ENVIRONMENTAL COMPARISON OF ALTERNATIVE WASTE MANAGEMENT OPTIONS

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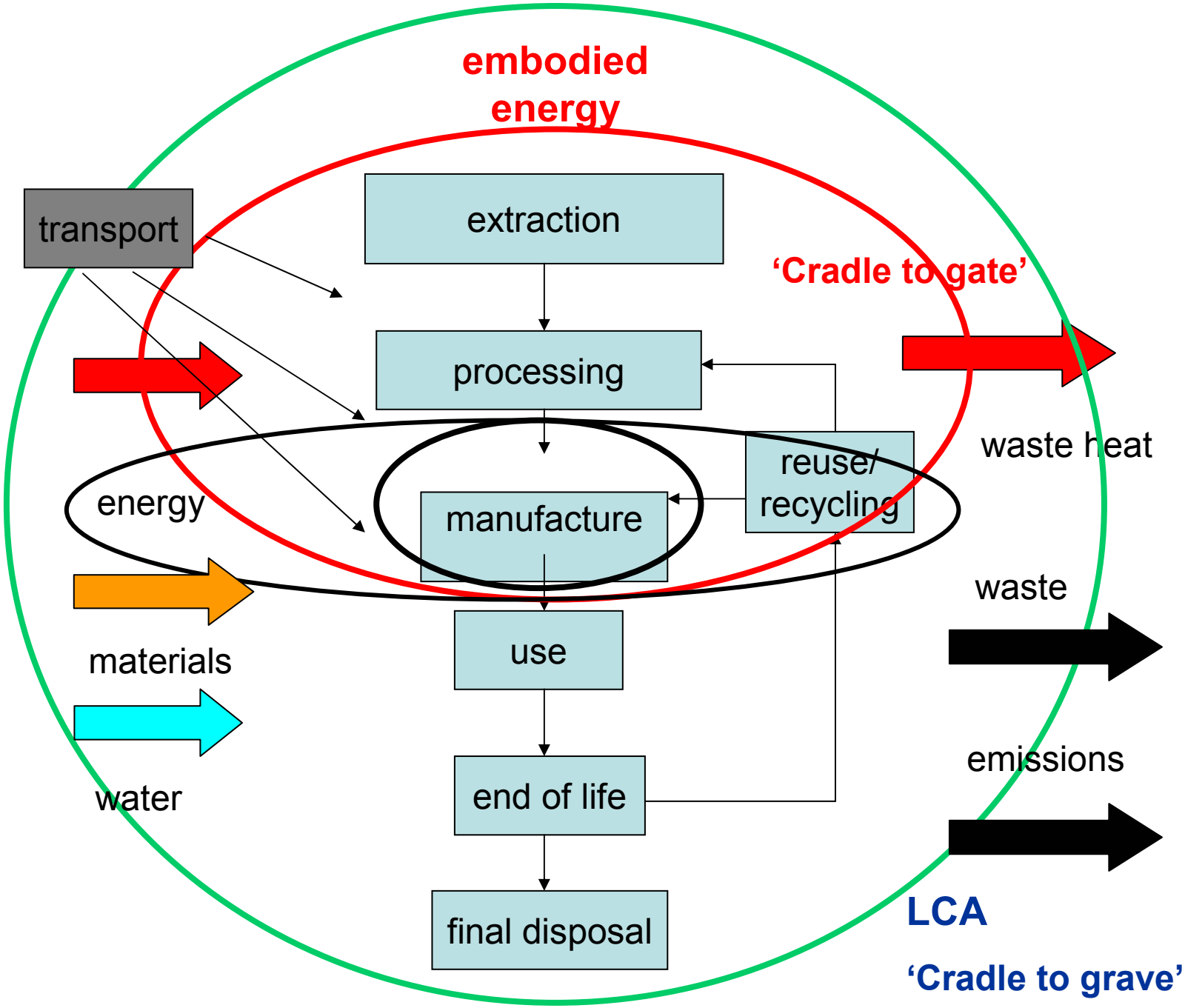
Environmental LCA as a tool for evaluating the sustainability of ecosystem services

University of Bath 09/07/08


embodied
energy
transport
extraction
'Cradle to gate'
processing
waste heat
reuse/
recycling
energy
manufacture
waste
materials
use
emissions
water
end of life
final disposal
LCA
'Cradle to grave'

