Can managed forest land provide effective strategies for climate change mitigation ? - examples from Sweden

IEA Bioenergy
Canberra, March 26-30, 2001

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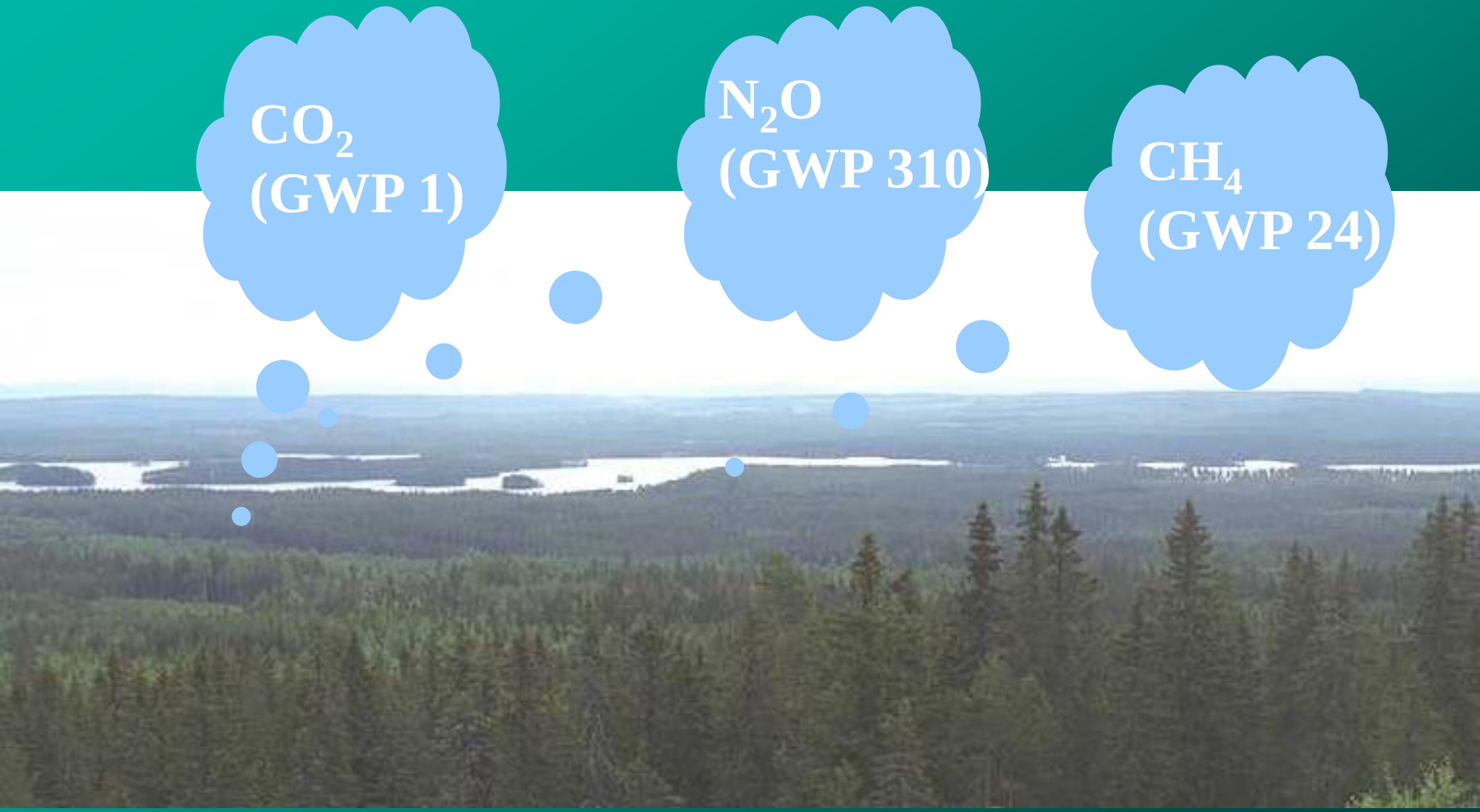
Based on a research programme funded by MISTRA in Sweden

