

Sustainability Considerations In Fibre-based Packaging Development Incorporating Nanomaterials

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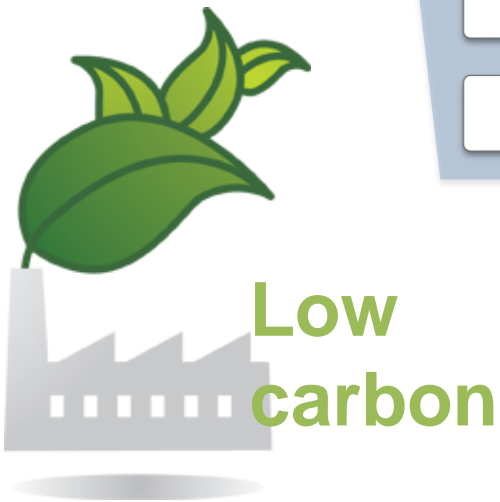
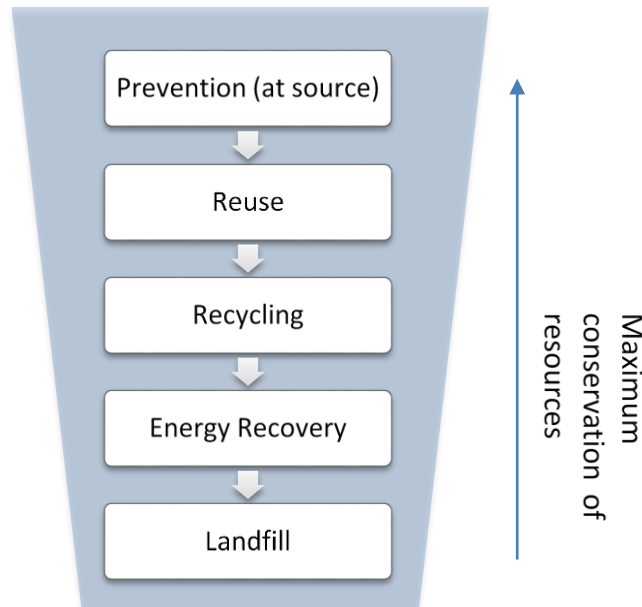
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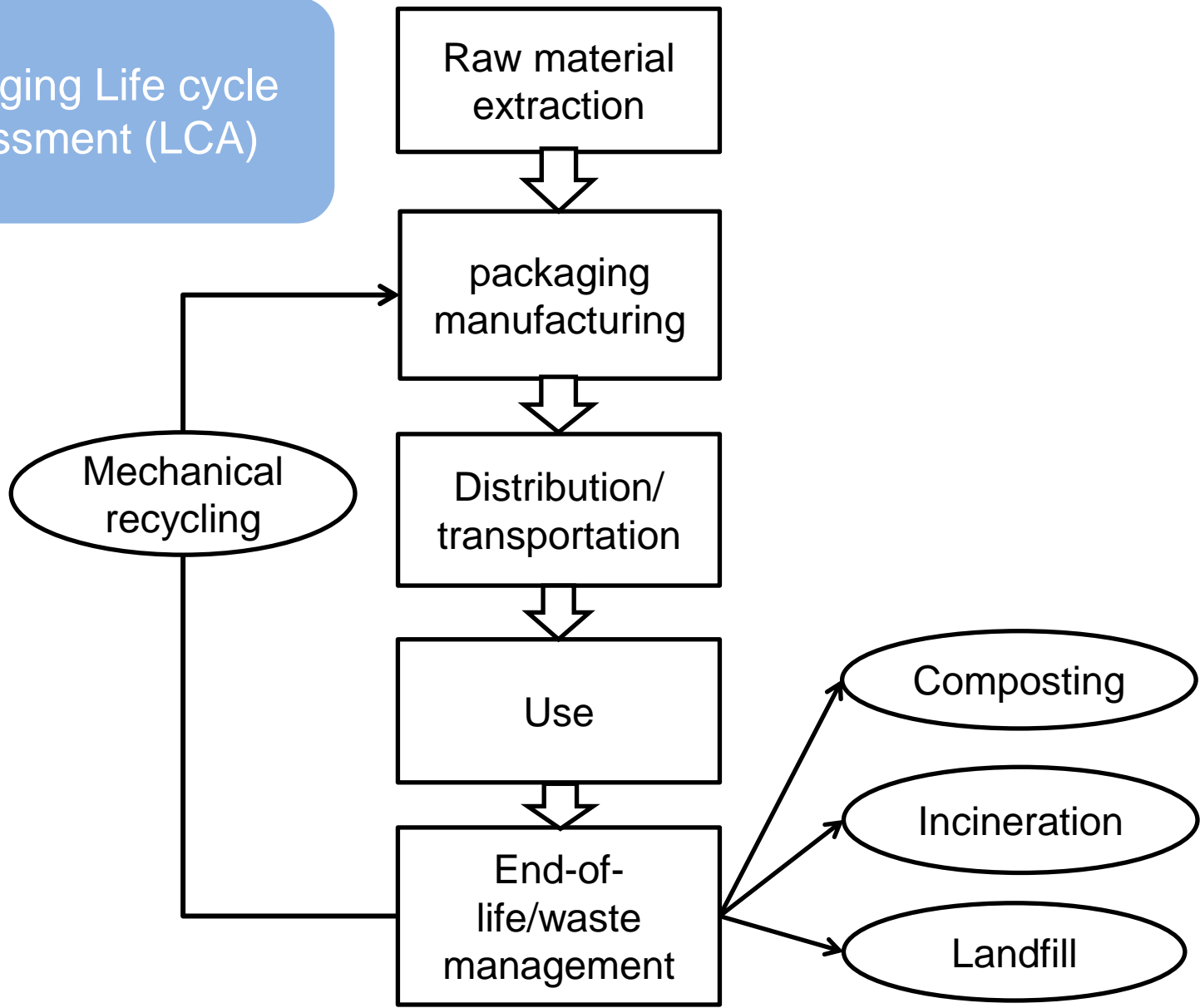
ITENE

