Life cycle based assessment of decarbonisation options - towards scientifically robust carbon neutrality

Vanessa Bach, Matthias Finkbeiner

LCM 2021

5th - 8th September, 2021
Stuttgart, online

SUSTAINABLE ENGINEERING

Technische Universität Berlin
Department of Environmental Technology
Chair of Sustainable Engineering

TU berlin

Carbon neutrality

- Main goal of the Paris Agreement is to tackle climate change
  - Net zero by 2050: From 2050 a balance shall be reached between CO_2 emissions and CO_2 absorption

- Carbon neutral products, services, organizations, countries…

Climate neutral
Product
ClimatePartner.com/00000-0000-0000

ups
CARBON NEUTRAL SHIPMENT
ups.com/carbonneutral

carbon footprint standard
Carbon Neutral Organisation

ALDI UK and ALDI Ireland will be carbon-neutral by 2019

Facebook and Google announce plans to become carbon neutral

Spain at last adopts promised law on becoming carbon neutral
May 13, 2021

Germany pledges to become carbon-neutral by 2045

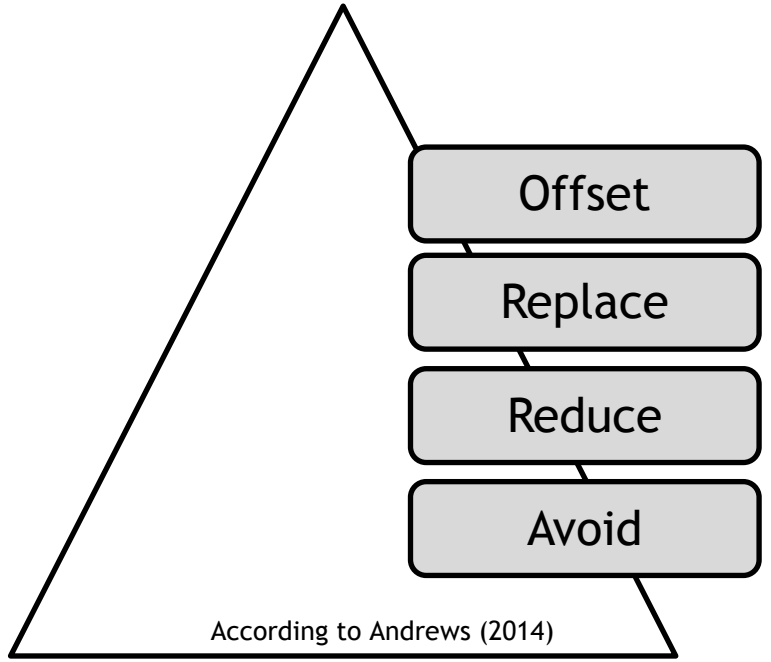
We need: scientifically robust assessment of carbon neutrality

Mitigation over compensation hierarchy

Different approaches of mitigation over compensation hierarchy

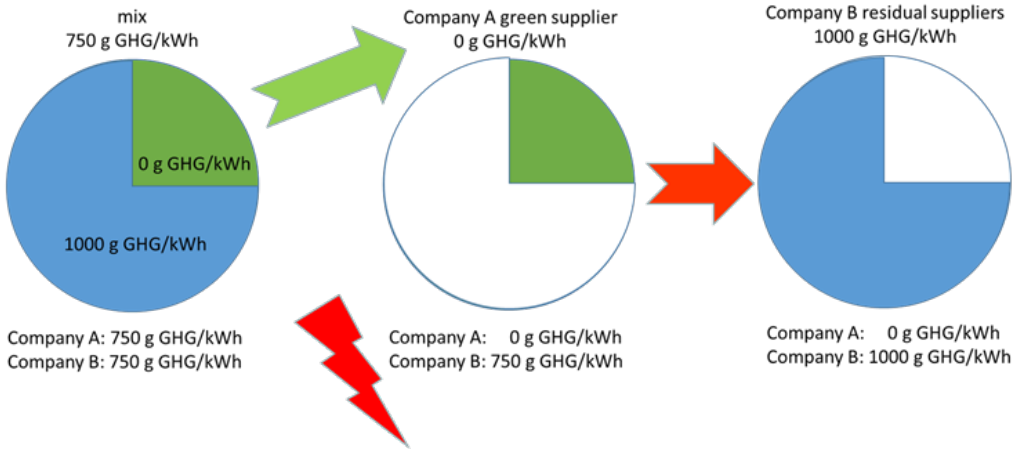
1. Reduction priority
   - ❖ Within all decarbonization measures, life cycle perspective should be adapted to avoid
     - double-counting
     - carbon leakage
     - problem-shifting
     - green-washing
2. Compensation necessity

