

Environmental Impacts of Packaging

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- Basic issues for environmental assessments
- The role of packaging in the food chain
- Influencing factors: materials & function, packaging design, waste management
- Bio-based packaging?
- Conclusions



Environmental Criteria, e.g. for a Life Cycle Assessment according to ISO 14040 ff. (2006)

- a) Emissions related to Global Warming (“Carbon Footprint”)
- b) Usage of fossil energy resources
- c) Total usage of energy resources
- d) Deposited inert waste
- e) Emissions of defined pollutants
(into air, water, ...)

a), b), and c) are highly correlated,

but: reductions in one area [especially d), e)] usually lead to increases in others [here: a), b), c)]

The only strategy for overall reduction: Reduce necessary inputs, i.e. use less for the same function!



Facts for food and food packaging, Western Europe

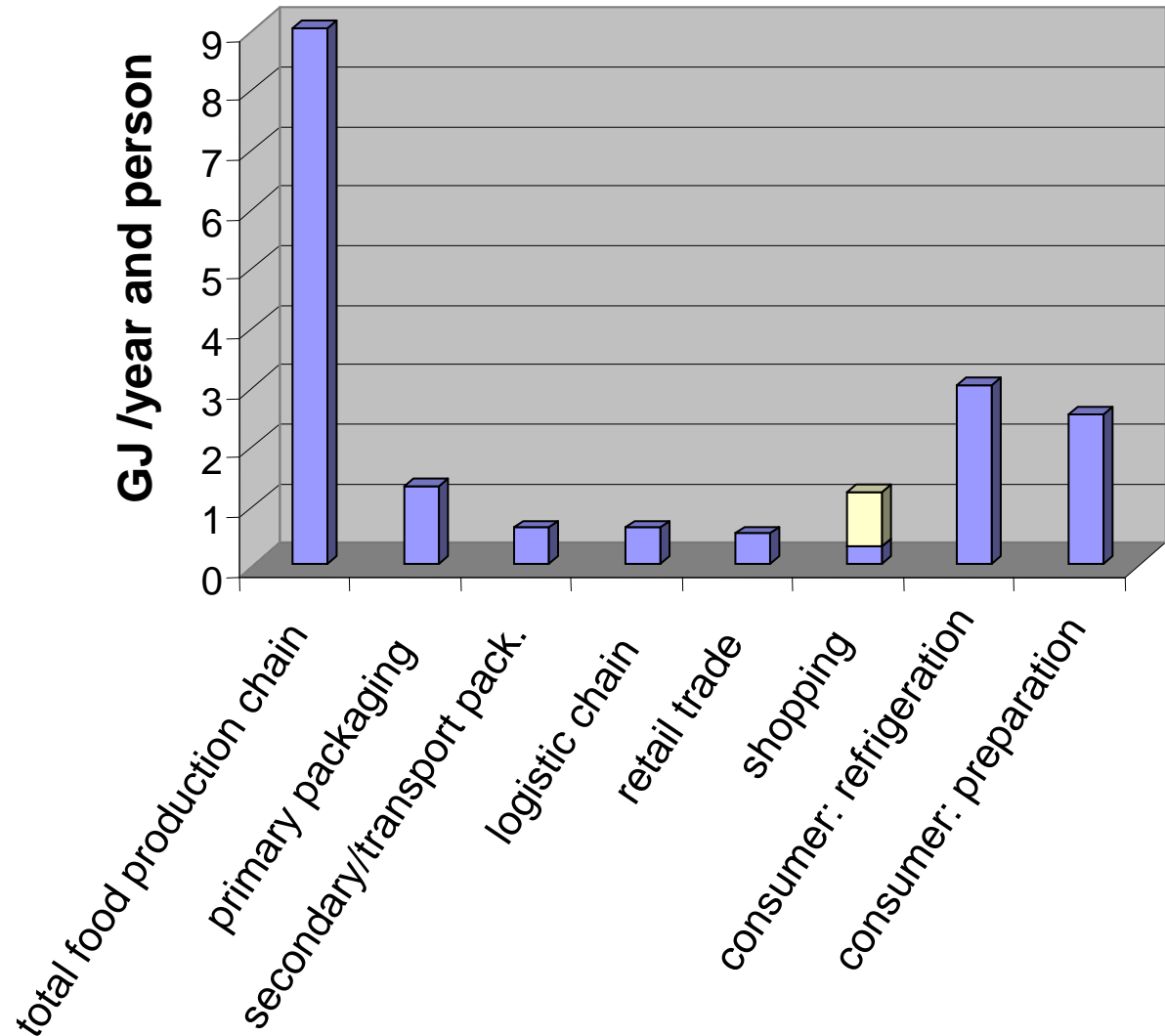
Survey for UK, 1995

Indicator: total energy used per consumer for food consumption

(Source: Kooijman 1996)

