Role of Packaging in LCA of food products in preventing food waste

Presented by:
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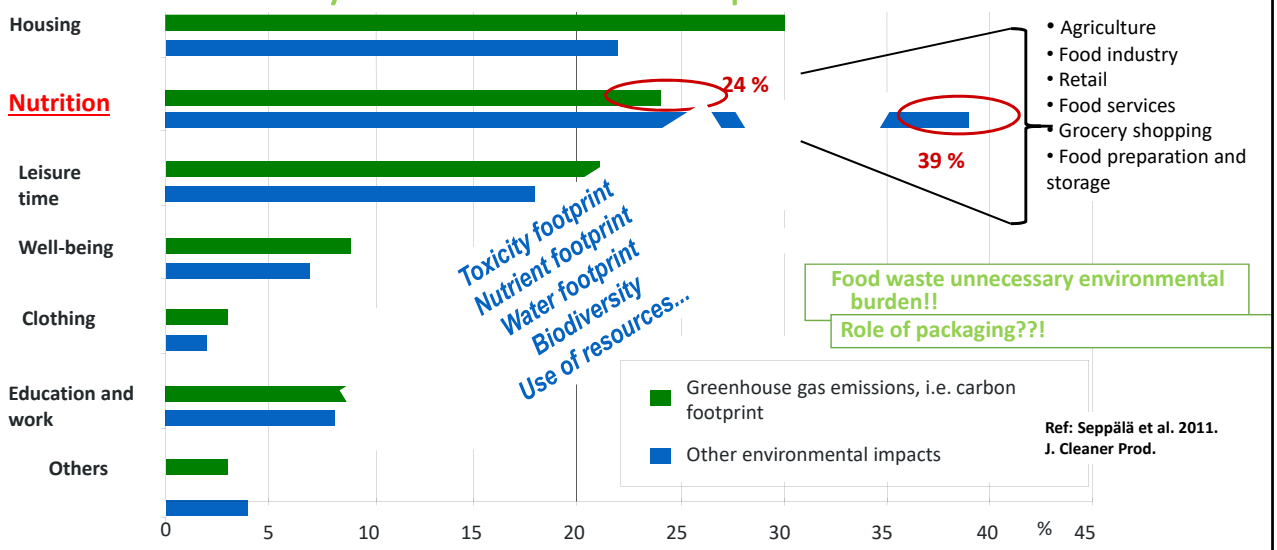
Some starting points

- Investigations and comparisons of the environmental impacts of packaging had been so far often made for the packages alone
- This attitude ignores the actual role of packaging
  - Protect the product
  - Enable distribution
  - Inform the consumers
  - Help display products on the shop shelf

Importance and significance of food and food waste: Unnecessary environmental impacts!



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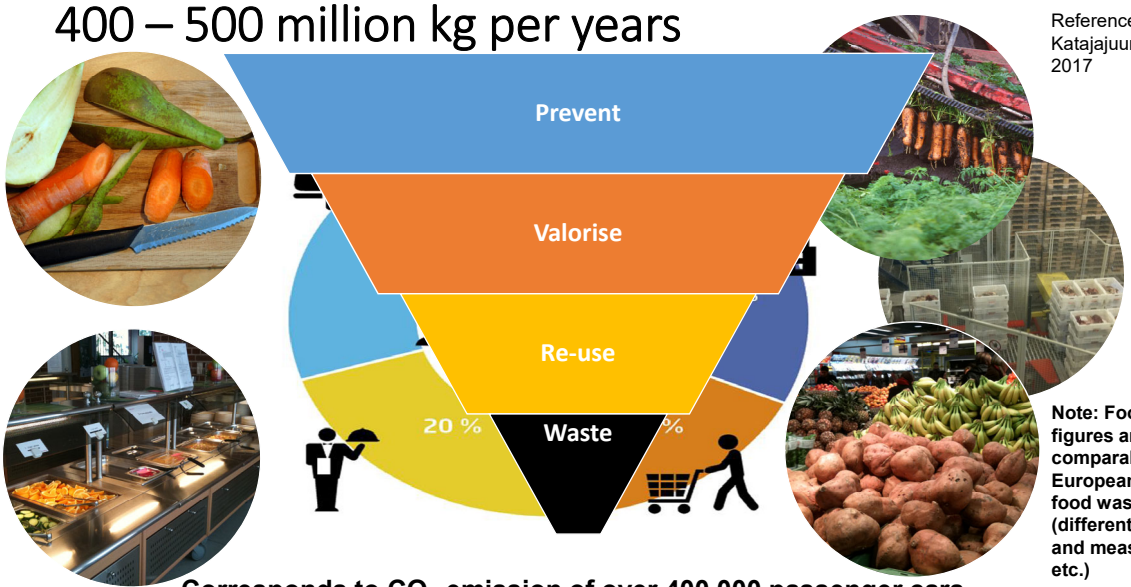
Edible food waste in the Finnish food chain – 400 – 500 million kg per years



