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Assessing and improving the overall carbon balance of the forest-wood sector – methods and approaches, uncertainties and consequences

TOURS 2012: International Conference

*Tackling climate change: the contribution of forest scientific knowledge
Scientific parallel session 3: mitigation 1*

22 May 2012, Tours



■ **Methods of estimating carbon effects of wood use**

- Greenhouse gas emissions along products life cycle (substitution effect)
- Methods for estimating delayed emissions of biogenic carbon (storage effect)

■ **Consideration of carbon effects in climate policies**

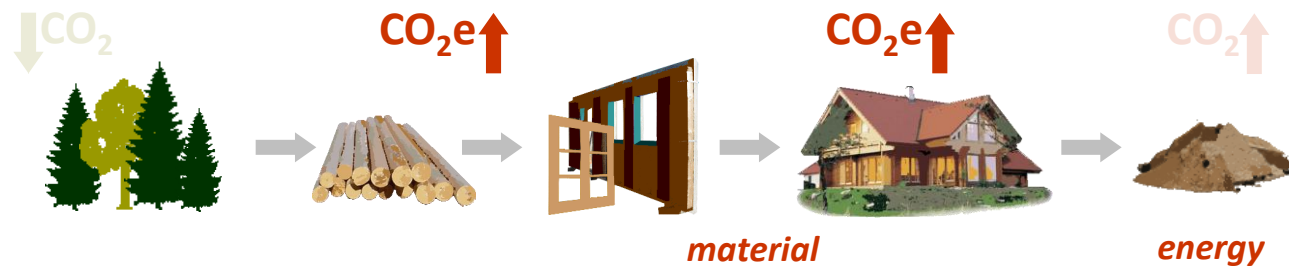
- Approach for accounting the storage effect (LULUCF decision 2/CMP.7)
- LULUCF FM reference level approach

■ **The CO₂-balance of the forest-wood sector**

- Example Germany
- Assessing the implications of different management regimes

Material and energy substitution

- GHG-emissions along the life cycle of products mainly due to energy consumption



- Comparison of on the basis of the same functional unit



- Estimation of environmental impact by means of life cycle assessment (LCA) acc. to ISO 14040 and 14044



- Climate relevant indicators are primary energy consumption (PE) and global warming potential (GWP 100)

Substitution potential of wood consumption

- By using wood products more energy intensive materials and fossil energy carriers can be substituted
- Results of BMBF-Project “ÖkoPot” scaled to 1 m³ of wood (here: without end of life credits)

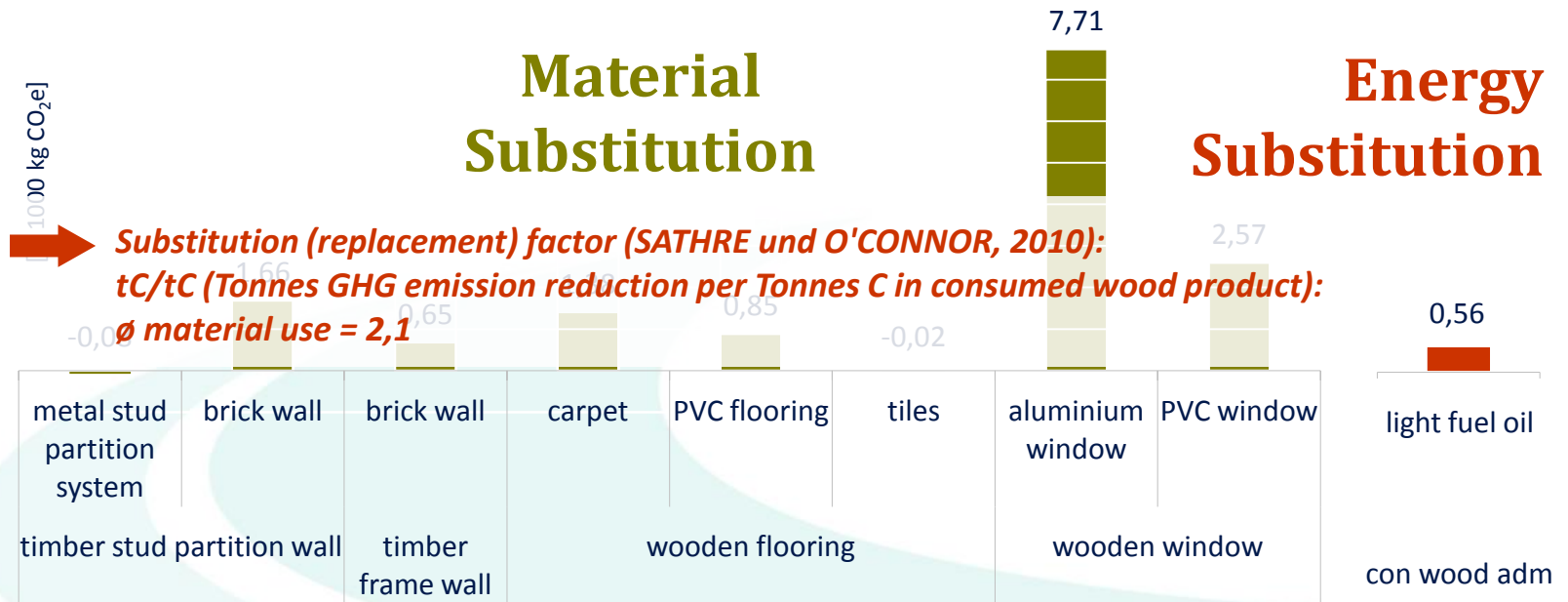


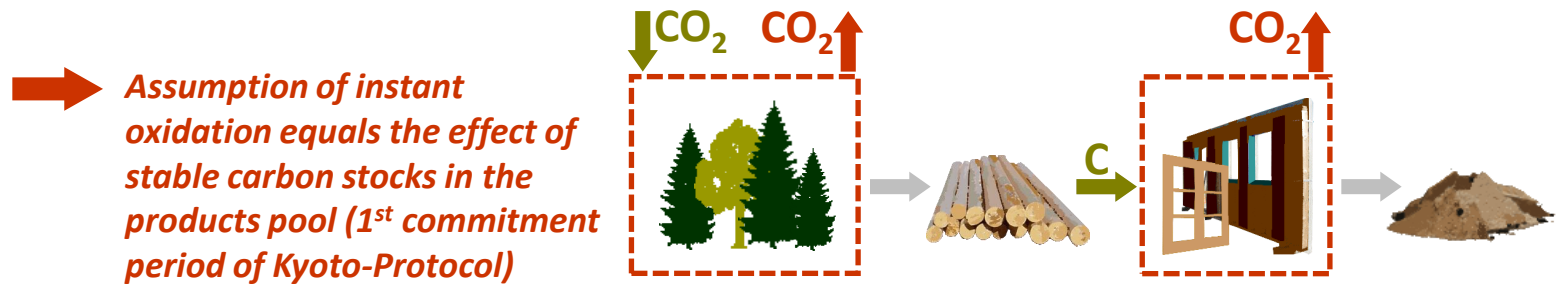
Fig 5-1: Material and energy substitution potential of 1m³ timber as compared to their substitutes (GWP 100)*

