80th LCA Discussion Forum

Biogenic carbon modelling in French building LCAs

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Context in France

New building regulation RE2020 from January 1rst (residential) and July 1st (tertiary) 2022

Strong will of politics to promote biobased materials (wood, straw, hemp…)

Applies after detailed design, required to get a building permit

Design tools for early design phases, aiming at a more science based approach, voluntary performance targets beyond regulatory requirements

European standard 15804

-1/+1 Method

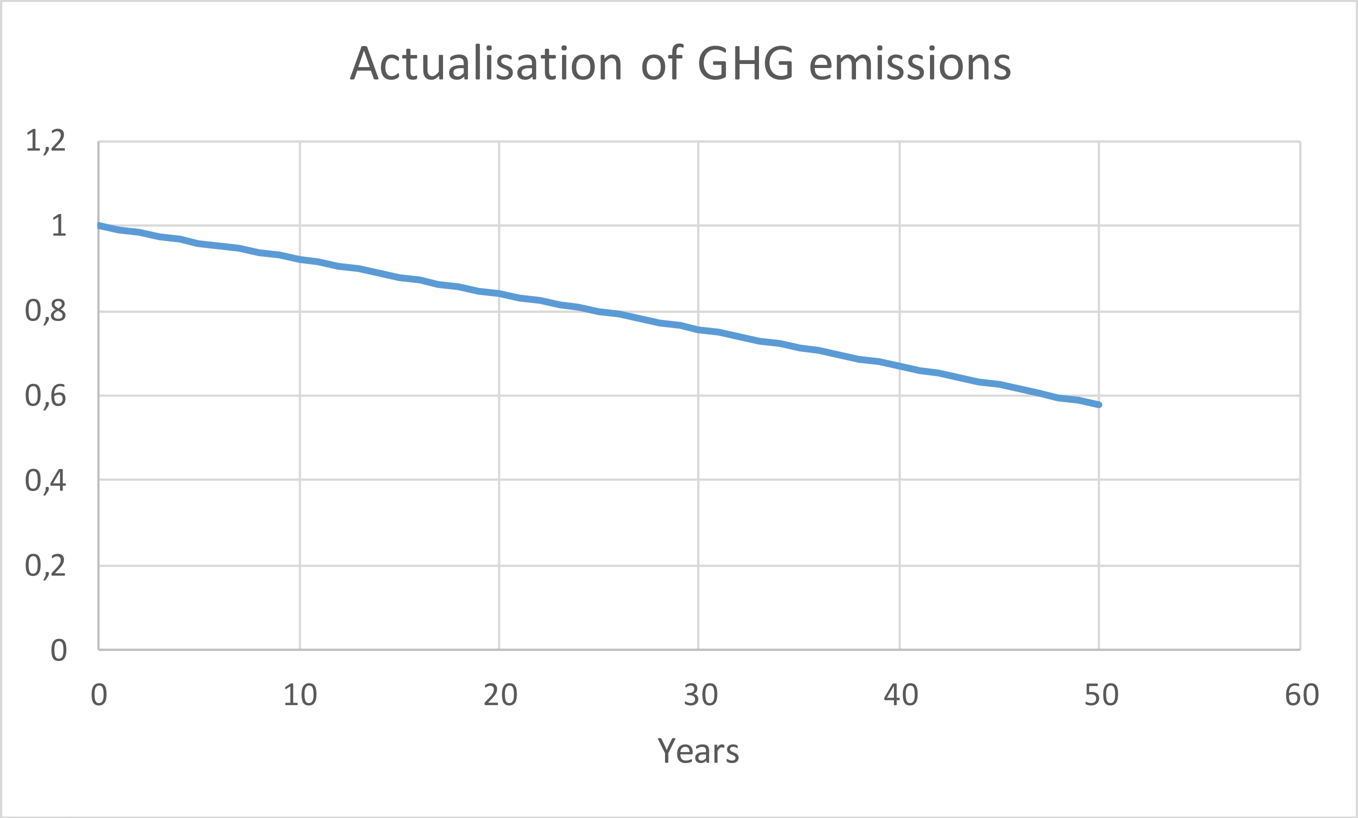
A quantity of CO_2 is absorbed when a tree is growing

