THE METHOD'S INFLUENCE ON CLIMATE IMPACT ASSESSMENT OF BIOFUELS AND OTHER USES OF FOREST BIOMASS

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Aims of our project

Contribute to more robust decision making concerning how to use Swedish forest biomass for reducing climate impact.

(intended audience: decision-makers in the forest product sectors, primarily the transportation biofuels sector)

Contribute to the process of improving the methods and practices of climate impact assessment in LCAs of forest products.

(intended audience: LCA community)

Background - challenges of carbon footprinting of forest products

Challenges relate to:

- Limitations in our:
  - understanding of how forests and the climate interact
  - understanding of how this interaction is influenced by the extraction of forest biomass
  - ability to model this interaction
- Value-based modelling choices

Examples of challenges:

1. Geographical aspects of modelling the carbon flows
2. Time-related aspects of modelling the carbon flows
3. Other climate aspects (N_2O emissions, the albedo effect, etc.)
4. Reference situation in the forest model

How we addressed the aims

Life cycle assessment (LCA) of **5 forest products**, comparing **3 different methods** for carbon footprinting

Forest biomass product		Functional unit	Benchmark product
Automotive fuel	Lignin-based fuel	Passenger car driven 1 km	Gasoline
	Butanol		Diesel
Building	Building with cross-laminated timber structure	1 m^2 living area	Building with concrete structure
Textile fibers	Viscose	1 kg fibers	Cotton
			Polyester
Chemical	Methanol	1 tonne methanol	Fossil methanol

The methods - selection

What influences/guides the LCA practitioner:

1. Approaches traditionally used in LCA

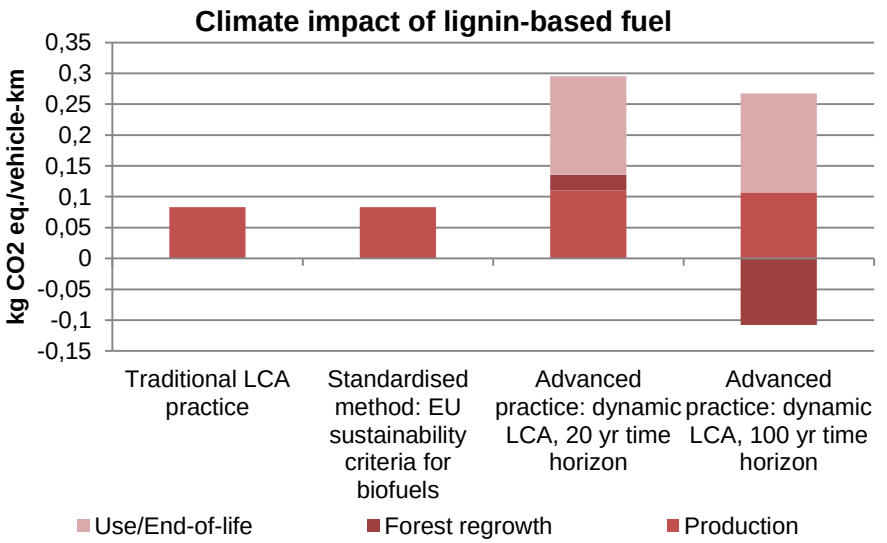
   (Røyne et al. 2016)