Implementing LCA as a basis for accounting
- What can LCA offer as solutions?
- What are remaining challenges?



State of the art and challenges related to decarbonisation strategies ”Avoid & Reduce & Replace”

- Avoid carbon-intensive activities or inputs
  - No accounting challenges
  - Rare case in reality
- Reduce carbon-intensive activities or inputs
- Replace
  - Focus of LCA: life cycle perspective, avoidance of trade offs
  - Methodological challenges:
    - Accounting of renewable energy: difficult to avoid double counting



State of the art and challenges related to decarbonisation strategies ”Avoid & Replace & Reduce”

- Avoid carbon-intensive activities or inputs
- Reduce carbon-intensive activities or inputs
- Replace
  - Focus of LCA: life cycle perspective, avoidance of trade offs
  - Methodological challenges:
    - Accounting of renewable energy: difficult to avoid double counting
    - Accounting for recycling
      - Which end-of life approach?
      - Mass-balanced accounting?
    - Accounting for biomass/biogenic carbon
    - Accounting for “green suppliers”
    - Accounting for avoided emissions

State of the art and challenges related to decarbonisation strategies ”Avoid & Replace & Reduce”

- Avoid carbon-intensive activities or inputs
- Reduce carbon-intensive activities or inputs
- Replace
  - Focus of LCA: life cycle perspective, avoidance of trade offs
  - Methodological challenges:
    - Accounting of renewable energy: difficult to avoid double counting
    - Accounting for recycling
    - Accounting for biomass/biogenic carbon
    - Accounting for “green suppliers”
    - Accounting for avoided emissions

Clear certificates of origin
Excluding renewable energy shares from datasets
Residual mixes

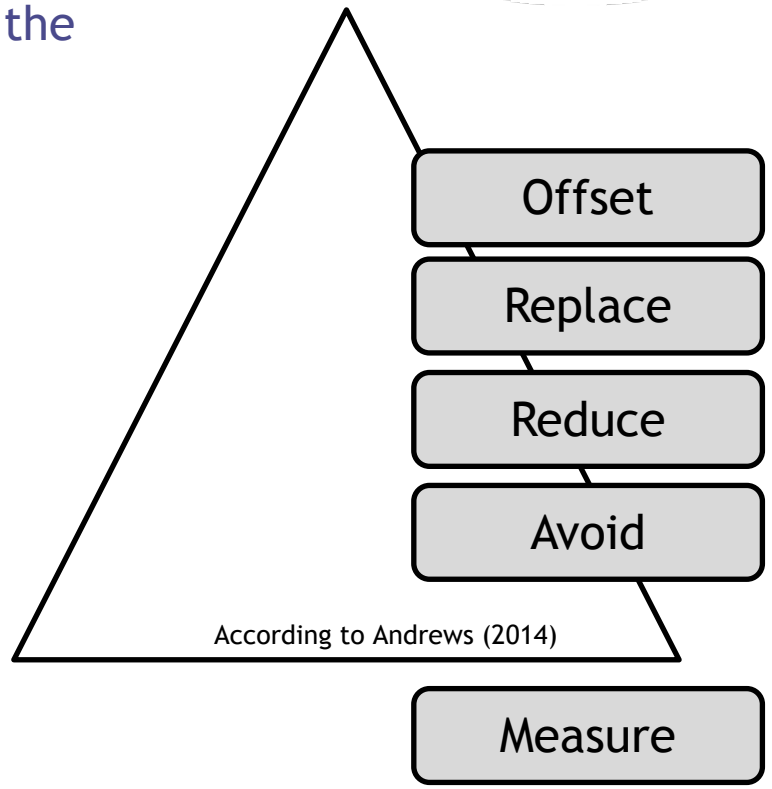
Only physical recycled content is accounted for

