Webinar

Incentives for energy recovery in LCA for plastics

2021-01-21

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Information and guidelines

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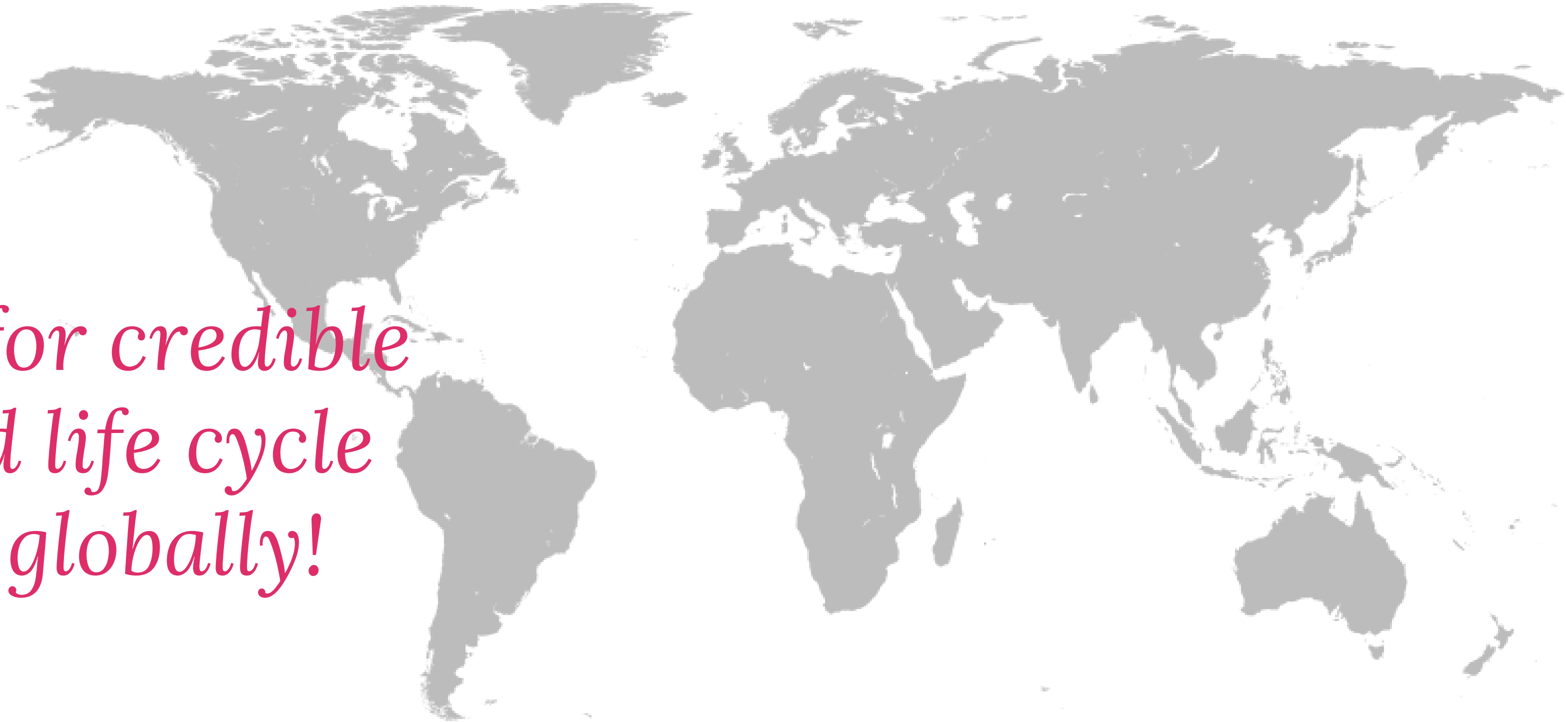

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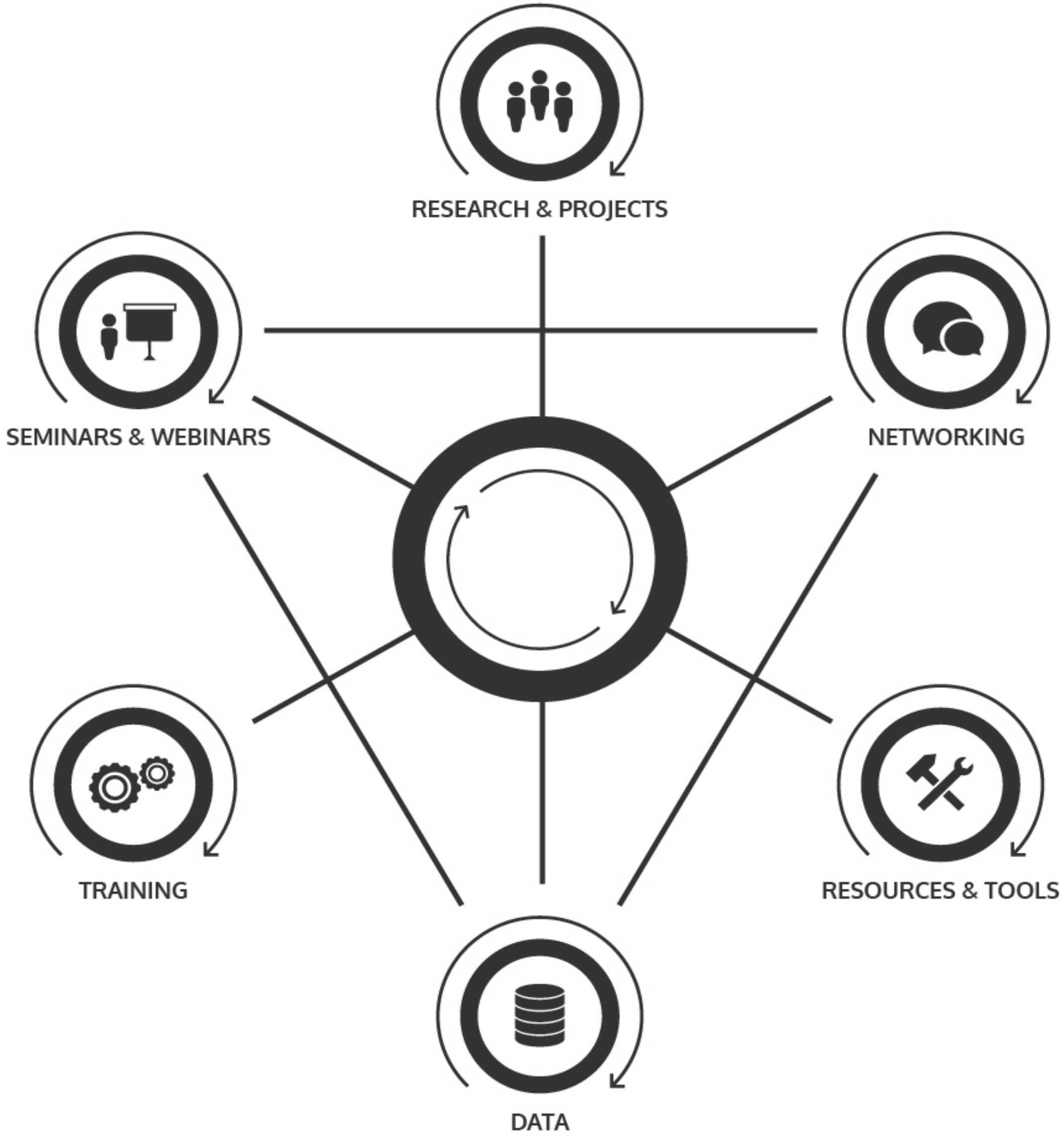
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Incentives for energy recovery in LCA for plastics