(Source: Rüter, 2010 and Albrecht et al., 2008)

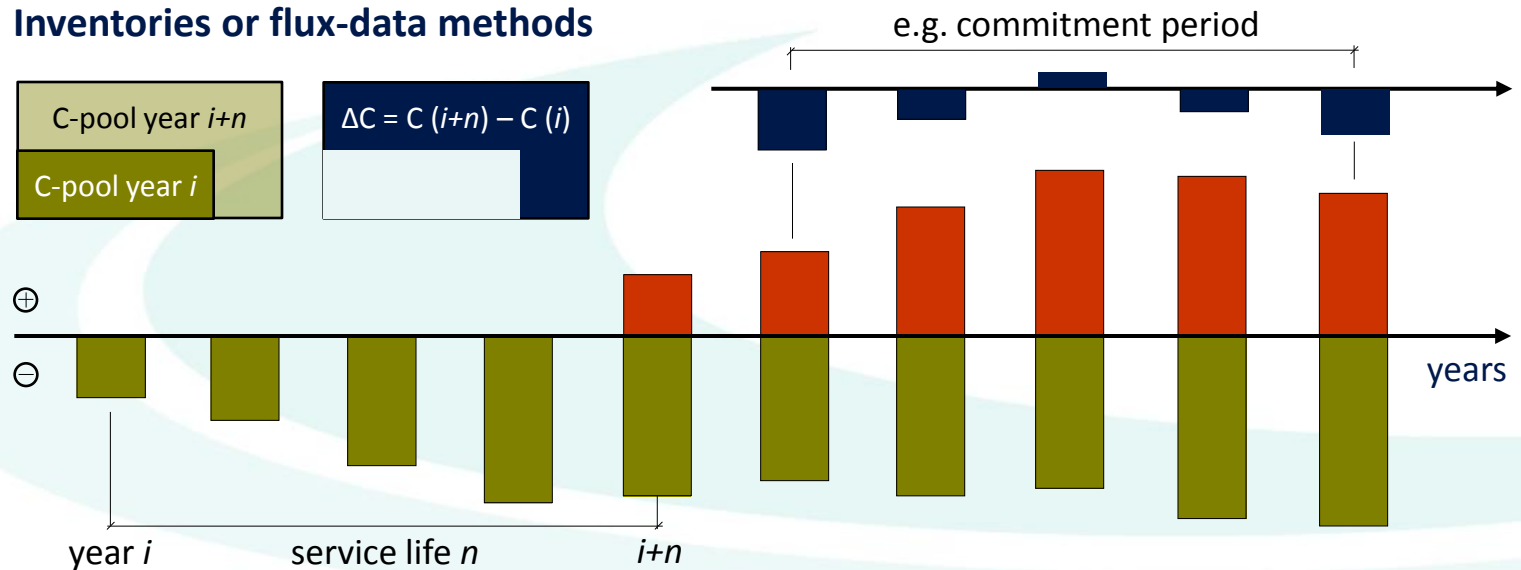
* calculated and reviewed acc. to ISO 14040 ff (life cycle assessment)

Estimating delayed emissions (storage effect)

- Wood products constitute a pool of carbon delaying emissions of biogenic carbon



- Inventories or flux-data methods



- Annual pool change for estimating net-emissions (here: Inflow – Outflow)

Methods for estimating net-emissions from wood products

■ Inventories (e.g. building stock)

