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Sustainable wood use, decarbonisation of energetic metabolism and forest development

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RESEARCH AIMS

- IDENTIFY COMMON MECHANISMS OF **TOXIC POLLUTION** FROM ATMOSPHERIC BURNERS, **COLLECTIVE AND INDIVIDUAL**
- QUESTION THE SUSTAINABILITY OF **CO_2-CREDITS** FOR BURNING **STEM WOOD PRODUCTS**
- SENSITISE FOR **CHOICES AHEAD** IN FOREST MANAGEMENT
- ENVISION COMPREHENSIVE **DE-CARBONISATION** OF ENERGETIC METABOLISM

AIR POLLUTION IN DENMARK

Wood stove emissions cause local health hazards being a mixture of:

90% of national total of PAH (carcinogenic)
60% of primary particles (PM2,5)
50% of dioxins (activate carcinogens)

For diluting 1 m³ contaminated air to urban background
7 x 10^5 m³ fresh air needed re. PAH
5 x 10^6 m³ " " " re. PM 2,5
- impossible with low chimneys in dense neighbourhoods
- end-of-pipe-solution: particle FILTERS
they are, however, NOT designed for dioxins
Dioxins (PCDD/PCDF) emissions:
Limit value for high rise (!) chimneys: 0,1 ng pr. m³

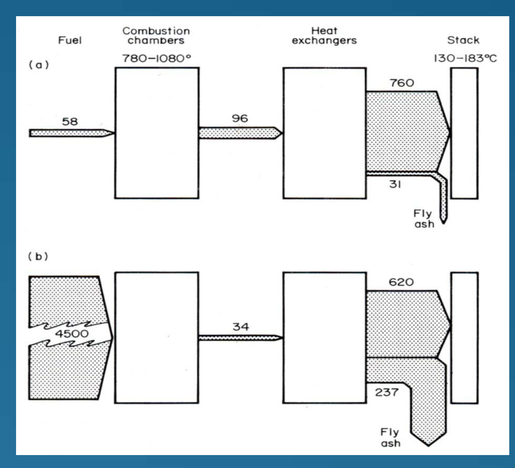
WOOD STOVE CHIMNEYS ACT AS DIOXIN REACTORS

Experimental measurements of **dioxin**
5 kW wood stove
pure, dry wood: birch and beech
6 h **burning test** with 2 **modes of loading**
(a) 5 portions à 1,9 kg (normal)
(b) 1 portion à 5 kg ('night' firing)

Results: (1) emissions of PCDD/PCDF
1 - 8 times EU limit value for waste incinerators

(2)"Against expectations, **night firing (b) shows lesser emissions of dioxin** than normal firing (a)"
(Source: Schleicher et al. 2001, p.38)

Same anomaly as in <u>waste incinerators</u>
(Fig. from Commoner 1987)



De-novo-synthesis of dioxin in waste incerators [µg/h]

C02-INDULGENCE versus POPs CONVENTION

DANISH REPORT to Stockholm Convention (2006) on dioxins:
"Total emissions **could be** reduced with a **ban on burning biomass in small installations without flue gas purification** ..." **YET**: „...such an initiative could have **undesirable effects in the context of the goals to reduce total CO_2 emissions.**"
The Ministry, thus, **accepts 50% of Danish dioxin emissions giving climate indulgence for substituting fossil fuels by tree.**
In reality, substituting wood e.g. for natural gas means CO_2-emissions GO UP 79% !

DANISH LAW on CO_2-quotas:
"Biomass: Fuels, which according to Annex 1 have a CO_2 -emission factor of ZERO"
Annex 1 shows figures with DELETED emission factors for ALL biomass fuels:

FUEL	Real CO_2 [kg/GJ]	Law CO_2 [kg/GJ]
Coal	95,0	95,0
Gas oil	74,0	74,0
Natural gas	56,9	56,9
STRAW	102,0	0,0
WOOD	102,0	0,0

Only by fast rotation in agriculture, however, the amount of CO_2 emitted is re-bound in a time certain (from year to year)

NO CLIMATE-NEUTRALITY FOR STEM WOOD BURNING

Physicist Bent Sørensen:
"...The **time lag for trees** may be decades or centuries, and in such case the temporary **carbon dioxide imbalance** may **contribute to climatic alterations**." (RENEWABLE ENERGY, 3rd.ed., 2004, 483)

When burning stem wood
a) count the **year's rings**
b) calculate, **how many trees You have to plant,** if the emitted amount of many years' CO_2 binding shall be re-bound within a few years from now!