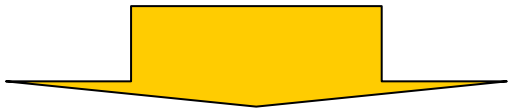
WASTE MANAGEMENT IN VALENCIA, SPAIN

- No individual household kerbside collection
- High density collection
  - residual waste
  - 20-50m
  - daily collection
- Low density collection
  - recyclables (bring)
  - separate containers
  - 50m

OBJECTIVE

This study analyses different alternatives for municipal solid waste management that can be implemented in the Valencian Community (SPAIN), to achieve the targets required by:

- European Landfill Directive
- Packaging and Packaging Waste Directive
- Spanish National and Regional Waste Management Plan

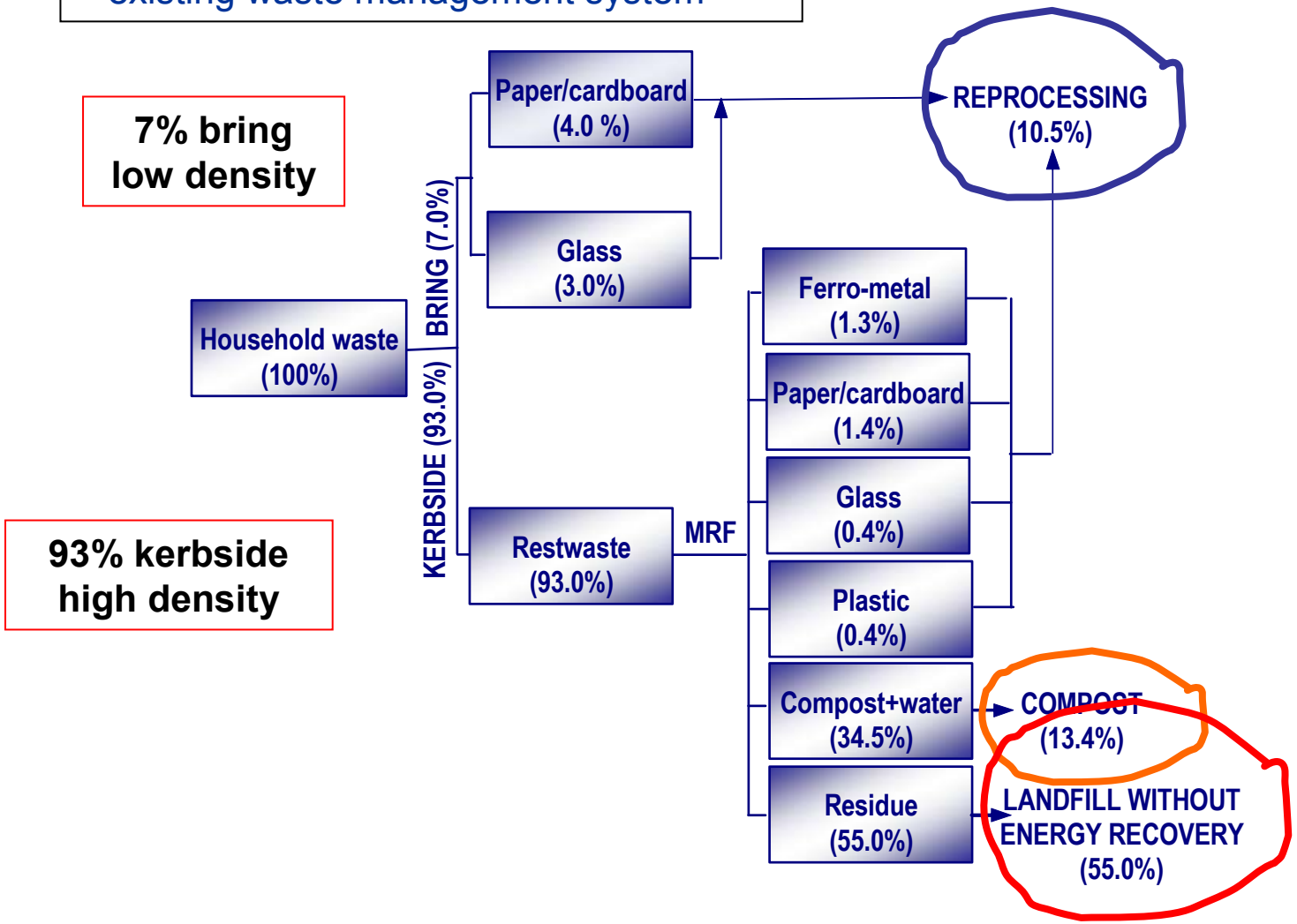


The aim is to limit the disposal of waste in landfills to the waste fraction that cannot be valorised

