How Packaging Contributes to Food Waste Prevention

Specific examples from Austrian stakeholder projects, including carbon footprint assessments
Consumer’s views of contributing to more sustainable environment

Figure 1: Consumers’ view of contributing to more sustainable environment

- Recycle bottles, cans, paper and other materials
- Walk or cycle
- Avoid dropping litter
- Avoid creating waste
- Use public transport
- Use less electricity
- Make fewer car journeys
- Use water wisely
- Clear up litter
- Turn down home thermostat
- Reuse bottles, containers
- Buy organic produce
- Take fewer holidays

Source: IPSOS MORI Packaging poll 2011

Source: PWC 2012 Sustainable Packaging

All packaging materials cause ONLY 1.3% of the total carbon footprint of Austrian consumers.
Food waste – an important issue

- About **30 percent of the carbon footprint** of an average European are linked to the production and distribution of food and to nutrition [European Commission 2006]

- **More than 100 Mill. tonnes of food are wasted** in Europe every year [European Commission 2014]

- **EU action plan for the Circular Economy** [European Commission Dec 2015]:
  - Plastics and **food waste** are priority areas
  - Development of a common **methodology and indicators to measure food waste** (2016)
  - **Stakeholders platform** to examine how to achieve SDGs goals on food waste, share best practice and evaluate progress (2016)
  - Explore options for more effective use and understanding of **date marking on food**
Project “How Packaging Contributes to Food Waste Prevention” [denkstatt 2014/15]

Packaging producers:
- Bio vom Berg
- Scheyer Verpackungstechnik
- Sealed Air Food Care
- Südpack

Packaging Recycling Association:
- ARA

Retailers:
- REWE Group
- Hofer
- Lidl
- MPREIS

Meat packer:
- denkstatt

Polymer producer:
- DSM

Industry association:
- Plastics Europe Austria

Research institute:
- Ofi
Recorded changes of food waste shares due to changes in packaging:

<table>
<thead>
<tr>
<th>Item</th>
<th>Original Waste Share</th>
<th>Reduced Waste Share</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sirloin steak</td>
<td>12%</td>
<td>3%</td>
</tr>
<tr>
<td>“Bergbaron” cheese</td>
<td>5%</td>
<td>0.14%</td>
</tr>
<tr>
<td>Yeast bun</td>
<td>11%</td>
<td>0.8%</td>
</tr>
<tr>
<td>Garden cress</td>
<td>42%</td>
<td>3.4%</td>
</tr>
<tr>
<td>Cucumber</td>
<td>9.4%</td>
<td>4.6%</td>
</tr>
</tbody>
</table>

denkstatt 2017
<table>
<thead>
<tr>
<th>Packed Food</th>
<th>Previous Version</th>
<th>Improved Version</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sirloin steak (and similar cuts of beef steak), 330 g</td>
<td>EPS Top seal tray with modified atmosphere, 12 % waste</td>
<td>PS/EVA/PE based skin packaging, 3 % waste</td>
</tr>
<tr>
<td>Bergbaron cheese, 150 g in slices</td>
<td>Cut from a 5 kg bar and sold at counter, 5 % waste</td>
<td>Slices in APET/PE/PSA tray + film packaging, 0.14 % waste</td>
</tr>
<tr>
<td>Plaited yeast bun, 400 g</td>
<td>Paper bag with plastic strip window, 11 % waste</td>
<td>OPP film packaging, 0.8 % waste</td>
</tr>
<tr>
<td>Garden cress growing on substrate, 100 g</td>
<td>In PS tray, 42 % waste</td>
<td>Additional PP film, 3.4 % waste</td>
</tr>
<tr>
<td>Cucumber, 350 g</td>
<td>Without packaging, 9.4 % waste</td>
<td>PE film, 4.6 % waste</td>
</tr>
<tr>
<td>Chicken meat, 350 g</td>
<td>PP tray plus lidding, 14 % waste at home</td>
<td>PP tray plus lidding, meat separated into two pieces, 5 % less waste at home</td>
</tr>
</tbody>
</table>
Darfresh skin packaging extends the shelf life from 6 to 16 days; enables steaks to be cut and aged in pack, eliminating separate packaging for aging; reduction of food waste by 9 percentage points.
Example 1 – Sirloin steak: results
Carbon Footprint, excluding consumed food