Greenhouse gases from the land-use sector



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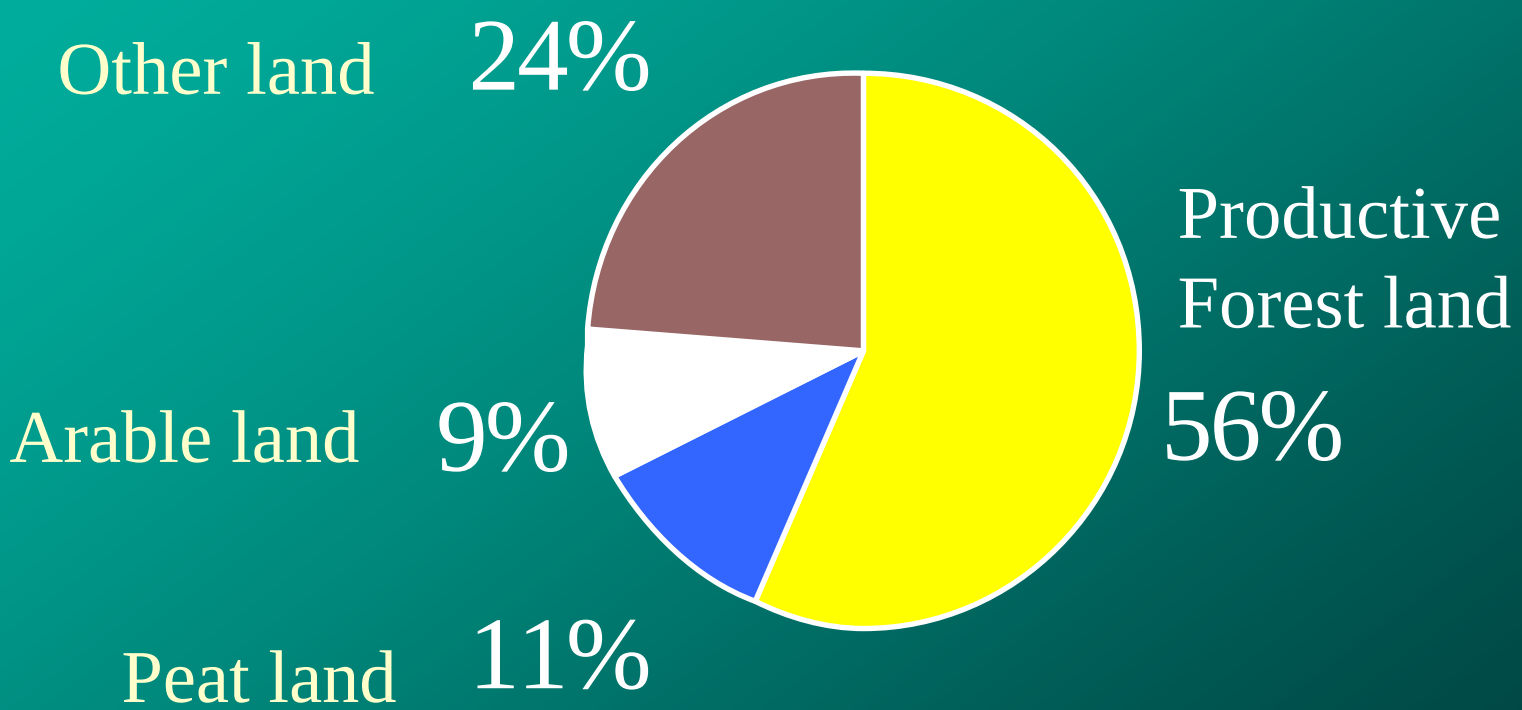
BASIC FACTS

Land area	411 000 km^2	(100%)
Forest area (International def. *)	27.4 M ha	(66.7%)
Forest land (Sw. National def. **)	23.3 M ha	(56.7%)

* *Potential to carry forest, under mature conditions, with a canopy cover > 10% and a stem height > 5m*

** *Land suitable for forest production with no other use and with a potential mean production > 1m^3 ha^{-1} yr^{-1}*

Land and land-use in Sweden, % of total land area (41 M ha)