It is offset at the end of life, whatever the process (incineration, landfill, recycling, reuse…)

Considered unfair, particularly for wood products

French regulation method RE2020

« Simplified Dynamic LCA » : future GHG emissions are discounted



1 kg CO_2 emitted year 50 = 0,578 kg CO_2 emitted year 0 (« dynamic GWP »)

CO_2 absorption (tree growing) considered year 0, incineration year 50 -> net negative balance

« Dynamic GWP » of RE2020 method

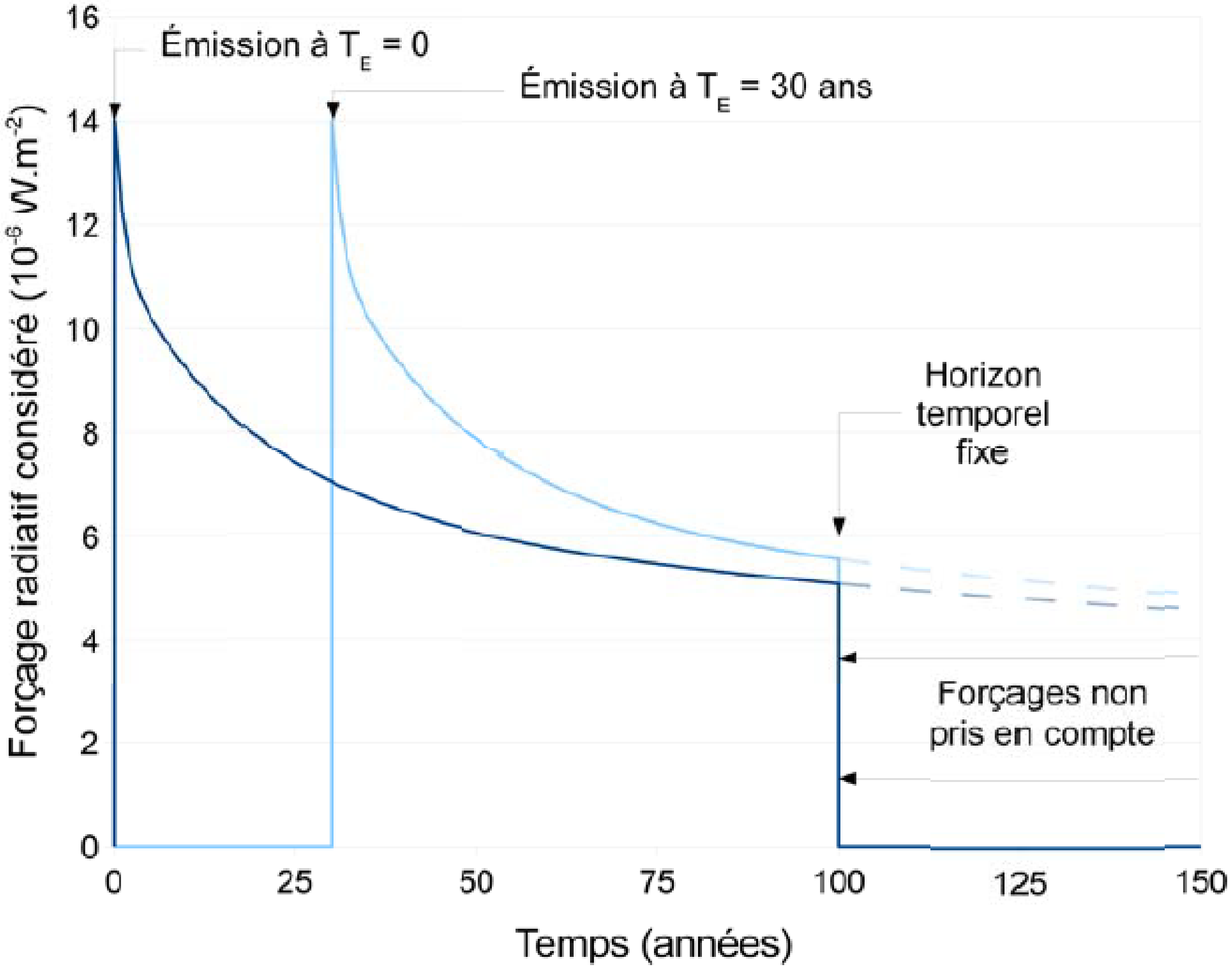


Figure IV.8 - Correction de la prise en compte temporelle du forçage radiatif d'émissions décalées dans le temps, cas des PRG définis à 100 ans

Source : Ventura A. and Feraille A. University G. Eiffel

« Dynamic GWP » :
GWP (t) = GWP (0) x Area under the curve (t) / Area under the curve (0)

Area considering a fixed time horizon of 100 years after year 0 instead of a rolling time horizon

Example for t = 30 years :
GWP(year 30) = GWP(year 0) x 0,75

1 dynamic GWP for CO_2 and another one for refrigerants

Side effects of this « simplified dynamic » approach

Fabrication of energy efficiency and renewable energy products at year 0, GWP(0)

Energy saving from year 0 to year 50, GWP(t) < GWP(0)

-> reduces the environmental benefit of energy saving and renewables

Other assumptions:

50 years life span -> lower importance of the use stage

Heating set point 16°C from 8h to 18h in residential buildings

Low ventilation rate (0,35 ach)

79 g CO_2/kWh electrical heating

-> in favour of selling more electricity (French state = main stakeholder of nuclear production)

Hourly dynamic approach in the Pleiades LCA design tool

Short term (over a year) variation of the electricity mix (e.g. peak demand in winter) -> higher GHG emissions per kWh electrical heating

Long term (over decades) variation but still import of electricity in long term (2050) scenarios (Environmental Agency, French TSO)

Design tool -> choice of consequential LCA -> marginal processes

More realistic life span (e.g. 100 years, structures lasting more than 200 years)

