2014 compared to 2013. The FMRL has projected an inflow of 131 Gg C compared to the reported 154 Gg C for 2014. This also shown in Table 7.

![Figure 7. Inflow to the HWP pool from 1990-2014 (Total_reported) compared with the projected inflow 2013-2020 by the corrected Forest Management Reference Level (Total_FMRL).](image)

Figure 8 shows the reported change in the HWP pool for 1990-2014 and the inflow projected by the corrected FMRL. The development seen is Figure 7 is also evident here. The FMRL has projected a change of 21 Gg C compared to the reported 43 Gg C.
Figure 8. Change in the HWP pool from 1990-2014 (Total_HWP) compared with the projected change 2013-2020 by the corrected Forest management reference level (Total_FMRL).

Table 7 summarises what is seen in the two figures above. From underestimating the inflow by 9% in 2013 the FMRL underestimated by 18% in 2014 – this is also evident when looking at the change in the pool, with larger deviations due the lower absolute figures. Looking at the level of harvest, which is used to make the projections of the FMRL, the predicted harvest in 2013 was 35% lower compared with the actual harvest partly explaining the underestimation. The FMRL projects the pool to be increasing by a decreasing amount over the period 2013-2020, however from 2013-2014 this has not been the case.

Table 7. Inflow and change for the HWP pool for the second commitment period.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Harvest [1.000 m$^3$]</td>
<td>Projected</td>
<td>2.661</td>
<td>2.643</td>
<td>2.613</td>
<td>2.608</td>
<td>2.595</td>
<td>2.576</td>
<td>2.582</td>
<td>2.572</td>
</tr>
<tr>
<td></td>
<td>Relative to average 2008-2012</td>
<td>108%</td>
<td>107%</td>
<td>106%</td>
<td>106%</td>
<td>105%</td>
<td>105%</td>
<td>105%</td>
<td>105%</td>
</tr>
<tr>
<td></td>
<td>Reported</td>
<td>3.590</td>
<td>3.801</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Difference</td>
<td>35%</td>
<td>44%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Inflow [1.000 Mg C]</td>
<td>Reported</td>
<td>144</td>
<td>154</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>FMRL</td>
<td>132</td>
<td>131</td>
<td>130</td>
<td>130</td>
<td>129</td>
<td>128</td>
<td>128</td>
<td>128</td>
</tr>
<tr>
<td></td>
<td>Difference</td>
<td>9%</td>
<td>17%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Change [1.000 Mg C]</td>
<td>Reported</td>
<td>34</td>
<td>43</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>FMRL</td>
<td>22</td>
<td>21</td>
<td>19</td>
<td>18</td>
<td>17</td>
<td>16</td>
<td>15</td>
<td>14</td>
</tr>
<tr>
<td></td>
<td>Difference</td>
<td>53%</td>
<td>107%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Inclusion of estimated non-reported figures for sawnwood production 2012 and 2013

As mentioned in Section 2.4.2.1 a method to estimate the production of non-responding sawmills in the Questionnaire regarding the 2014-reporting has been developed in 2015. The method makes it possible also to include non-reported production for 2012 and 2013. Thus it is interesting to compare the reported figures for 2013, 2014 and the corrected FMRL, which was estimated with only the reported production of sawmills - with recalculated figures, where the non-reported production has been included.

In Table 8, Table 9 and Table 10 the reported figures for 2013 are compared to the recalculated figures for 2013. Including the non-reported sawnwood production increases the total inflow by 4,1%. The total stock and outflow are not affected, however the annual change (increase) in stock is increased by 16,8%, as the pool of sawnwood is now increasing instead of decreasing as reported for 2013.

In Table 11, Table 12 and Table 13 the same is shown for 2014. As opposed to 2013, the effect of including the non-reported production is very low.

Regarding the FMRL the figure is changed from $\div 0,65 \text{ Mt CO}_2 \text{ eq.} / \text{year}$ to $\div 0,67 \text{ Mt CO}_2 \text{ eq.} / \text{year}$ or 2,1%. As 2012 is included in the reference period (2008-2012), this explains why the FMRL is changing.