Drivers for sustainability in packaging sector

94/62/EC
Packaging and packaging waste directive



Packaging Life cycle assessment (LCA)



Sustainability issues of "NewGenPak"



Case study 1

- LCA: essential oil component enabled MAP* for fresh beef

Case study 2

- LCA: selection of nanomaterial based antimicrobial agent

Case study 3

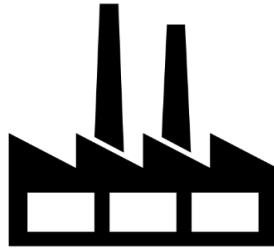
- Fate of nanomaterial in fibre based packaging recycling steam

*MAP, modified atmosphere packaging

Food losses along the value chain (avoidable losses)



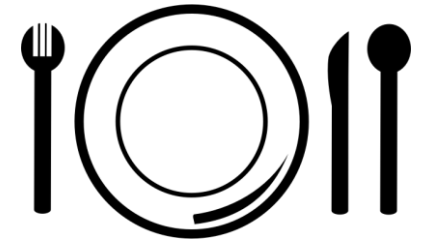
13%
Agricultural production



31%
Processing



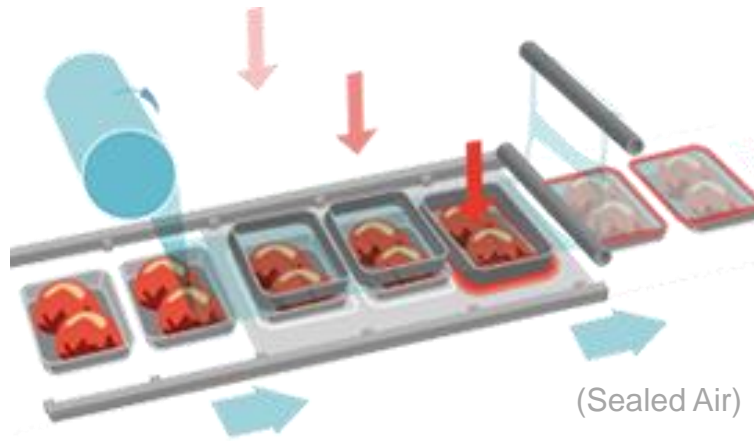
4%
Retail



45%
Households

Active packaging &
food shelf life

Data source: Beretta et al., 2013



KEY POINTS

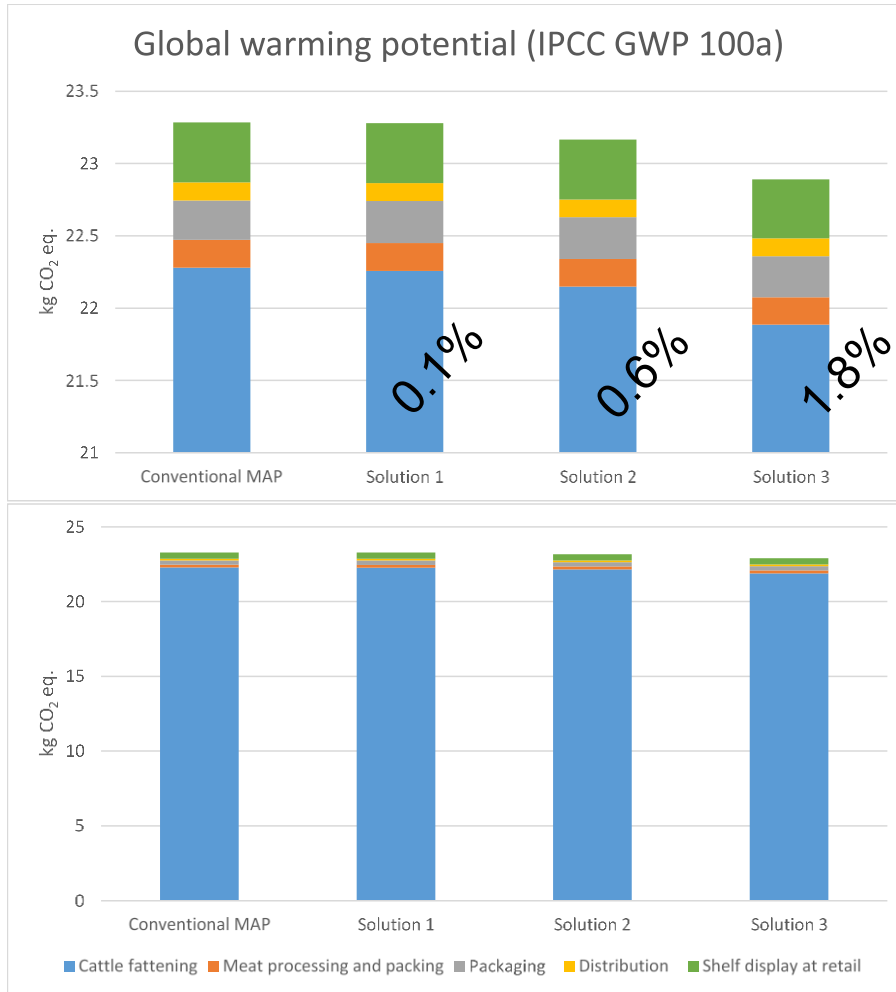
- Active coating (essential oil component) applied on the internal side of lid film
- Scenarios: shelf life extension reduces food loss at retail level
- In LCA calculation, consider food and packaging as a whole system

Food loss saving	Packaging ID
0	Conventional MAP
0.10%	Solution 1
0.60%	Solution 2
1.80%	Solution 3

With active coating

CONCLUSIONS

- The system's environmental impacts drop with the increasing of food loss saving
- Trade-off between additional life stage (active coating) and food loss saving
- This relationship is sensitive to food type and the associated environmental impacts



(Results plot in a panel chart to highlight the contributions from stages other than food production)