■ Flux data-methods

inflow ▶ Direct estimations

▶ Data on production and trade of wood products*

▶ Harvest data

** IPCC 2006 GL tier 1 default method*

outflow ▶ Direct estimation

▶ Estimates based on service life data

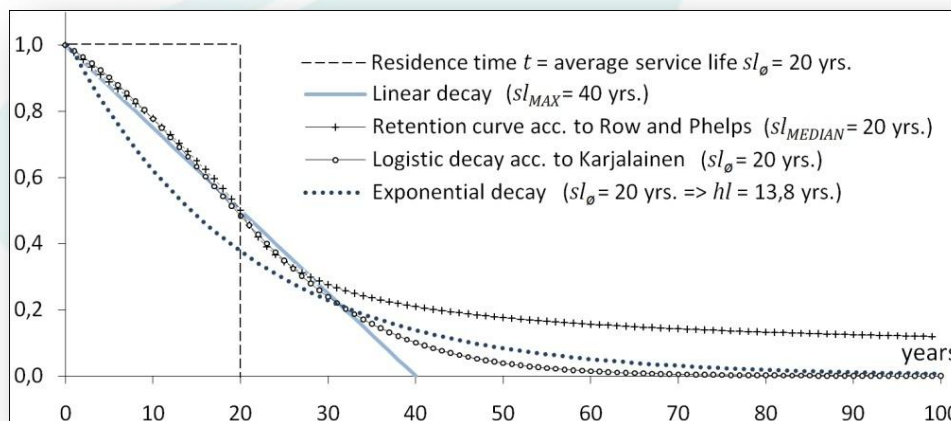
year *i*



year *i+n*



$$\Delta C \times (44/12) = \underline{\text{CO}_2 \text{ net-emission}}$$



▶ Linear decay

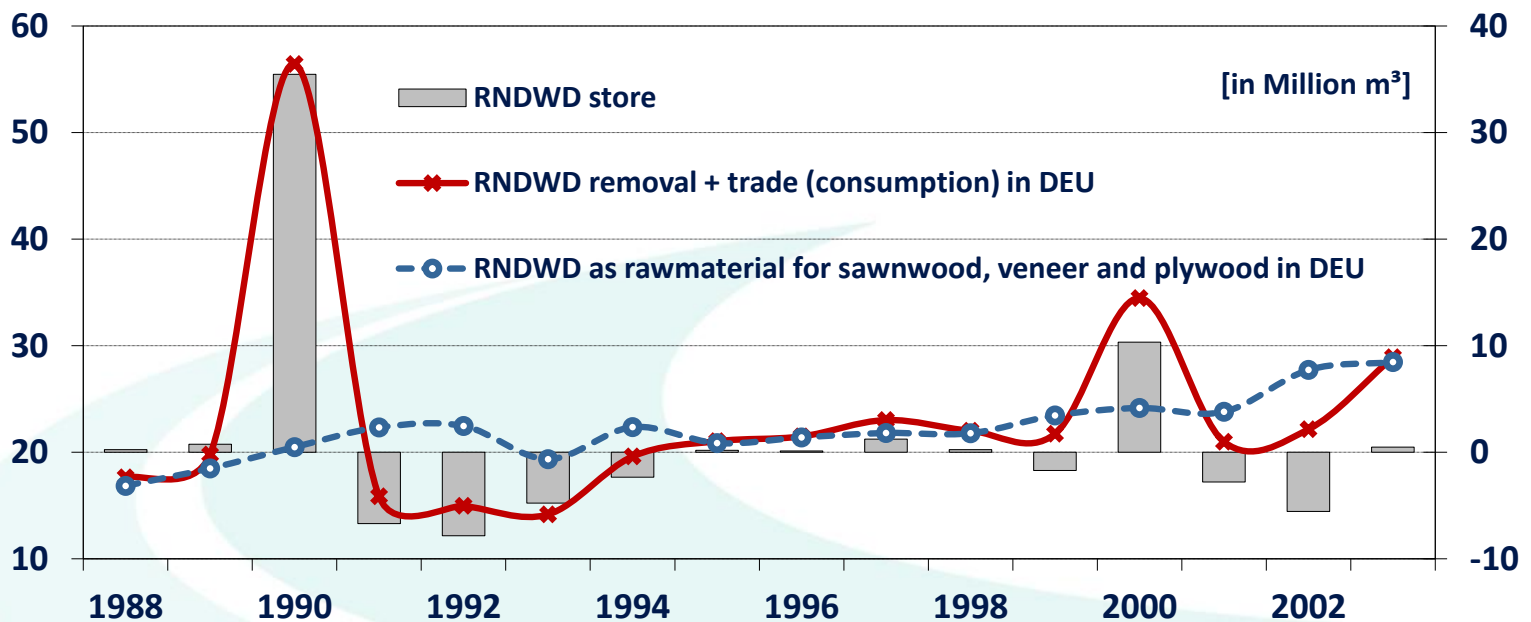
▶ Logistic decay

▶ Exponential decay*

➔ *Method to neither overestimate the storage effect, nor to underestimate the emissions from the pool („good practice“ according to IPCC 2003)*

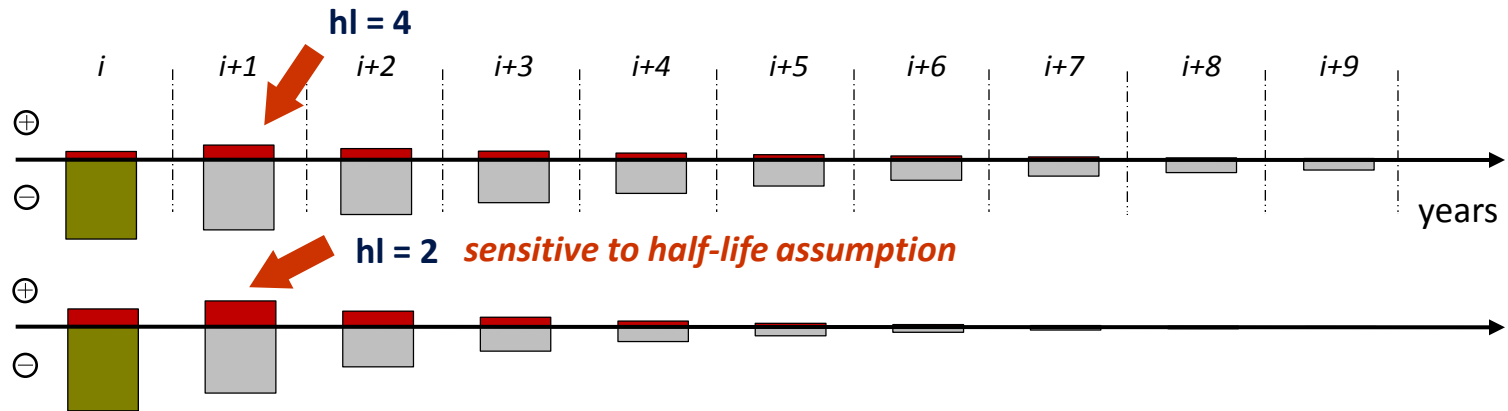
Harvest data time series vs. production/trade statistics

- Annual variability of **harvest volumes / roundwood consumption** (available amounts of roundwood being used as raw material) and subsequent **production of HWP** (here: sawnwood and selected wood based panels)



➔ Activity data (carbon inflow to wood products pool) needs to reflect real carbon fluxes

Estimation using service life data



IPCC 2006 tier 1 defaults

- Solid wood products (sawnwood, wood based panels)
- Paper products (paper and paperboard)

half-life

30 yrs

2 yrs

service-life

43 yrs

3 yrs

➔ *Service life (half-life) is country-specific (market distribution, etc.)*

Example: Germany (combination of info on use of wood in market segments and spec. service life data)

- Sawnwood coniferous 30,5 yrs 44 yrs
- Particle board 15 yrs 22 yrs
- Oriented strand board 38 yrs 55 yrs

Mass weighted average (solid wood products)

24 yrs

34 yrs

(Rüter, 2009)



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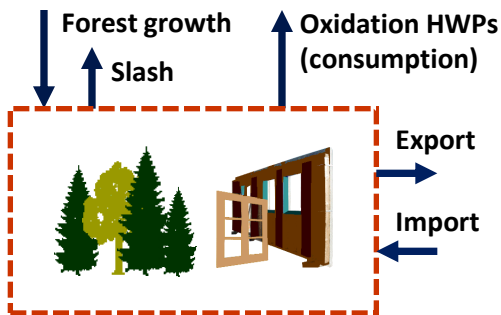
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■ **The CO₂-balance of the forest-wood sector**