THE SWEDISH POLICY GOALS *

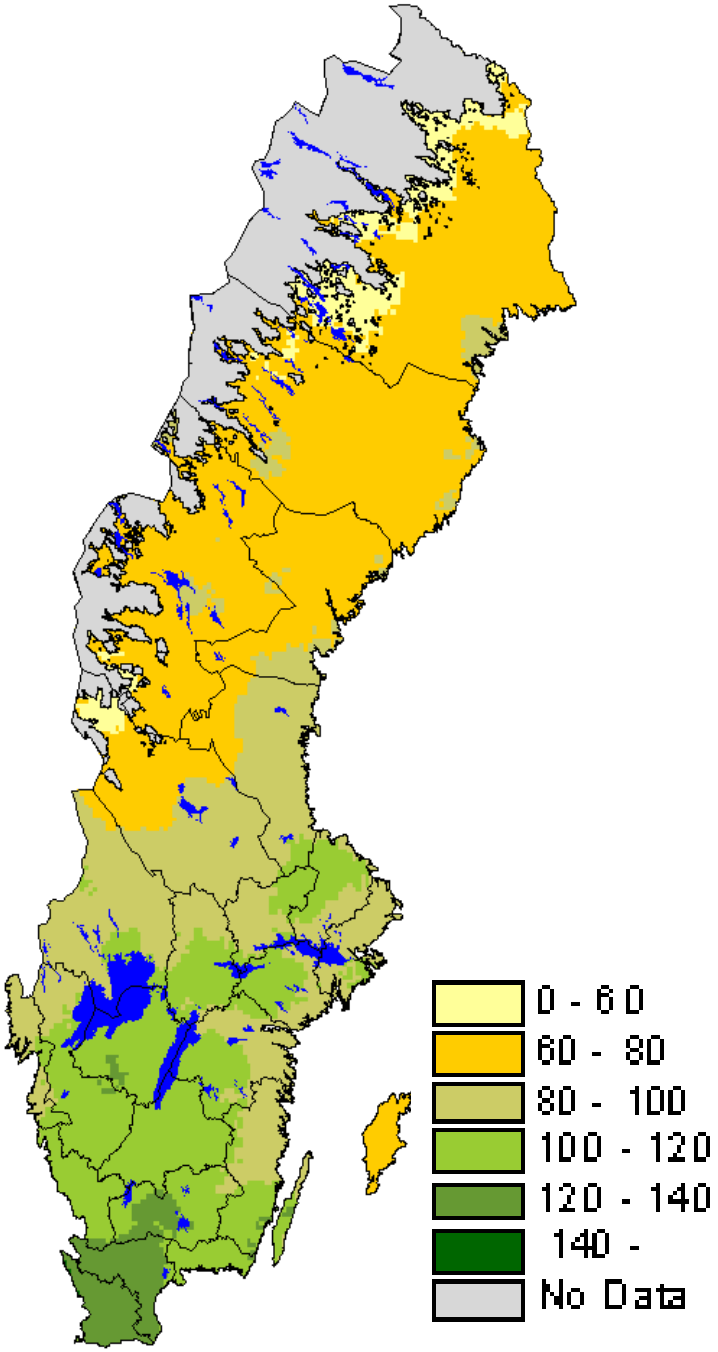
The long-term goal

Emissions of greenhouse gases should be reduced to ca. 50% by the year of 2050, as compared to the emissions 1990

The short-term goal

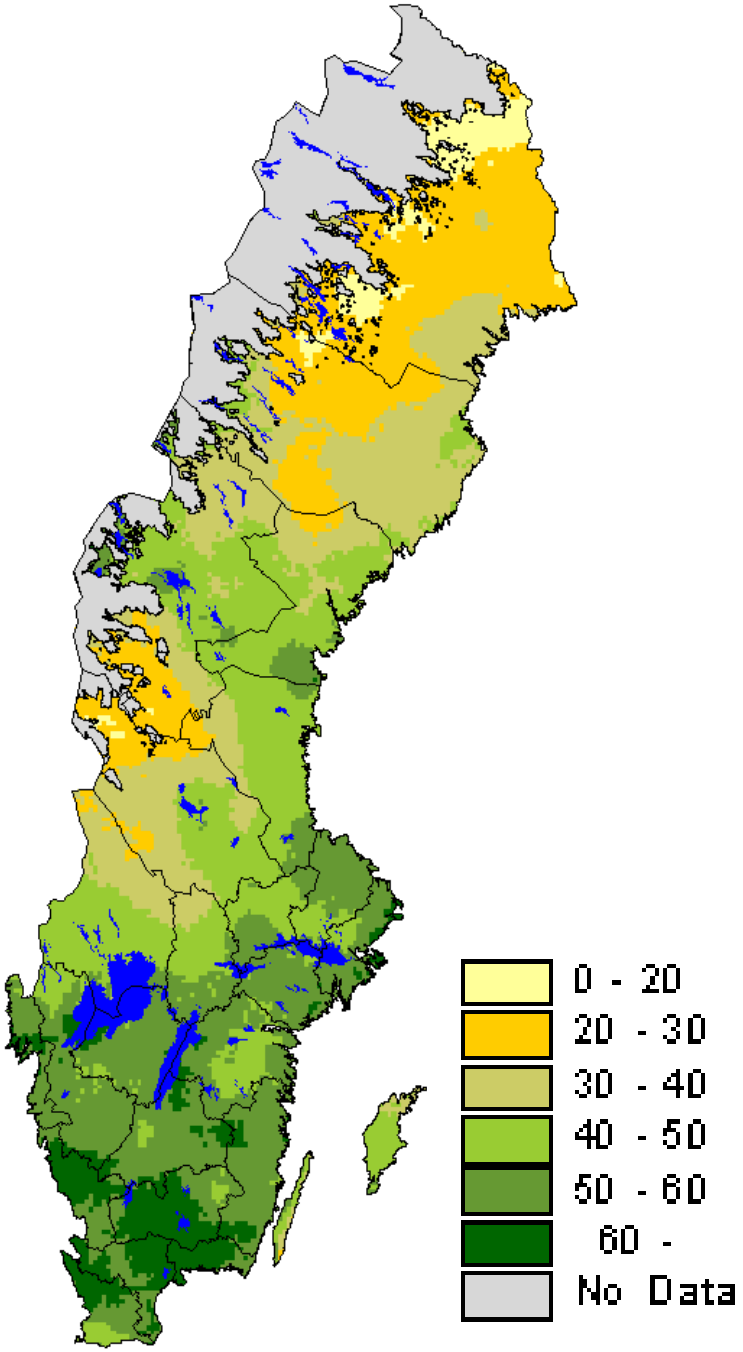
Annual emissions of greenhouse gases should during the committment period 2008-2012 be 2% lower than emissions 1990.