Reference: Katajajuuri et al. 2017

Note: Food waste figures are not comparable to European or other food waste figures (different definitions and measurements etc.)

Corresponds to CO_2-emission of over 400 000 passenger cars

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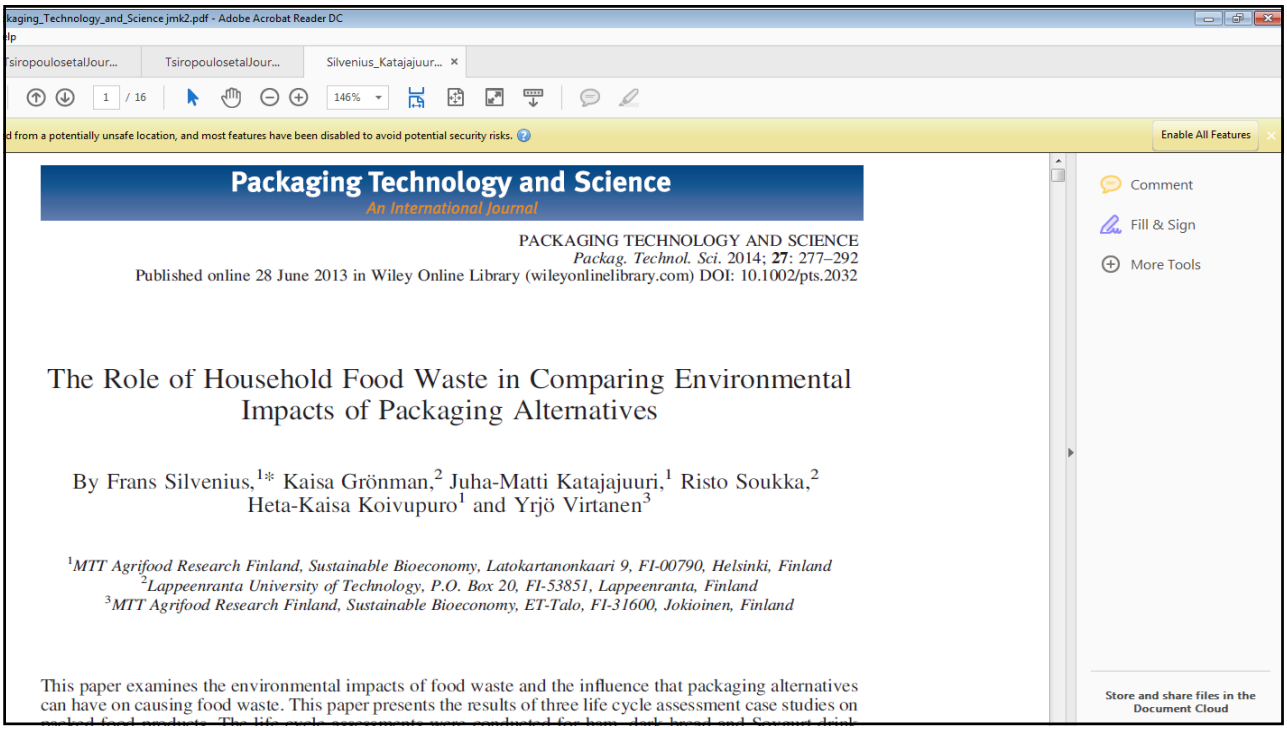
Some myths related to packagings