Energy equivalent to drive a typical smaller car over 10000 km:

about 20 GJ

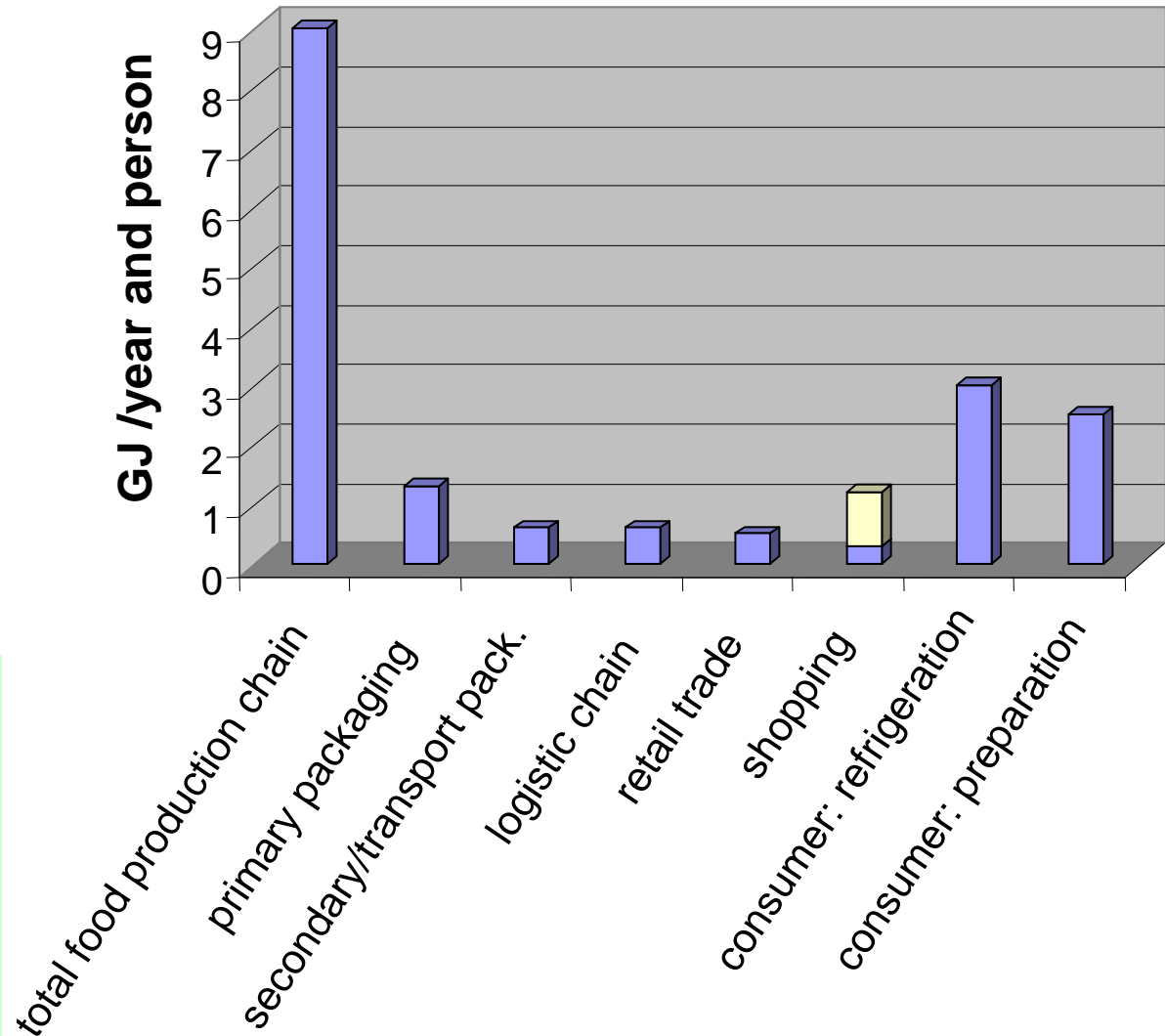


Facts for food and food packaging, Western Europe

Food losses before sales: 1...2 %