SCENARIOS

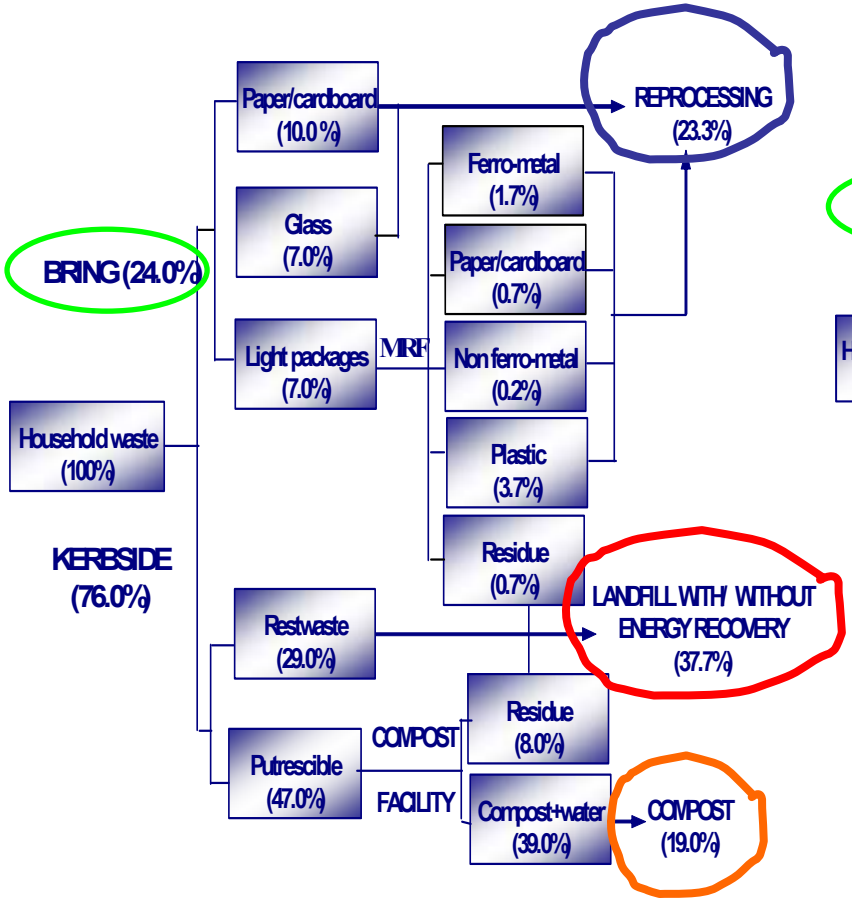
BASELINE (SCENARIO 0)