* *According to SOU 2000:23, Sweden´s proposed climate strategy*



Carbon in forest soils Ton C ha^{-1} **(1m)**

Based on a site index - C stock model and site data from the Forest Survey and the Soil Survey (Torgny Lind)



Carbon in total tree biomass (roots >5cm) Ton C ha^{-1}

Based on data from the Forest Survey in Sweden (Torgny Lind)

STRATEGIES IN FORESTRY

Forestry can contribute to reduced net emissions of greenhouse gases through three main ways :

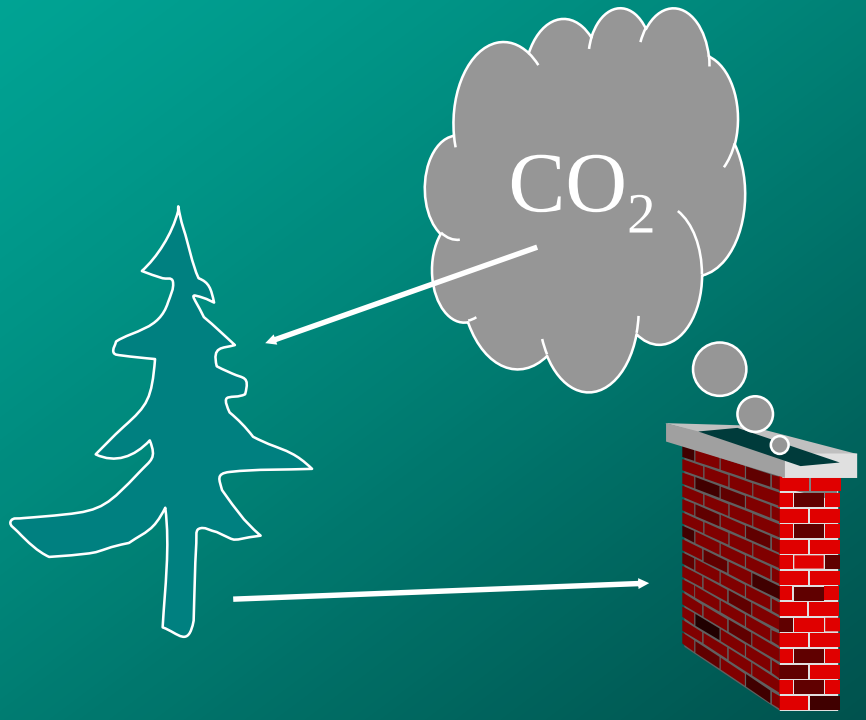
1) Sustainable use of biofuels as replacement for fossil fuels - SUBSTITUTION