Food losses at the consumer: 9...15 %

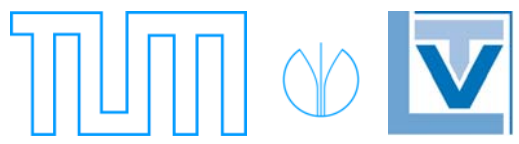
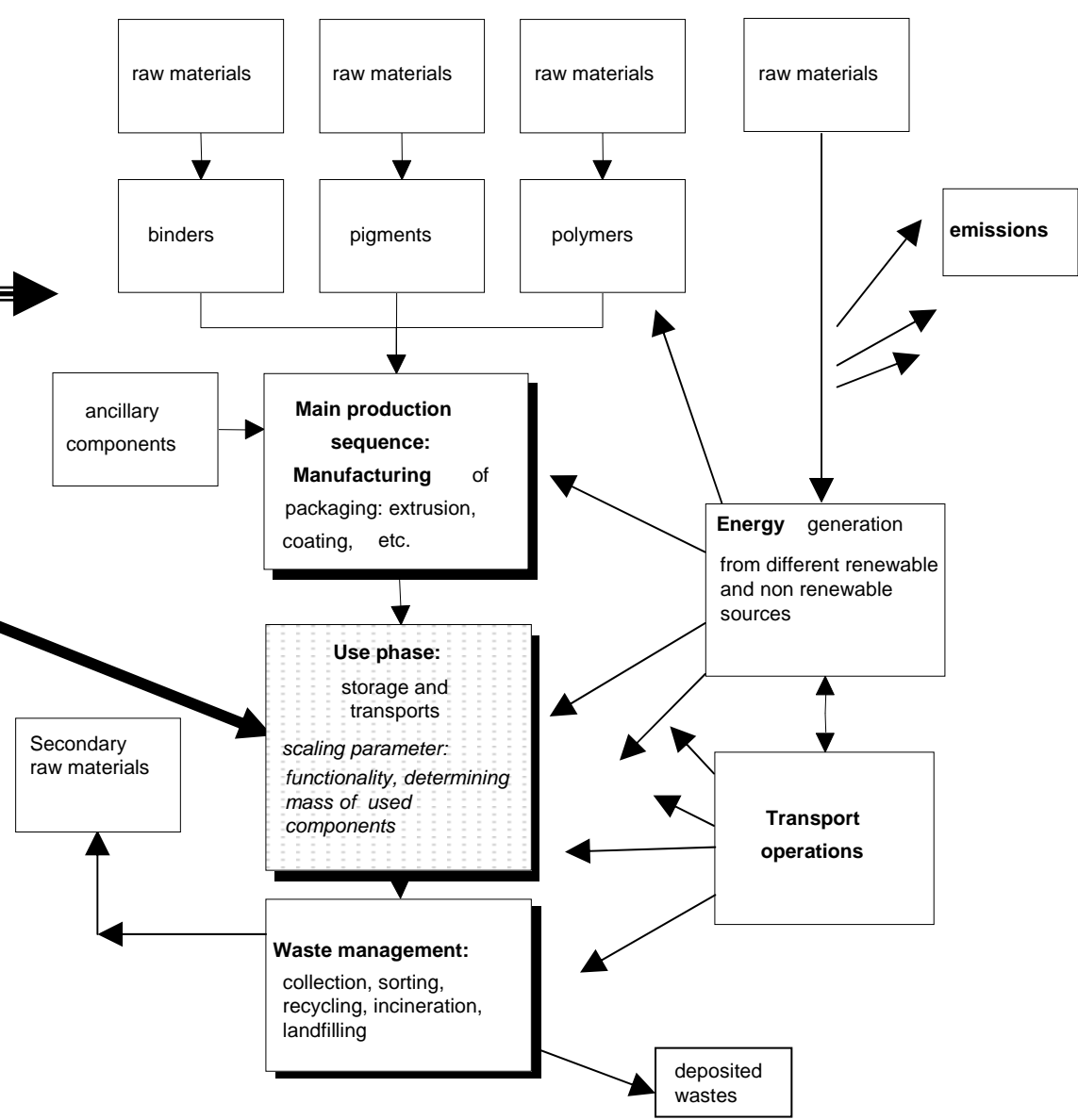
Fact No. 1: Food that is lost at the consumer creates the highest environmental loads compared to all other factors