Effect of optimised packaging: - 5 g CO₂e
Savings of reduced food waste: - 730 g CO₂e

Functional unit = consumed amount = 330 g Sirloin steak
Example 2 – “Bergbaron” cheese

Photo: denkstatt
Example 2 – “Bergbaron” cheese
Basic input data

2a: distribution via delicatessen counter

- 16.8 g PE/EVA+PE/PVdC/EVA+PE shrink bag for 5 kg of cheese, plus transport packaging
- 150 g sliced cheese sold at the delicatessen counter in 6.9 g wrapping paper & “1/3” paper bag (3 products per bag)

**Food waste: 5 %**

- Net load on the transport truck: about 22 t

2b: distribution via self service shelf

- 150 g sliced packed cheese in self service shelf. Packaging: 11.9 g APET/PE tray with PET/PE/PSA/PE lidding film, plus transport packaging

**Food waste: 0.14 %**

- Net load of the transport truck: about 14 t

Data provided by REWE, Berglandmilch, OFI
Example 2 – “Bergbaron” cheese: results
Carbon Footprint, excluding consumed food

Gram CO$_2$e per 150 g of sliced cheese

- Reduced GHG emissions due to reduction of food losses from 5% to 0.14%: $-69$ g CO$_2$e
- Increased GHG emissions for better packaging: $+28$ g CO$_2$e
- Small relevance of increased transport and less recyclability

Impact: benefit ratio = 1 : 2,5

Net-benefit of improved packaging solution

functional unit = consumed amount = 150 g Bergbaron cheese
Example 3 – plaited yeast bun

PP film bag instead of paper bag – less dehydration
0.8% food waste instead of 11%
Example 3 – plaited yeast bun: results
Carbon Footprint, excluding consumed food

- Optimization of packaging: - 12 g CO₂e
- Reduced food waste: - 136 g CO₂e

functional unit = consumed amount = = 400 g plaited bun
1. Optimized packaging often provides environmental advantages. The reason is that benefits of prevented food waste are usually much higher than environmental impacts of production or optimization of the packaging involved.
2. In most cases the **protective function** of food packaging is more important than the impact of different packaging materials, also regarding their recyclability.

3. A **high value of the product** should be complemented by a high standard of packaging to ensure optimal product protection.

4. Advantages of improved packaging solutions should be **communicated along the value chain** in a transparent way.

5. Intense **communication and cooperation within all stakeholders** in the value chain will support future optimization.

6. In **follow-up projects** additional examples shall be identified and assessed.
Design guidelines for a circular, resource-efficient economy

Sustainable design “formula”:

+ optimised material production
  \times \text{ small material demand per functional unit}

+ **high functionality / quality / use-benefits**

+ optimal recovery/recycling-mix *(determined by CBAs!)*

= **Low eco-footprint, economic & social impact**

Priority for functionality, then raw material and recycling aspects
Quantitative assessment of the impacts of improved processing and packaging on food waste reduction

A 3 year multi stakeholder project
October 2016 – September 2019
Case studies

Meat packaging
• Vacuum packaging versus MAP (beef, pork; odour aspects)

Fruit and vegetables
• Tomatoes, strawberries, cut salad, etc.
  (conventional vs. biodegradable films; gas mixtures and perforation; etc.)

Consumer level
• Influence of packaging on food waste; effects of portion size; awareness raising

Eggs
• Influence of different materials on fracture rate

Barrier design
• Avoiding over-performance (example coffee capsule & fresh juices); recyclability versus protective function

Vegetable processing
• Reducing food losses by improved processing)
Optimized food packaging and processing are reducing food waste, which results in environmental and economic benefits.

Guideline for processing, packaging, logistics & retailers

Objective and comprehensive environmental and economic life-cycle assessments

Identification, improvement and development of new packaging and process innovations

Evaluation of effects on food waste at consumers and retailers
We drive the change to a sustainable society.

