Wood preservation (carbon sequestration) or wood burning (fossil-fuel substitution), which is best for mitigating climate change?

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Atmosphere

Atmospheric increase: 4,1 ± 0,2 GtC/yr

Residual of the other budget terms

Land sink

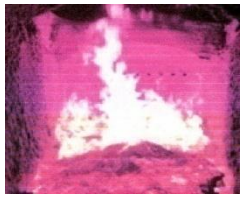
1 ± 0,7 GtC/yr

Land use change

≈ 1GtC/yr

Harvested wood

7,9 ± 0,5 GtC/yr



Fossil fuel combustion and cement production

2,3 ± 0,5 GtC/yr

Ocean sink

The global carbon budget (2000-2010 flux averages)

1 GtC = 10^9 tons of carbon = 3,67 $GtCO_2$

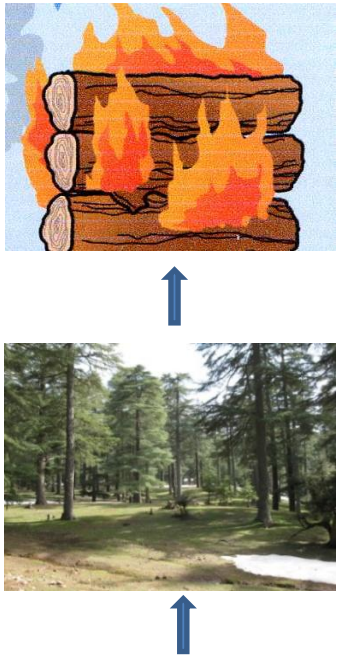
Sources:: Global Carbon Project, 2011; FAO, 2010

Resource	Emission factor (tC/toe)	Wood burning (1)	Wood preservation (2)
Wood (anhydrous)	1,16	**0**	**1,16**
Coal	1,1	1,1	0,06
Electricity (EU-mix)	1,06	1,06	0,1
Fuel oil	0,84	0,84	0,32
Natural gas	0,64	0,64	0,52
Electricity (F-mix)	0,25	0,25	0,91
toe: ton-oil-equivalent 1 tC = 3,67 tCO_2		**Avoided emission (tC/toe)**	**Net capture (tC/toe)**

(1) Substitution of wood for other fuels (under assumption of biomass carbon neutrality)
(2) Substitution of fuels for wood, wood being preserved for "a long time"

The logic of emission factors

Sources: CONCAWE/EUCAR/JRC, 2007
IPCC guidelines, 2006

	Wood burning (A)		Wood preservation (B)	
Emission	1,16 tC/toe	0	0	0,64 tC/toe
Sequestration	0	0	1,16 tC/toe	0
				
Capture	**X** or 1,16 tC/toe(*)	0	**X** or 1,16 tC/toe(*)	0
Net capture	X – 1,16 tC/toe or 0(*)		X – 0,64 tC/toe or 0,52 tC/toe(*)	
Balance B - A			**NET CAPTURE 0,52 tC/toe**	

1 tC = 3,67 tCO_2

[(*) under assumption of biomass carbon neutrality]

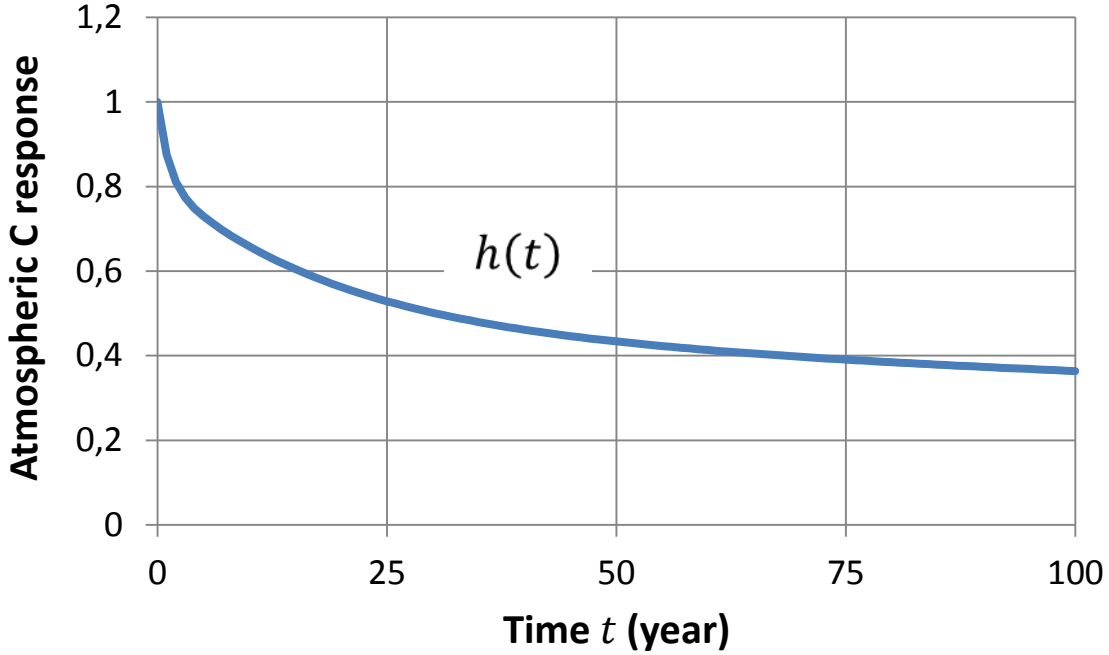
Better is to store wood than use it as a fuel