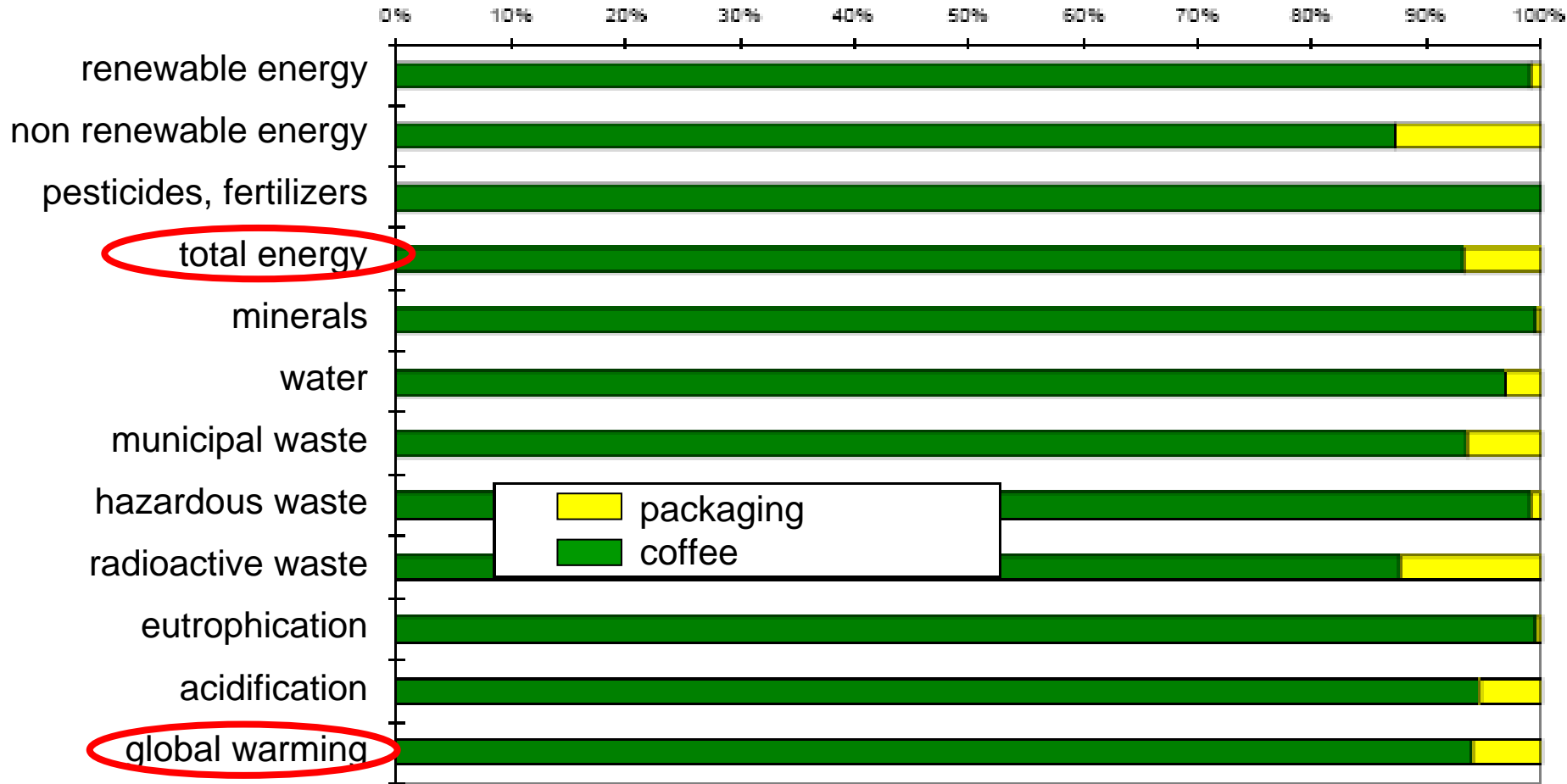
Fact No. 2:
 For any specific product, environmental benefits can only be supported reliably via a **Life Cycle Assessment**

Fact No. 3:
 For any product, the degree of **fulfilment of the function** gives a scaling factor.

Fact No. 4:
 For a packaging product, energy supply and transports are dominating factors.



