



*Discussion panel: LCM approaches to support Circular Economy*

*September 5<sup>th</sup>, 2017*

# **A decision support framework for circular economy implementation in the packaging sector**

## **Lessons from the Carlsberg Circular Community**

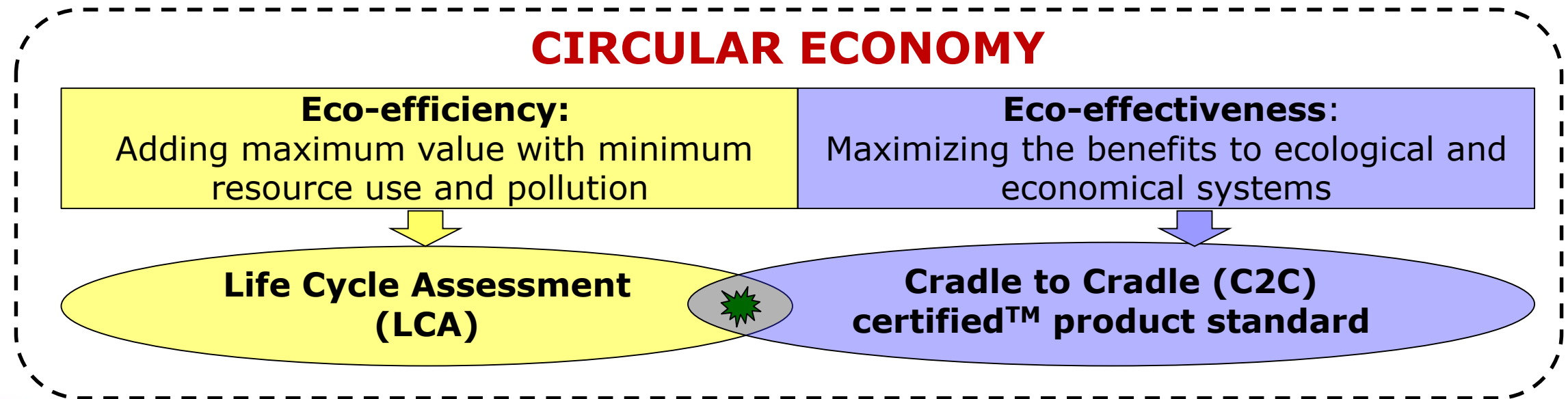
[Monia Niero<sup>1</sup>](#), Michael Z. Hauschild<sup>1</sup>, Simon B. Hoffmeyer<sup>2</sup>, Stig I. Olsen<sup>1</sup>

1 - Division for Quantitative Sustainability Assessment (QSA), DTU Management Engineering