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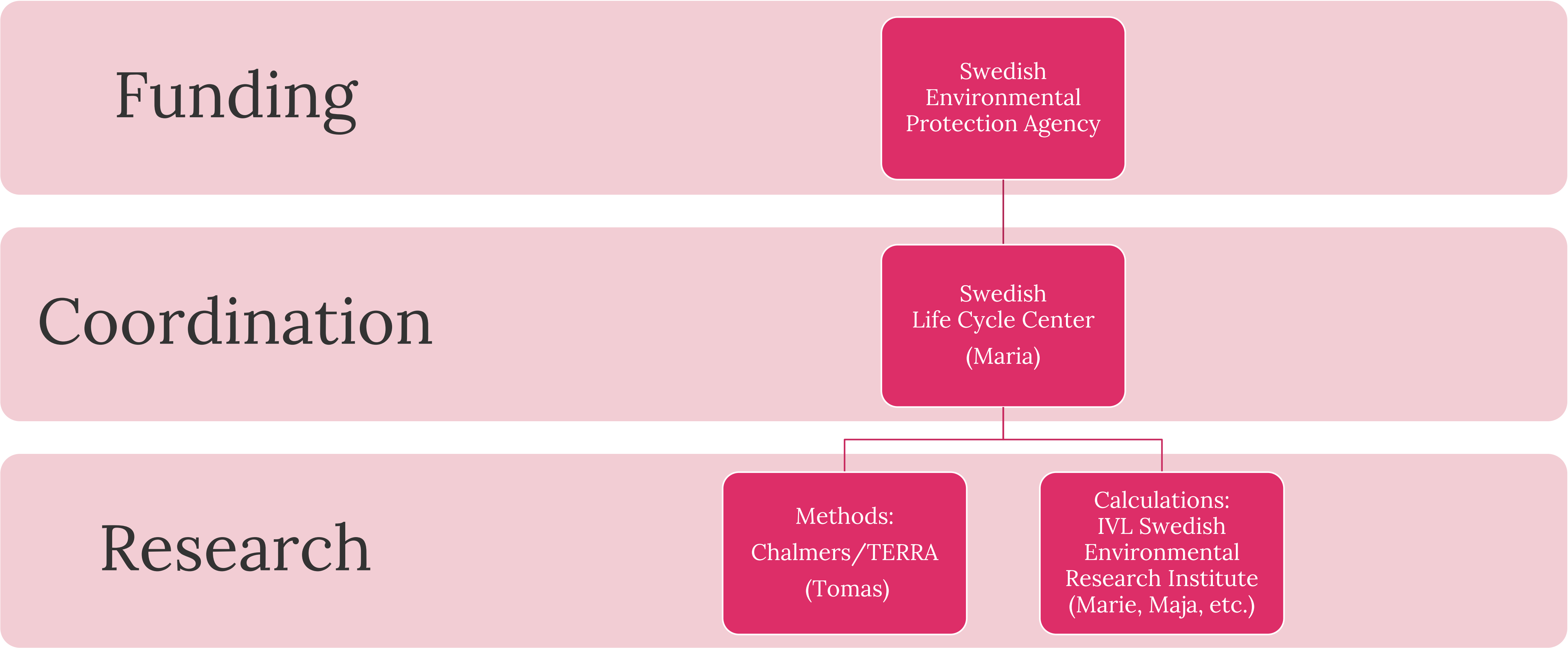
Incentives for energy recovery in plastics LCA