"It is more environmentally friendly to buy a big product package in order to reduce the amount of packaging materials needed per unit of product."

"Packages are significant sources of environmental concern."

"When planning a package it is of utmost importance to minimise the amount of packaging materials."



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Packaging Technology and Science
An International Journal

PACKAGING TECHNOLOGY AND SCIENCE
Packag. Technol. Sci. 2014; **27**: 277–292
Published online 28 June 2013 in Wiley Online Library (wileyonlinelibrary.com) DOI: 10.1002/pts.2032

The Role of Household Food Waste in Comparing Environmental Impacts of Packaging Alternatives

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This paper examines the environmental impacts of food waste and the influence that packaging alternatives can have on causing food waste. This paper presents the results of three life cycle assessment case studies on

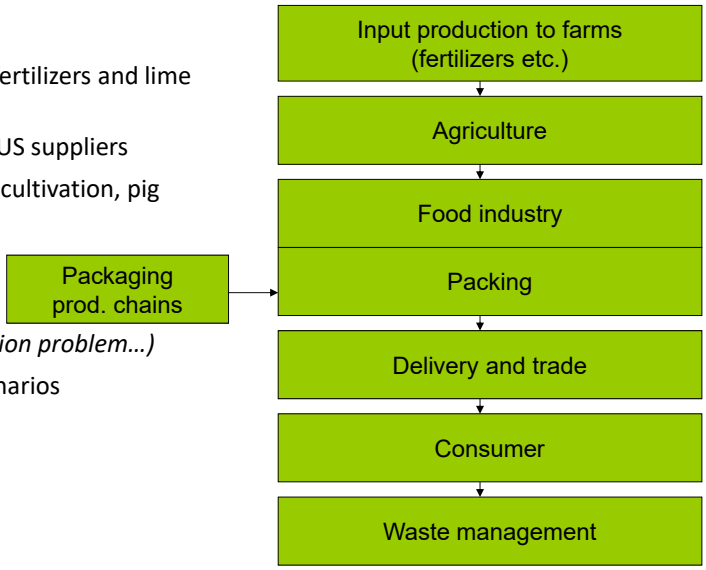
But what we see and hear… Waste entering totally wrong places - attitudes

Studied product and packaging systems

- Sliced rye bread
  - Polypropylene (PP), 9 and 4 slices
  - Polyethylene (PE), 9 slices
  - Laminated paper + PP window, 9 slices
  - Reusable transport boxes
- Ham, whole meat cold cuts
  - APET/EVOH/PE + PE/EVOH/PET 300 g and 150 g
  - PP/PE/PA(Polyamide)/EVOH + PP/PE/EVOH 300 g and 150 g
  - Carton/PE/EVOH + PP/PE/EVOH 300 g and 150 g
  - Reusable transport boxes
- Soygurt drink (fermented soy based drink)
  - Liquid packaging board with aluminium barrier 750 ml
  - PP cup with aluminium cover 150 ml
  - Corrugated board as secondary packaging
  - Pallet and PE shrink films