2) Storage of C in biomass, humus and peat.
- SEQUESTRATION

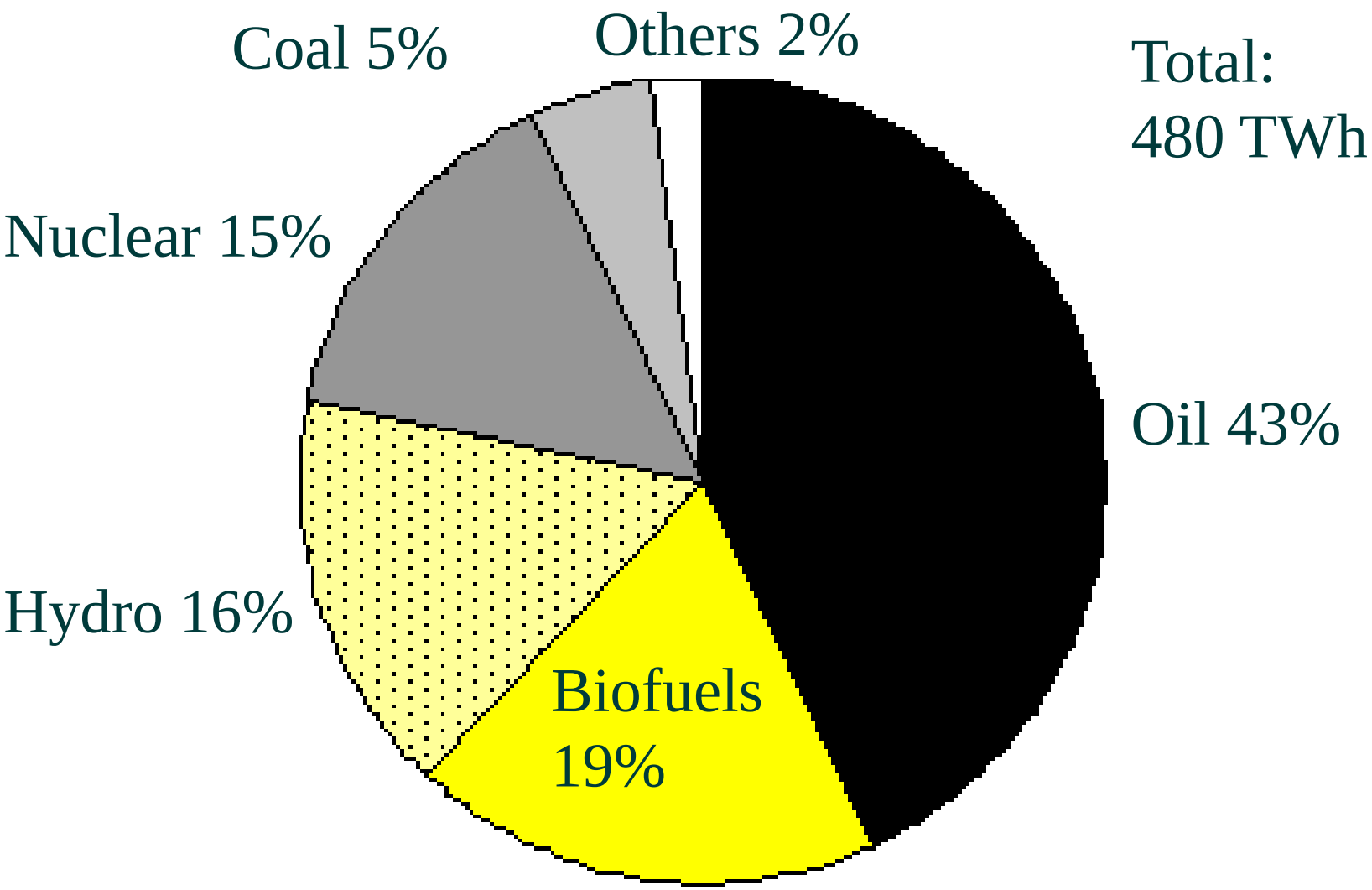
3) Avoidance of methods that increases emissions
- CONSERVATION

* By letting fossil fuels remain in the earth crust no new CO_2 is emitted from these sources.

* Combustion of biofuels is just a part in recirculation of already assimilated CO_2 to the atmosphere and gives no net emission