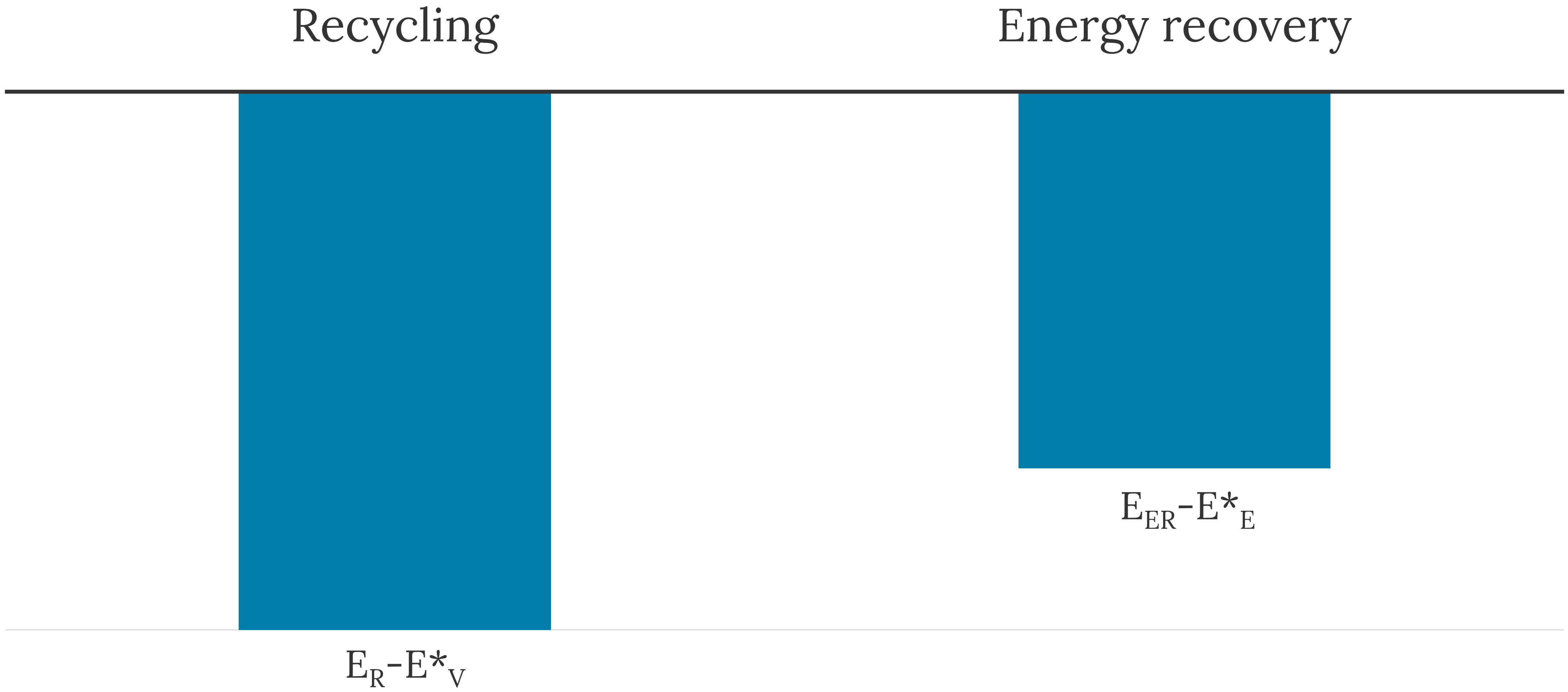
Introduction and methods

Tomas Ekvall, Chalmers & TERRA

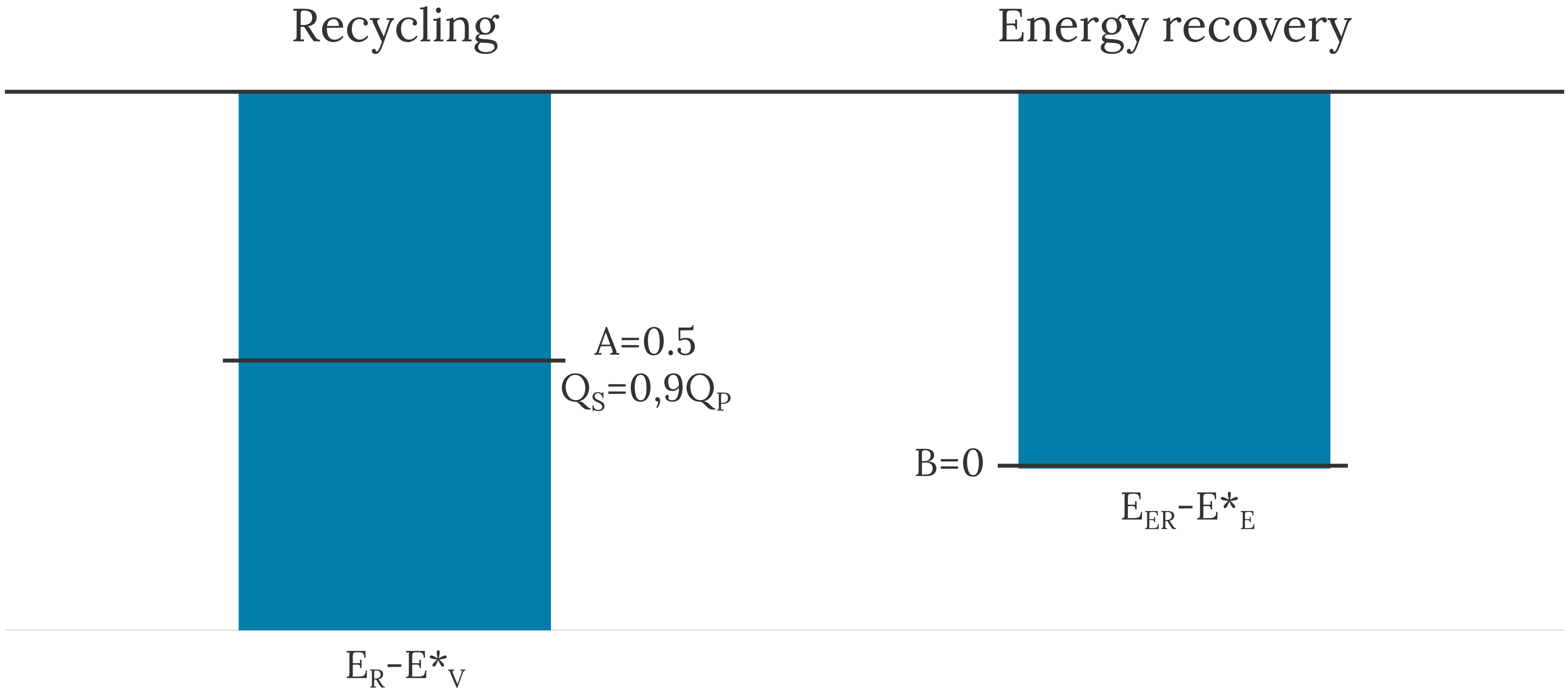
Pilot project organization



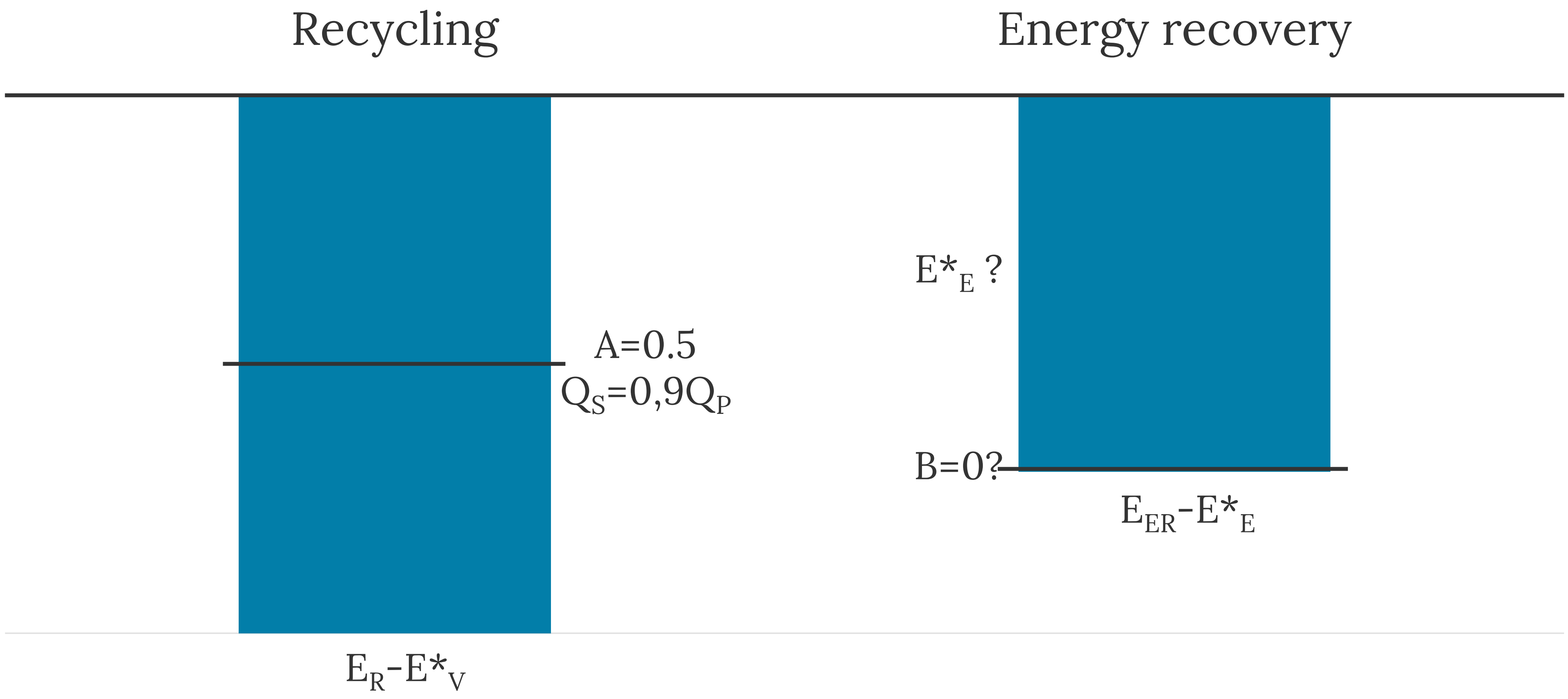
Environmental benefits (hypothetical case)



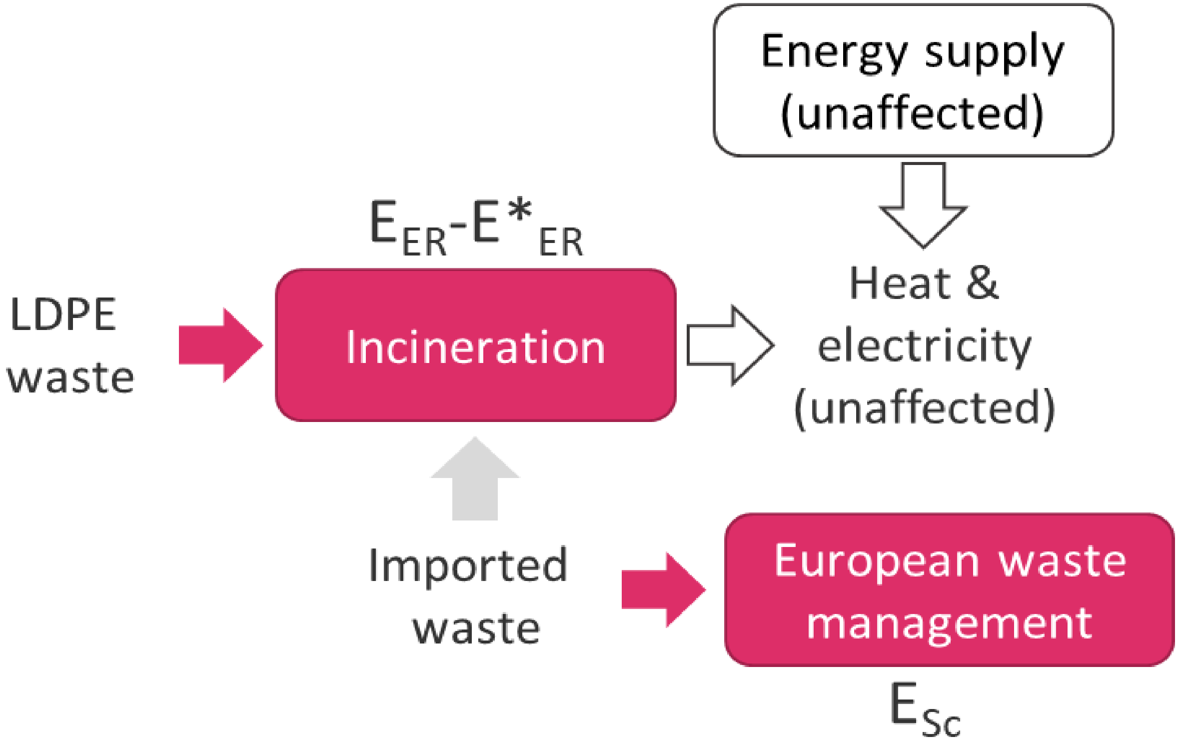
Environmental benefits assigned to waste management



Alternative modelling of energy recovery



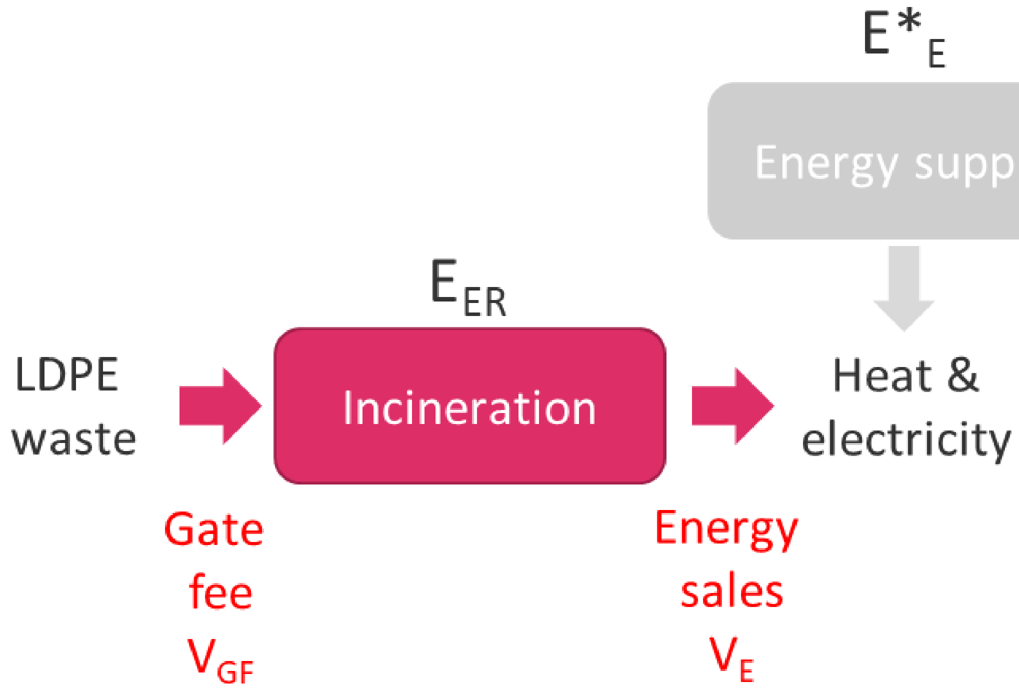
Impacts of a change in LDPE incineration (E^*_E ?)