✓existing waste management system

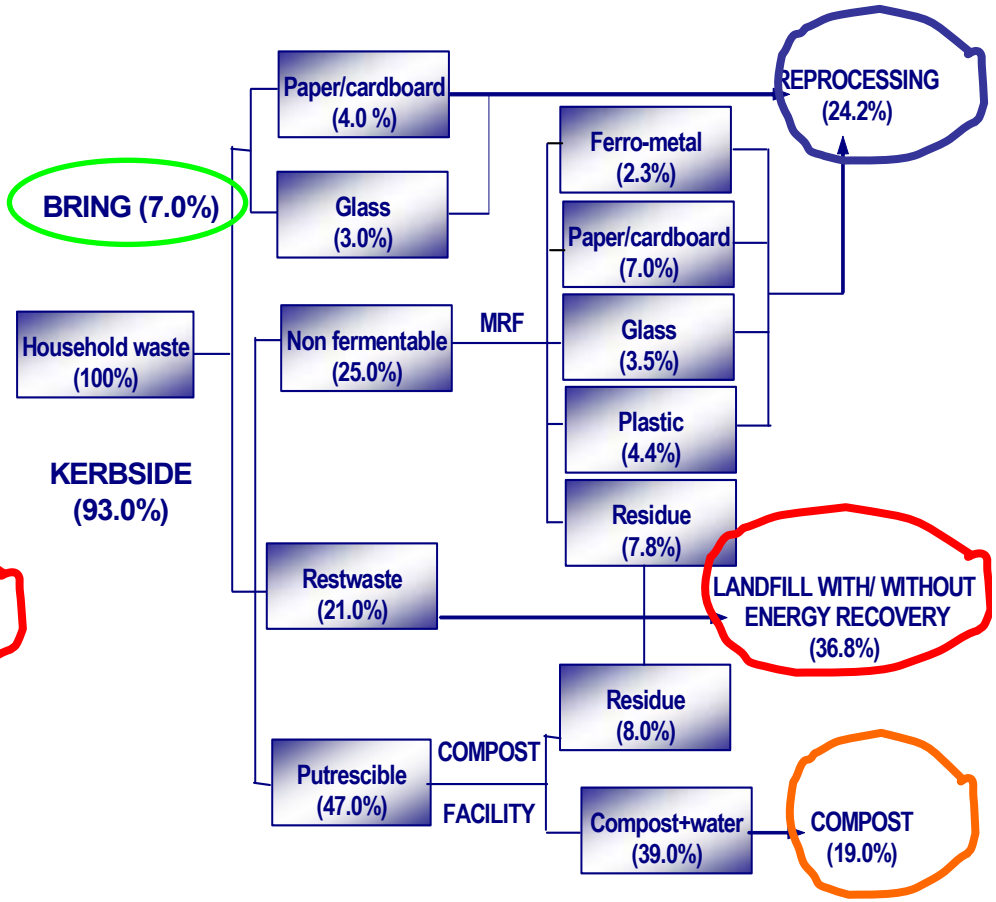


DESCRIPTION OF THE SCENARIOS

SCENARIO 1/1v



SCENARIO 2/2v



GOAL & SCOPE DEFINITION

GOAL

✓evaluate the environmental performance of the current solid waste management system in the Valencian Community

✓ compare with integrated alternatives

FUNCTIONAL UNIT

✓the management of 1 tonne of household in the area under study

	Household waste composition (%)
Metal	3.80
Glass	7.11
Paper/cardboard	15.21
Plastic	10.10
Putrescible	57.08
Textile	3.50
Other	3.20

LIFE CYCLE INVENTORY

IMPACT CONTRIBUTIONS DUE TO THE FOLLOWING ACTIVITIES

Bags	✓3 different waste bags for kerbside collection system
Containers	✓for kerbside collection and bring system ✓additional impact due to washing containers •water consumption •fuel consumption of washing trucks
Transport	✓collection system (fuel consumption/collected tonne) ✓other than collection: urban, rural and highway route, with different load (fuel consumption/tonne*km)
Transfer Stations	✓energy consumption during transfer activities ✓water consumption during cleaning activities
Materials Recycling Facility	✓energy consumption by sorting equipment & compressing bales ✓water consumption during cleaning activities

LIFE CYCLE INVENTORY

IMPACT CONTRIBUTIONS DUE TO THE FOLLOWING ACTIVITIES

Composting

- ✓energy consumption to produce compost

Landfill

- ✓fuel consumption (vehicle) during waste disposal & site
- ✓landfill gas from biodegradable organic fraction
- ✓leachate production due to:
  - •rain in the geographical area
  - •water content for each waste fraction
  - •water deduction from reactions with biodegradable organic fraction.

Recycling

- ✓transportation of the recovered material from MRF to reprocessing site

LIFE CYCLE INVENTORY

IMPACT SAVINGS DUE TO THE FOLLOWING ACTIVITIES

Composting	✓compost avoiding fertilizers (assumption: 100% replacement of organic fertilizer based on N & P content)
Landfill	✓energy generation from biogas (scenarios with energy recovery 1v/2v)
Recycling	✓recycled material avoiding virgin material

LIFE CYCLE IMPACT ASSESSMENT

ANALYSIS

By impact categories

✓emissions from the LCI have been arranged into impact categories according to CML (2001):

- global warming
- ozone layer depletion
- photochemical oxidation
- acidification
- eutrophication

