fabrique de solutions durables

LCA of composites for automotive : what are the findings ?

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EPD
Climate - Carbon Footprint
Biodiversity

ECO-DESIGN
Eco-design accompaniment
Creativity and product innovation

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References extract - composite industry

- 2016 – ADEME - LCA of biobased composite vs fossil automotive piece

- 2010 – 2015 – PSA - LCA of biobased composite vs fossil wing mirror
  + peer review of composite LCA

- 2012-2017 – COMPOFAST project - LCA of composite structural part for automotive

General Context

Composites manufacturing is an innovative sector that represents a **real opportunity for the development of new solutions based on high performance fibers.**

Composites utilization is an important cornerstones of eco-design in different type of sector : transport, sport, building, …

Increasing interest from industries and institutions for composites is due to:

- Need of high performance product
- Awareness of sustainable development issues (in particular Global Warming)

Composites are complementary to other material for complexe design.

Issue

In order to achieve recognition on the market, **composite materials need to prove their relevance** in terms of :

- **Technical properties** (equal or new properties compared to reference product)
- **Economic competitiveness**
- **Environmental performance**

Life Cycle Assessment (LCA) is nowadays considered as **the reference methodology for environmental impact assessment** of products.

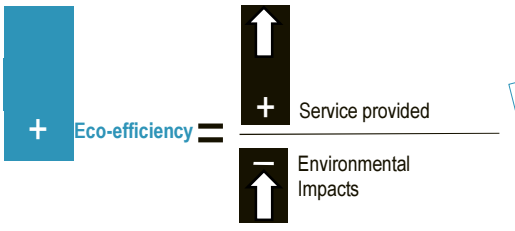
LCA contributes to highlight the environmental interest of composites compared to other materials.

What is eco-design?

- **Improving the service provided,** i.e. the product functions
- And/or **reducing their environmental impacts**

→ With an optimized cost based on the targets and means of the company

Product eco-efficiency (goods and services)



Source : EVEA training

STRATEGIC examples toward ECO-EFFICIENCY:

- *Time of life extended (robuster and/or reusable)*
- *Multi-functions (ex: table with integrated chairs) or conversely « just necessary »*

What is an eco-product?

An eco-product can :

Have a lower environmental footprint for the same service provided

and / or

Cont… the environmental …r system

What about composites ?

What is an eco-product?

An eco-product can :

Composites can have a higher manufacturing impact than other materials

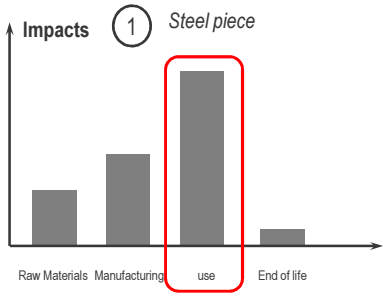
BUT

Contribute to reduce the use phase impact of a vehicule

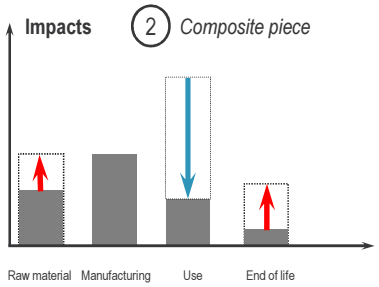
Is it balanced ?

Global comparison between 2 automotive pieces

The major impact is use step of the car



Impact reduction in the delivery step but increase in other steps



Fuel consumption due to automotive pieces weight

Reference : On the calculation of fuel savings through lightweight design in automotive life cycle assessments

Source : Christopher Koffler, 2010, IJLCA

Hence, the *decrease (or increase) in fuel consumption* for a given design option i calculates as:

$$\Delta C_{comp,i} = \Delta m_i * V_{100\ kg,\ NEDC} * 0.01$$

$$= (m_{comp,i} - m_{comp,ref}) * V_{100kg,\ NEDC} * 0.01 \quad (16)$$

with

$\Delta C_{comp,i}$ weight-induced decrease (or increase) in fuel consumption of component design option *i* (l/100 km)

$m_{comp,i}$ component mass of design option *i* (kilogram), and

$m_{comp,ref}$ reference component mass (kilogram).