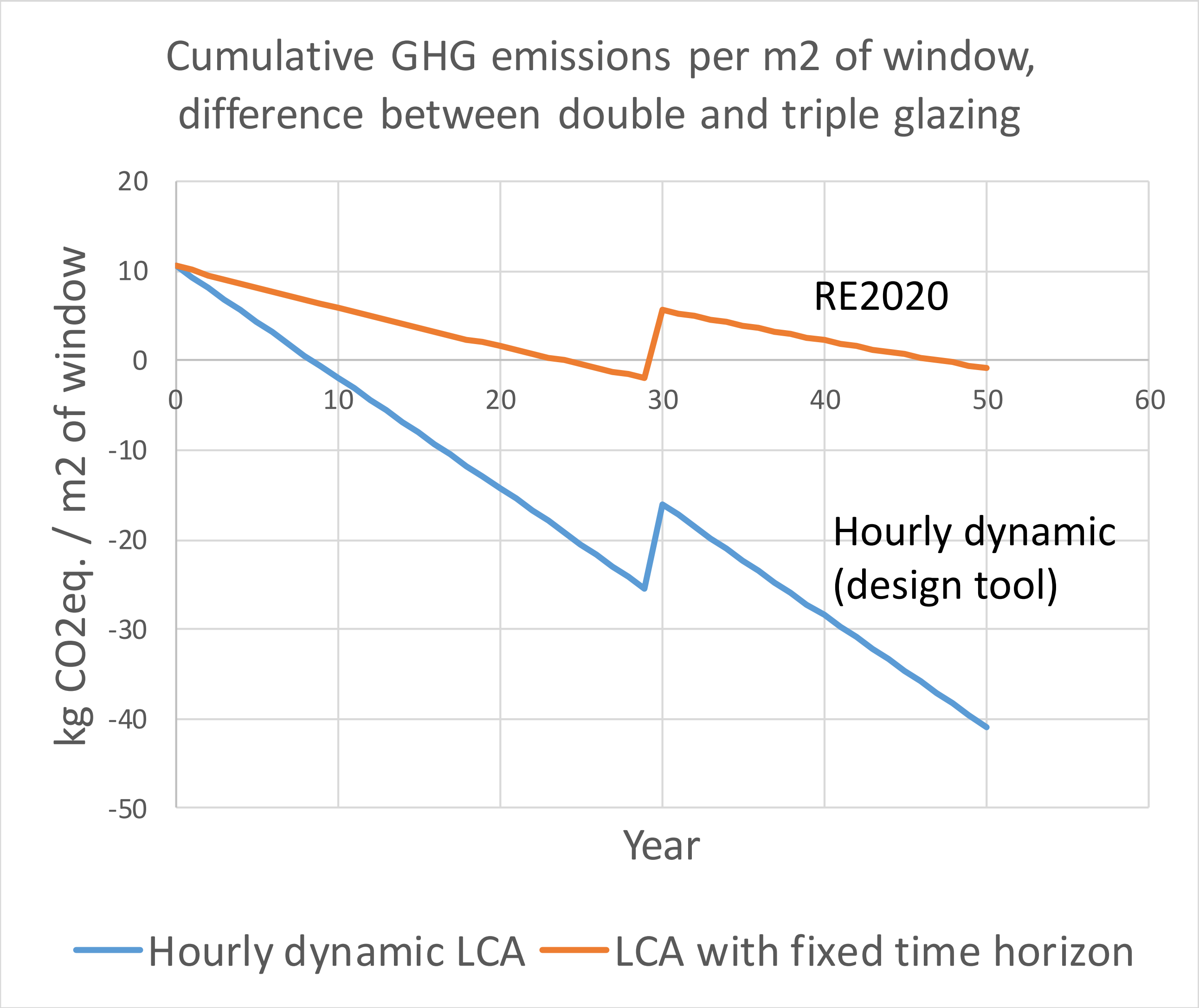
More realistic thermostat set points (e.g. 21°C) -> higher importance of operational energy

Example, double versus triple glazing

According to the hourly dynamic LCA, triple glazing reduces 5 times the fabrication emissions

According to the « simplified dynamic LCA » of RE 2020, there is no benefit for triple glazing

Case of a building heated by a heat pump



Objectives of a biogenic CO_2 model in a design tool

Integrate scientific knowledge as much as possible

Future GHG emissions do not have less impact than present emissions

Promote good practice : choice of low impact products, end of life processes

Example : choose wood from certified forest

The carbon stored in a building would be stored in a forest if the tree was not cut