Are You sure You will be part of the solution – and NOT of the problem?

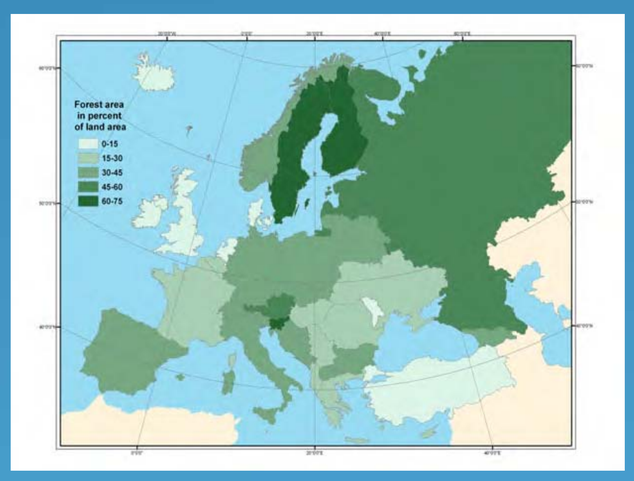
IPCC 2001:
"Natural processes and management regimes may reduce or increase the amount of **carbon stored in pools** with **turnover times** of the order of tens to hundreds of years (**living wood, wood products and modified soil organic matter**) and thus influence the **time evolution of atmospheric CO_2 over the century**."
IPCC 2007: Harvested wood products be used for climate mitigation!
This is also hindered by wood burning because of emissions of black carbon particles with direct warming (Ramanathan et al. 2008).

LAND AND WOOD USE PROPORTIONS

1990 to 2005: Energetic use of harvested wood products doubled in Denmark
Planned: another doubling to 2030 !

The political aim of doubling forest area in a tree generation (as against 1989), is, however, out of sight. Only 11-12% of land area are today covered by forests

So, Denmark increasingly imports tree for use in domestic heating (40% of Russia's woods are not registered in Kyoto process)



Source: MCPFE/UNECE/FAO "State of Europe's Forests 2007", based on data collected by UNECE/FAO available at http://www.unece.org/pxweb/DATABASE/STAT/Timber.stat.asp

ENERGETIC OVERUSE versus FOREST SUSTAINABILITY

POTENTIALS OF CONTINUOUS COVER FORESTRY
"The high C stock in semi-natural forests...suggests that *more C* could be stored by conversion from the traditional forest management system based on clear-cutting and replanting to continuous cover forestry with focus on the maintenance of the dead wood component" (Vesterdal et al. 2007)
2-3 times as much C might be stored by intensified near-natural forest management (Vesterdal in Danish radio)
If forest management is to maximise CO_2-sink functions of forest ecosystems, it should expand strategies of 'near-natural forestry'. These were part of the Danish National Forest Programme of 2002, but are today put into question politically

OVEREXPLOITING FORESTS AS ENERGY SUPPLY
Research results from Austria:
Pre-industrial society threatened forest sustainability by "intensive, multi-functional use"
Fossil energy based industrialisation, especially of agriculture, led to higher C densities and larger forest areas (Erb et al. 2008)
To 2020: "Increases in wood harvest could lead to a reduction of the functioning of forest ecosystems as carbon sinks" (Haberl et al. 2003, based upon high quality data)

Promoting the energetic use of stem wood products (e.g. as CO_2-neutral) is, after all, incompatible with prudent climate mitigation by forest management

CONCLUSIONS

Defining CO_2-neutral biomass:

Exclude tree species with rotation periods longer than a couple of years;
Carbon dioxide emitted from **burning non-fossil plant matter** must also be accounted for nationally **(full carbon accounting)**

Priority be given for implementing **the Stockholm Convention** on **out-phasing** persistent organic pollutants (POPs) over promoting wood burning
Wood burning should, rather, be substituted by **low- and non-carbon energy procurement e.g.** in a hydrogen economy (Sørensen 2005)

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