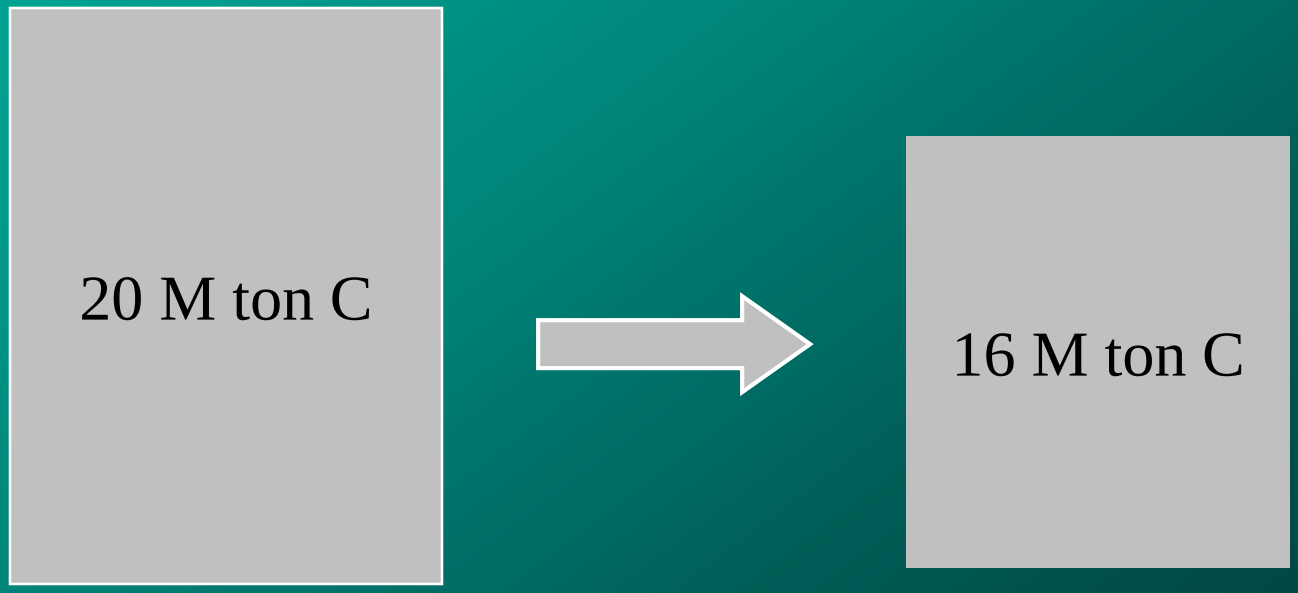
Total energy supply in Sweden 1998



About 60% of the biofuels is wood or tree residues from forestry or forest industry

Present use of forest residues

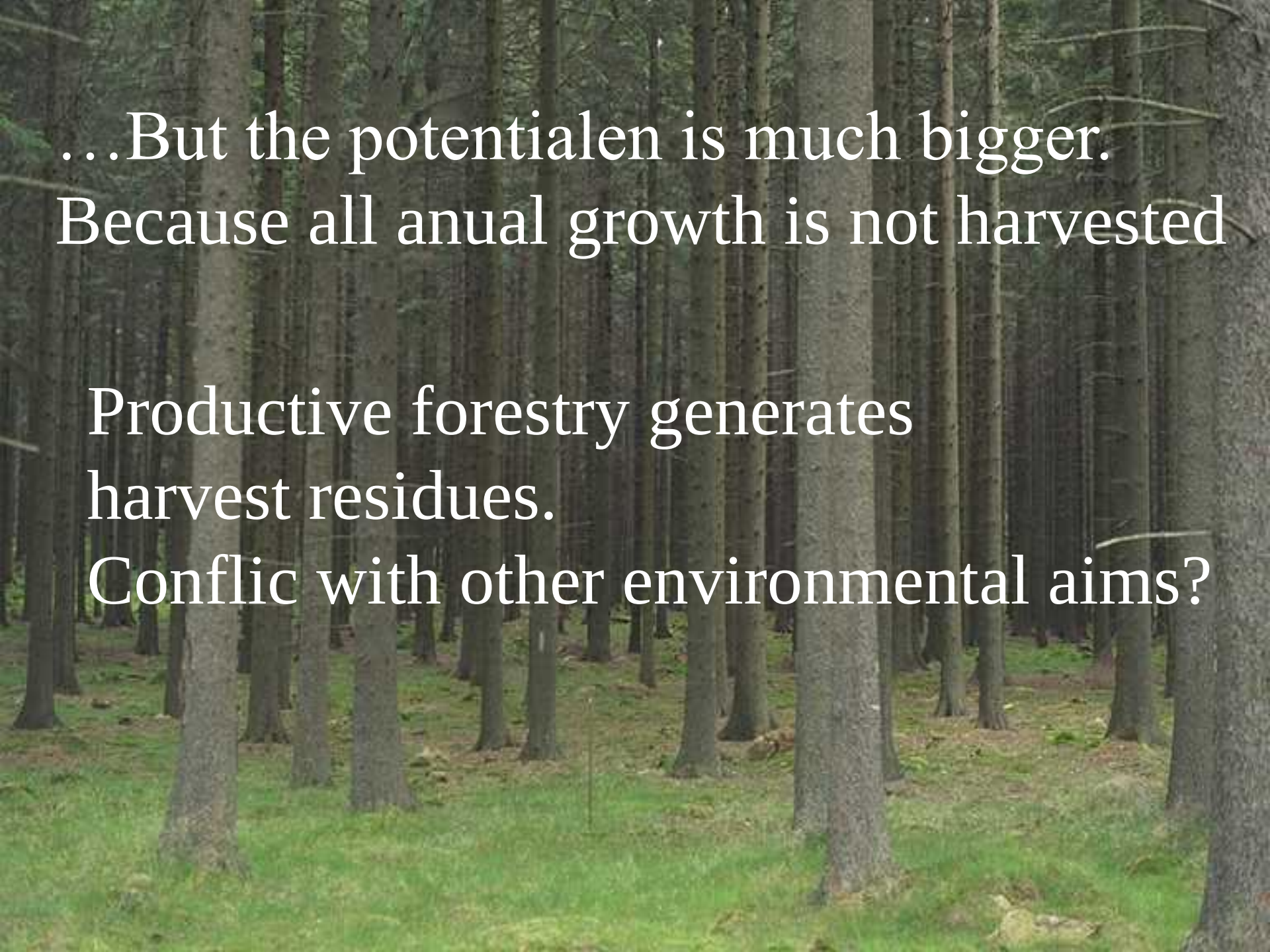
Wood residues from forestry and forest industry replace today ca. 46 TWh . If this energy was generated with fossil fuels it would induce emissions of close to 4 M ton C-CO_2 per year in Sweden