Currently there is no intention of changing the official reporting-figures for 2013 and the FMRL, however these recalculation show the potential consequences of including the estimated non-reported sawnwood production for 2012 and 2013.

Table 8. Reported figures for 2013 (non-corrected inflow figures for sawnwood for 2012 and 2013).

<table>
<thead>
<tr>
<th>HWP&lt;br&gt;FM&lt;br&gt;DH DC, 2013</th>
<th>Stock</th>
<th>Inflow</th>
<th>Outflow</th>
<th>Half-life</th>
<th>Annual change in stock</th>
<th>Net emissions</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>[Mg C]</td>
<td>[Mg C]</td>
<td>[Mg C]</td>
<td>[years]</td>
<td>[Mg C]</td>
<td>[Mg CO₂ eq.]</td>
</tr>
<tr>
<td>Total</td>
<td>4.924.305</td>
<td>144.317</td>
<td>110.015</td>
<td>34.302</td>
<td></td>
<td>-125.692</td>
</tr>
</tbody>
</table>

Table 9. Corrected figures for 2013 (corrected inflow figures for sawnwood for 2012 and 2013).

<table>
<thead>
<tr>
<th>HWP&lt;br&gt;FM&lt;br&gt;DH DC, 2013</th>
<th>Stock</th>
<th>Inflow</th>
<th>Outflow</th>
<th>Half-life</th>
<th>Annual change in stock</th>
<th>Net emissions</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>[Mg C]</td>
<td>[Mg C]</td>
<td>[Mg C]</td>
<td>[years]</td>
<td>[Mg C]</td>
<td>[Mg CO₂ eq.]</td>
</tr>
<tr>
<td>Sawnwood</td>
<td>3.308.723</td>
<td>68.589</td>
<td>65.496</td>
<td>35</td>
<td>3.093</td>
<td>-11.335</td>
</tr>
<tr>
<td>Total</td>
<td>4.932.148</td>
<td>150.184</td>
<td>110.114</td>
<td>40.071</td>
<td></td>
<td>-146.830</td>
</tr>
</tbody>
</table>

Table 10. Difference between non-corrected and corrected figures for 2013.

<table>
<thead>
<tr>
<th>HWP&lt;br&gt;FM&lt;br&gt;DH DC, 2013</th>
<th>Stock</th>
<th>Inflow</th>
<th>Outflow</th>
<th>Half-life</th>
<th>Annual change in stock</th>
<th>Net emissions</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>[Mg C]</td>
<td>[Mg C]</td>
<td>[Mg C]</td>
<td>[years]</td>
<td>[Mg C]</td>
<td>[Mg CO₂ eq.]</td>
</tr>
<tr>
<td>Sawnwood</td>
<td>0,2%</td>
<td>9,4%</td>
<td>0,2%</td>
<td>35</td>
<td>-215,6%</td>
<td>-215,6%</td>
</tr>
<tr>
<td>Total</td>
<td>0,2%</td>
<td>4,1%</td>
<td>0,1%</td>
<td>16,8%</td>
<td></td>
<td>16,8%</td>
</tr>
</tbody>
</table>
Table 11. Reported figures for 2014 (non-corrected inflow figures for sawnwood for 2012 and 2013).

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Sawnwood</td>
<td>3,305.883</td>
<td>70.424</td>
<td>65.421</td>
<td>35</td>
<td>5.003</td>
<td>-18.332</td>
</tr>
<tr>
<td>Total</td>
<td>4,967.689</td>
<td>154.433</td>
<td>111.049</td>
<td></td>
<td>43.384</td>
<td>-158.971</td>
</tr>
</tbody>
</table>

Table 12. Corrected figures for 2014 (corrected inflow figures for sawnwood for 2012 and 2013).

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Sawnwood</td>
<td>3,313.573</td>
<td>70.424</td>
<td>65.575</td>
<td>35</td>
<td>4.849</td>
<td>-17.769</td>
</tr>
<tr>
<td>Total</td>
<td>4,975.379</td>
<td>154.433</td>
<td>111.203</td>
<td></td>
<td>43.230</td>
<td>-158.407</td>
</tr>
</tbody>
</table>

Table 13. Difference between non-corrected and corrected figures for 2014.