By LCIA methods

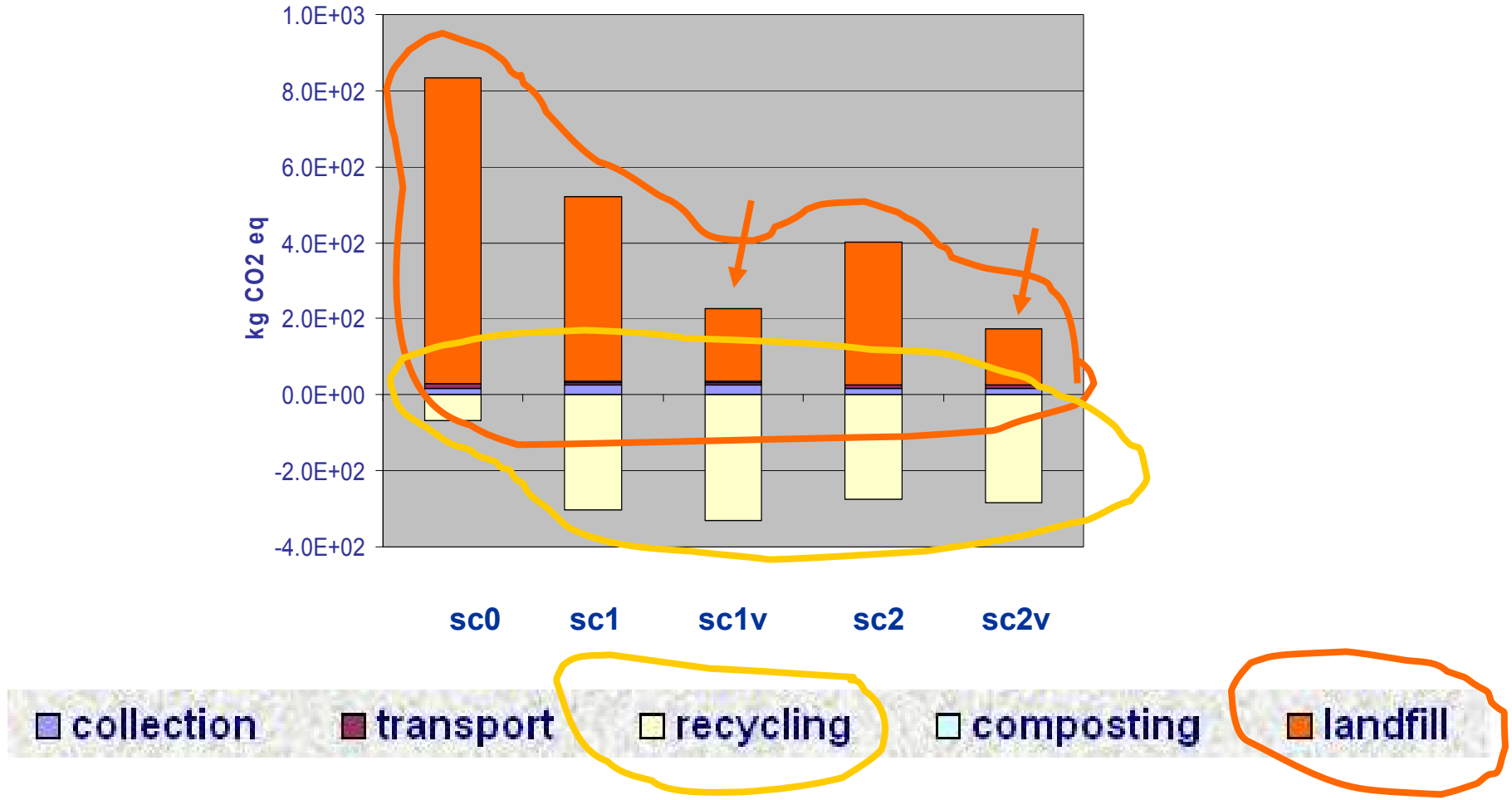
✓4 LCIA methods nave been tested in parallel:

- Eco-Indicator'95
- Eco-Indicator'99
- EPS 2000
- CSERGE

LIFE CYCLE IMPACT ASSESSMENT

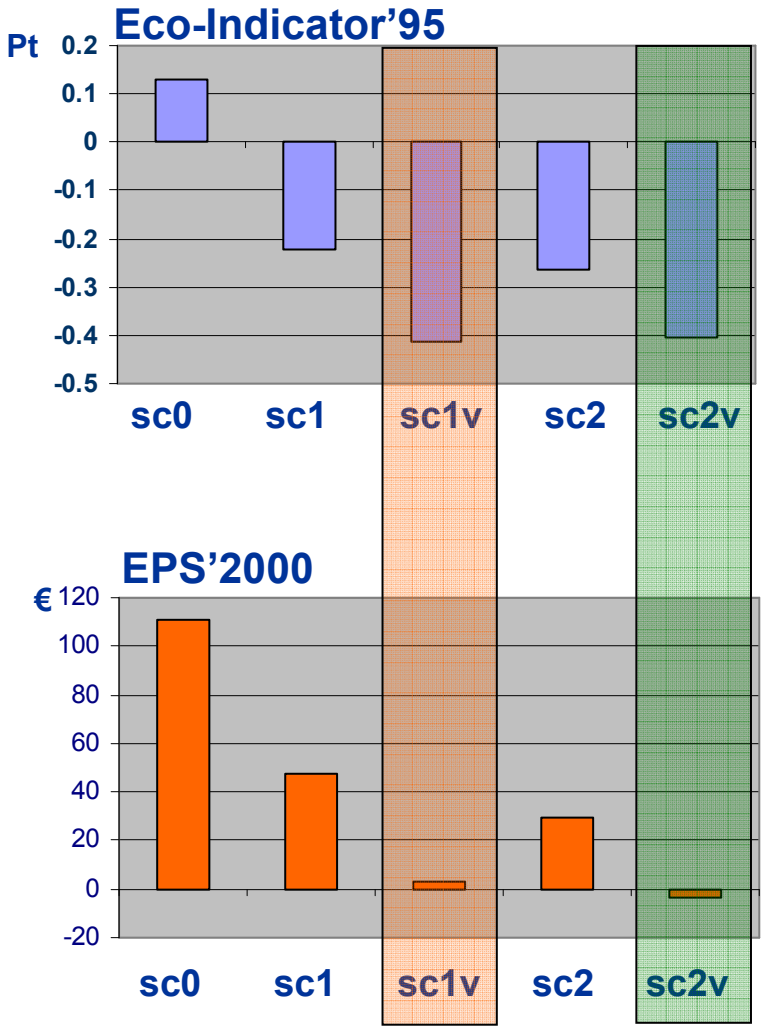
ANALYSIS BY IMPACT ASSESSMENT CATEGORIES