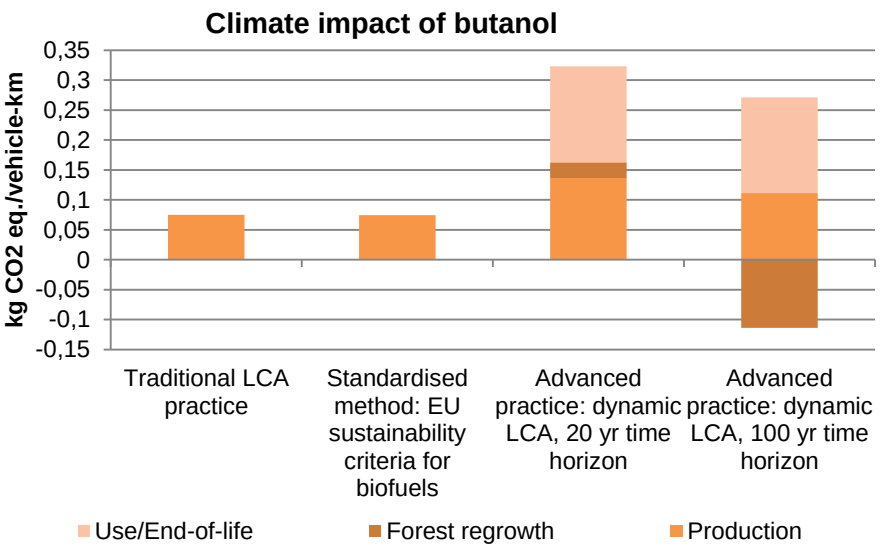
2. Recommendations in standards
   - EU sustainability criteria for biofuels
   - Product Environmental Footprint standard
3. New methods proposed in the scientific literature
   - Dynamic LCA

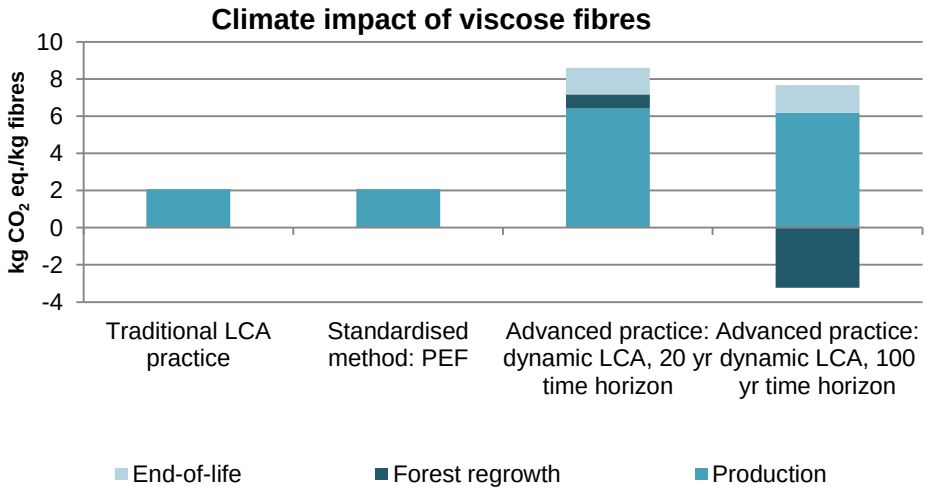
The methods - procedure

Aspect of climate impact	Traditional LCA practice	Standards	Dynamic LCA
Timing of emissions and CO_2 capture	X	X	V
Biogenic CO_2 emissions = climate impact	X	X	V
Time horizon of characterization factors	100 years	100 years	Any time horizon possible
Change of soil organic carbon	X	(V)	V
N_2O emissions from land use (fertilisation)	X	(V)	(V)
Albedo effects	X	X	(V)
Aerosol effects	X	X	(V)
Indirect land use change	X	X	(V)
(Article only) Reference situation at forest	X	X	(V)