System boundaries and data sources

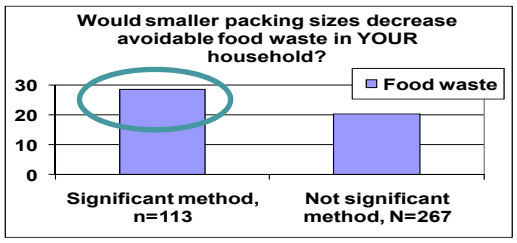
- Ham, rye bread, Soygurt
- Agricultural inputs such as supply chains of fertilizers and lime mainly primary data from producers
- Mainly primary data of soy cultivation from US suppliers
- Finnish average primary data of agriculture (cultivation, pig production etc.)
- Primary data from food and feed industry
- Retail data from retailers *(interesting allocation problem…)*
- Waste management modelled with four scenarios
  - Two present and two future scenarios
  - With and without energy recovery
  - Different recycling assumptions



LCA data sources – packaging

- **Plastics from APME/Plastics Europe**
- **Liquid packaging board from the producer**
- **Corrugated board from Finnish/Nordic producers**
  - **Challenge with Finnish open loop recycling scheme – open-loop + economical allocation was chosen**
- **Carton data from the producer**
- **Paper data from producer**
  - **some additional data concerning auxiliary materials (such as chemicals) from secondary data sources**
- **Aluminium from EAA**
- **Conversion of packaging mainly primary data**

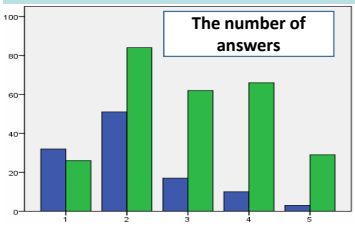
Do you think that smaller packaging sizes would decrease avoidable food waste in your household?

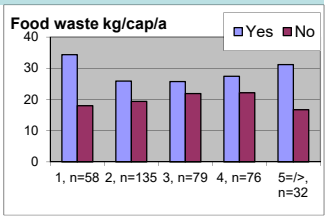


- We asked the impacts of packaging size to food waste, and according to the results

  ➔ More food waste was produced in those households where the inhabitants believed they could reduce the amount of food waste by using smaller packaging sizes

- The smaller the size of the household the preferable method smaller packaging sizes are in reducing food waste
- In all household sizes more food waste was produced if the household perceived smaller packaging sizes a good way in reducing food waste in their household





- The size of the household: 1, 2, 3, 4 and 5 (/or more) inhabitants
- Reducing the packaging size:
  blue= Significant method, N=113
  green/red= Not significant method, N=267

System boundaries and data sources

- **Consumer survey on amount of food waste of case products, as a function of different size and type of packaging**
- **500 consumer answers**
  - **Majority, 60 – 80%, claimed that they don't waste any food**
  - **Some consumers announced product losses over 20 %**
- **Sliced rye bread, average product loss around 4%**
  → Product loss scenarios: 0 slices, 0.5 slices (5,5%) and 1 slice (11%), for 9 slice bread
- **Ham, average product loss 2%**
  → Product loss scenarios: 0, 1 (4%) and 2 slices (8%), for 300 g ham packaging
- **Soygurt, average product loss 1.5-2.5%, 3-9 % left in the packaging (measurements made with different opening practices, for LPB more than cup…)**
  →Scenarios 2, 4 and 6% waste for polypropylene cup
  →Scenarios 5, 8 and 11% waste for liquid packaging board