$$V_{100\ kg,\ NEDC} = 1.95\ MJ * 1.02 * 0.07\overline{3}\ l/MJ \approx 0.15\ l/(100\ km * 100\ kg)$$

for naturally aspirated gasoline engines, to

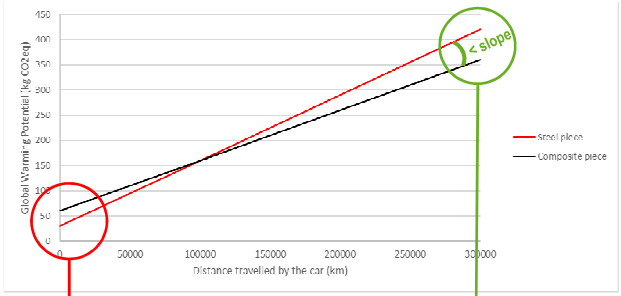
$$V_{100\ kg,\ NEDC} = 1.95\ MJ * 1.02 * 0.076\ l/MJ \approx 0.15\ l/(100\ km * 100\ kg)$$

for turbocharged gasoline engines, and to

$$V_{100kg,\ NEDC} = 1.95\ MJ * 1.02 * 0.06\overline{1}\ l/MJ \approx 0.12\ l/(100\ km * 100\ kg)$$

Global Warming potential of 2 automotive pieces

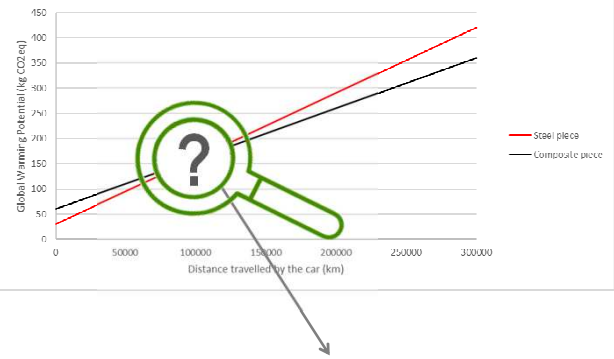
Global Warming potential of 2 automotive pieces



Production impact

Utilisation benefits

Global Warming potential of 2 automotive pieces

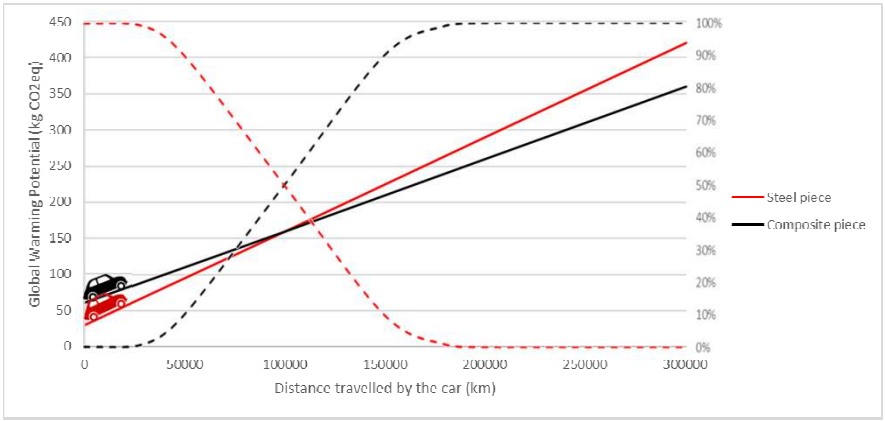


At this point, it is not possible to distinguish the 2 solutions…

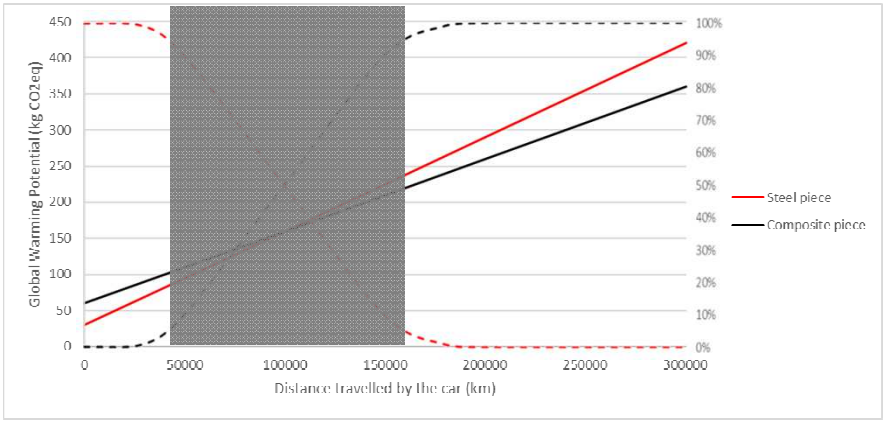
What is the uncertainty on this breaking point ?