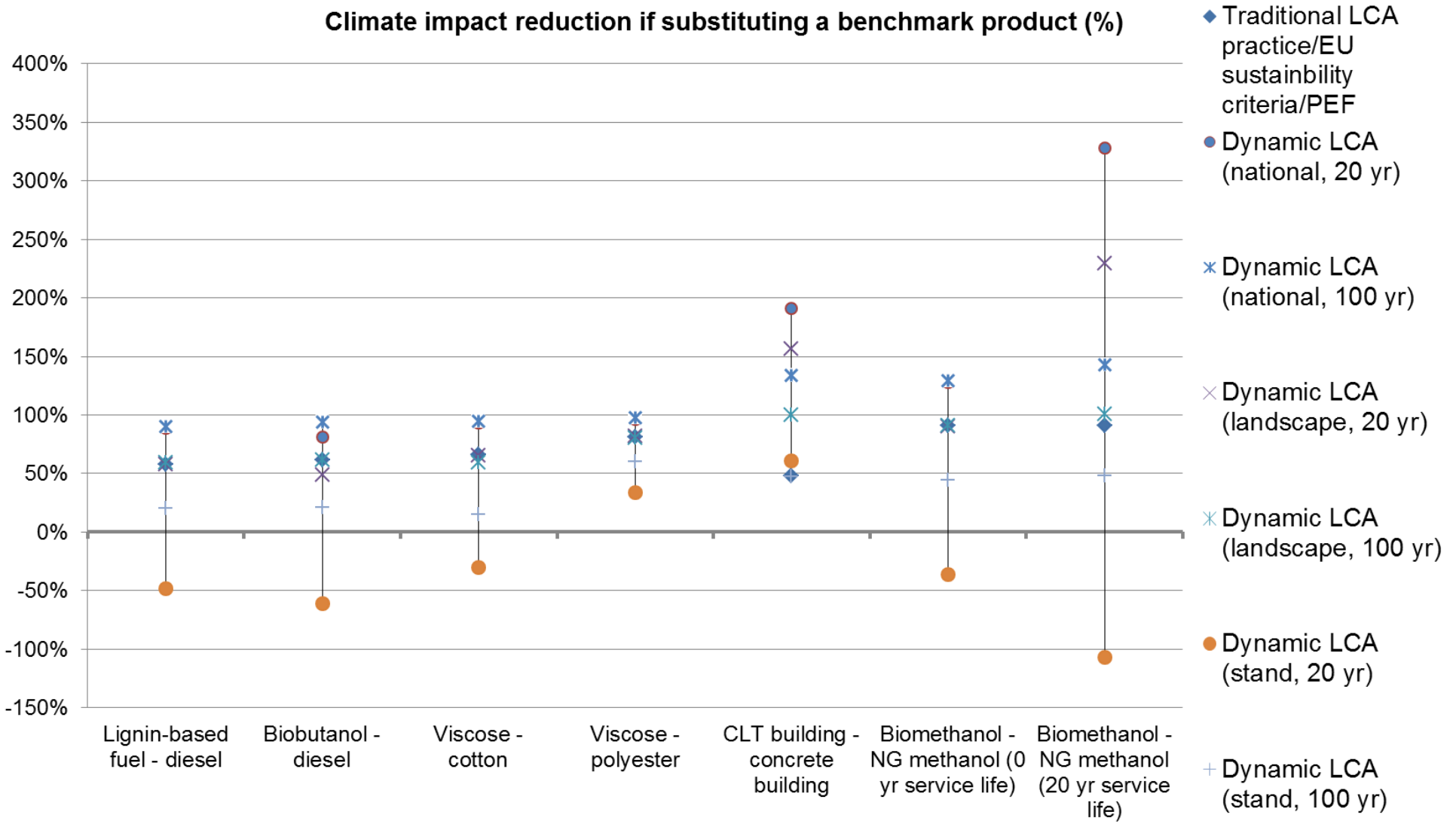
Results – Short-lived products





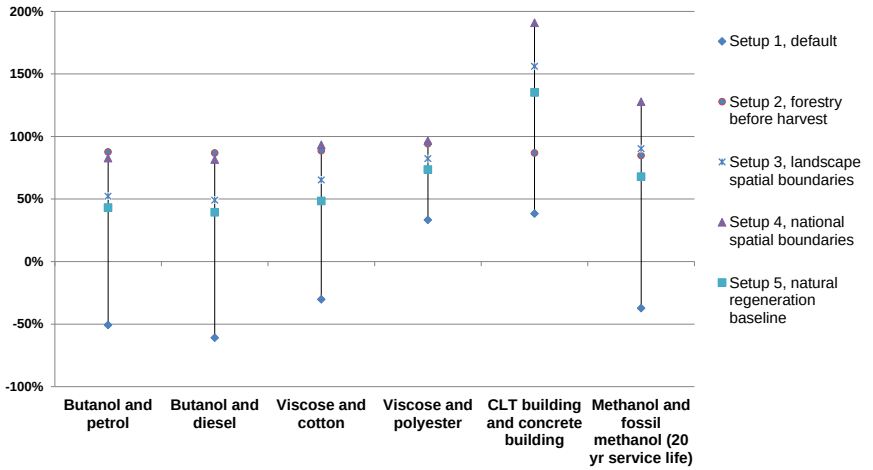


Results (Report)