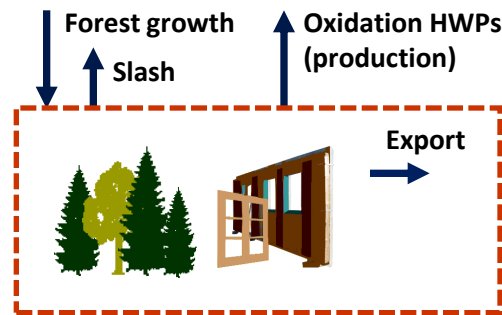
- Example Germany
- Assessing the implications of different management regimes

Different accounting approaches in the past (storage effect)

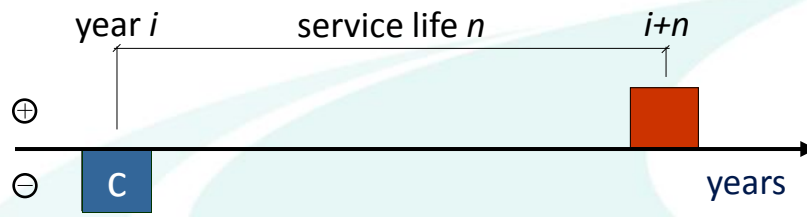
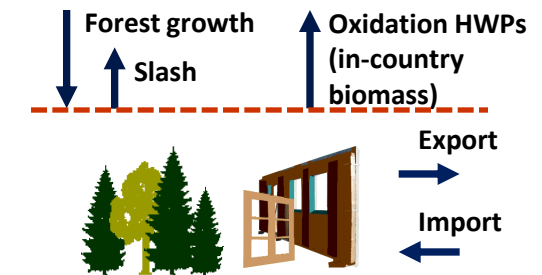
Stock-change approach



Production approach



Atmospheric flow app.



Consumption = Production + Import - Export

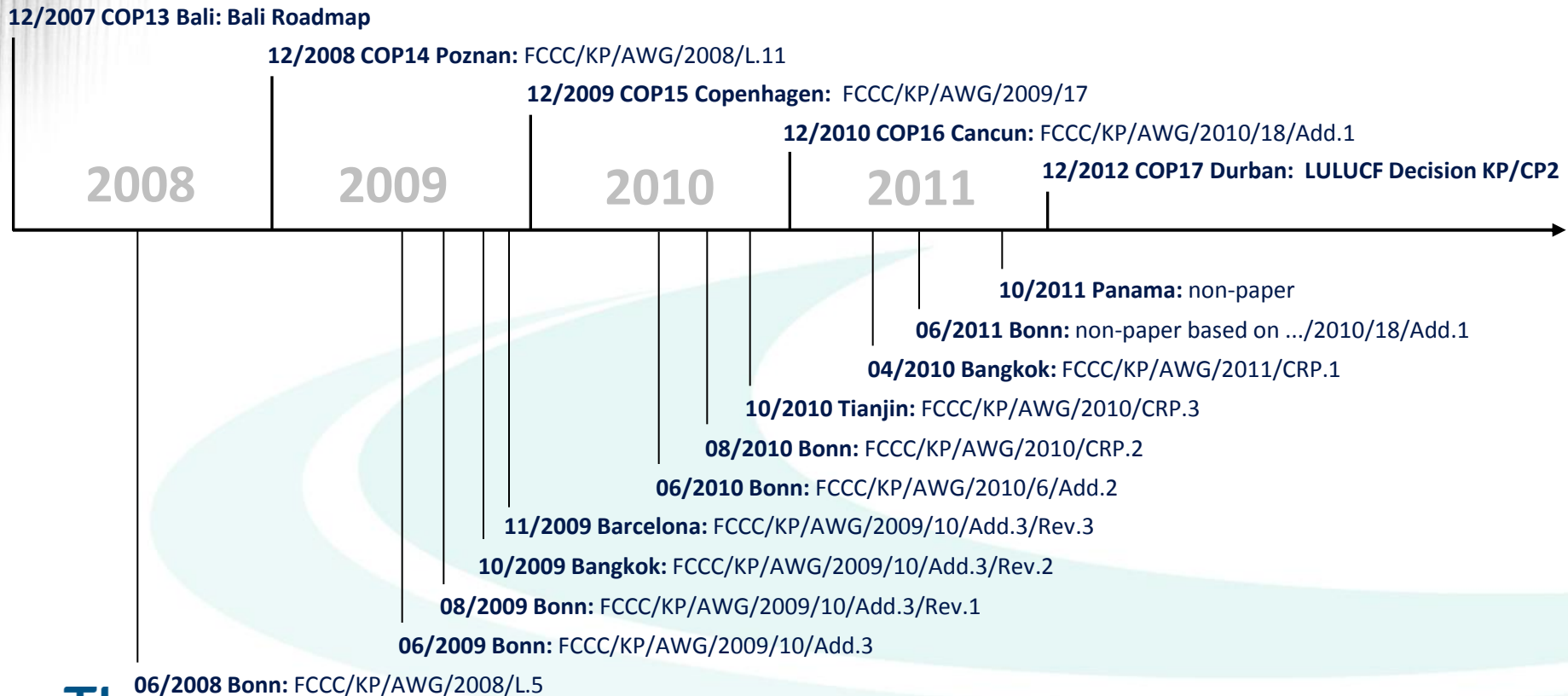


➔ *'Accounting' = consideration of carbon storage effect (net-emissions) for compliance with agreed emission reduction target (Kyoto-Protocol)*

➔ *System boundaries to be defined by policy (framework convention)*

UNFCCC process (LULUCF/HWP in AWG-KP)

■ Conference of Parties (COP), SBSTA meetings and Intersessionals to set the framework