2 – Group Corporate Affairs, Carlsberg Breweries A/S

# Aim of the research project

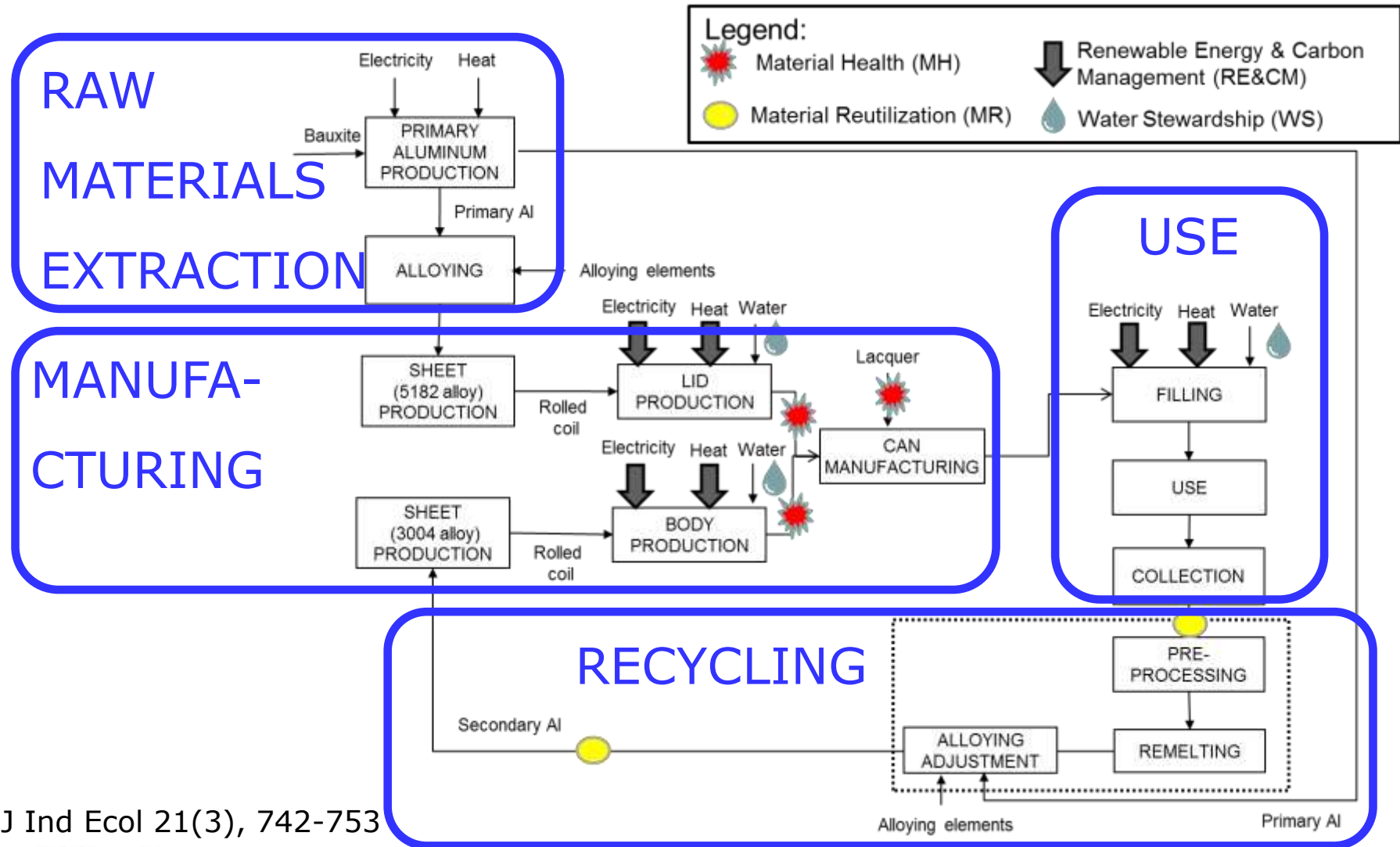
- **Vision** → support **Carlsberg** in the development of **environmentally sustainable and innovative** beer packaging solutions
- **Objective** → combine **Life Cycle Assessment** and **Cradle to Cradle® design framework** for **continuous loop** packaging systems



# Context: Carlsberg Circular Community

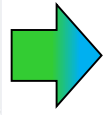


# Case study: aluminium cans



Source: Niero et al. (2017) J Ind Ecol 21(3), 742-753

# Lessons from Eco-effectiveness



design for improving the **value of material**,  
optimization of the product composition for next use



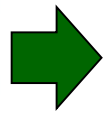
✓ Substances even at ppm level have an impact on value and recyclability



✓ Ensuring recyclability is prerequisite for high recycled content



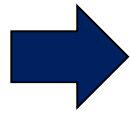
✓ Performances at process and production level need to be included in the optimization strategy