Pulse response:

$$h(t) = \sum_i a_i \exp\left(-\frac{t}{\tau_i}\right)$$

$a_0 \approx 0.22 \quad a_1 \approx 0.26$
$a_2 \approx 0.34 \quad a_3 \approx 0.19$

$\tau_0 \approx millenaries \quad \tau_1 \approx 170\ yr$
$\tau_2 \approx 18{,}5\ yr \quad \tau_3 \approx 1.2\ yr$



General response:

$$m(t) = \int_0^t e(\tau)h(t-\tau)u(t-\tau)d\tau \qquad t \geq 0$$

$e(\tau)$: carbon mass (or CO2 mass) emitted between times τ and $\tau + d\tau$
$m(t)$: carbon mass present in the atmosphere at time t
$u(t)$: unit step function

Global warming potential:

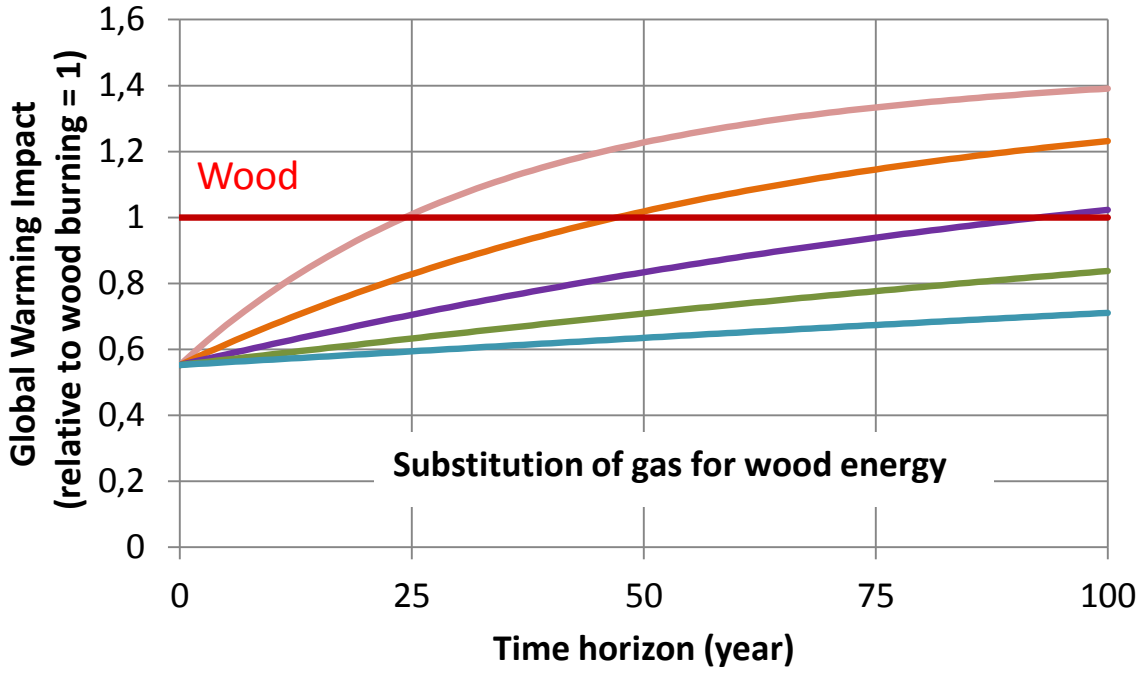
$$GWP = \int_0^{TH} R_F(t)dt \approx \int_0^{TH} \beta m(t)dt$$