Potential additional use of harvest

Current harvest intensities gives ca 10 M ton DM residues
(70% of branch and top, 30% of needles)

Harvest residues	**10 yr**	**30 yr**	**100 yr**	**500 yr**
Change in soil C stock, Mton C / yr	-2,8	-1,0	-0,3	-0,1
Substituted oil-C, Mton C / yr	3,7	3,7	3,7	3,7
Sum	0,9	2,7	3,4	3,6



…But the potentialen is much bigger.
Because all anual growth is not harvested

Productive forestry generates
harvest residues.
Conflic with other environmental aims?

- The main strategy, to reduce net GHG emissions is to manage forest land in a way that increases the supplies of biofuels
  - to substitute oil.

- Such a strategy might affect emissions of GHG from the soil.
  - pool changes/sequestration

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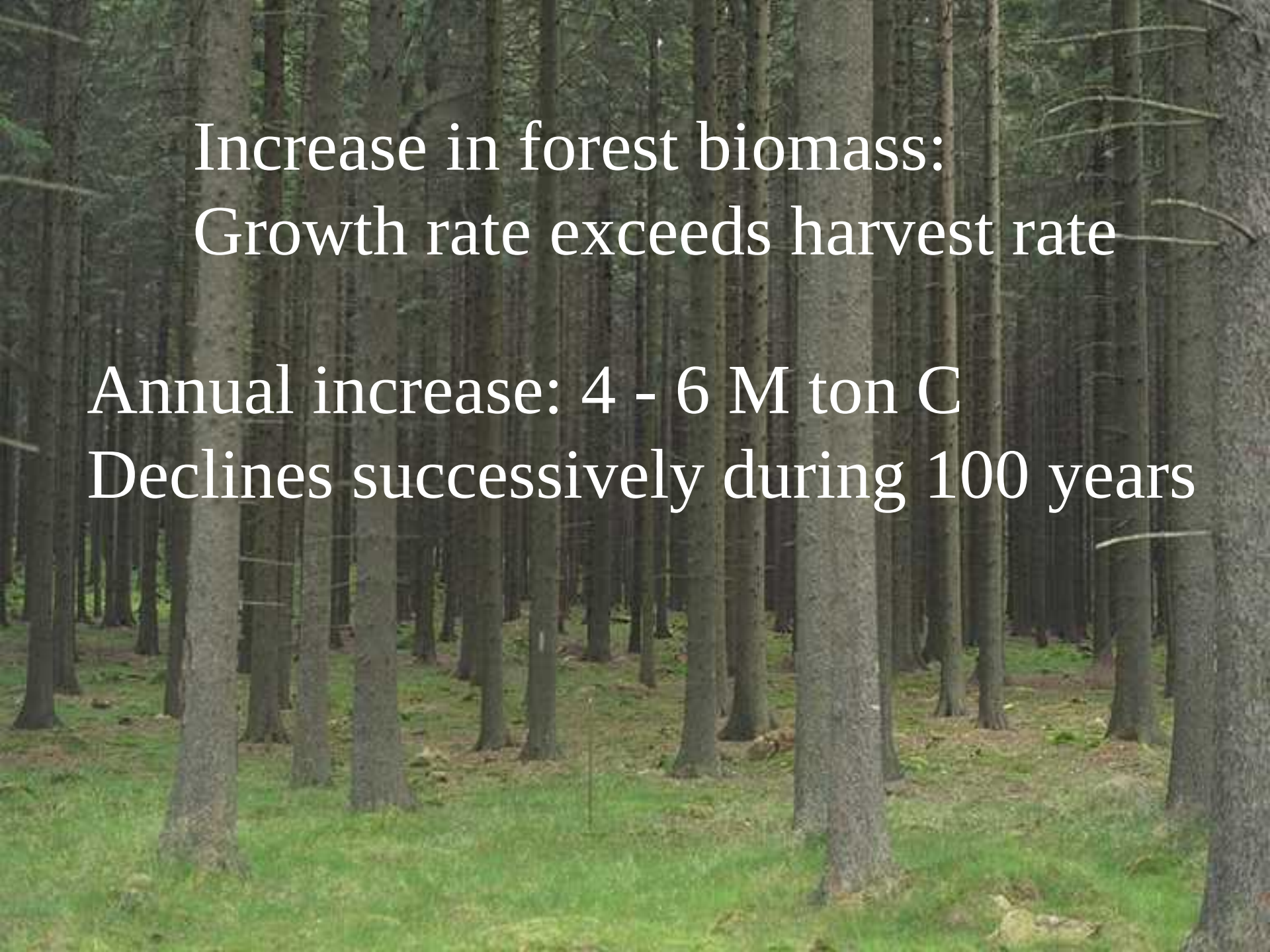