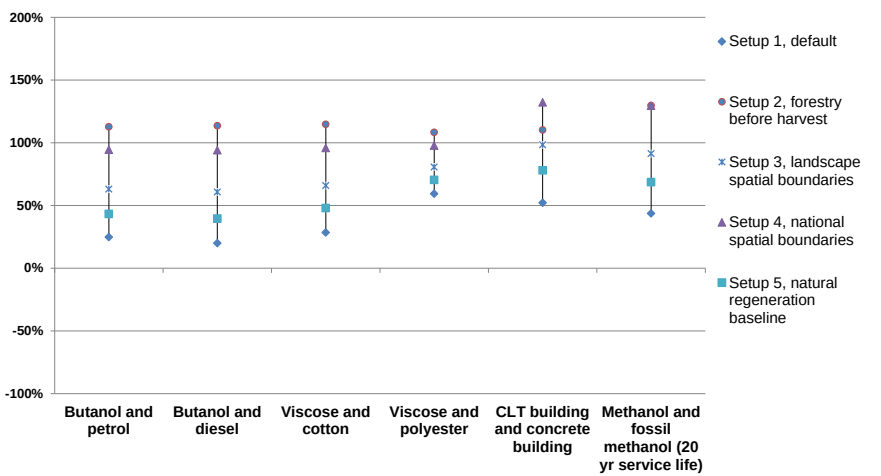


Results (Article)

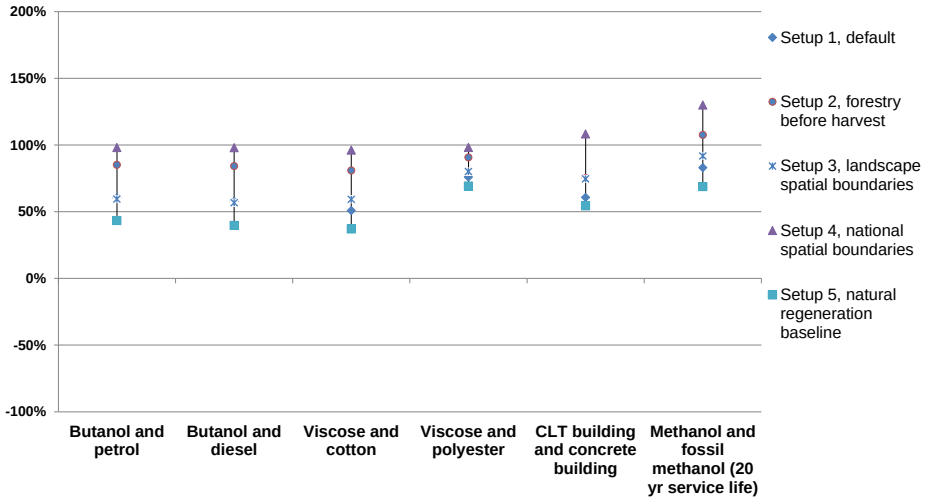
(a) Difference from benchmarks at 20-years time horizon