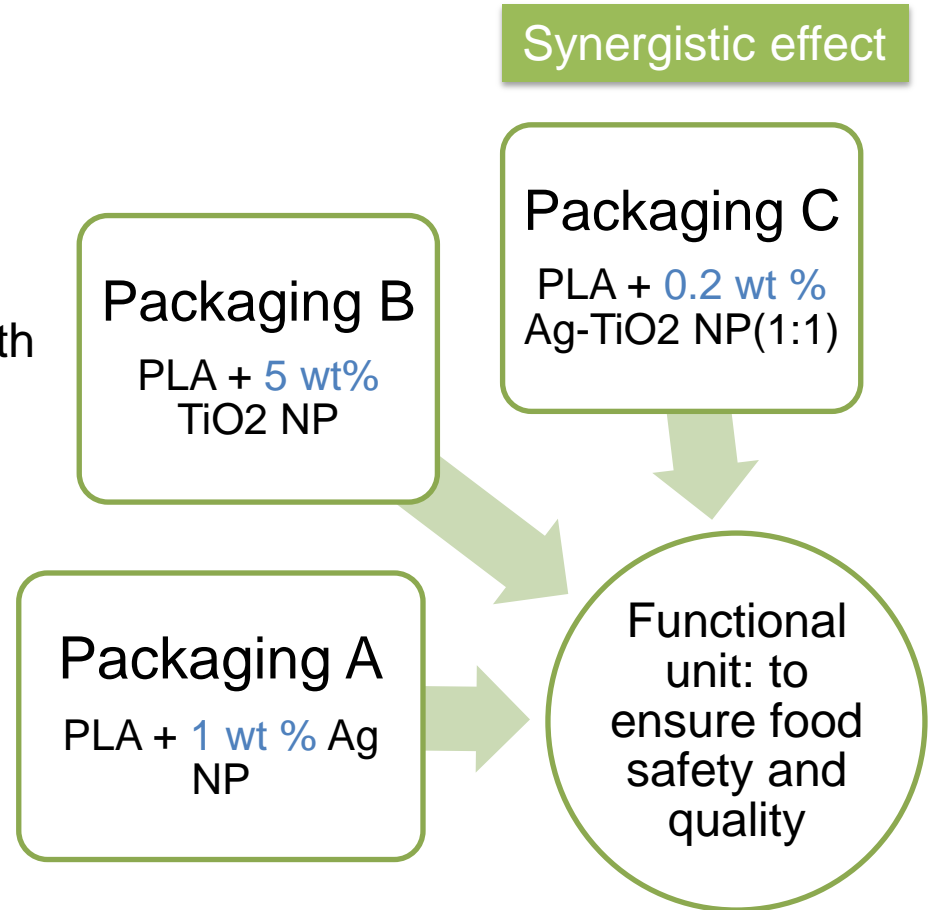
Metallic nanoparticles as antimicrobial agent