Improving **can composition** with focus on **material level**

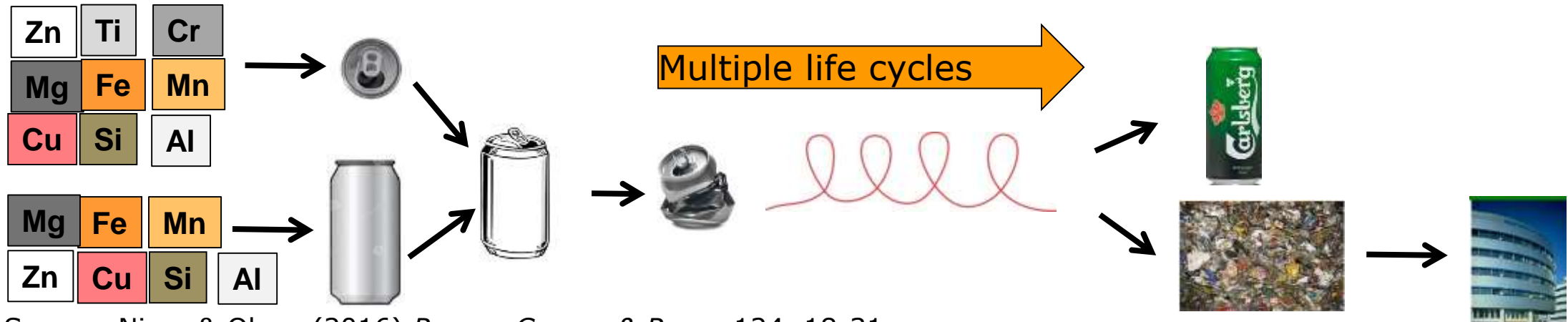
But **which actions to prioritize** to reach higher certification levels?

# Lessons from Eco-efficiency



identification of **best option** from an environmental point of view **for the next use** of the material

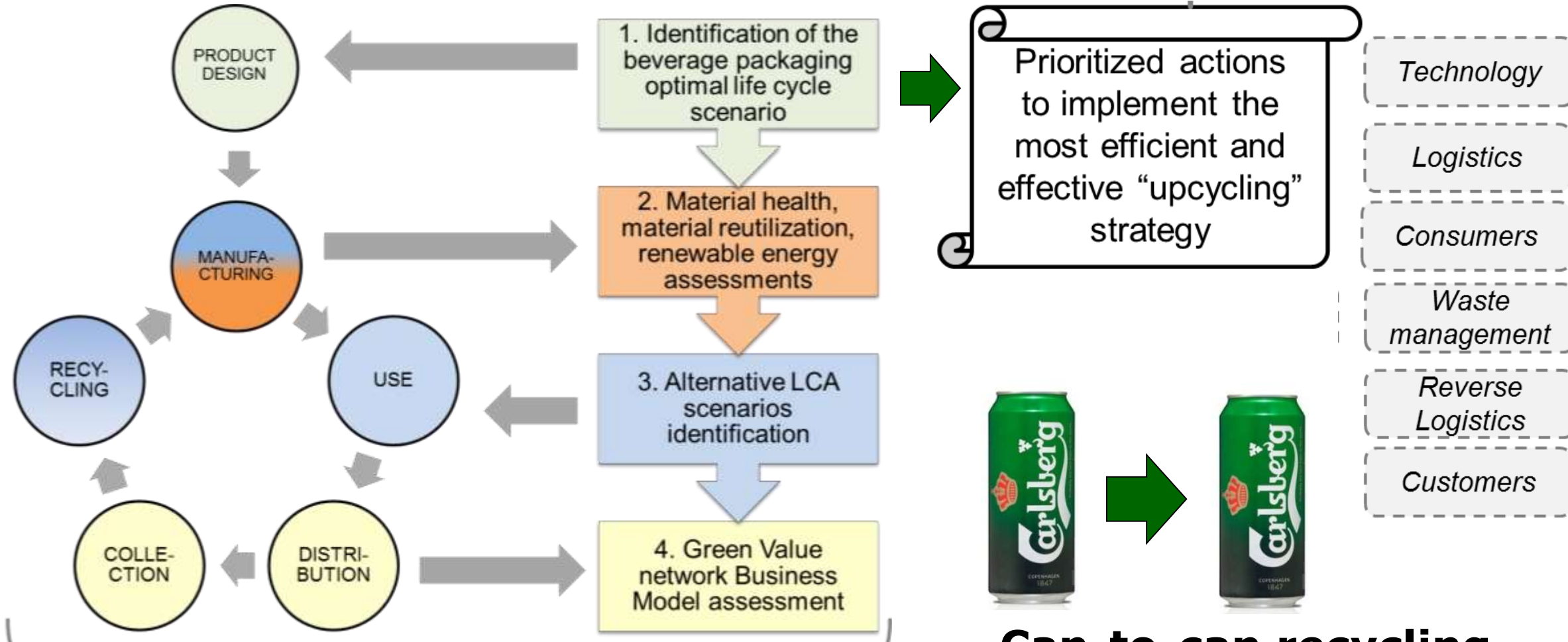
- The **actual material composition** needs to be taken into account while addressing the use of aluminum in continuous loops