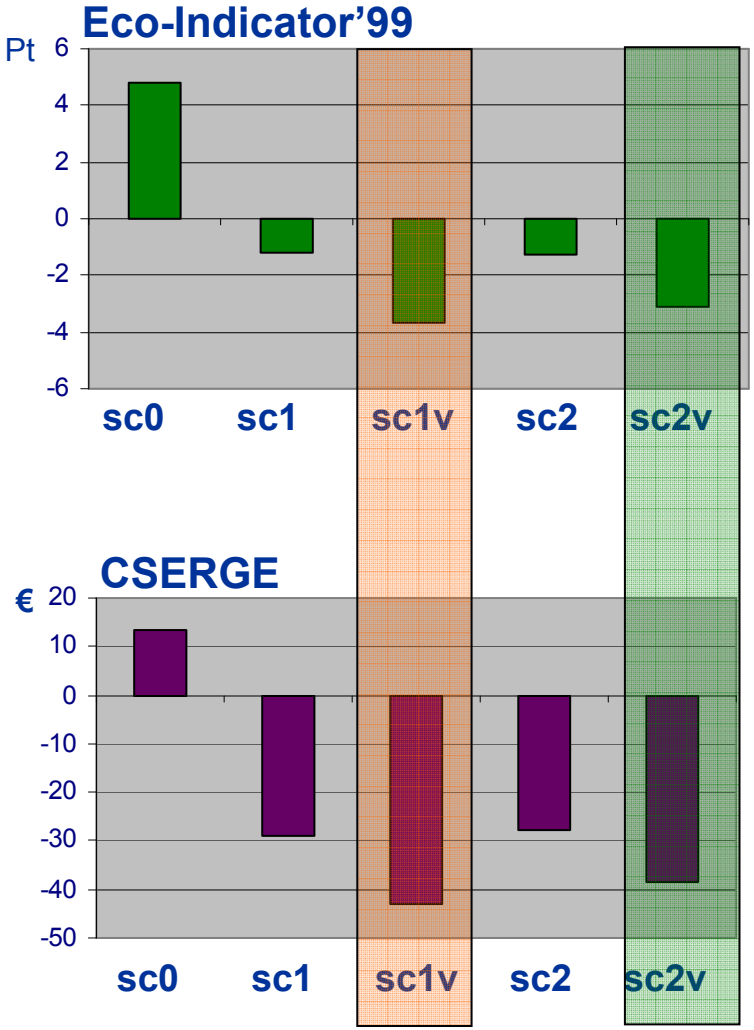
global warming



LIFE CYCLE IMPACT ASSESSMENT

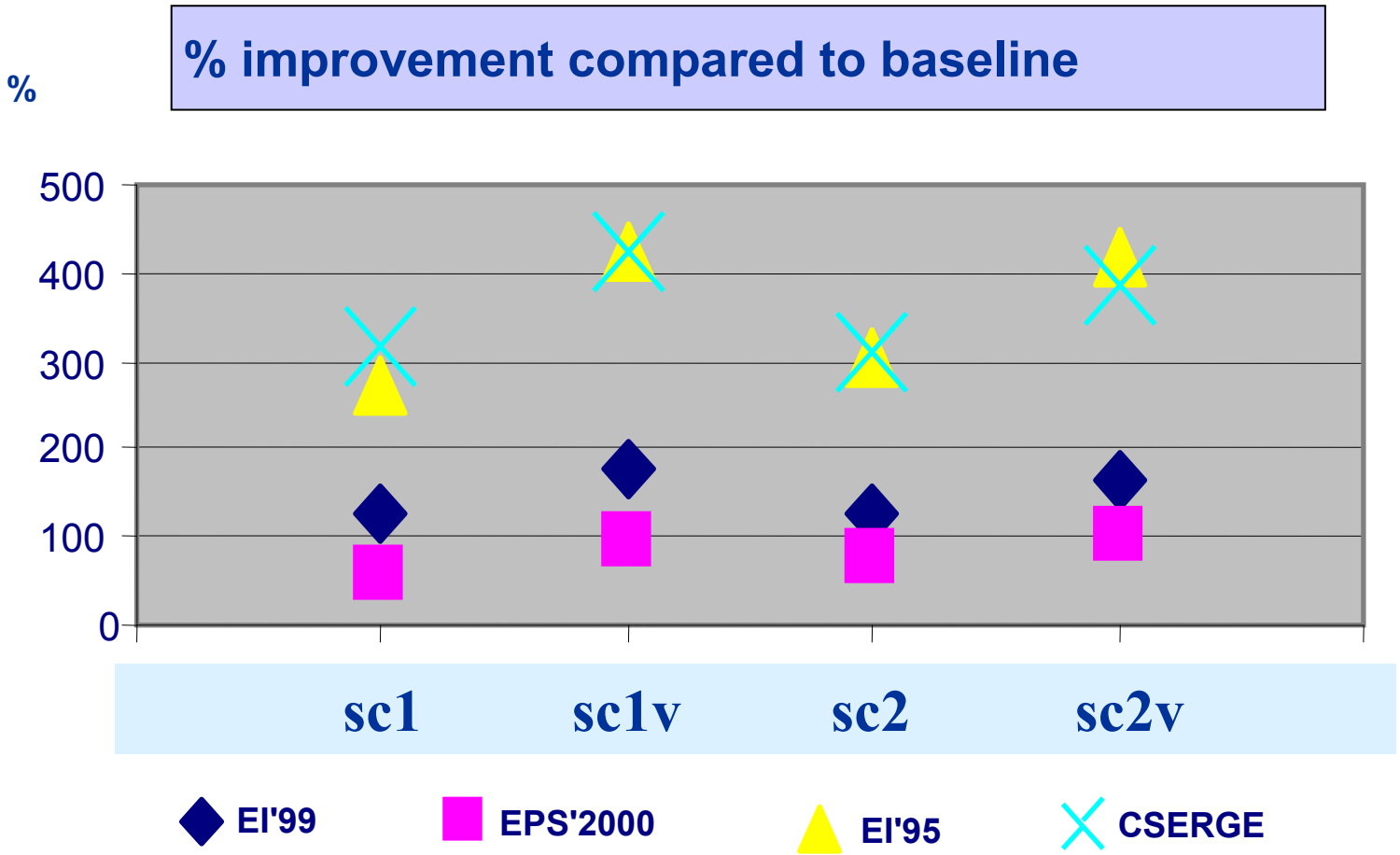
ANALYSIS BY LCIA METHODS





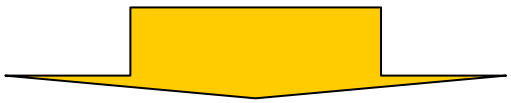
LIFE CYCLE IMPACT ASSESSMENT

ANALYSIS BY LCIA METHODS



SENSITIVITY ANALYSIS

- Exclusion of biological CO2 in the landfill process
- Exclusion of the transfer station in kerbside collection
- Change in % of fertilizer displaced from the composting



The same results as the initial LCI model

CONCLUSIONS

Ranking scenarios

✓Scenarios with energy recovery achieve better environmental performances than those without.

✓Scenario 1v performs slightly better than scenario 2v, for most of the impact categories and impact assessment methods.