Breaking point uncertainty evaluation : Using Monte Carlo analysis into sensitivity analysis

UNCERTAINTY ANALYSIS



Breaking point uncertainty evaluation : Using Monte Carlo analysis into sensitivity analysis



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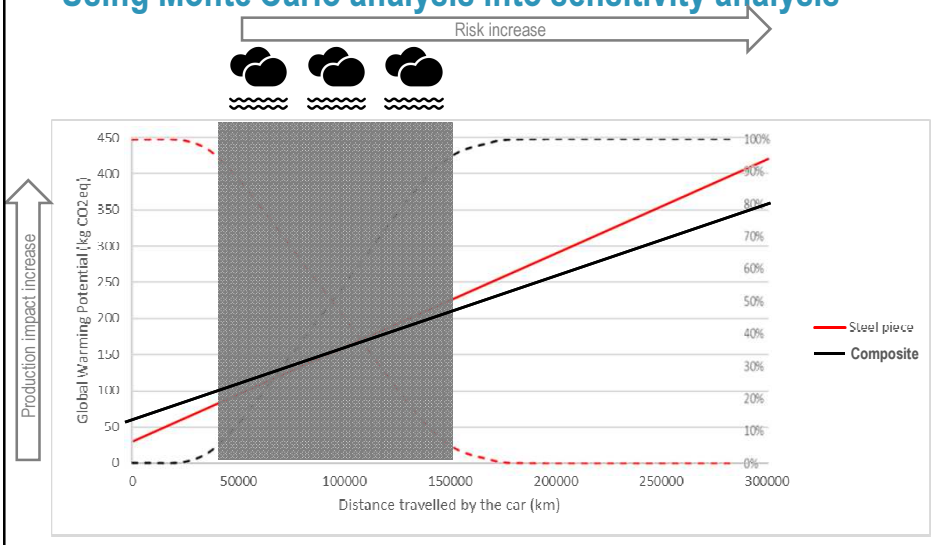

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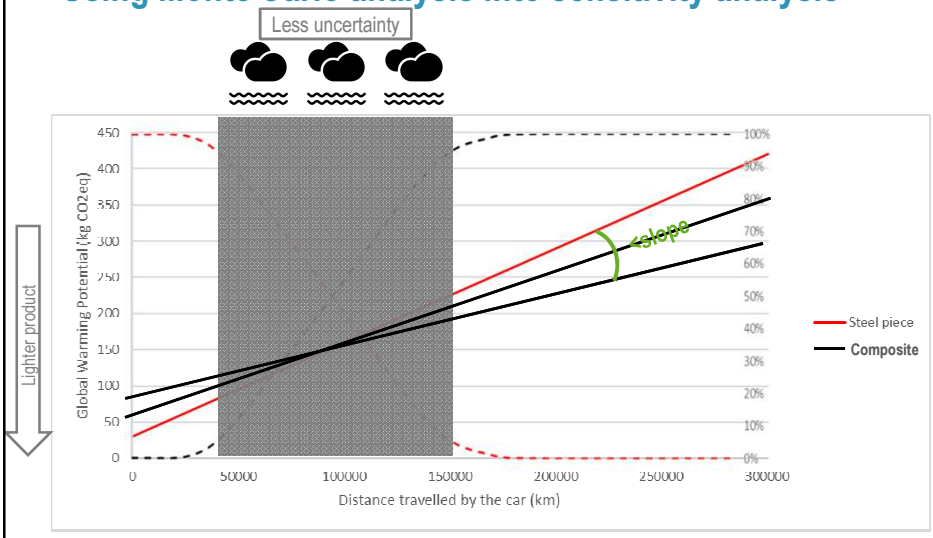

Conclusion

- LCA generally highlights the environmental interest of composites for automotive application
- Nevertheless, it is important for the composite industry to ensure this interest by:

Reducing the production impact (preforming waste, recycling, energy consumption…)

+

Continue to lighten the products (high performance resin and fibers…)

→ Reduction of the breaking point value + → Reduction of the uncertainty range

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Thank you for your attention !

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