Decision 2/CMP.7 on harvested wood products accounting

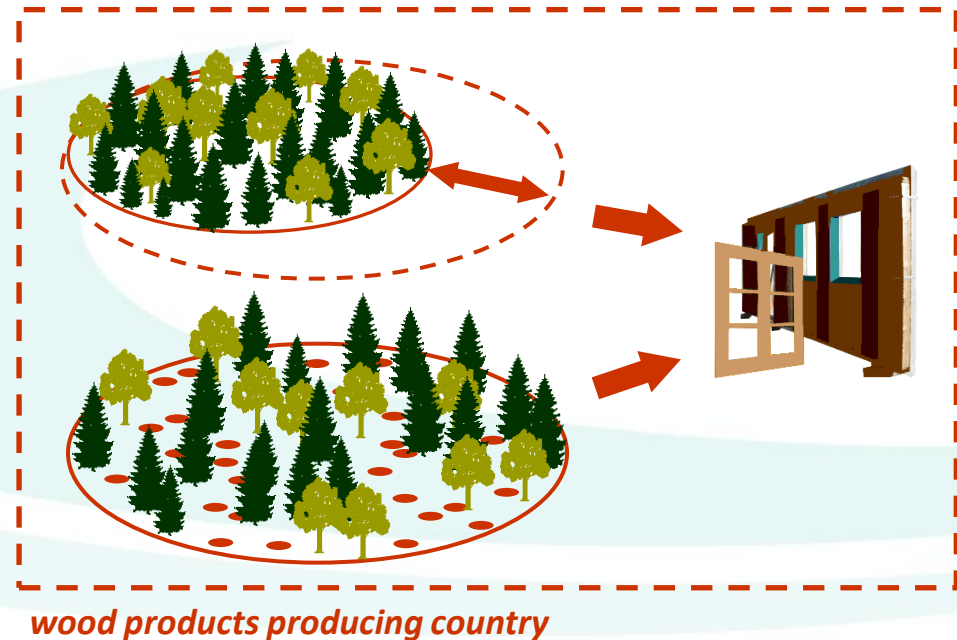
- **Para 27:** Emissions from harvested wood products removed from forests which are accounted for by a Party under Article 3, paragraphs 3 and 4, shall be accounted for by that Party only. Imported harvested wood products, irrespective of their origin, shall not be accounted by the importing Party.
- **Para 30:** Harvested wood products resulting from deforestation shall be accounted for on the basis of instantaneous oxidation

Article 3.3 (since 1990)

- afforestation
- reforestation
- ~~deforestation~~

Article 3.4

- forest management



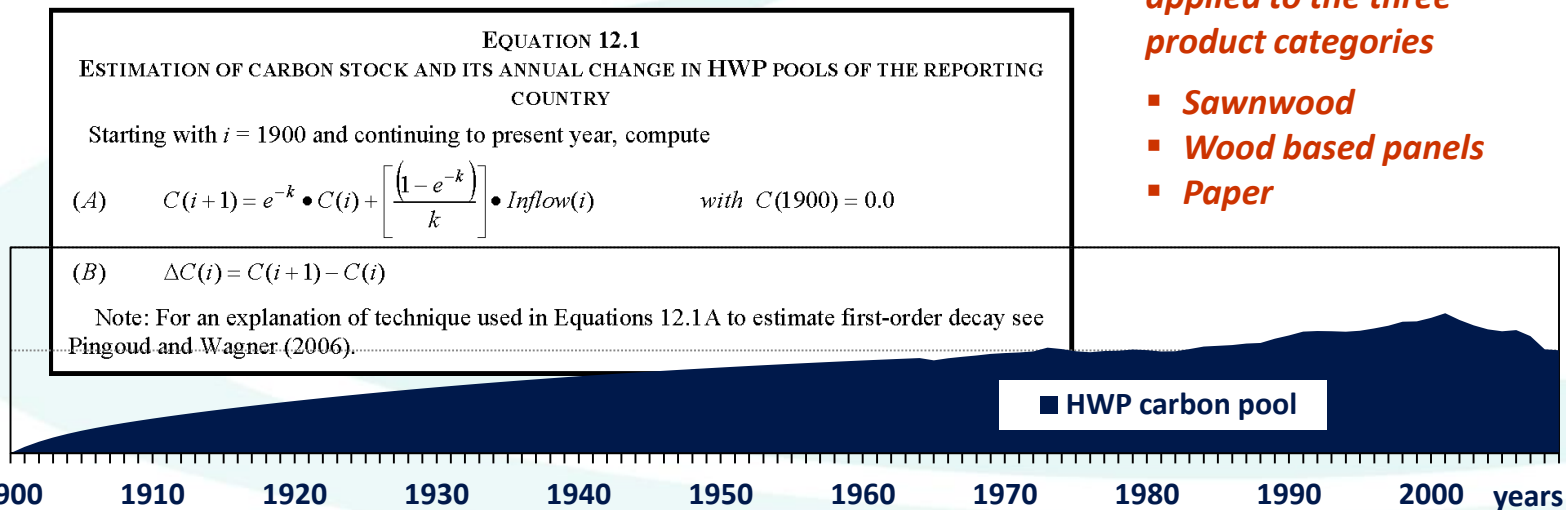
Decision 2/CMP.7 on harvested wood products accounting

Para 29: Notwithstanding paragraph 28 above, and provided that transparent and verifiable activity data for the harvested wood product categories specified below are available, accounting shall be on the basis of the change in the harvested wood products pool during the second and subsequent commitment periods, estimated using the first-order decay function with default half-lives of two years for paper, 25 years for wood panels and 35 years for sawn wood.

First order decay function 12.1 (IPCC 2006: 12.11)

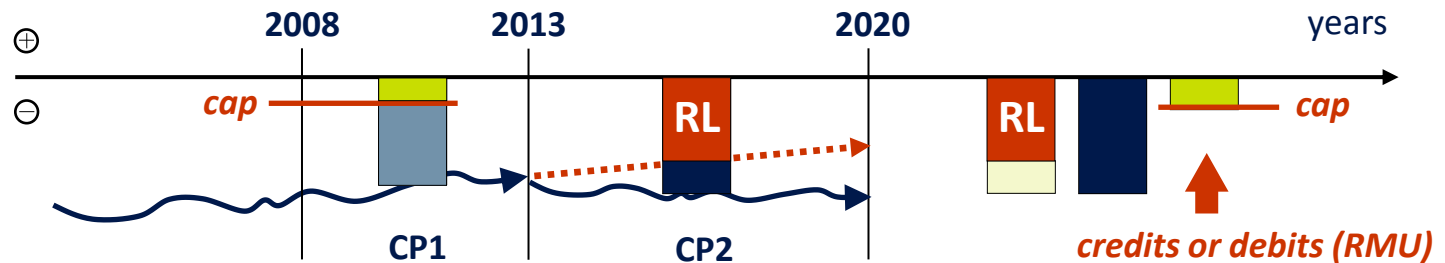
➔ IPCC 2006 GL Equ. 12.1 is default method to be applied to the three product categories