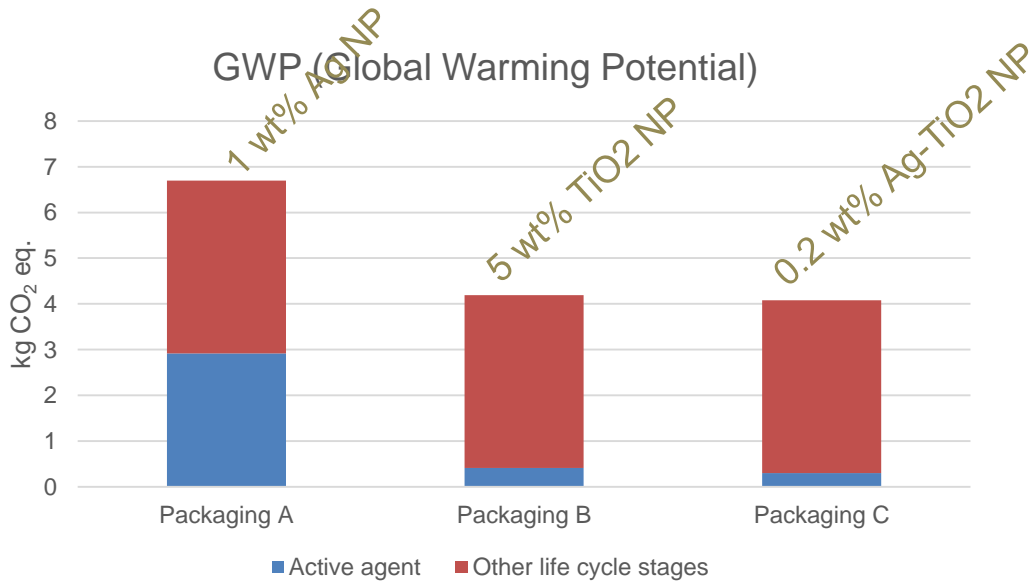
NP, nanoparticle

KEY POINTS

- PLA film incorporating active agents produced by melt-extrusion
- Functional unit: application oriented, considering **antimicrobial efficacy** of each agent (MIC*)
- Scenarios: packaging A, B and C with respective agent loadings
- Full life cycle (cradle-to-grave)

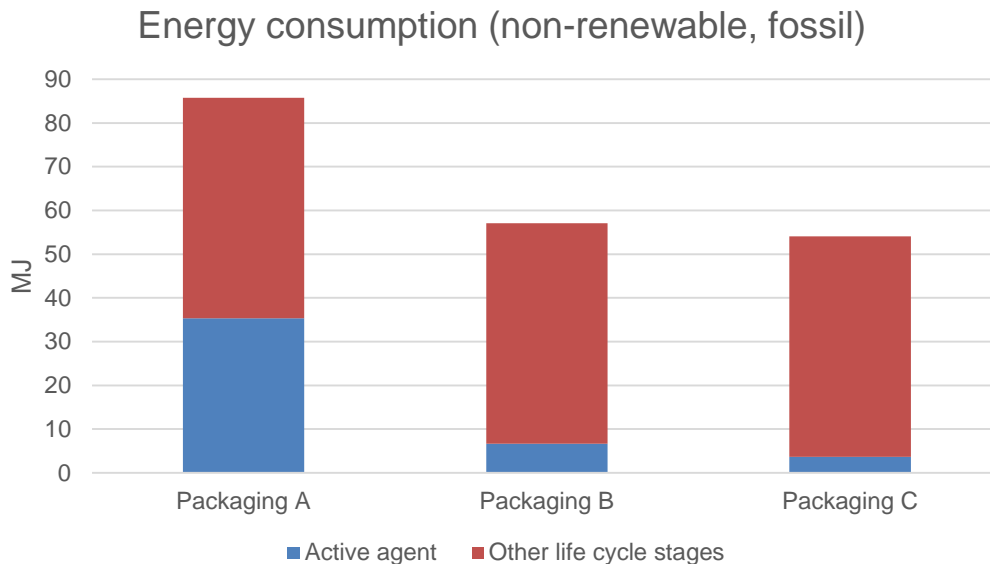


*MIC, minimum inhibitory concentration



Conclusions

- Active packaging oriented functional unit definition
- Synergistic effect of using a mixture of active agents
- The impacts of Packaging C drop to 60% of Packaging A
- Data comprehensiveness of TiO₂ (the emission side) should be improved





END-OF-LIFE OF PACKAGING

Method: ATICELCA MC 501-13
Fate of nanomaterials
(*work in progress*)

Factors involved:

- Fibre
- Binder
- Mechanical treatment
- PH
- ...

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Case study 3

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*MAP, modified atmosphere packaging

THANK YOU FOR YOUR ATTENTION!

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Highlights:

- Zhang, H., et al. "The Effect of Active Packaging on Minimizing Food Losses: Life Cycle Assessment (LCA) of Essential Oil Component-enabled Packaging for Fresh Beef." Packaging Technology and Science (in press).
- Zhang, H., et al. "Selection of nanomaterial based active agents for packaging applications: using life cycle assessment (LCA) as a tool." Packaging Technology and Science (in press).
- Zhang, H. Oral presentation at symposium innovative packaging PTS&COST action conference 2014, Munich, Germany.
- Zhang, H. Oral presentation at 27th IAPRI Symposium on Packaging 2015, Valencia, Spain.
- Aliaga, C., Zhang, H., et al. "The influence of printed electronics on the recyclability of paper: A case study for smart envelopes in courier and postal services." Waste Management 38 (2015): 41-48.