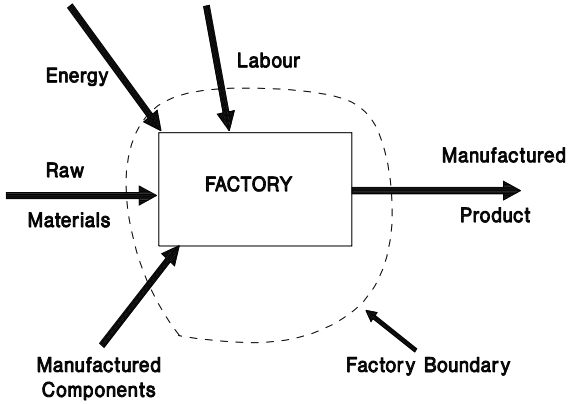
✓In spite of differences between the four impact assessment methods, the results give the same preference ranking

CONCLUSIONS

Recovery targets required by legislation

Glass	scenario 1/1v better than 2/2v
Paper/cardboard	scenario 2/2v better than 1/1v
Plastic	scenario 2/2v better than 1/1v
Reduction of biodegradable fraction	
Valorisation of residue/restwaste fraction going to landfill	

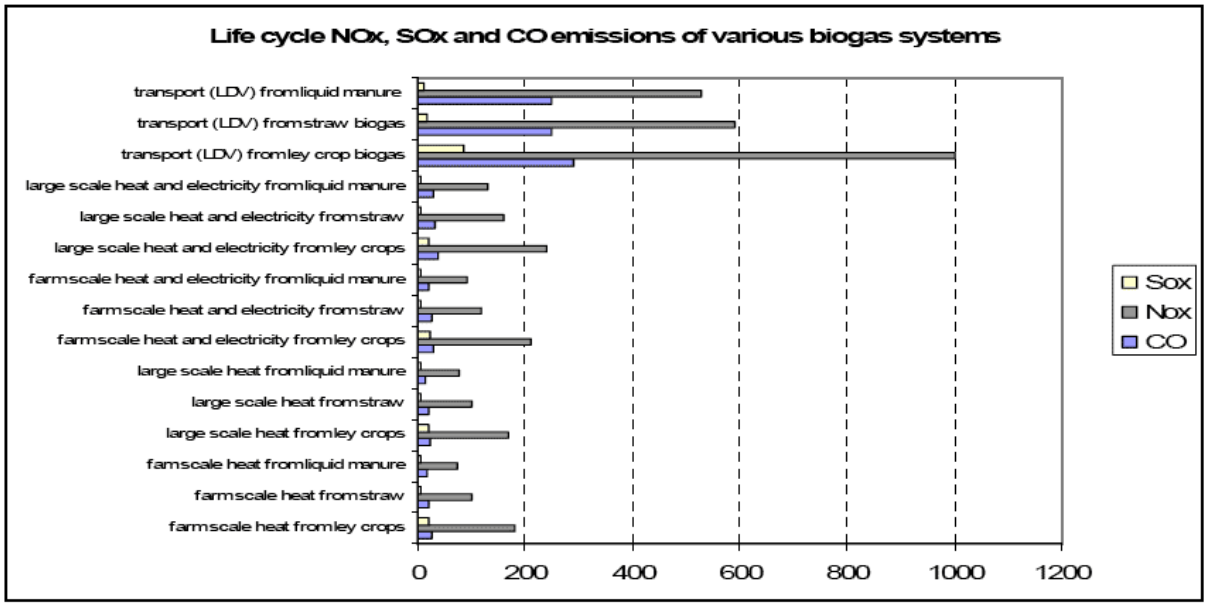
LCA CHALLENGES



Transparency
- Assumptions
  - results can be different for similar studies
- Boundaries

- Just a snapshot of the environmental impacts
  - does not easily take long term effects into consideration (?)
- Scientifically-defensible tool (scientists and engineers) vs. decision making tool (business managers and policy makers)
- Full LCA is detailed and time consuming
  - Limit impacts – carbon footprint
  - Restrict boundaries

MORE CHALLENGES



- Some impacts difficult to quantify
- Results of lifecycle inventory (LCA)
  - Long lists of environmental impacts all in different units
  - Decision support
- Data availability
  - European databases, old data
- Lack of expertise in UK

DEVELOPMENT OF LCA

- Whole systems approach
  - Trade-offs/ burden shift
- Incorporate behaviour
  - Compare different levels of public engagement
  - Adoption of policies, technologies
- Can be expanded further -
  - link with other tools
  - e.g. scenario analysis, economic valuation, multicriteria evaluation, energy modelling

QUESTIONS?