- Sawnwood
- Wood based panels
- Paper



Accounting of forest management with reference level (RL)

- Projection of net-emissions from carbon stock-changes in managed forests under 'business as usual' scenario for the period 2013 – 2020 (2nd CP of KP)

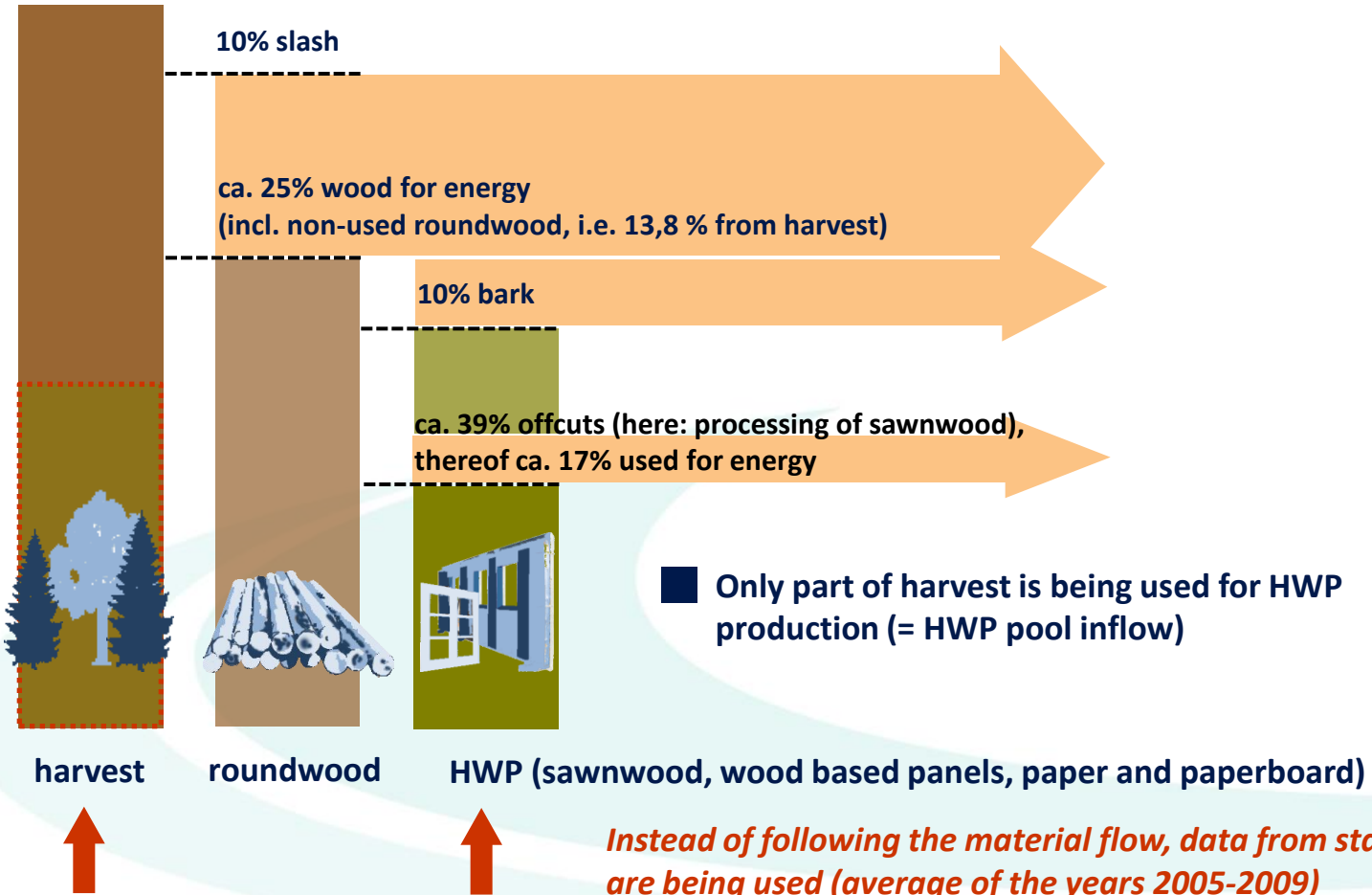


- Forest development and timber resource modelling (German WEHAM model, vTI-WOI)

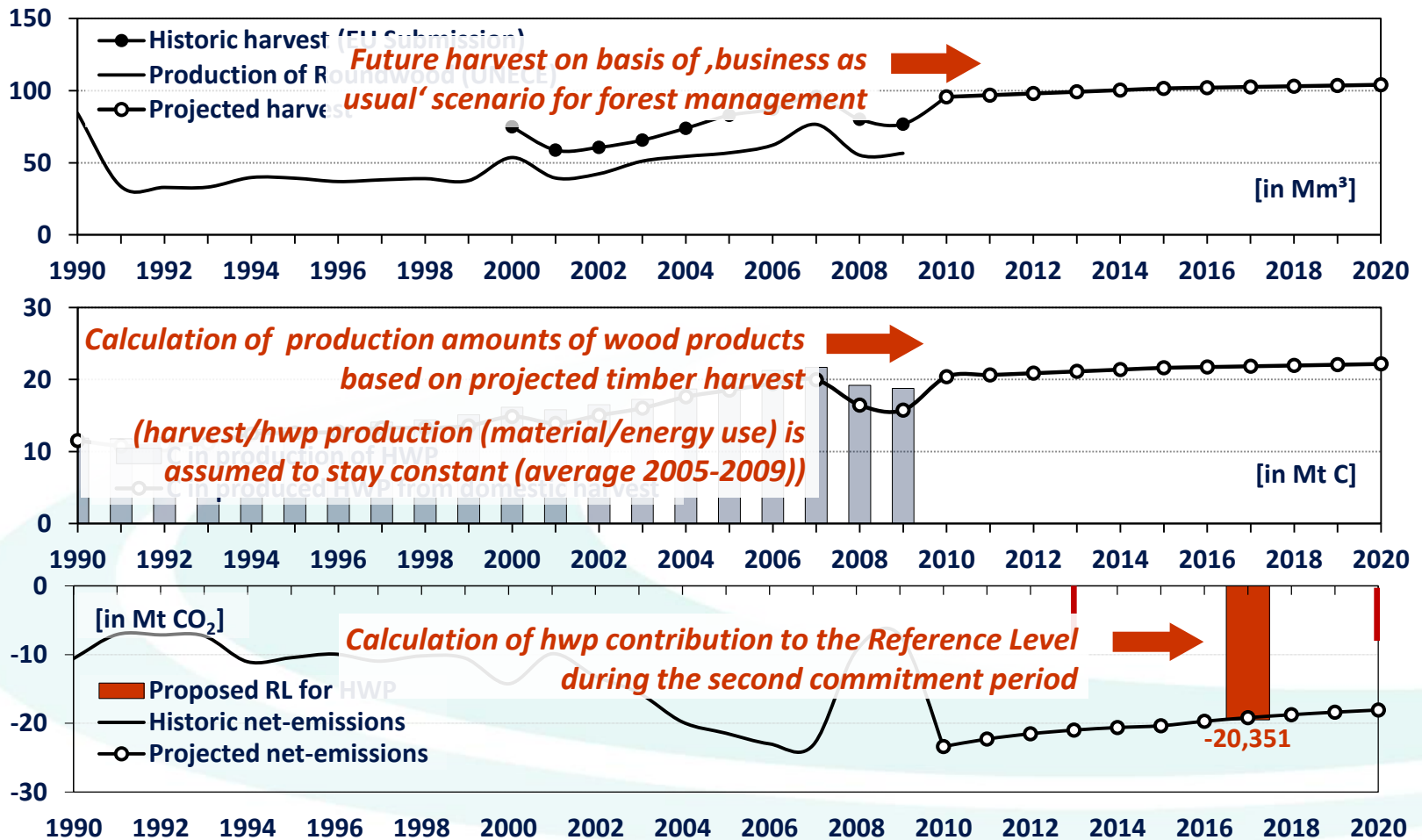
- Includes growth and management simulator and grading model
- Based on information from forest inventories → German FM RL = -2,067 Gg CO₂e/year