(b) Difference from benchmarks at 100-years time horizon



(c) Difference from benchmarks at 300-years time horizon

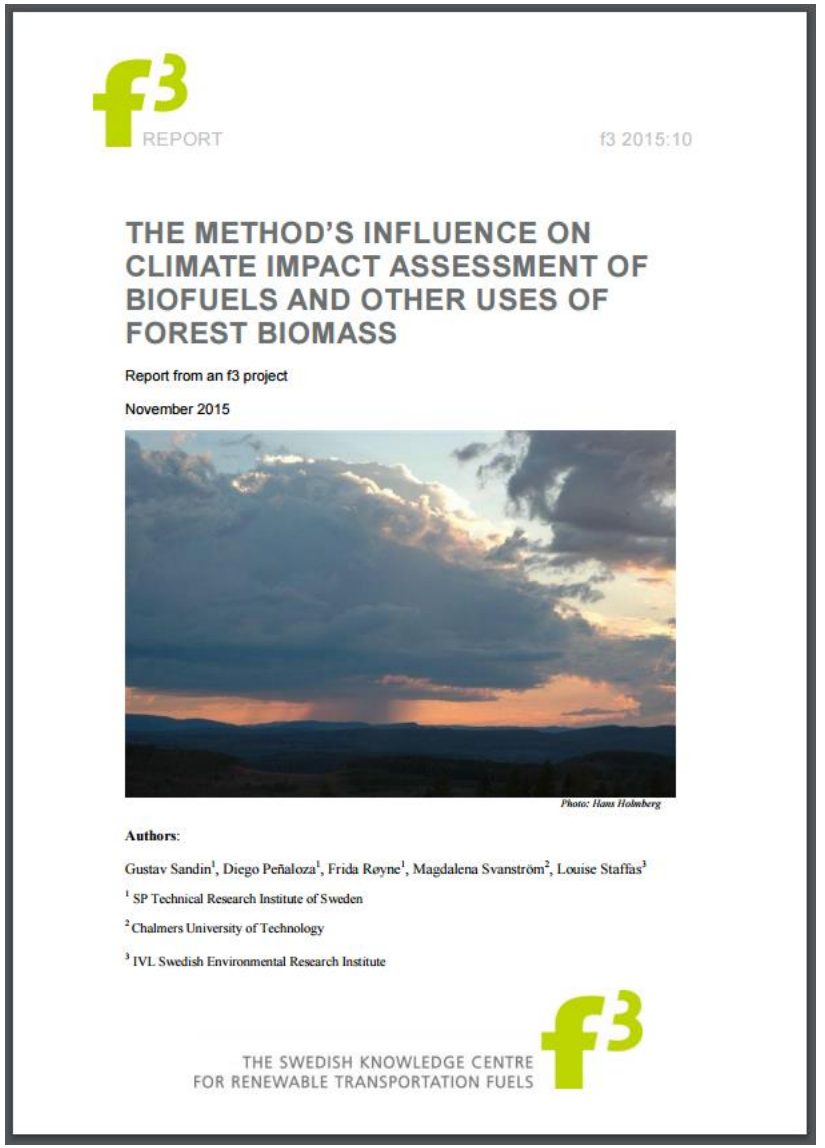


Main observations

- Traditional practice and standards: marginal difference
- Dynamic LCA: remarkable difference
  - Acknowledges timing
  - Time horizons large impact
  - Service life decisive
- Comparison with benchmarks depends much on method
  - More for short-lived products

Concluding remarks

- Aspects not explored (ILUC, albedo, aerosols) could have large impact
- Is GWP100 (100-year time horizon) a good fit for forest products?
- Location, growth rates and harvest patterns are important
- Advanced methods are data demanding
  - Location, growth rates, harvest patterns!
- **Method choice: depends on the study aim**
  Important with awareness and transparency



REPORT f3 2015:10

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Report from an f3 project

November 2015

Photo: Hans Holmberg

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THE SWEDISH KNOWLEDGE CENTRE FOR RENEWABLE TRANSPORTATION FUELS

Thank you for your attention!