-> carbon is stored only if a new tree is planted

Avoid collateral damage on other sectors (e.g. energy) and transfer of pollution

No discounting for future emissions

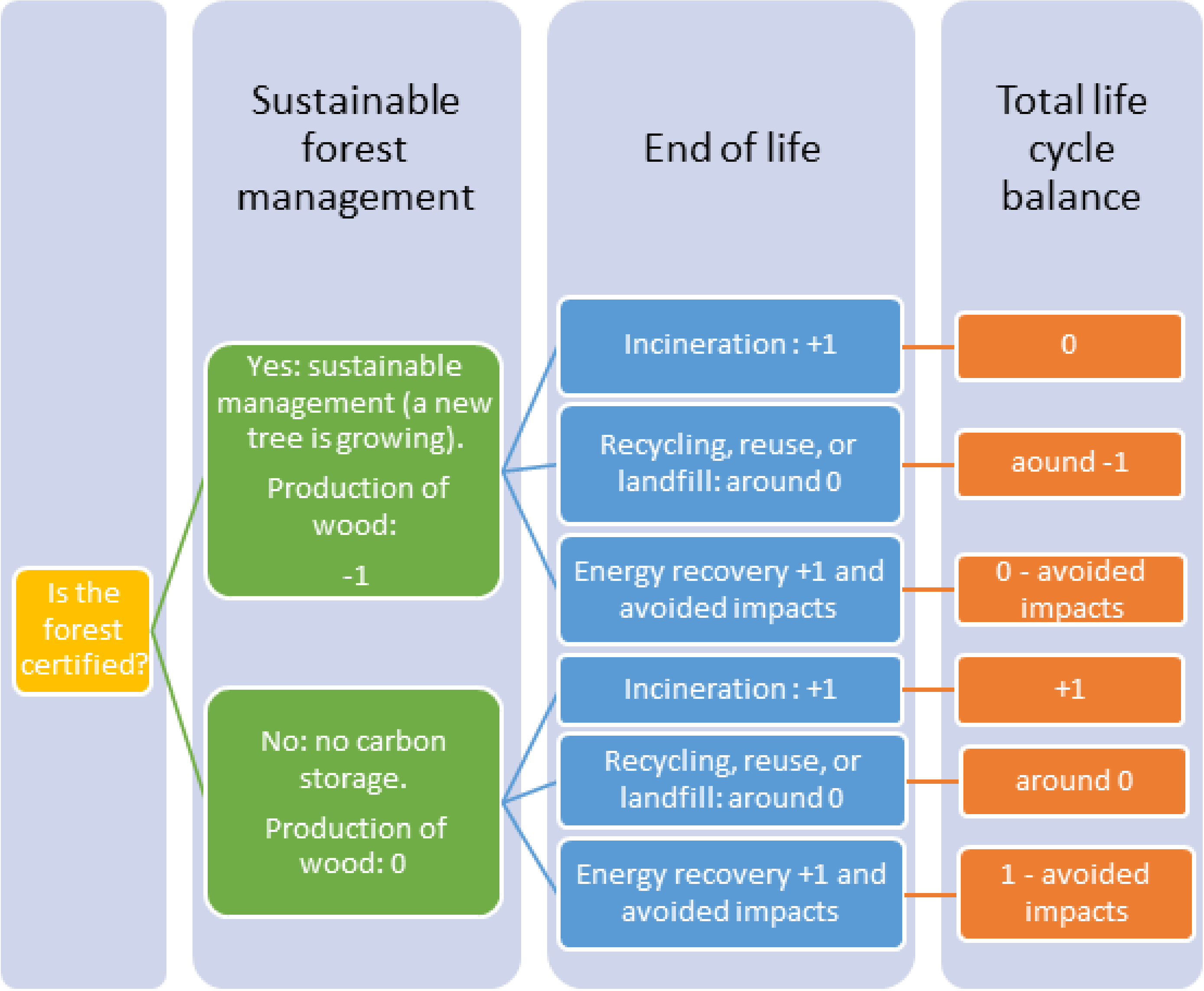
Total life cycle indicator allowing a global optimisation (biogenic + fossil)