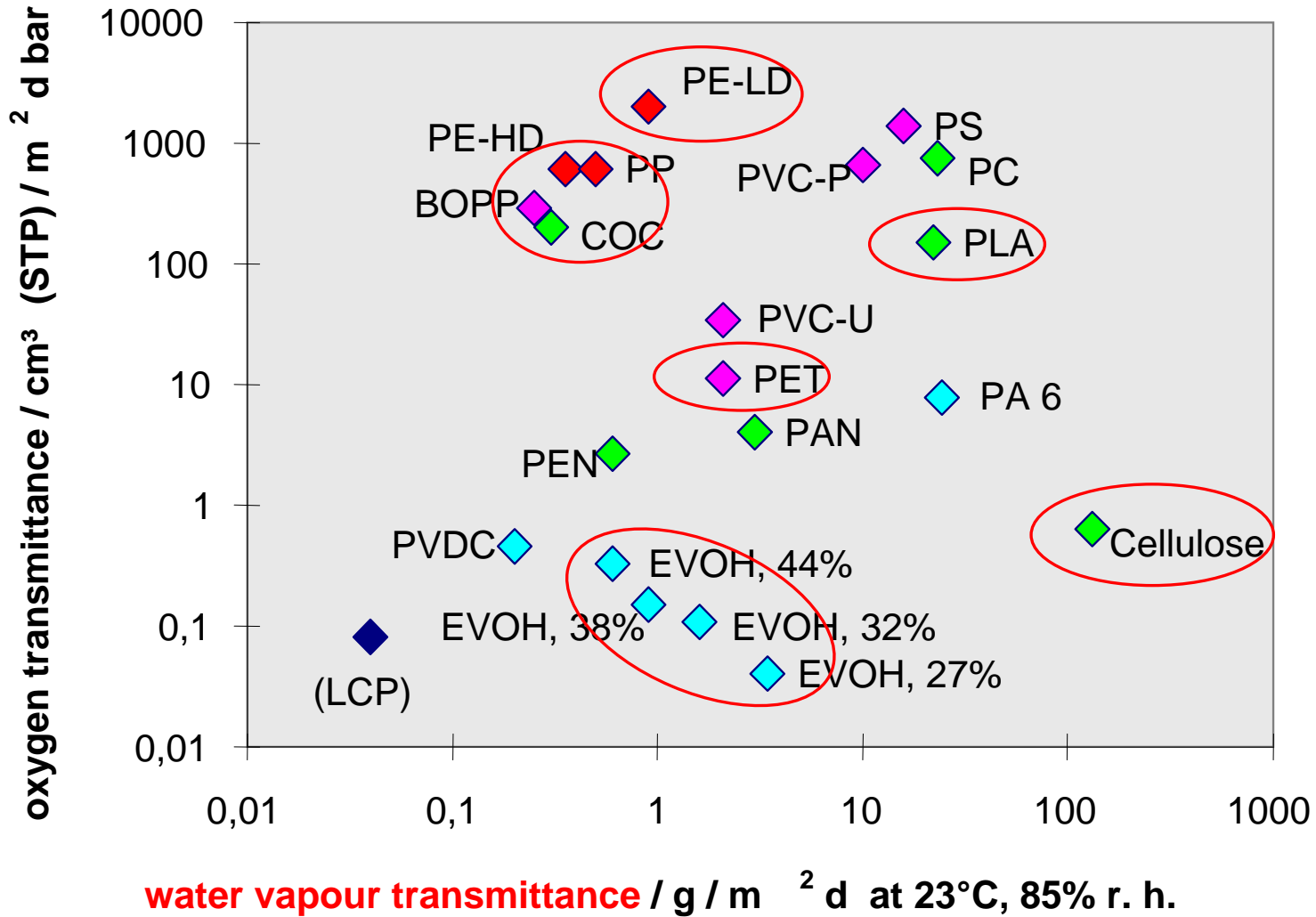
Example: LCA of vacuum packed coffee prepared at the consumer, product vs. packaging, relative figures



Source: Diers, A., Langowski, H.-C., Pannkoke, K., Hop, R.: Produkt-Ökobilanz vakuumverpackter Röstkaffee. LCA Documents, Vol. 3. ecomed-Verlag, Landsberg, 1999