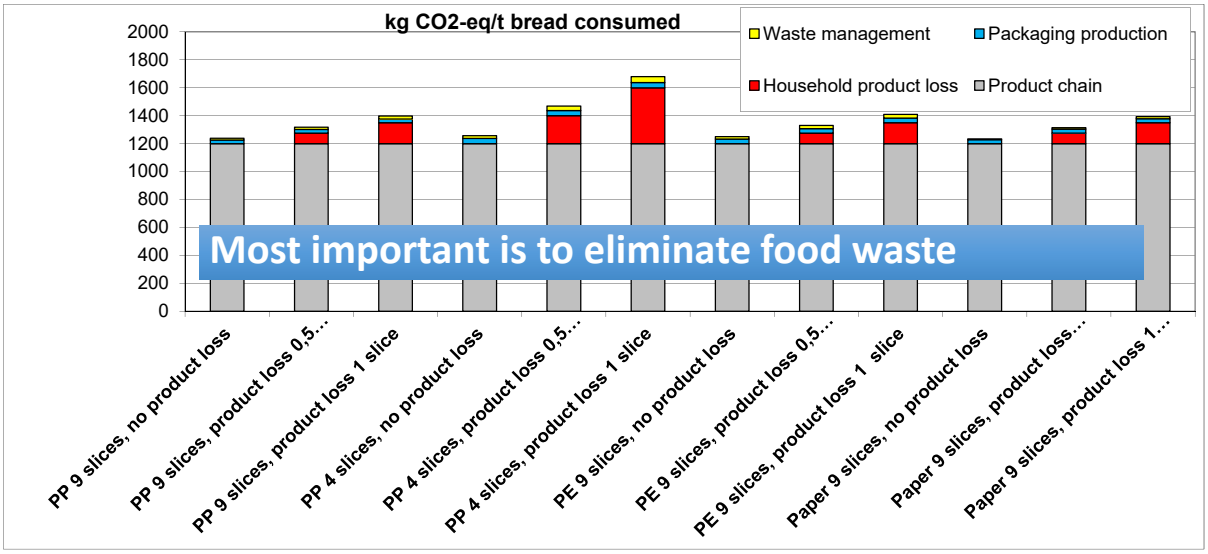
Main results in general – climate impact

- Climate impact of the product chain of packaging low
  - For ham <1-5 %
  - For rye bread 2-4 %
- The significance of product loss usually higher than packaging
  - For ham up to 18 % (scenarios 0, 4, 8, 16 % waste)
  - For rye bread up to 26 % % (scenarios 0, 6, 12 and 25 % waste)

- Only minor differences between packaging materials
- Only minor differences between waste management alternatives

Climate impact of bread system

- current situation with energy recovery

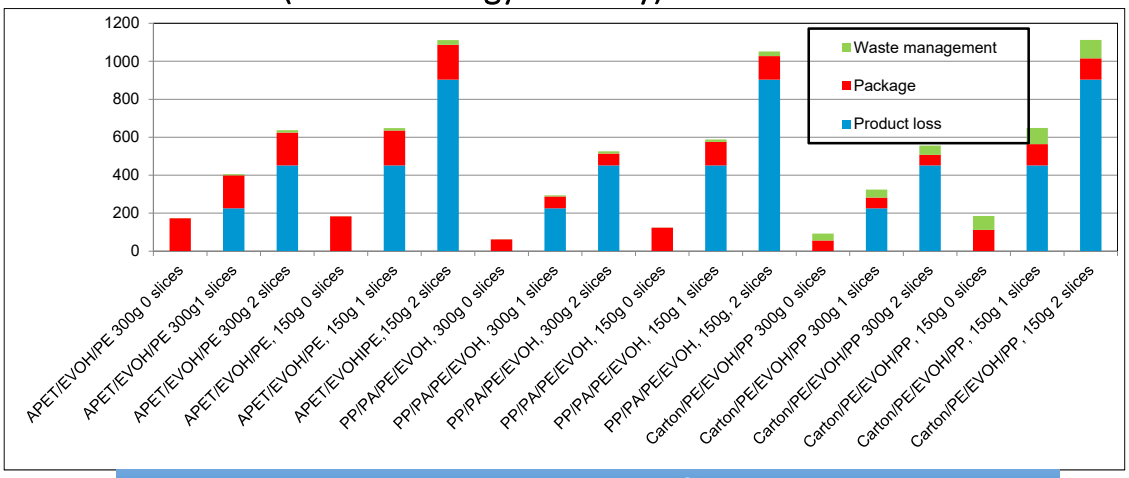


Most important is to eliminate food waste

Climate impact of ham packaging system, kg CO_2-eq/t:

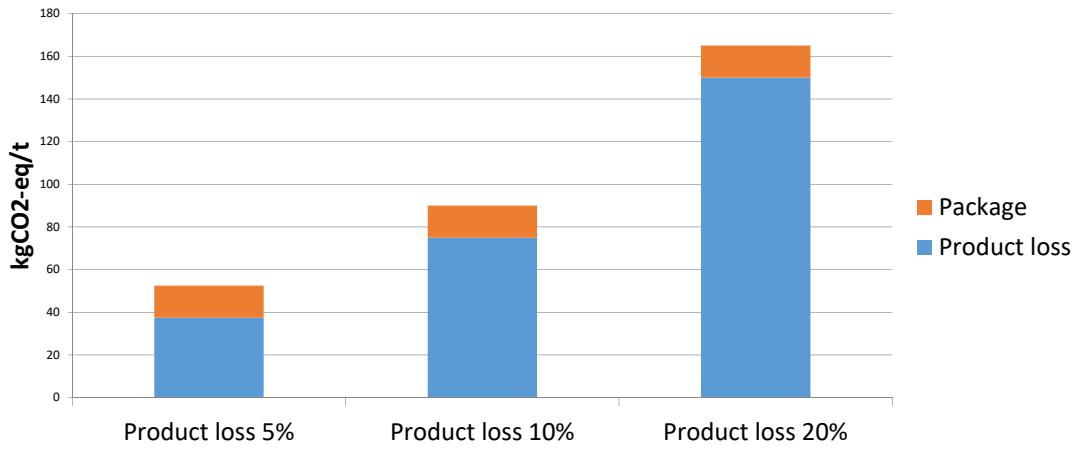
product loss, packaging and WM (product excluded)

- current situation (without energy recovery)



Most important is to eliminate food waste

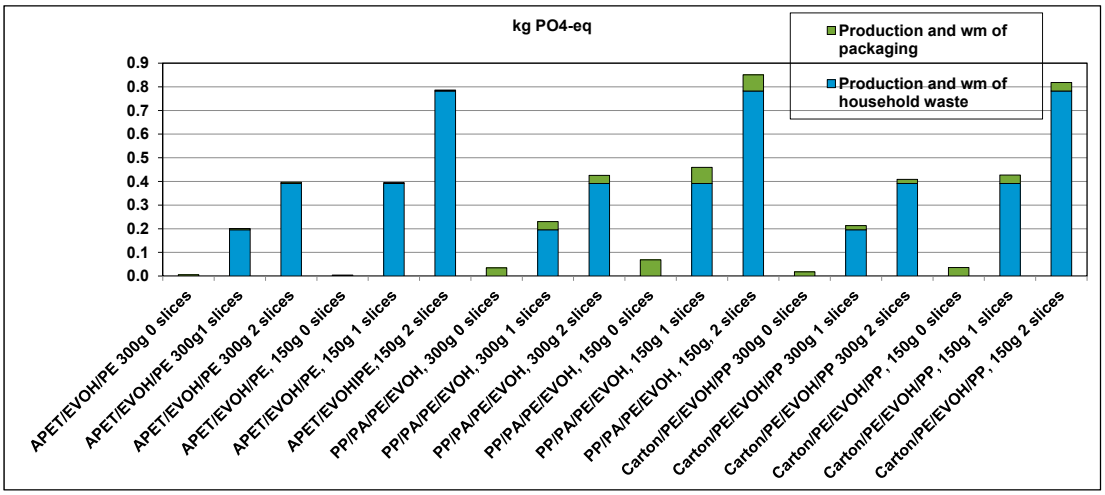
Climate impact of cucumber packaging system (kg CO_2-eq/t)



Main results – other impacts

- Eutrophication impact of the product chain of packaging even lower than climate impact in relation to the product chain
  - For and bread <1%
- Acidification impacts
  - For ham up to 2.5 %
  - For rye bread up < 1 %

Eutrophication impact of ham packaging system: product loss, packaging and WM (product excluded) – current situation (without energy recovery)



Big Environmental Myths related to Packaging

- ***"It is more environmentally friendly to buy a big product package in order to reduce the amount of packaging materials needed per unit of product."***

  → This is not automatically true - a bigger package may lead to unnecessary consumption or a part of the product may not be utilised and wasted!