Biogenic CO2 balance of wood

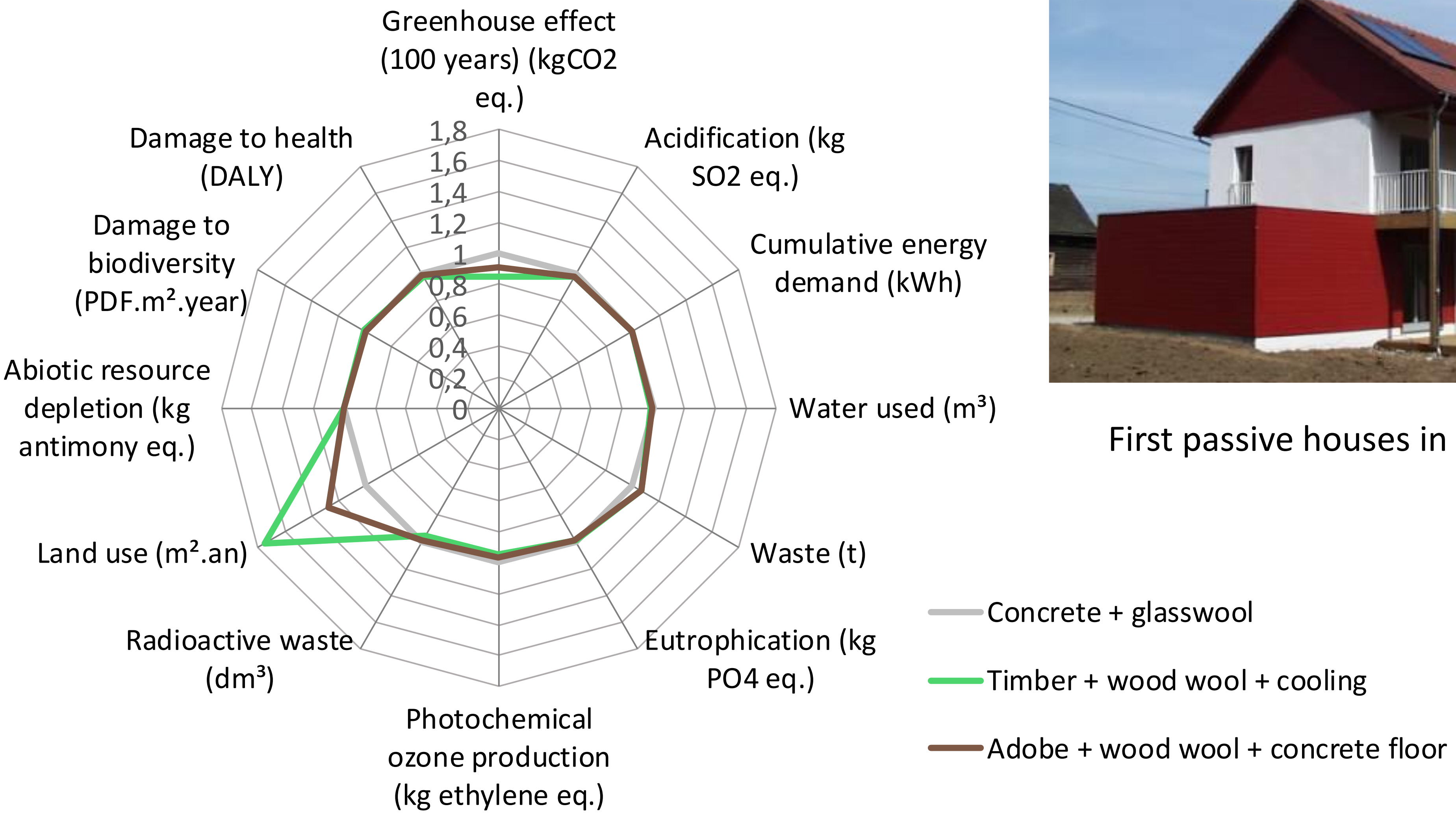
0.494 kg C/ kg dry wood

0.412 kg C / kg wood with 20% humidity x 44 / 12
-> 1. 51 kg CO_2 eq.

« +1 » = 1.51 kg CO2 eq.