Functionality: O₂-, H₂O- transmittance of various polymers



Transmittance:
Permeability at
23°C, for 100 µm
film thickness



Functionality vs. environmental impact

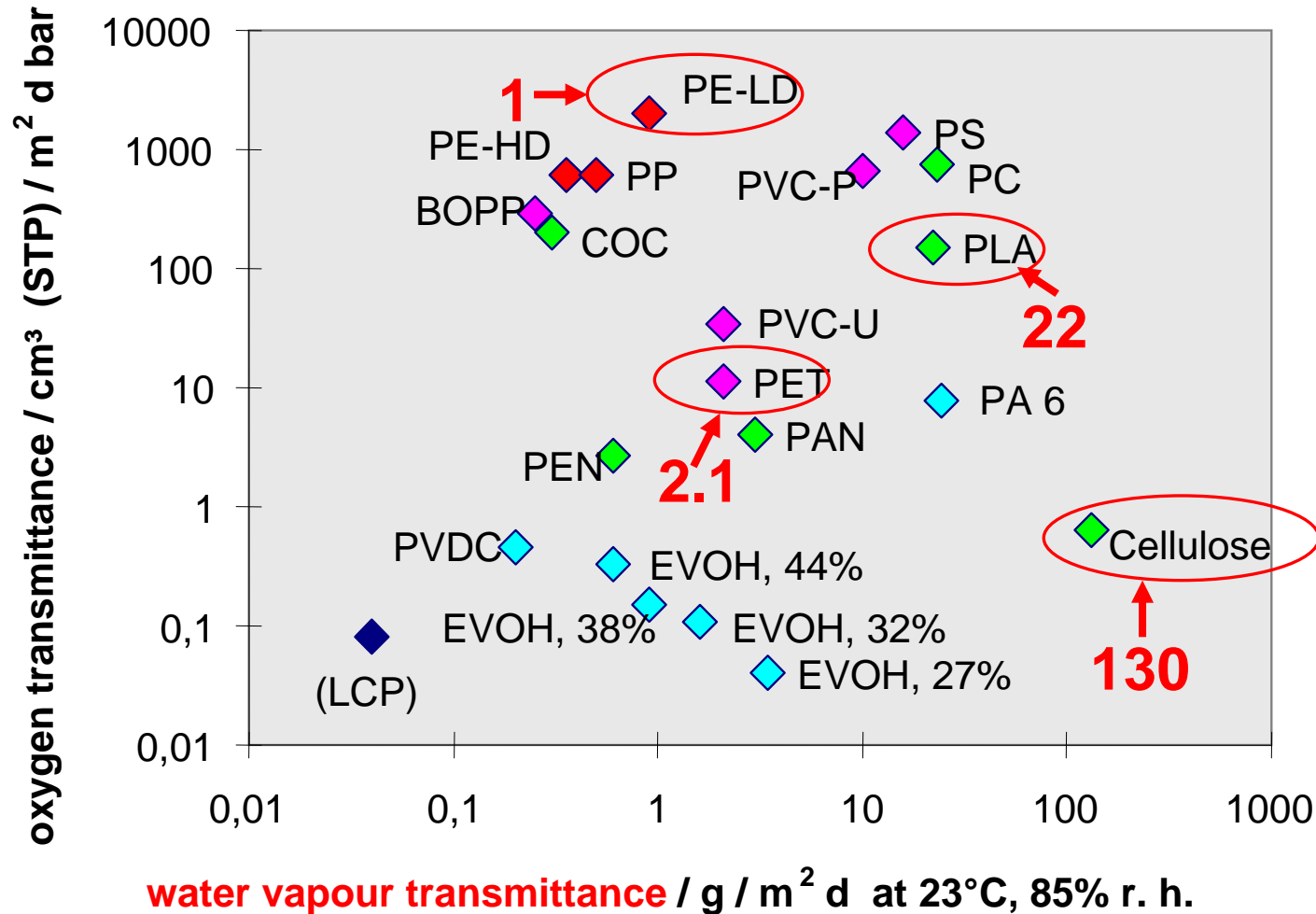
Polymers may differ in their packaging related function by 10^3 to 10^5 ,

but in their specific impact by a factor of much less than 10 (maximum difference: paper vs. engineering plastics)

Consequences on shelf life

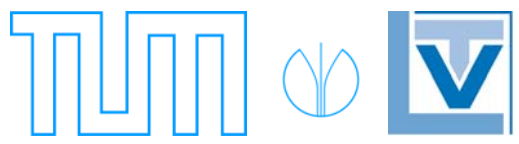
If the shelf life of water in a PET bottle is 1 year, it will just be 38 days in an identical PLA bottle

The shelf life of a dry product will be 22 times shorter in PLA vs. PE-LD of the same thickness