Two scenarios:

- European landfill with landfill gas extraction
- European incineration with electricity production

Impacts of a change in LDPE incineration (B=0?)



- Proposed approach: $B=V_E/(V_{GF}+V_E)$
- Tentative for Sweden: B=0.6

Incentives for energy recovery in plastics LCA

Calculations and results

Marie Gottfridsson and Maja Nellström, IVL Swedish Environmental Research Institute

Case study

- Climate impact of three waste management options for LDPE: Mechanical recycling, chemical recycling and incineration in Sweden.
  - Functional unit: 1 tonne waste LDPE
  - Fossil and renewable LDPE
  - Two different scenarios for incineration with energy recovery
- The Waste-management options are compared with four different methodological approaches.
- Calculations are made with CFF formulas for mechanical recycling and incineration

Modelling

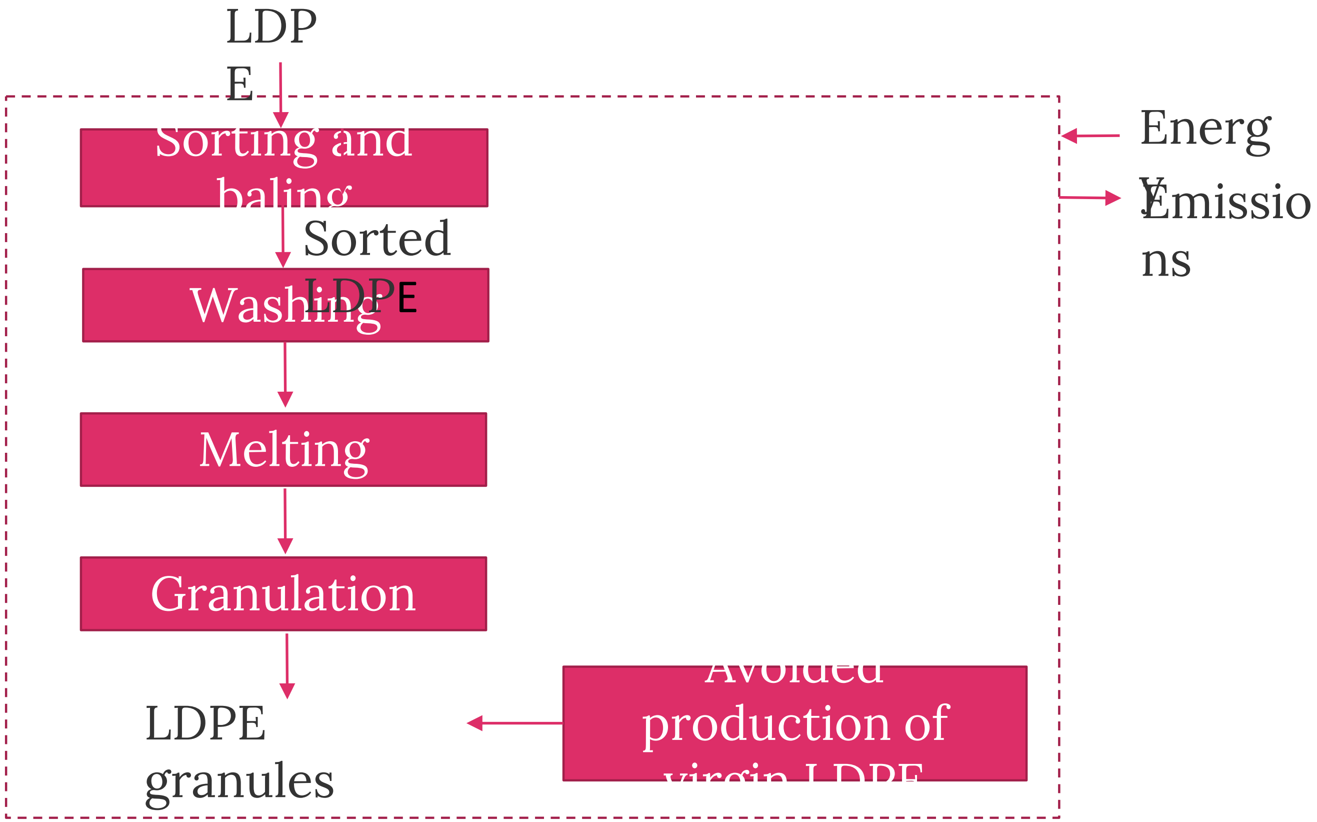
- Waste management options: GaBi Software with databases from Thinkstep/Sphera and EcoInvent.

- The scenarios: WAMPS (WAste Management Planning System)

Key assumptions and limitations

- The recycling and incineration routes - located in Sweden
- Short-distance transportation within Sweden – excluded
- Emissions of biogenic CO_2 - climate-neutral
- Swedish average data for district heat and electricity

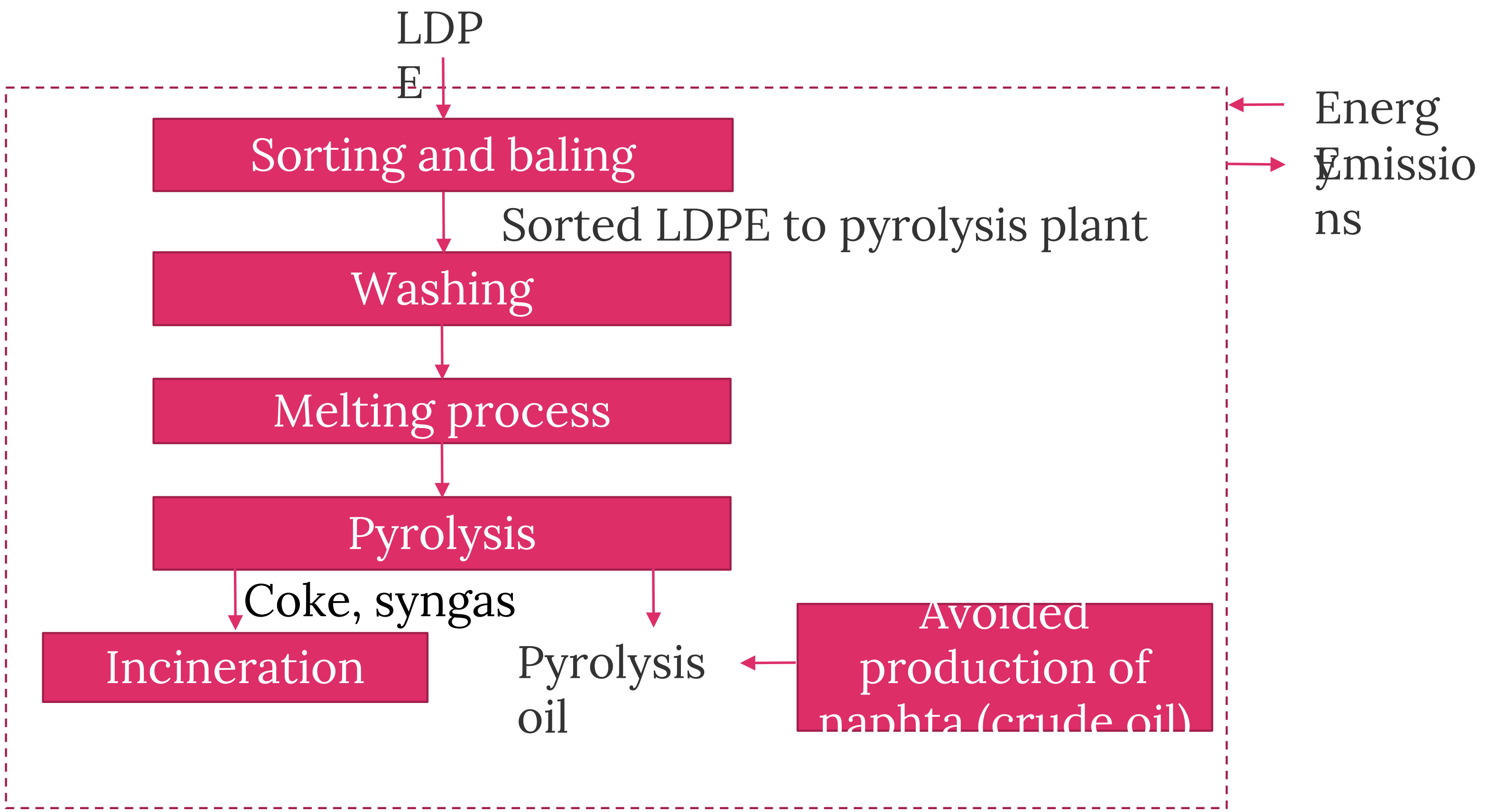
Flowchart – Mechanical recycling



Mechanical recycling

- We assume that the mechanical recycling process occurs in Sweden
- We get 1 tonne recycled LDPE per 1 tonne LDPE waste.
- The recycled polymer is assumed to replace 1 tonne virgin LDPE

Flowchart – Chemical recycling (Pyrolysis)



Chemical Recycling (Pyrolysis)

- Pyrolysis products = Coke, syngas and pyrolysis oil
- The pyrolysis oil will replace naphtha (crude oil), coke and syngas will be incinerated
- 720 kg pyrolysis oil is formed per tonne recycled LDPE

Incineration with energy recovery

- The route:
  - Incineration of plastic waste
  - Generated energy used for electricity and district heating

- Modified CFF formula for climate impacts of the scenarios:

$$CF = (1 - B)R_3 \times (E_{ER} - E_{ER}^{*} + E_{Sc})$$

E^{*}_{ER} is = specific emissions from the avoided energy recovery process of imported waste and E_{sc} = scenario-dependent specific emissions from the alternative treatment of the imported waste in a European county other than Sweden.