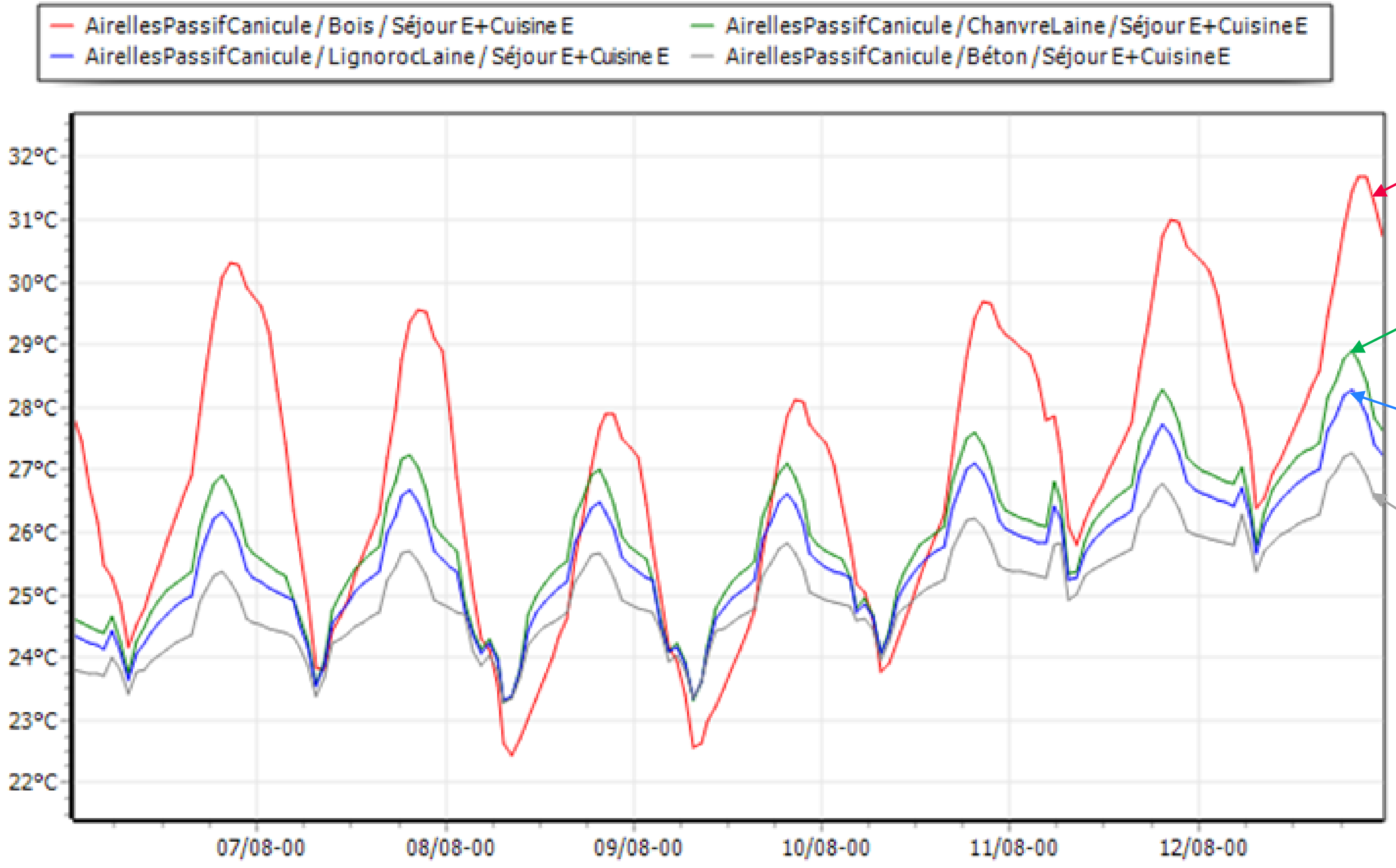


Example application, house



First passive houses in France, Formerie (2007)

Effect on cooling needs



House, 2003 heat wave

Timber structure and 30 cm glasswool

31 cm wood wool + 20 cm hemp concrete

38 cm wood wool+ 20 cm wood concrete

30 cm glasswool+ 20 cm concrete

27°C (high thermal mass) more comfortable than 32°C (light timber house)