Optional slides for clarifications

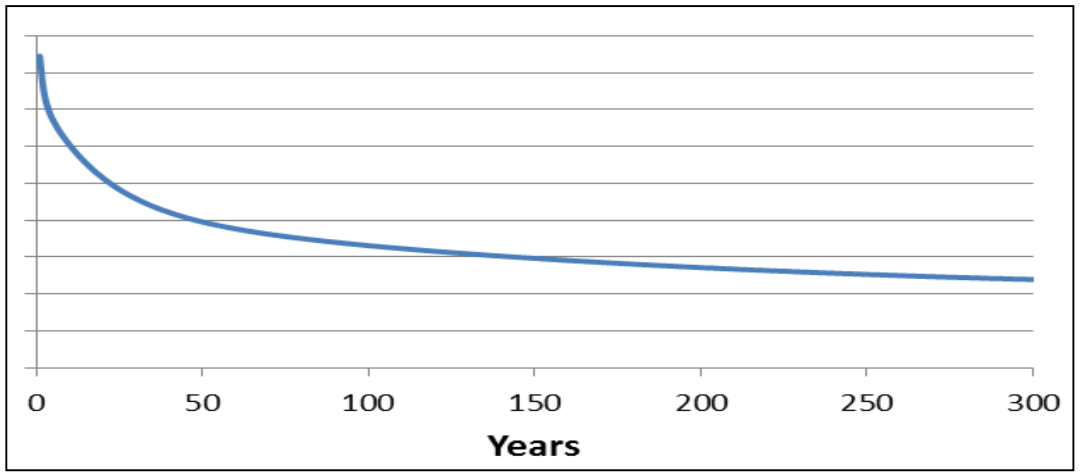
DYNAMIC LCA AND CARBON SEQUESTRATION

The basics of GWP

What is the impact of 1kg CO_2?

Radiative forcing

Unit: $W*m^2$

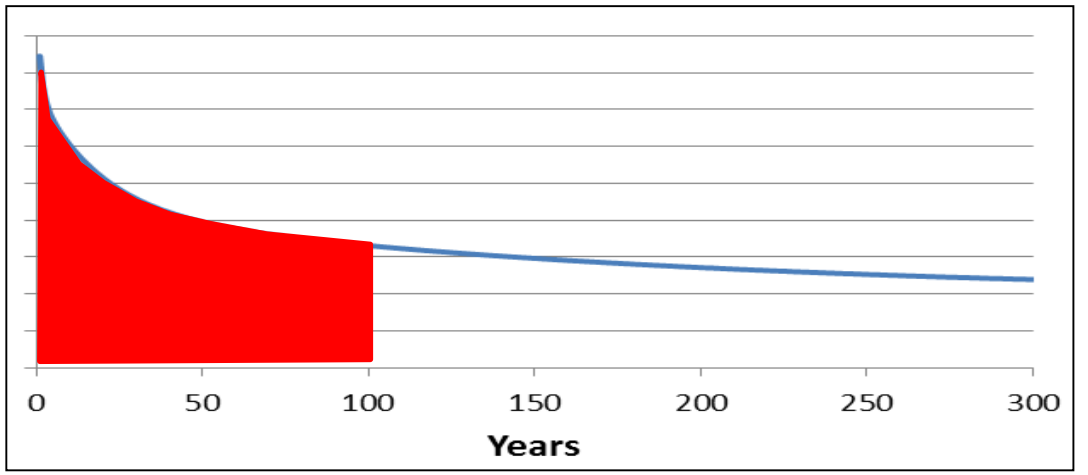


What is Global Warming Potential?