Increase in forest biomass:
Growth rate exceeds harvest rate

Annual increase: 4 - 6 M ton C
Declines successively during 100 years

Increase of soil C stock - humus layer

2 - 5 M ton C per year

Additional management strategies

..with the aim to increase supplies of biofuels
but with implications for sequestration and conservation

N - fertilisation	- CO_2 + N_2O
Drainage	+ CO_2 + N_2O -CH_4
Forest plantation on set-aside farmland	- CO_2
Mitigated site preparation	- CO_2

Example with optimised N fertilisation on 1M ha selected forest land

Optimised N-fertilisation	**10 yr**	**30 yr**	**100 yr**	**500 yr**
Substitution, M ton C yr^{-1}	0,0	0,0	0,34	0,45
Increase biomass, M ton C yr^{-1}	2,0	2,0	0,0	0,0
Increase soil C, M ton C $år^{-1}$	1,40	0,72	0,29	0,08
N_2O emission, M ton C $år^{-1}$	-0,18	-0,18	-0,18	-0,18
Sum	2,22	2.54	0.45	0.35

Observe:

In the short perspective, 0-30 years, stock increase is important

In the long perspective, > 50 years, the substitution effect is most important

Estimated total sink for managed forest land (23 M ha) through substitution, sequestration and conservation

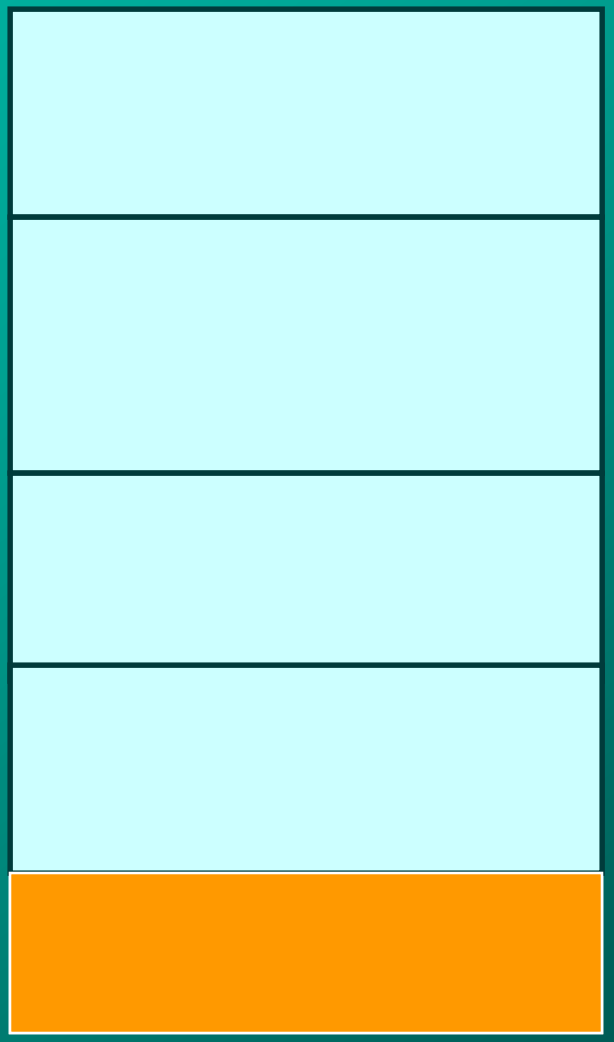
	0-10 yrs	**0-100 yrs**
Increase stand biomass	4-6	0,5-1
Increase soil humus	2-5	2-5
Harvest residues	1	4
Afforestation	1	0,5
N-fertilisation	2	0,5
Sum	10-15	7,5-11

0-10 years: total substitution: 1 (ca. 7-10%)

0-100 years: total substitution: 4,5 (ca 40-60%)

CONCLUSIONS

SUMMARY



Already substituted **4Mton**

Business as usual in managed forest - increase in stand biomass **5Mton**

Business as usual in managed forest - increase in soil humus **3,5Mton**

New strategies **4Mton**

Remaining emission **3,5 Mton**

CONCLUSIONS

* The current use of forest biomass as fuel has replaced other forms of energy - if fossil fuels, it would correspond to 20% decrease in emissions of CO_2

* Forestry has a big additional potential to reduse GHG emissions - at least up to 75% of the present emissions, due to substitution, sequestration and conservation

* It is better to build on strategies that enable substitution than to rely on stock increases in stand and soil


END