Source: Niero & Olsen (2016) *Resour Conser & Recyc* 124, 18-31

- Hamlet dilemma for aluminium cans in a circular economy: to be or not to be - in a closed product loop? **TO BE (climate change)**

# Decision support framework for optimization of continuous loop packaging systems



Source: Niero et al. (2017) J Ind Ecol 21(3), 742-753

## Conclusions and recommendations

- **Eco-efficiency and eco-effectiveness** approaches can be made **operational** by combining **LCA and C2C certification program**
- Main lesson of Carlsberg Circular Community with optimization of **aluminium cans**: improve **transparency in materials composition** to assure **high-quality recycling**
- Main recommendations from decision support framework:
  - ensure a system enabling **can-to-can recycling**
  - design packaging for “**zero contamination**”
- The suggested **framework for optimization of continuous loop system** can be **applied and adapted** by any other company familiar with eco-efficiency and eco-effectiveness approaches



# Do you want to know the details?

- Niero M, Hauschild MZ, Hoffmeyer SB, Olsen SI (2017) **Combining eco-efficiency and eco-effectiveness for continuous loop beverage packaging systems: learnings from the Carlsberg Circular Community.** *Journal of Industrial Ecology* 21(3), 742-753
- Niero M, Olsen SI (2016) **Circular economy: to be or not to be in a closed product loop? A Life Cycle Assessment of aluminium cans with inclusion of alloying elements.** *Resources Conservation & Recycling* 114: 18-31
- Niero M, Negrelli AJ, Hoffmeyer SB, Olsen SI, Birkved M (2016) **Closing the loop for aluminum cans: Life Cycle Assessment of progression in Cradle-to-Cradle certification levels.** *Journal of Cleaner Production* 126, 352-362.
- Niero M, Olsen SI, Laurent A. **Renewable Energy and Carbon Management in the Cradle-to-Cradle certification: Limitations and opportunities** *Journal of Industrial Ecology* DOI: 10.1111/jiec.12594
- Stewart R, Niero M, Murdock K, Olsen SI **Exploring the implementation of a circular economy strategy: the case of a closed-loop supply of aluminum beverage cans.** To be submitted to *Procedia CIRP*
- Niero M (2016) **How to bridge the gap between the packaging sector and circular economy.** <http://www.carlsbergfondet.dk/en/Research-Activities/Research-Projects/Postdoctoral-Fellowships/Monia-Niero-How-to-Bridge-the-Gap-Between-the-Packaging-Sector-and-Circular-Economy>

# Acknowledgements

CARLSBERG FOUNDATION



**Thank you for your attention!**

**Dr.-Ing. Monia Niero**  
**[monni@dtu.dk](mailto:monni@dtu.dk)**

Division for Quantitative Sustainability  
Assessment (QSA)  
Department of Management Engineering  
Technical University of Denmark  
Bygningstorvet Building 115, room 014  
2800 Kgs. Lyngby (Denmark)



CARLSBERG FOUNDATION