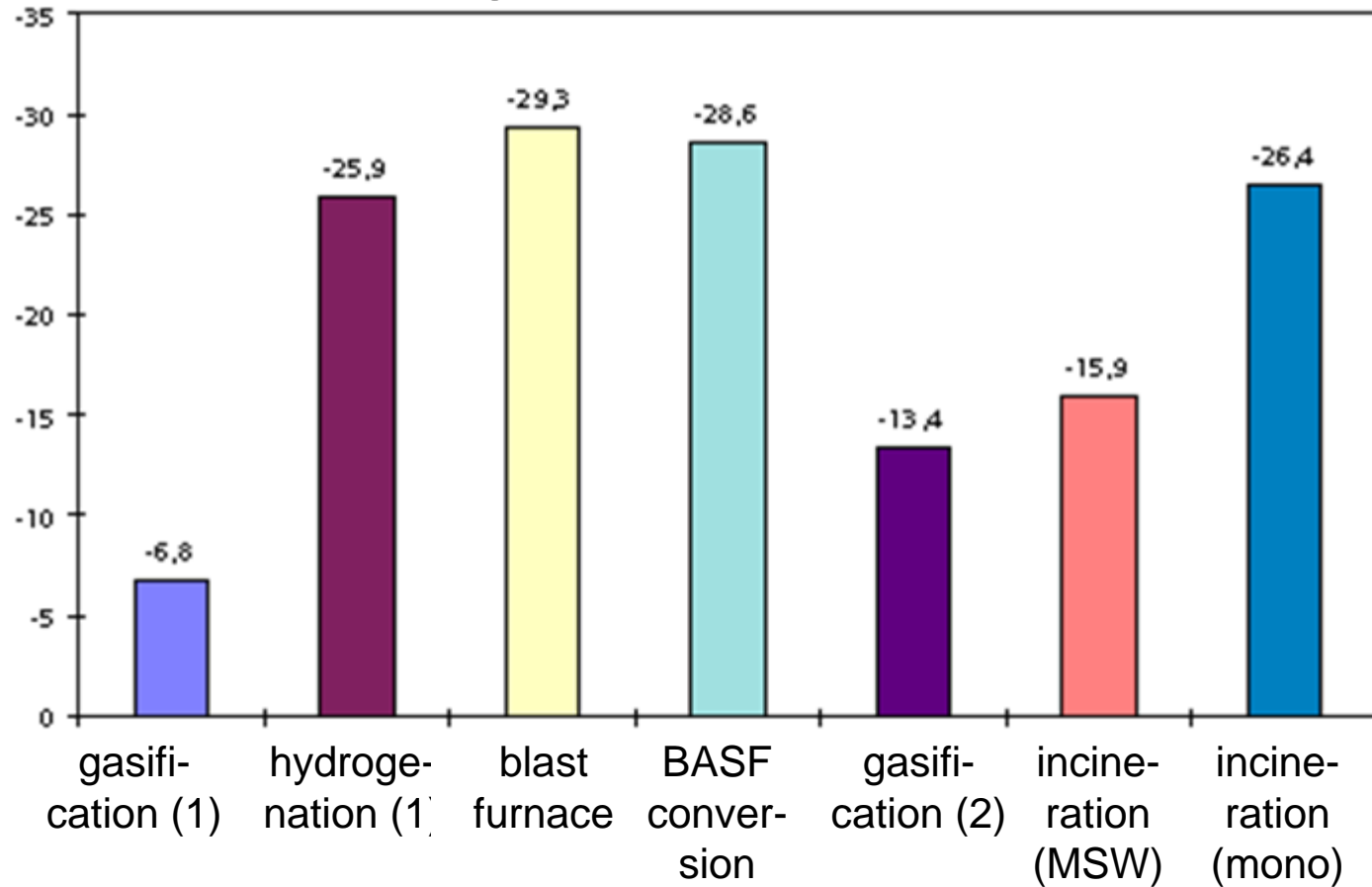
Results of the German BMBF project „thin films“: Film thickness may be halved in many cases without compromising functional properties

| | standard film | downgauged film |
|-------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| nuts | <p>PET 12 μm BOPP_{met} 15 μm PE-LD 40 μm 70 μm</p> | <p>PET_{met} 7 μm PP-multi layer 28 μm PE 12 μm 42 ... 47 μm</p> |
| chips | <p>BOPP_{met} 20 μm BOPP 20 μm 40 μm</p> | <p>BOPP_{met} 15 μm BOPP 12 μm 27 μm</p> |



Energy recovery (various methods assessed in 1996) vs. landfilling of plastics waste