- ***"Packages are significant sources of environmental concern"***

  → Packages have their own environmental impact, but the product itself will in general cause bigger environmental loads than the packages!

  → Packages protect the product and with good packages unnecessary production of products – that would lead to much bigger environmental impacts – can often be avoided!

Big Environmental Myths related to Packaging

- ***"When planning a package it is of utmost importance to minimise the amount of packaging materials"***

  → This holds only true if the minimisation of material use will not lead to bigger product loss and the package still fulfils other required functions and properties!

- ***"Certain packaging material is more sustainable/unsustainable"***

  → we are not able to categorise materials ecologic/sustainable as such in general – all materials havet heir SWOTs. Protection properties in key role when justifiying material sustainable…

Conclusions in the big picture

- **Basic role of packaging is to deliver and protect product through logistic chain to consumer in good shape and give shelf-life**
- **Wasted food causes larger environmental impacts via unnecessary production of food compared to production and waste management of packaging**
  - **Packaging should be delivered after use for the waste management / collection**
- **Sustainability of packaging alternatives is strongly linked to that, how different solutions protect product and get products to be consumed**
- **When designing packaging, focus on best material solutions/combinations and size solutions to protect products to minimize food waste**
  - **Recyclability / degradability of materials one aspect there**
- **Big amount of consumers are a bit lost from the pic picture - claiming that they are keen on ecological packaging…**

Conclusion between different materials… What can be said and done?

We are not able to simplify, based on today's scientific results and understanding, whether e.g. bio-based material would be holistically more sustainable compared to some other material

- Case by case we are able to assess these overall sustainability considerations – comparability to be justified/checked
  - Need of Industrial Ecology and Life Cycle Assessment scientific discipline
    - Material (packaging) 1 vs material 2 with common waste utilization patterns in most of the environmental impact categories
      - Micro plastics/toxicity models needs to be developed
  - Consumer and other studies needed to assess effect of packaging on food waste

Luke LCA Services

Environmental sustainability of packaging

Luke has more than 20 years' experience on LCA for food products and different packaging systems

- What is the environmental sustainability of our packaging and products?
- Have new bio-based packaging materials and solutions smaller environmental footprint than fossil based solutions?
- How can we assess reliably carbon and environmental footprint of our new packaging solution?

New Packaging Solutions for People, Planet and Business

Package · Heroes

- VTT, Luke, LUT University, Åbo Akademi
- **3.9M€** (2018-2021), + optional 2022-2023 from **Strategic Research Council** (at Academy of Finland)
- Sustainable food packaging solutions
- WPs: Co-creating transformation; Building business ecosystems; Cultural ethnographies; Feasibility and sustainability of new solutions; Policy mixes; Interaction; Management
- LCA, bio-based materials, nanocellulose
- www.packageheroes.fi; @PackageHeroes

Acknowledgements

- Tekes - the Finnish Funding Agency for Technology and Innovation
- Fazer Bakeries
- HK Ruokatalo
- Raisio
- Nokia
- Borealis Polymers
- Pyroll
- UPM Raflatac
- StoraEnso
- M-real
- Inex Partners
- Finnish Corrugated Board Association
- Environmental Register of Packaging PYR

Silvenius, LCM 2011 - Towards Life Cycle Sustainability Management. August 28-31.2011, the Dahlem cube, Berlin

"Thank You"
for your patience

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