GWP 100

Unit: kg CO_2-equivalents

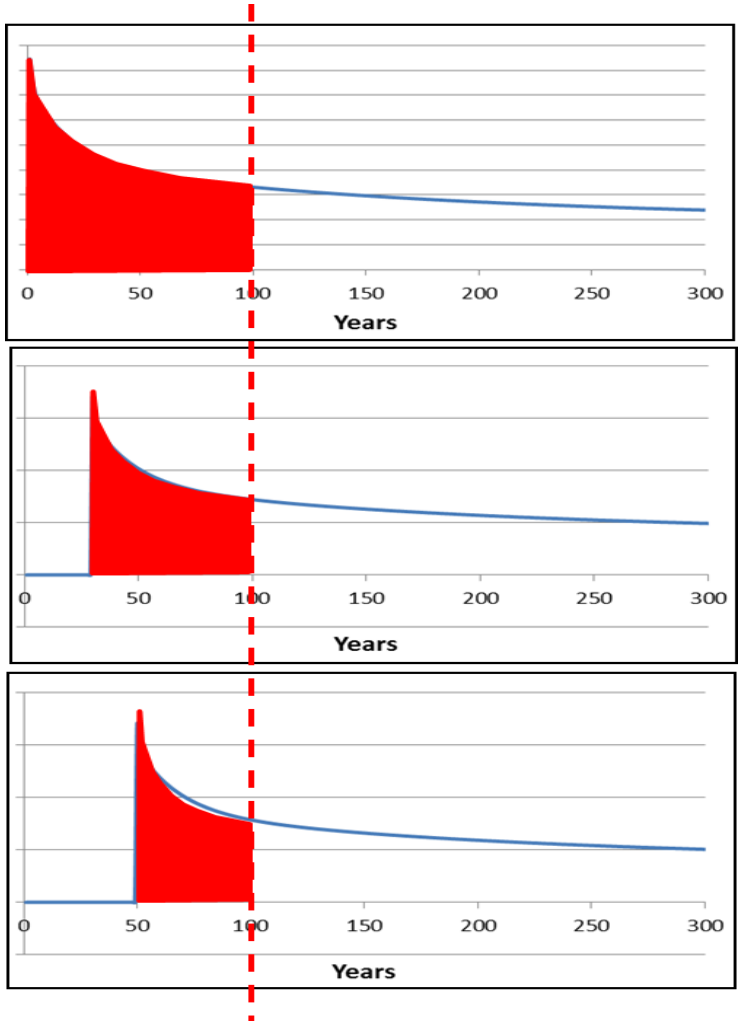
100 years “Time Horizon”



Further reading:
Intergovernmental Panel for Climate Change (IPCC)
“The Science of Climate Change” - 1992