Example for material flow from harvest to HWP (Germany)



■ Projection of future storage effect (net-emissions) from product pool (2013-2020) based on carbon stock-changes to estimate hwp contribution to reference level (RL)





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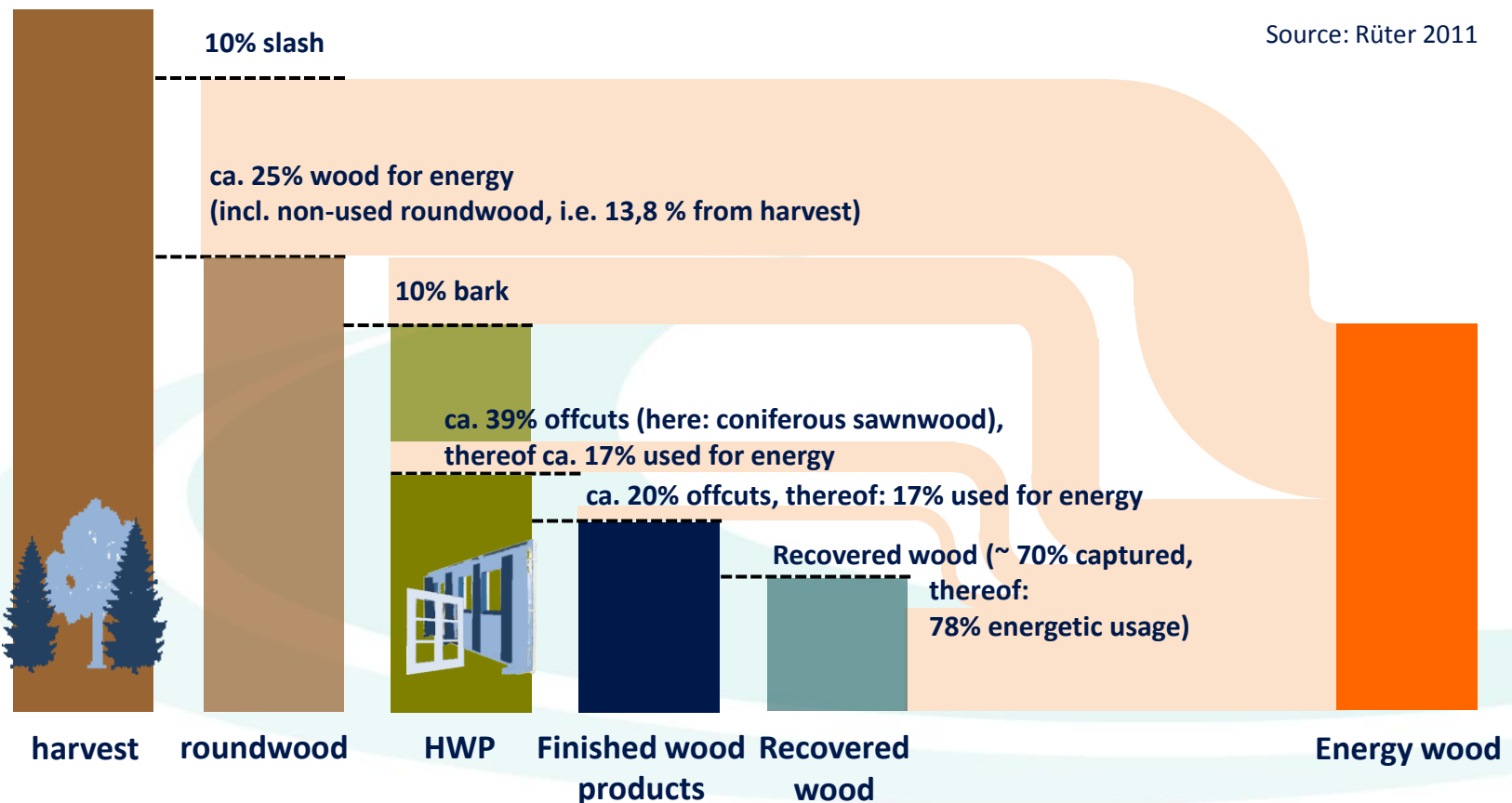
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■ **The CO₂-balance of the forest-wood sector**

- **Example Germany**
- **Assessing the implications of different management regimes**

Quantification of CO₂-balance of the forest-wood sector

- Application of methods (storage & substitution) on wood material flow
 - calculation based on statistics and market surveys (*inter alia* Mantau et al.)