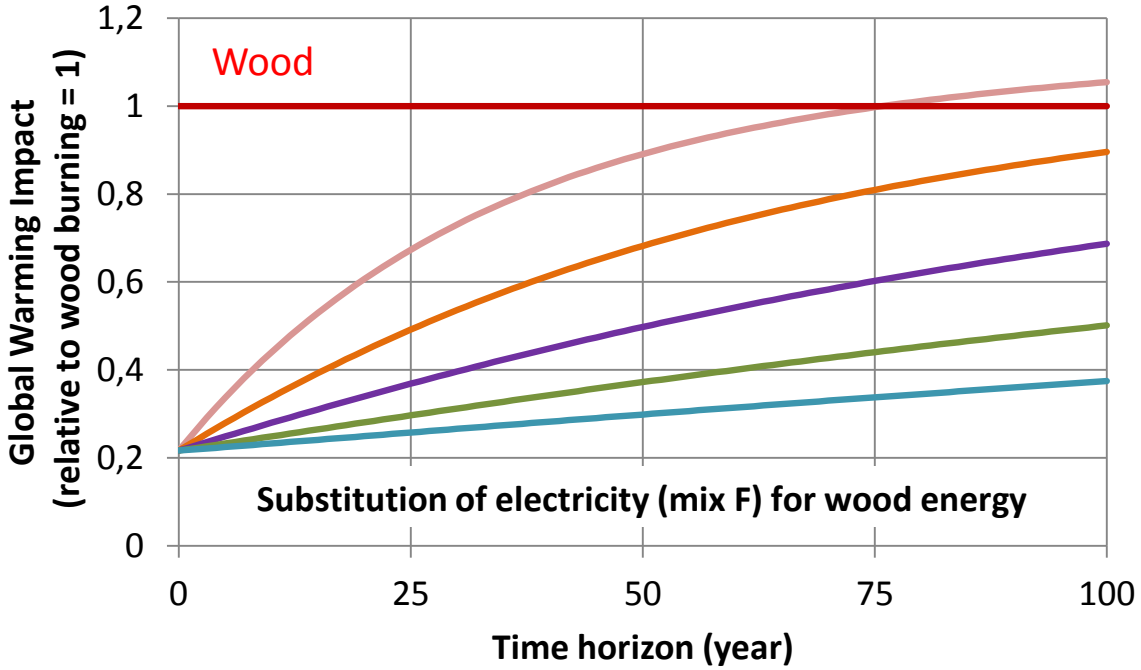
$R_F(t)$: radiative forcing $\approx \beta m(t)$ for small perturbations $m(t)$
TH : time horizon $\qquad \beta \approx 6.47 \times 10^{-15}\ W.m^{-2}.(kgC)^{-1}$

CALCULATION FRAME OF A GLOBAL WARMING IMPACT

Source : IPCC, 2007

GLOBAL WARMING IMPACTS: SUBSTITUTION OF GAS OR ELECTRICITY (MIX F) FOR WOOD FUEL





Wood degradation time constants:

- $\tau = 20$ years
- $\tau = 40$ years
- $\tau = 80$ years
- $\tau = 160$ years
- $\tau = 320$ years

wood reference

CONCLUSION

The concept of "carbon neutrality" in its application to wood is misleading :

- it occults the possibility of keeping wood as a means of carbon storage
- wood retains carbon for a long time if it is preserved
- wood is the worst fuel as regards carbon emissions

⟶ **It is better to store wood rather than use it as a fuel.**

A strategy of climate mitigation by wood storage is achievable:

- forests are efficient in removing carbon dioxide from the atmosphere
- wood conservation is possible over the long term by way of using it as a material and by recycling, landfilling or burying.
- during the necessary transition towards carbon emission stop, heat needs can be satisfied by available low emissive sources, such as natural gas, or electricity if it is produced mainly by carbon free means (hydro, nuclear, wind, solar)

MAIN REFERENCES

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