recovered
energy /
MJ / kg of
waste

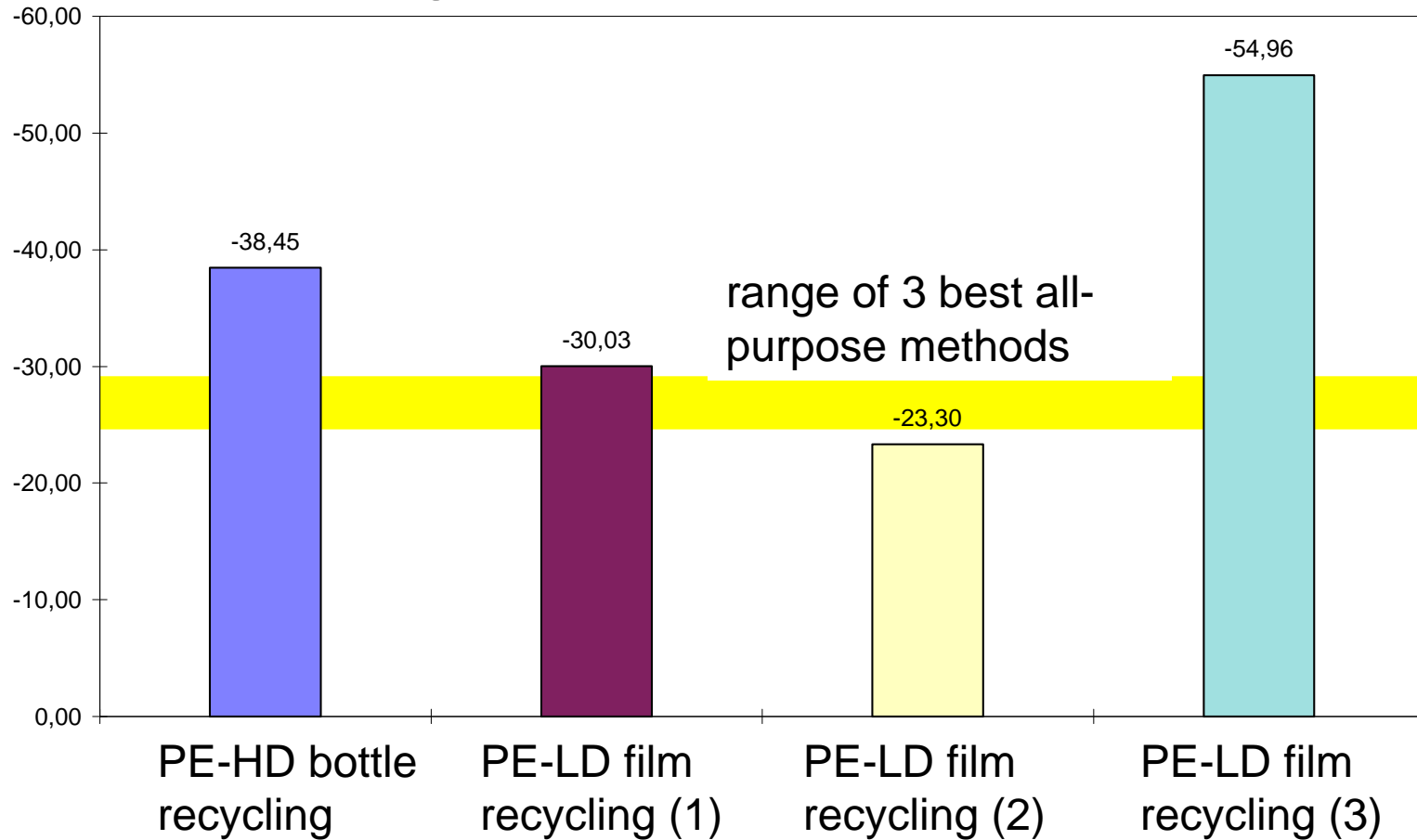


Heyde, M., Holley, W., Kremer, M.: Ökobilanzen zur Verwertung von Kunststoffabfällen aus Sammlungen des Dualen Systems. VDI Berichte Nr. 1288, S. 57 - 77. VDI Verlag Düsseldorf, 1996



Specific recycling (various methods assessed in 1996) vs. landfilling of plastics waste

recovered
energy /
MJ / kg of
waste



Heyde, M., Holley, W., Kremer, M.: Ökobilanzen zur Verwertung von Kunststoffabfällen aus Sammlungen des Dualen Systems. VDI Berichte Nr. 1288, S. 57 - 77. VDI Verlag Düsseldorf, 1996



There are high efficiency methods in recycling as well as in energy recovery.

Everything depends on the technical method actually applied and the surrounding infrastructure.

Remark: standard composting does not allow for energy recovery!



PLA-based bottle for mineral water (source: Biota)

Bio-based packaging?



March
2008

What is the right place for
compostable plastics?



Fraunhofer
Institut
Verfahrenstechnik
und Verpackung

„Compostable acc. to EN 13432“ means high temperature industrial composting in a related infrastructure



Conclusions for packaging of low environmental impact

- Packaging with insufficient functionality creates high environmental loads due to product losses
- There are no “good“ or “bad“ packaging materials. Their functionality is the decisive factor.
- Composting is not an efficient alternative to many current recovery schemes
- Substitution of fossil resources by renewable materials is questionable as long as we just burn 83 % of the crude oil for energy supply and transports
- **Proper packaging design helps us to use the lowest possible amount of resources via highly functional materials**