Example, IZUBA building

Plus energy building

biobased + geobased materials

Timber structure, straw insulation

Thermal mass: raw earth, concrete floors

Renewable energies: gethermal heating,

Solar hot water, photovoltaic electricity

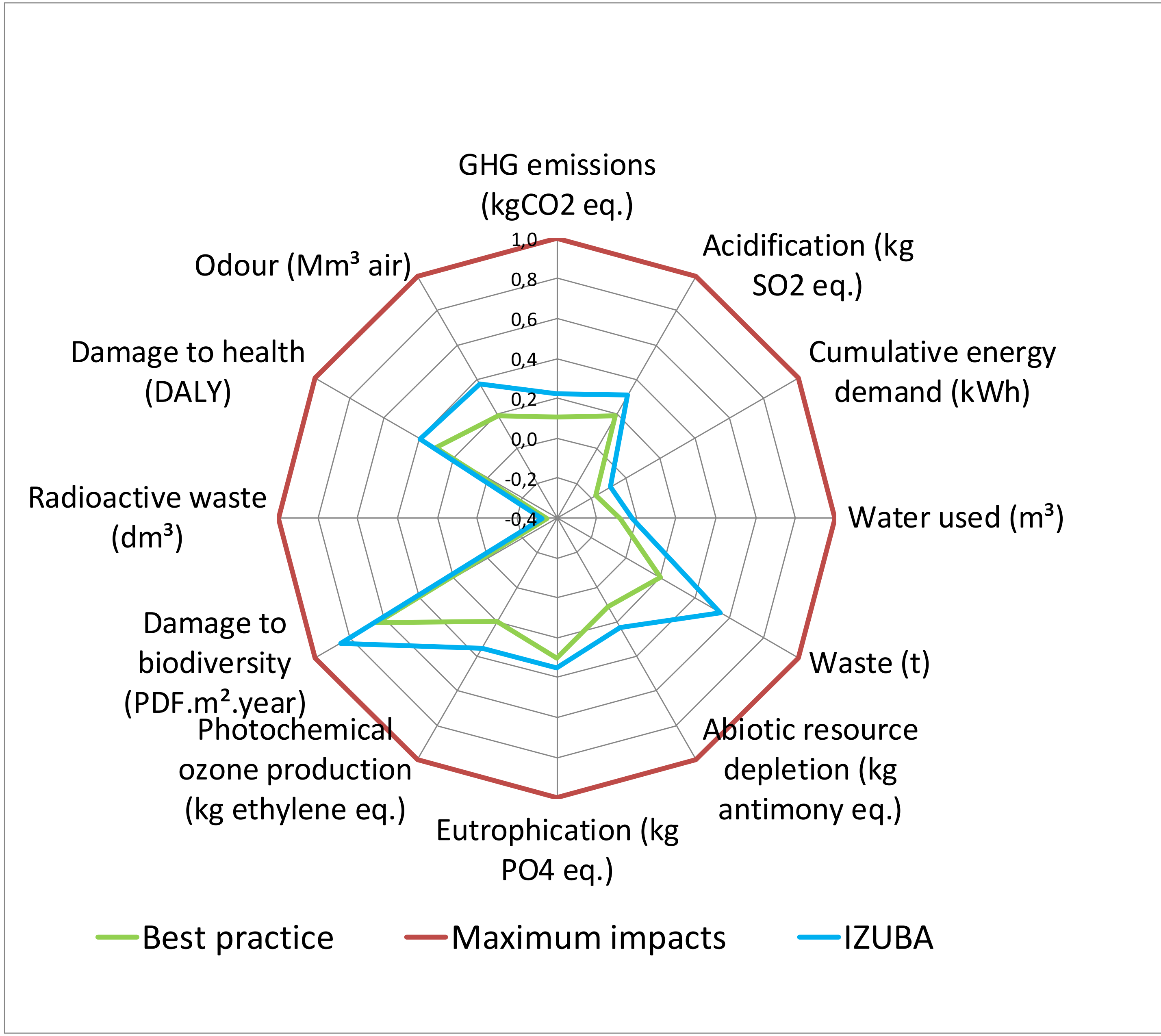
Architect: Vincent Rigassi, photos: Steven Morlier for IZUBA

Example, IZUBA building

Benchmark Annex 72
International Energy Agency

20 000 calculations -> references (best practice and maximal impacts)

Pleiades ACV design tool



Conclusions

Biobased and geobased materials generally reduce environmental impacts compared to mainstream materials

Need of appropriate evaluation methods

RE2020 may still be updated, consultation continues

Design tools evolve according to scientific knowledge

Questions ?

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