<table>
<thead>
<tr>
<th>HWP_{FM, DH, DC} 2014</th>
<th>Stock [Mg C]</th>
<th>Inflow [%]</th>
<th>Outflow [%]</th>
<th>Half-life [%]</th>
<th>Annual change in stock [%]</th>
<th>Net emissions [%]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sawnwood</td>
<td>0.2%</td>
<td>0.0%</td>
<td>0.2%</td>
<td>-3.1%</td>
<td>-3.1%</td>
<td>-3.1%</td>
</tr>
<tr>
<td>Total</td>
<td>0.2%</td>
<td>0.0%</td>
<td>0.1%</td>
<td>-0.4%</td>
<td>-0.4%</td>
<td>-0.4%</td>
</tr>
</tbody>
</table>

3.3 Wood flows
The mapping of the collective wood flows in Denmark has, but for a meeting with relevant parties, not progressed during 2015. However at this meeting, where representatives from Statistics Denmark, the Danish Nature Agency, the Danish Energy Agency, Force Technology and IGN were present, a fruitful dialogue arose between parties and it was agreed that further meetings should take place to explore the reasons for the deviations in the wood flows as stated by Schou et al. (2015). It was agreed that data should be exchanged between parties to make the background of calculations methods more transparent.

3.4 HWP in the Danish building stock
The progress on this subproject has also been limited during 2015. Some data has been acquired from Statistics Denmark, but these have not been processed yet. The expectation is that these will only contribute with limited knowledge. Contact has been made with some relevant parties including The Royal Academy of Fine arts, School of architecture, the Danish Building Research Institute, the Danish Technology Institute and the Technical University of Denmark. A joint meeting, however, has not taken place as of now.

3.5 Uncertainty
No new methods or figures has been developed or made available by the IPCC in 2015. See Schou et al. (2015).
4 Conclusion

The production of the Danish wood industry and the inflow to the HWP pool has been increasing compared to 2013 and thus still on the general same level as for the years 2011-2013, for which data by questionnaire was first collected from the industry in 2014. A new method to estimate production from non-responding companies has been introduced in 2015, partly causing an increase in the inflow, and thus not reflecting an actual increase in production. The deviation in relation to the FMRL has also increased with larger inflows and pool increases than projected.

New methods to estimate production of non-reporting sawmills and the share of HWP originating from deforestation has been introduced for 2014, but not backwards in time.

The subprojects regarding mapping of the Danish wood flows and estimating HWP in the Danish building stock has only progressed slightly – this has primarily consisted of identifying and contacting relevant parties regarding the subjects. This has been somewhat successful in that a dialogue was initiated. These projects are still fundamental in the validation procedure regarding the data for HWP reporting.

5 References


Statens Forstlige Forsøgsvæsen, 1990: Skovbrugstabeller [Forestry Table]. København. 270 s. (in Danish)


UNFCCC, 2006: Report of the Conference of the Parties serving as the meeting of the Parties to the Kyoto Protocol on its first session, held at Montreal from 28 November to 10 December 2005.

UNFCCC, 2011: Report of the Conference of the Parties serving as the meeting of the Parties to the Kyoto Protocol on its sixth session, held in Cancun from 29 November to 10 December 2010.

UNFCCC, 2012: Report of the Conference of the Parties serving as the meeting of the Parties to the Kyoto Protocol on its seventh session, held in Durban from 28 November to 11 December 2011.


Data bases


Statistics Denmark: Felling in forests and plantation in Denmark by region, species of wood and area - StatBank Denmark, [online], Statistics Denmark, [accessed 23/02-2015], http://www.statistikbanken.dk/statbank5a/default.asp?w=1680

Statistics Denmark: Imports and exports CN (EU Combined Nomenclature) by imports and exports, commodities, country and unit - StatBank Denmark, [online], Statistics Denmark, [accessed 23/02-2015], http://www.statistikbanken.dk/kn8y