Quantification of CO₂-balance of the forest-wood sector

■ Average CO₂-balance of the last years in Germany [in MT CO₂]

| | |
|--|----------------|
| Total storage effect | - 38,3 |
| <i>Net-emissions from forest carbon pools</i> | - 20,4 |
| <i>Net-emissions from wood product carbon pool*</i> | - 17,9 |
| Substitution effect of wood consumption total | - 86,8 |
| Material use (sawnwood and wood based panels)** | - 56,7 |
| Energy use*** | - 30,1 |
| Annual CO₂-balance total | - 125,1 |

Source: Heuer 2011 und Rüter 2011

* calc. acc. to 2/CMP.7 (without deforestation)

** using substitution factor of 2,1 tC/tC (finished products from sawnwood and wood-based panels, without paper)

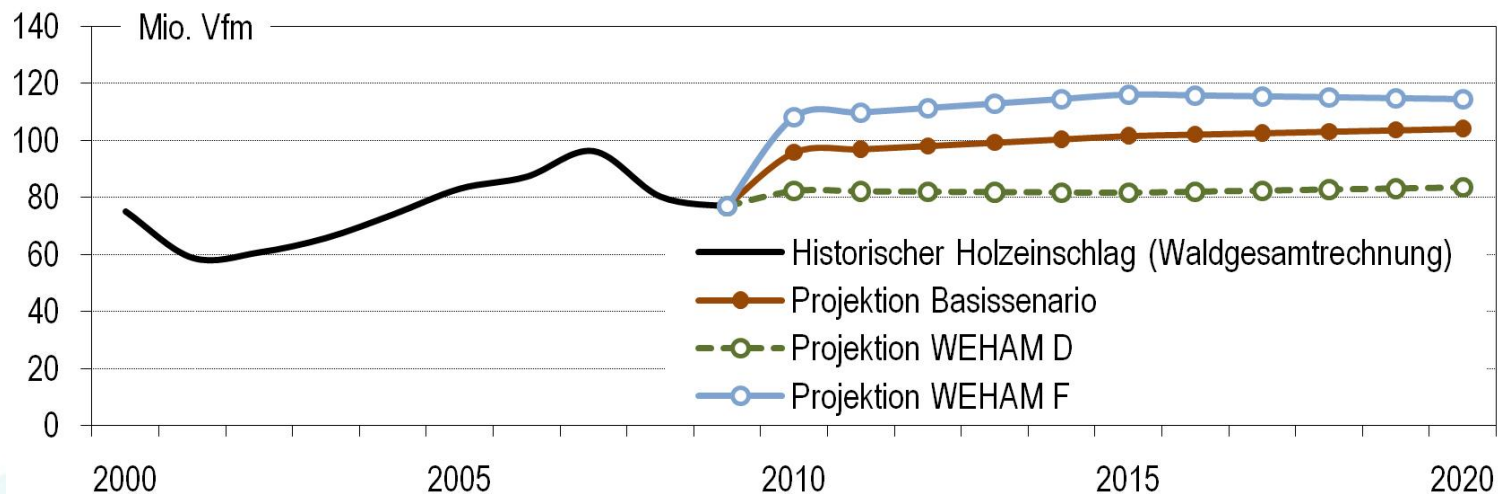
*** using substitution factor of 0,67 tC/tC (including recovered wood from end of life)

■ Total GHG-Emissions of Germany at about 789 MT CO₂e in 2009 (NIR)

➔ Absolute contribution of forest-wood sector amounts to 16 % of German GHG-emissions

Quantification of CO₂-balance using scenarios

- Different forest management scenarios (WEHAM model) resulting in different harvest amounts



Approach:

- Estimation of carbon balance of forest (Inventories, WEHAM Scenarios)
- Via roundwood removal: carbon balances of wood products (2/CMP.7 UNFCCC)
- Estimation of wood product amounts for material and energy substitution

➔ *Assessment of impact of different FM management options on sectors' carbon balance*

Tab. 1: Annual average CO₂-balance of forest wood sector acc. to WEHAM-Scenarios and accounting rules (2/CMP.7) for commitment period 2013-2020 (in Mio. t CO₂)

| | absolute CO ₂ -balance of reference | absolute CO ₂ -balance of scenarios | | CO ₂ -Bilanz in comparison to reference | |
|---|--|--|---------------|--|-------------|
| | Base scenario | WEHAM F | WEHAM D | WEHAM F | WEHAM D |
| Storage effect | | | | | |
| Net-emissions forest pools | -2,1 | +22,7 | -18,8 | +24,8 | -16,7 |
| Net-emissions product pool | -20,4 | -25,1 | -12,2 | -4,7 | +8,2 |
| Storage effect total | -22,4 | -2,3 | -30,9 | +20,1 | -8,5 |
| Mitigated emissions through substitution | | | | | |
| material | -67,8 | -76,2 | -54,6 | -8,4 | 13,2 |
| energy | -37,7 | -41,6 | -29,9 | -3,9 | 7,8 |
| substitution total | -105,5 | -117,8 | -84,5 | -12,3 | 21,0 |
| CO₂-balance total | -127,9 | -120,1 | -115,4 | 7,8 | 12,5 |
| Potentially to be accounted* | 0,0 | +20,1 | -8,5 | +20,1 | -8,5 |

* accounted will be deviations of future net-emissions from forest and wood products pool from base scenario (reference level)

Source: Rüter et al. 2011

■ Measuring the ,climate effects‘ of the forest wood sector

- Substitution effects to be assessed using Life Cycle Assessment (LCA) (ISO 14040/44) on basis of defined functional units (energy and material use)
- Substitution effects highly variable, but numerous studies show benefits from wood use
- Storage effects to be assessed using inventories or flux-data methods (sensitive to lifetime assumptions)

■ Accounting the sectors benefits in international climate agreement (COP 17, 2/CMP.7)

- Agreement on accounting approach for harvested wood products (HWP)
- Default method to be applied for sawnwood, wood-based panels and paper
- Mandatory accounting of HWP using projected FM reference level (RL) approach
- Connection of wood products pool with forest pools reflects dependencies (deforestation contributes to 20 % of global CO₂-emissions!), thus strengthening sustainable FM

■ Options to improve the sectors CO₂-balance

- Forest carbon pool: management options (increment, tree species, etc.)
- HWP carbon pool: increase material use, increase service lifetime
- Substitution effects: increase efficiency of energy and material consumption (energy management systems, etc.)

Thank you for your attention

More information

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