Scenarios for incineration

- European incineration
  - Increased incineration of plastic waste in Sweden
  - Reduced waste imports
  - More waste incinerated in a European country (other than Sweden)

- European landfill
  - Increased incineration of plastic waste in Sweden
  - Reduced waste imports
  - Increased disposal of untreated residual waste in a European country (other than Sweden)

Methodological approaches

The methodological approaches used for the three waste management options are:

1. Simple substitution
2. Default PEF approach with B=0
3. PEF calculations with B=0.6
4. Adjusted PEF calculations with a European systems perspective on Swedish incineration (scenarios).

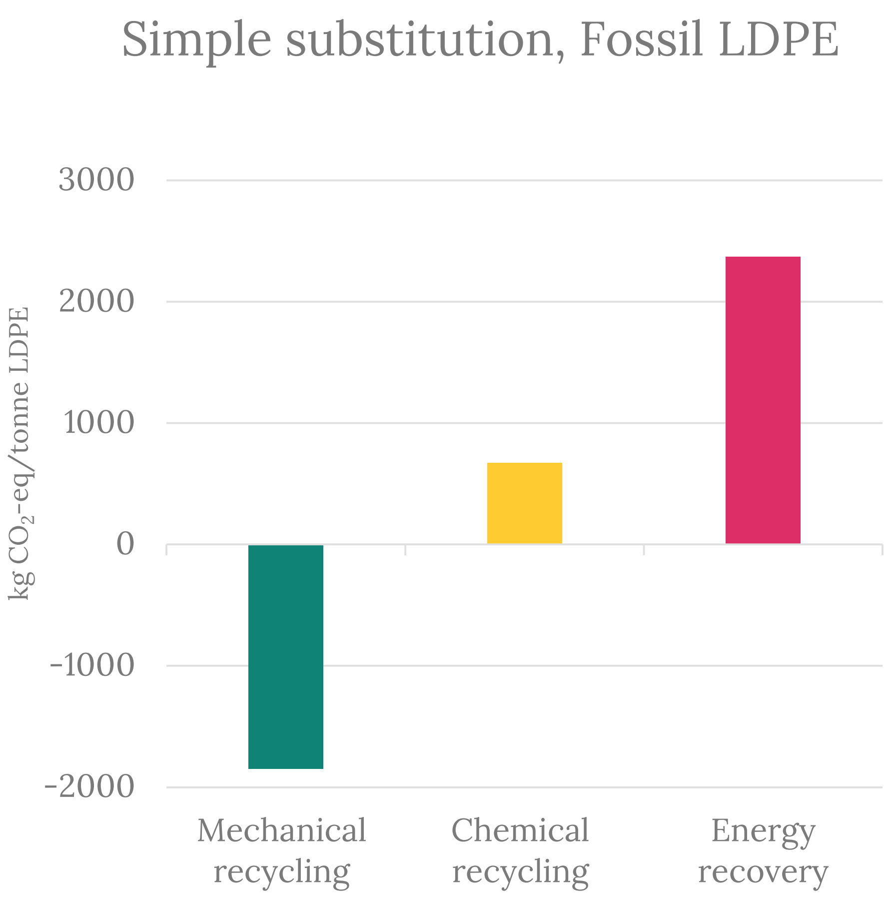
Methodological approaches

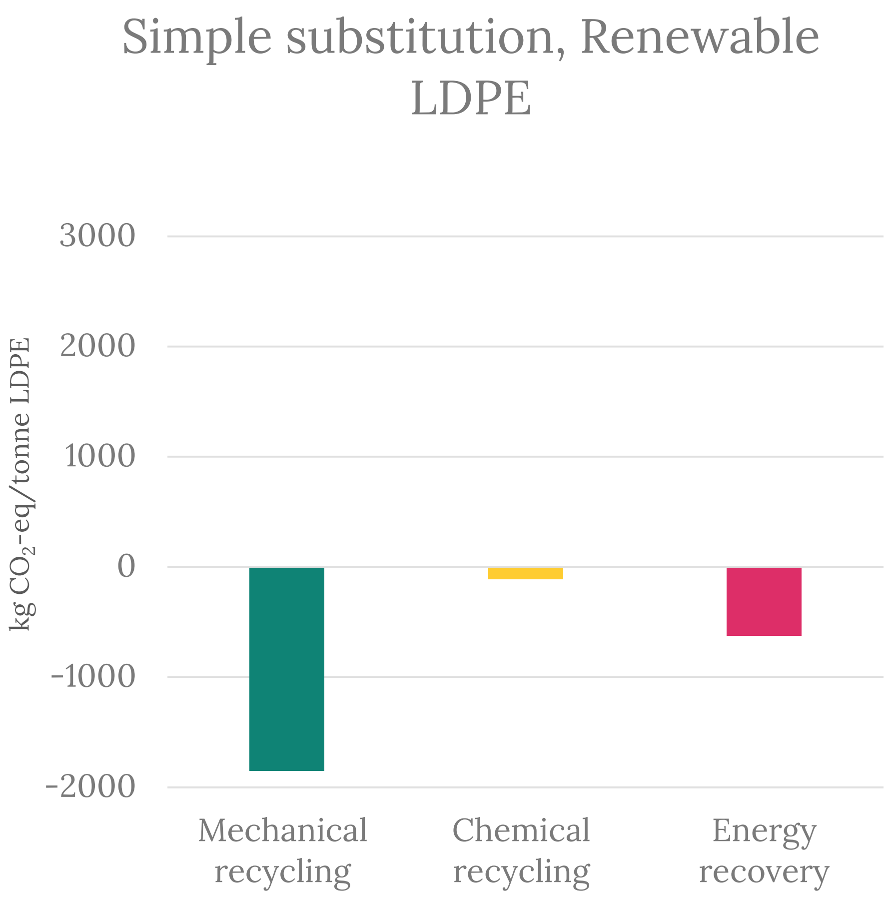
Methodological approach	Waste management option	CFF Variables		
		A	Qs/Qp	B
Simple substitution	Mechanical recycling	0	1	
	Chemical recycling	0	1	
	Energy recovery			0
PEF default	Mechanical recycling	0.5	0.9	
	Chemical recycling	0.5	1	
	Energy recovery			0
PEF with B=0.6	Mechanical recycling	0.5	0.9	
	Chemical recycling	0.5	1	
	Energy recovery			0.6
PEF scenarios	Mechanical recycling	0.5	0.9	
	Chemical recycling	0.5	1	
	Energy recovery: European incineration			0
	Energy recovery: European landfilling			0

Presentation of results

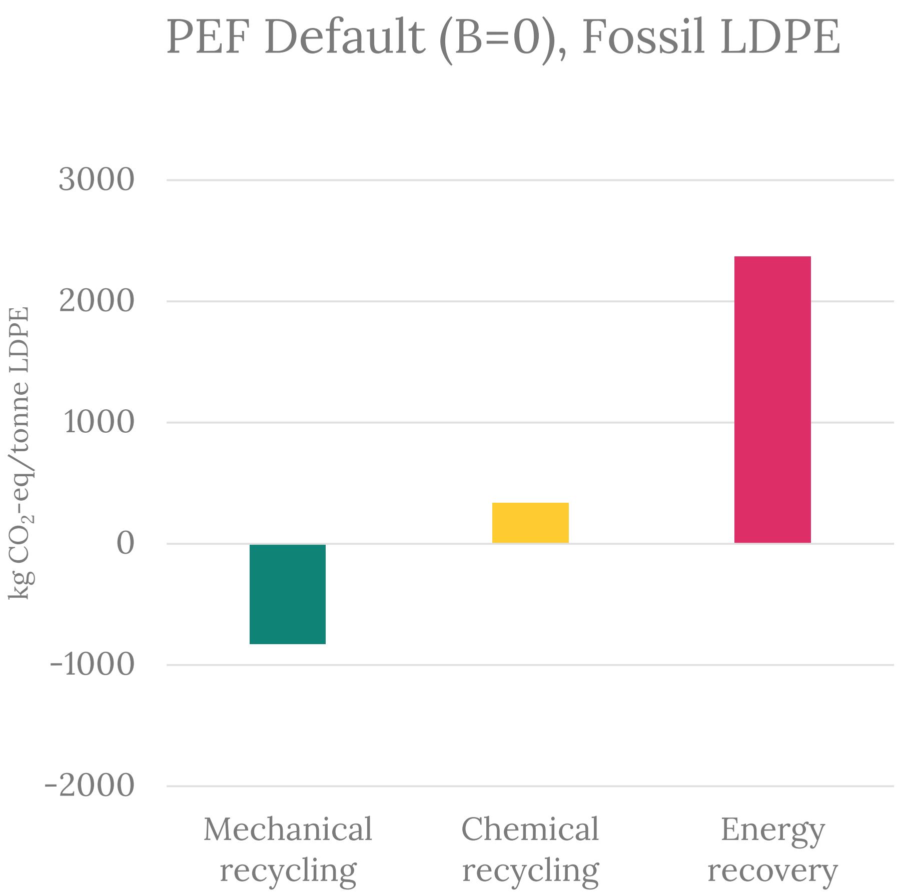
- Results of climate impact (kg CO_2-eq/tonne LDPE)
- Compare fossil LDPE with renewable LDPE