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Let’s not forget about the relevance

How many car kilometres are compensating the CO$_2$ benefit (per capita) of

- 1 year abstaining from plastic shopping bags
  14 car km

- 1 year buying water in PET refillable bottles instead of PET one-way bottles
  38 car km

- 1 year of separate collection & recycling/recovery of plastic packaging
  70 – 100 car km

Source: denkstatt studies 2007 - 2011
Methodology used for assessing the case studies in total life-cycle

- Comparison of total waste amounts and of Carbon Footprint (CO$_2$-equiv.) of previous and improved packaging solution
- Consideration of production, transport (displayed separately only for examples 1 and 2), use-phase, and waste treatment of food and packaging
- All results are based on the same functional unit = same amount of *consumed* food for each case study
- Food waste in households is not included (except in example 6 for chicken meat)
- Net greenhouse gas emissions of packaging recovery are calculated with an existing reviewed ARA/denkstatt-model
- No greenhouse gas emissions are assigned to treatment of food waste in waste incineration plants
Example 1 – Sirloin steak

Basic input data

1a: previous packaging

- 20 g PE/EVA+PE/PVdC/EVA+PE vacuum-bag (for 6 kg meat) = aging packaging
- 11 g EPS tray and 4 g EVOH/PE/PA film – final packaging (absorbent pad not considered)
- 358 g of packed food (scaled down to 330 g)
- Food waste: 12 %

1b: improved packaging (shelf life of 16 days instead of 6 days; no separate aging packaging needed)

- 19 g PS/EVA/PE based “Darfresh” skin packaging (absorbent pad not considered); aging takes place in final packaging
- 300 g of packed food (scaled up to 330 g)
- Food waste: 3 %

Data provided by REWE, Sealed Air, OFI, Köhrer
Results example 1 – Sirloin steak

- Total waste (product and packaging) reduced by 50 %

- The high environmental impact of top quality beef results in high environmental benefit of reduced food waste

- The differences concerning production and recovery of packaging are comparably small

- As a general rule: the more valuable / expensive the product, the more important is a robust protection of the product by high quality packaging
Results example 2 – “Bergbaron” cheese

- Amount of packaging material per consumed food amount increases. Small increase of the total waste amount (product plus packaging)

- High environmental impact of cheese production results in high environmental benefit related to prevention of 5 % cheese waste

- This benefit is 2.5 times higher than the sum of the additional environmental impacts of
  - the production of an increased amount of packaging material
  - increased impact of transport (less load on truck)
  - higher emissions related to recovery of packaging

- Remark: Limited comparability of the two distribution methods “delicatessen counter” and “self service shelf”, which provide different offers, address different needs and target groups, ....
Example 5 – cucumber

No packaging versus PE film
(prolonged shelf life, less moisture loss)
4.6% food waste instead of 9.4% (at the retailer)
Example 5 – cucumber

5a: previous situation

- No packaging
- Average weight of the cucumber: 480 g (own measurements, 11 products)
- Food waste: 9.4%

5b: cucumber with packaging (prolonged shelf life, less moisture loss)

- Average weight of the film: 1.5 g (own measurements)
- Average weight of the cucumber: 480 g (own measurements)
- Food waste: 4.6%

Data provided by MPREIS, OFI
Example 5 – cucumber: results
Carbon Footprint, excluding consumed food

“best case calculation” for cucumber without packaging

- Additional emission of packaging: + 4.5 g CO₂e
- Reduction of the food waste: – 3.5 g CO₂e
- Alternative results: see next slide

- Functional unit = consumed amount = 480 g cucumber
The environmental benefits of food waste reduction surpass the environmental impact of the film packaging, if ONE of the following conditions is fulfilled:

- The food waste is reduced by >6.3 percentage points (e.g. 3.7% instead of 10% food waste); in the example above the reduction is 4.8% points (remark: the impact of food waste in households is not included in the calculation)

- The thickness of the film is reduced by 22% (films with different thicknesses are used today, the calculation is based on an average value)

- The distance for transport is increased by 60% (the calculation is based on local production)

- The cucumber is grown in a greenhouse (calculation: open field)

- 2/3 of film packaging is collected separately (calculation: 1/3)