No subtraction of delayed emissions

➢ **Fixing of value choices to achieve scientifically robust accounting for carbon neutrality**

Offsetting

- Consistency in the calculation of the damage (environmental burden) and the calculation of the environmental repair (offsets) is needed
  - Consistent accounting framework; also for offsets
- Many challenges:
  - Life cycle emissions are not taken into account
  - Clear calculation rules for baseline, risk assessment and buffer as well as stored/saved CO_2 emissions
  - Permanence
  - Trade-offs with other sustainability aspects



➢ Establishing quality criteria and proper accounting rules
  ➢ Especially accounting

Conclusion

- Principles, that need to be considered and implemented for “real” climate neutrality:
  - Life cycle completeness
  - GHG completeness
  - Avoidance of trade-offs (Do no harm principle)
  - Absolute reduction
  - Improve offsetting schemes
- Scientifically robust solutions are necessary
  - Research on the mentioned issues is needed
  - Additional issues might need to be addressed

The International Journal of Life Cycle Assessment (2021) 26:635–639
https://doi.org/10.1007/s11367-021-01902-4

EDITORIAL

Life cycle assessment of decarbonization options—towards scientifically robust carbon neutrality

Matthias Finkbeiner[1] · Vanessa Bach[1]

Published online: 1 April 2021

1 Background

Climate or carbon neutrality is a key concept to tackle climate change in both public and private organizations (we use the term carbon neutral as synonym for climate neutral for the purpose of this editorial). The Paris agreement (UNFCC 2015) includes the goal to reach carbon neutrality. According to the Intergovernmental Panel on Climate Change, limiting global warming to 2 °C requires global carbon neutrality by 2070, while a 1.5 °C target requires global carbon neutrality by 2050 (IPCC 2018). Carbon neutrality describes a state in which the activities of an individual, products, or an organization (e.g., company, city, country) result in net-zero emissions of CO_2. The net-zero implies that they the activities do not release any greenhouse gases or that the GHG released after decarbonizing are removed and sequestered (IASS 2015).

To achieve carbon neutrality, decarbonization strategies are needed. Most scholars and stakeholders argue for a hierarchy of decarbonization approaches. As an example, Andrews defines the four steps of Avoid (carbon intensive activities), Reduce (material and energy demands by increasing efficiency), Replace (fossil fuels and materials by renewable alternatives), and Offset (those emissions that remain after the previous steps) (Andrews 2014). Other scholars propose just two or three steps, but there seems to be a general agreement on two issues—also reflected by the United Nations Climate Change Race to Zero Initiative (UNFCCC 2021):

- Reduction priority: all reduction measures take priority over compensation measures as they are less prone to assumptions, more tangible, more time-independent and verifiable.
- Compensation necessity: all decarbonization strategies need compensation measures as there is no alternative way to achieve net-zero emission. While they are the lowest priority and should be limited to cover the “unavoidable” residual emissions, they are also a necessity for becoming carbon neutral.