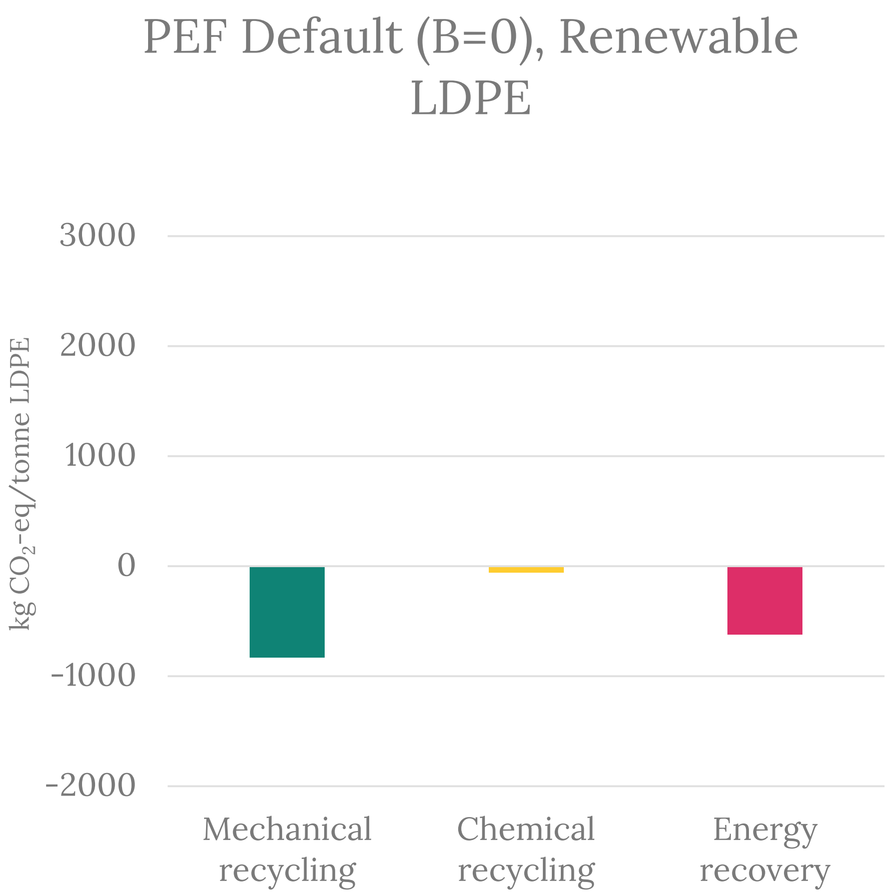
Results – Simple substitution



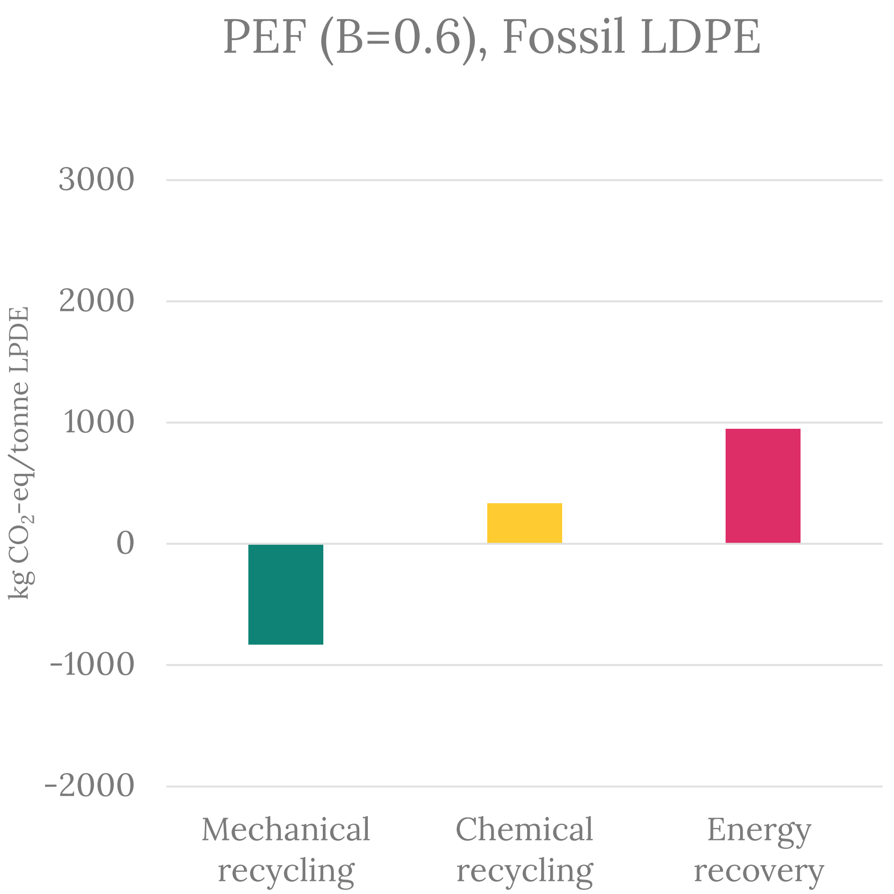


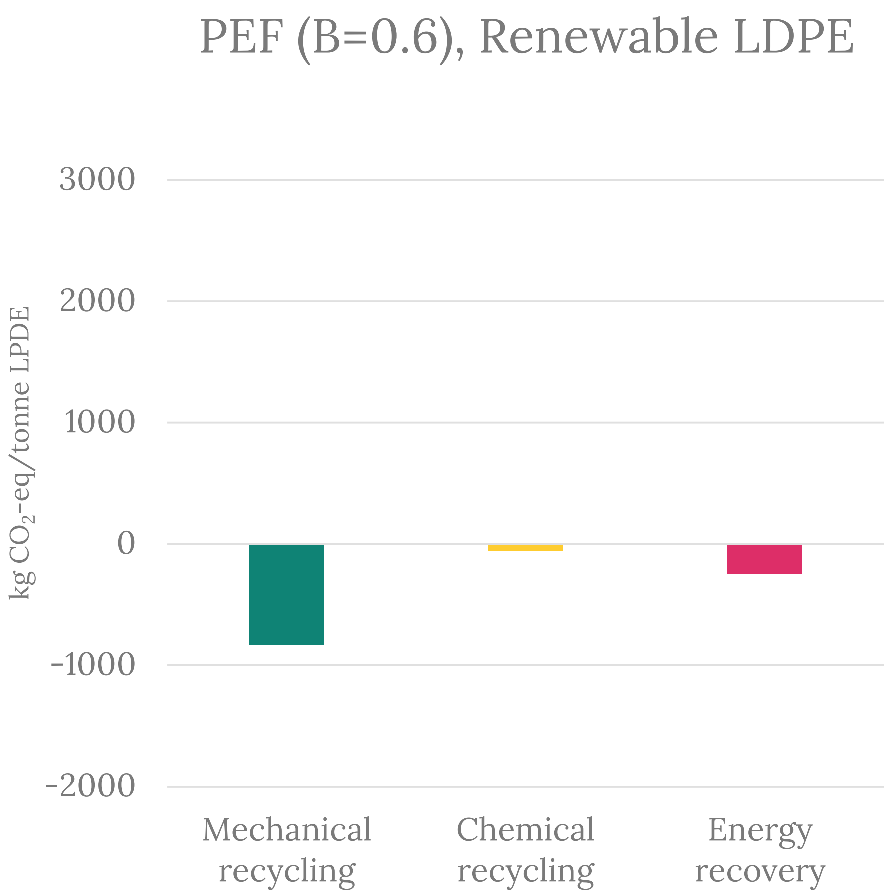
Results – PEF Default



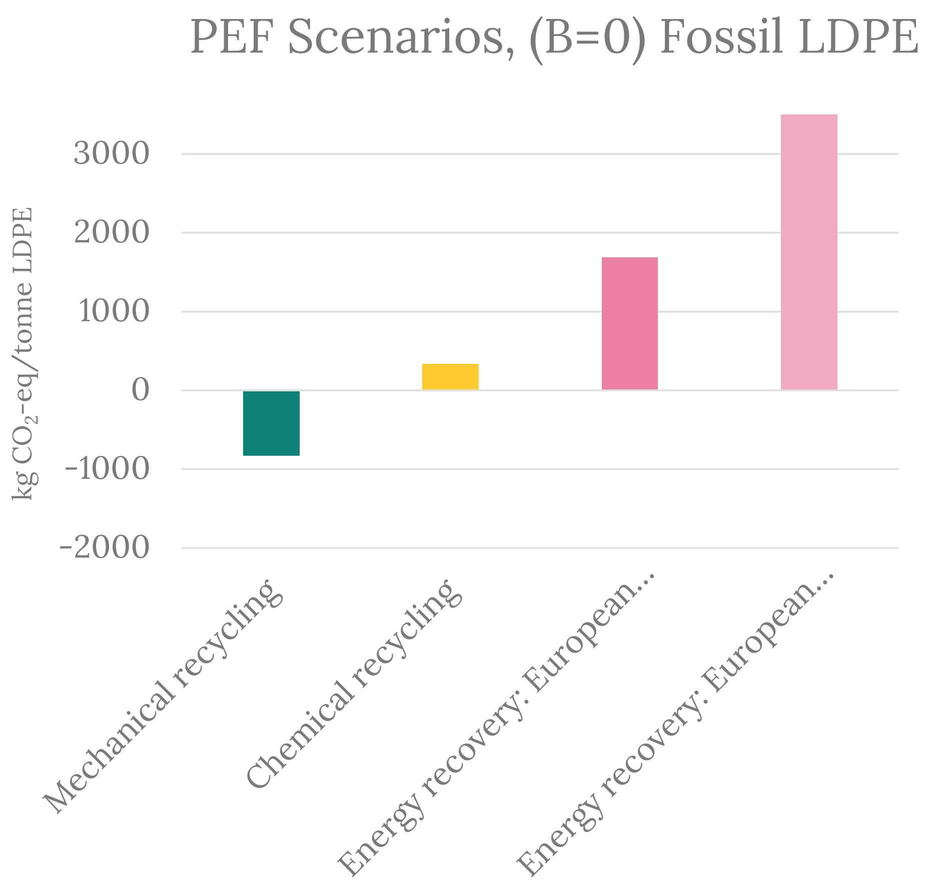