Dynamic LCA

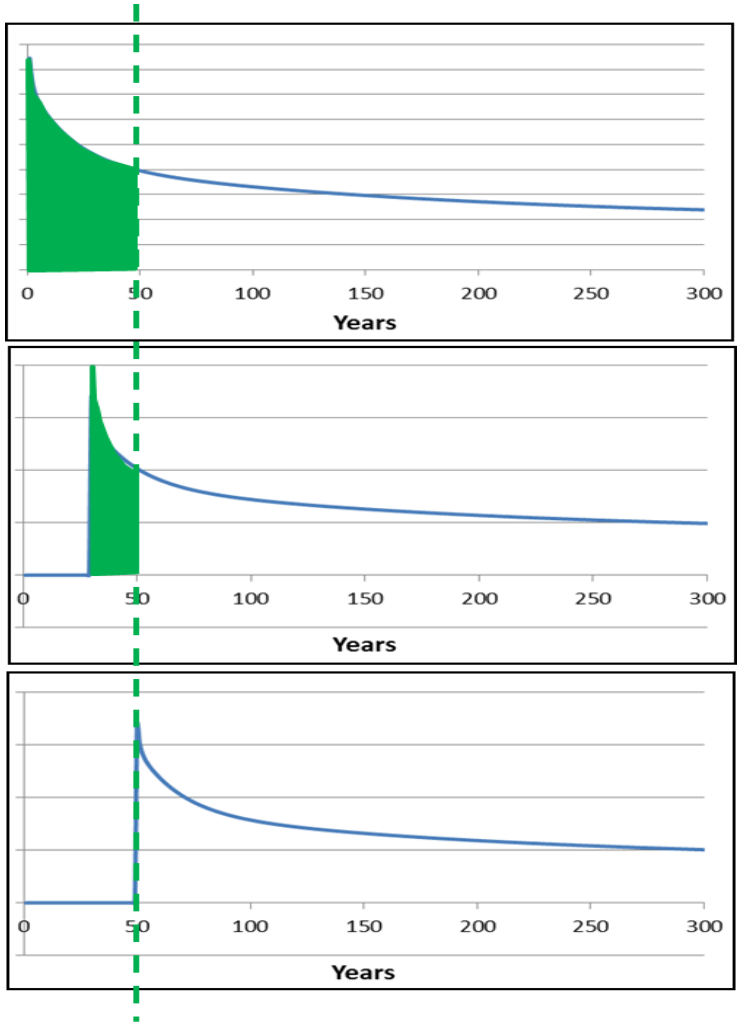
Time horizon of 100 years



In year 0

In year 30

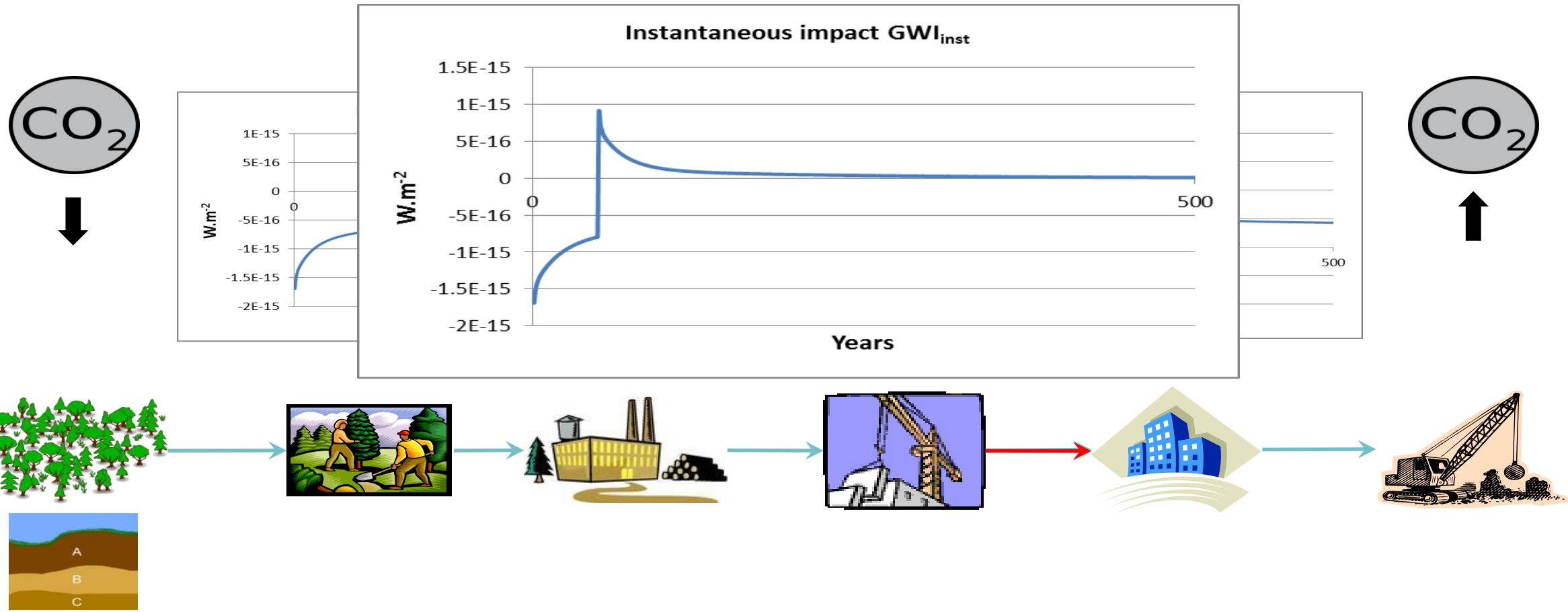
In year 50



Time horizon of 50 years

Further reading:
Levasseur, A. Lesage, P., Margni, M., Samson, R. (2012). Biogenic carbon and temporary storage addressed with dynamic life cycle assessment. J. Ind. Ecol. 17 (1), 117-128. Doi: 10.1111/j.1530-9290.2012.00503.x.

Capturing carbon storage in forest products



Further reading:

Brandão, M., Levasseur, A., Kirschbaum, M., Weidema, B., Cowie, A., Jørgensen, S., Hauschild, M., Pennington, D. and Chomkhamsri, K. (2013). Key issues and options in accounting for carbon sequestration and temporary storage in life cycle assessment and carbon footprinting. International Journal of Life Cycle Assessment 18, 230-240.