For both options, a life cycle perspective is inevitable. All decarbonization steps need to embrace the life cycle perspective in order to be effective, in order to avoid double-counting, in order to avoid carbon leakage and ultimately problem-shifting as well as green-washing. While we hopefully all agree on this principle, it is less obvious what we can already offer as LCA community in terms of solutions and what we still need to address in terms of remaining challenges for a scientifically robust assessment of carbon neutrality. The intention of this editorial is twofold. First, we want to encourage a more proactive role of this community in the carbon neutrality and decarbonization debate as we have important and relevant knowledge to contribute. Second, we want to encourage further research efforts to tackle the substantial accounting challenges that are still unresolved.

2 Scientific state-of-the-art and challenges

In this section, we present a high-level overview of the scientific state-of-the-art and identify some of the remaining challenges according to the decarbonization strategies Avoid, Replace, Reduce, and Repair (Offset).

2.1 Avoid

The strategy to avoid carbon-intensive activities or inputs is from an LCA standpoint either uncritical or identical with the replacement strategy. It is uncritical, if activities or inputs are avoided without any substitution or replacement. In reality, this is probably a rather rare case. If for example

✉ Matthias Finkbeiner
matthias.finkbeiner@tu-berlin.de

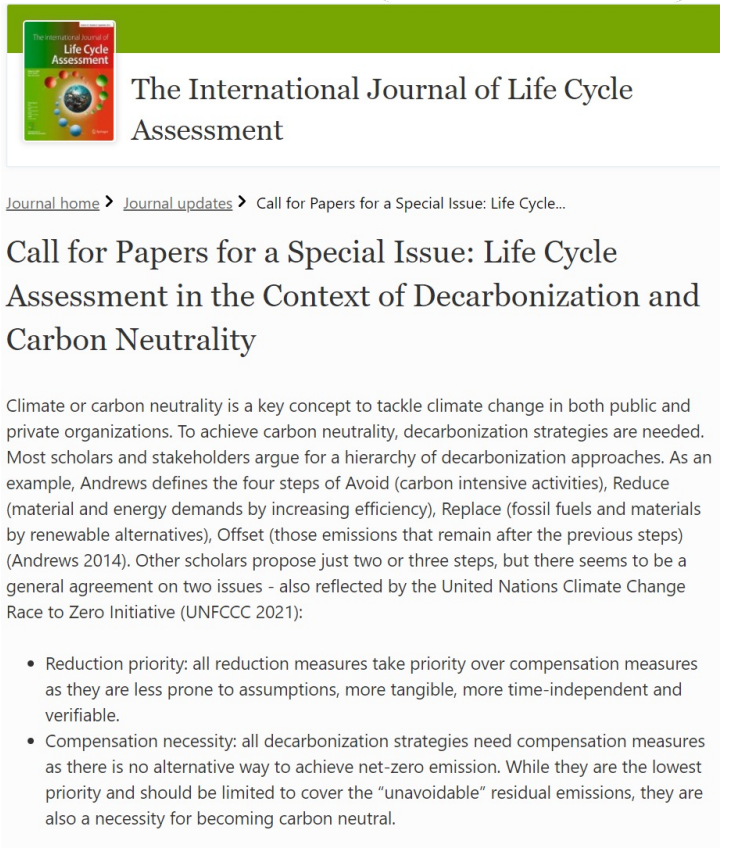
[1] Chair of Sustainable Engineering, Technische Universität Berlin, Berlin, Germany

Call for papers

Special issue in International Journal of LCA

- Call for Papers for a Special Issue: Life Cycle Assessment in the Context of Decarbonization and Carbon Neutrality
- Full paper submission deadline: 31 January 2022
- Guest Editors: Dr. Vanessa Bach & Dr. Stephan Krinke
- Topics:
  - Discussion of standards/guidelines for carbon footprinting and neutrality
  - Application and case studies of decarbonization including examples that show the trade-offs with other environmental aspects
  - Contributions to the methodological challenges for decarbonization and carbon neutrality claims
  - …

https://www.springer.com/journal/11367/updates/19018988



Thanks for your attention!

Dr. Vanessa Bach

Technische Universität Berlin

Chair of Sustainable Engineering

vanessa.bach@tu-berlin.de