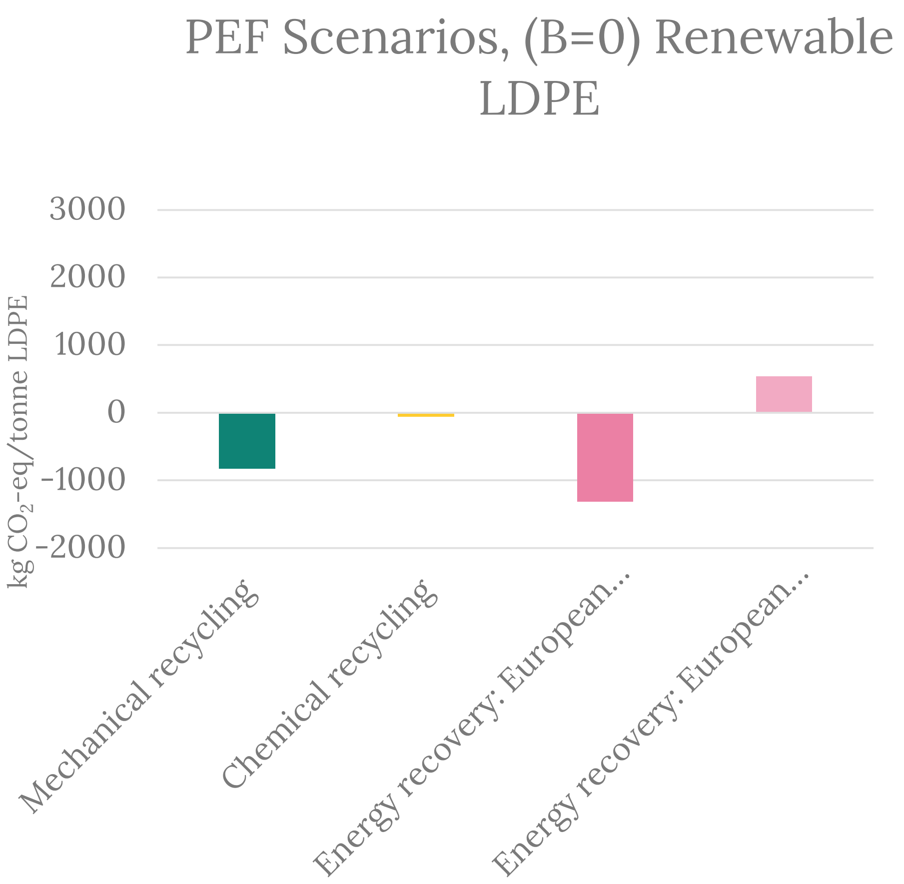
Results – PEF with B=0.6





Results – PEF Scenarios





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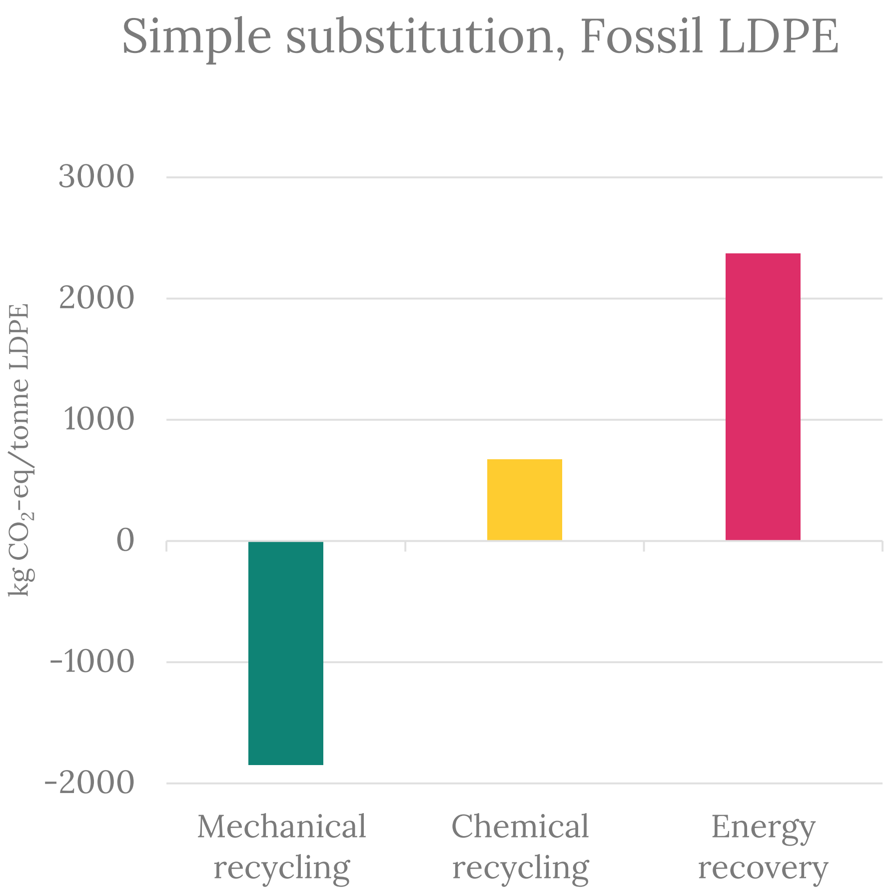
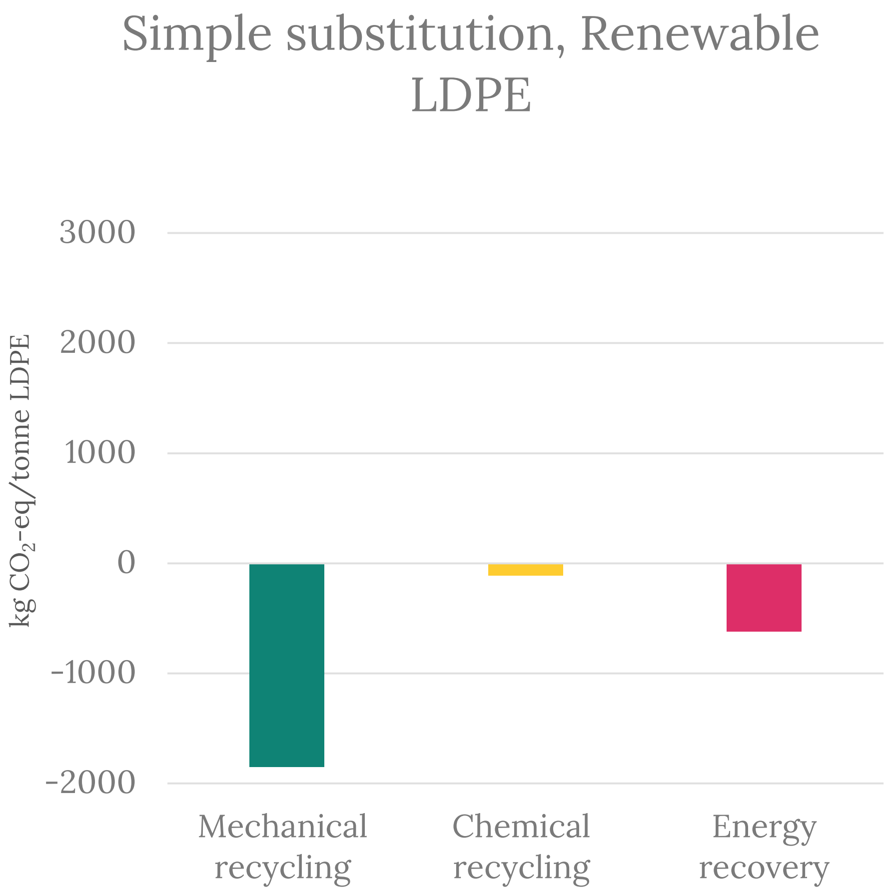
Discussion and conclusions

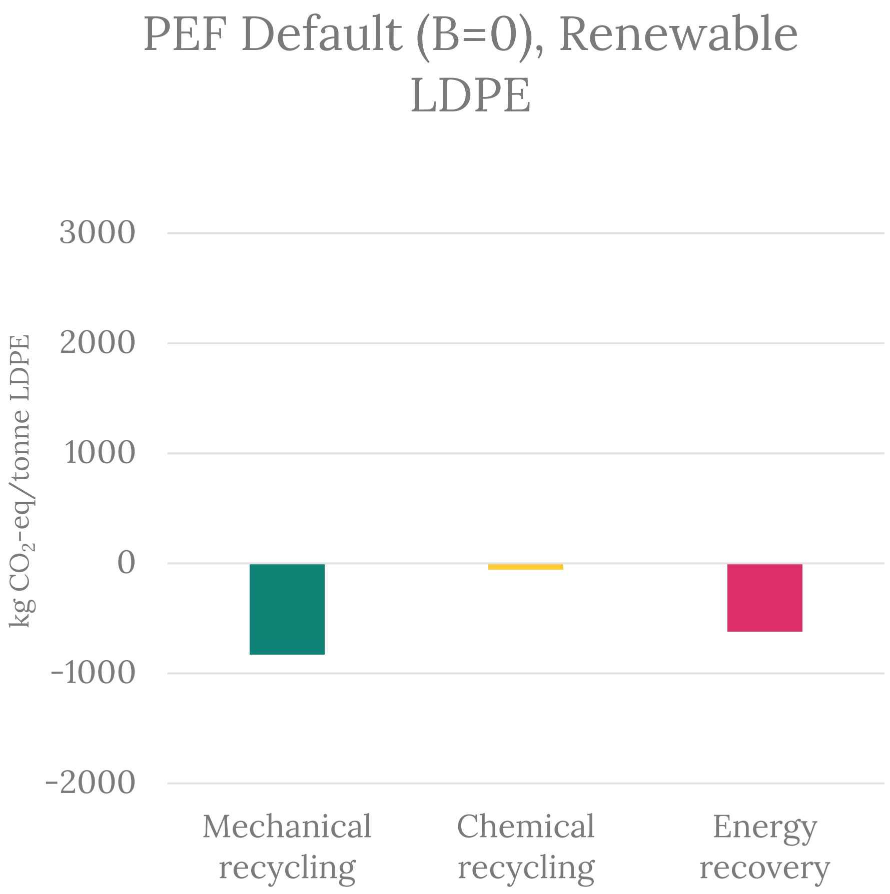
Tomas Ekvall, Chalmers & TERRA

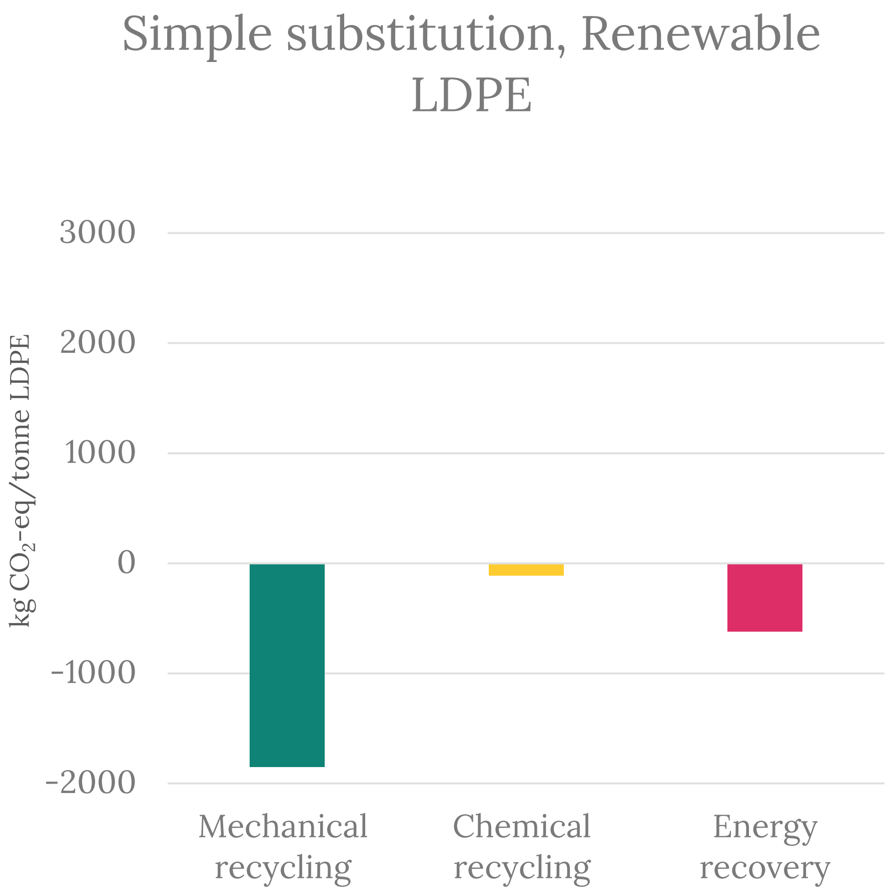




No climate benefit from energy recovery
No risk for incorrect incentive

Climate benefit from all options
Risk for incorrect incentive

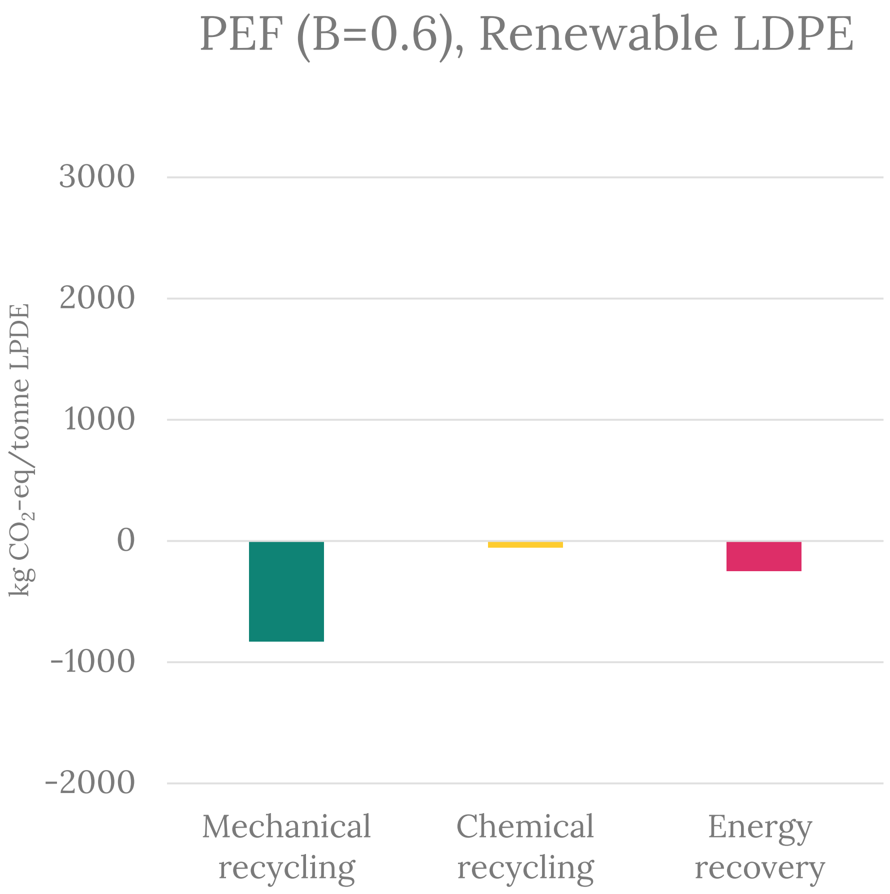


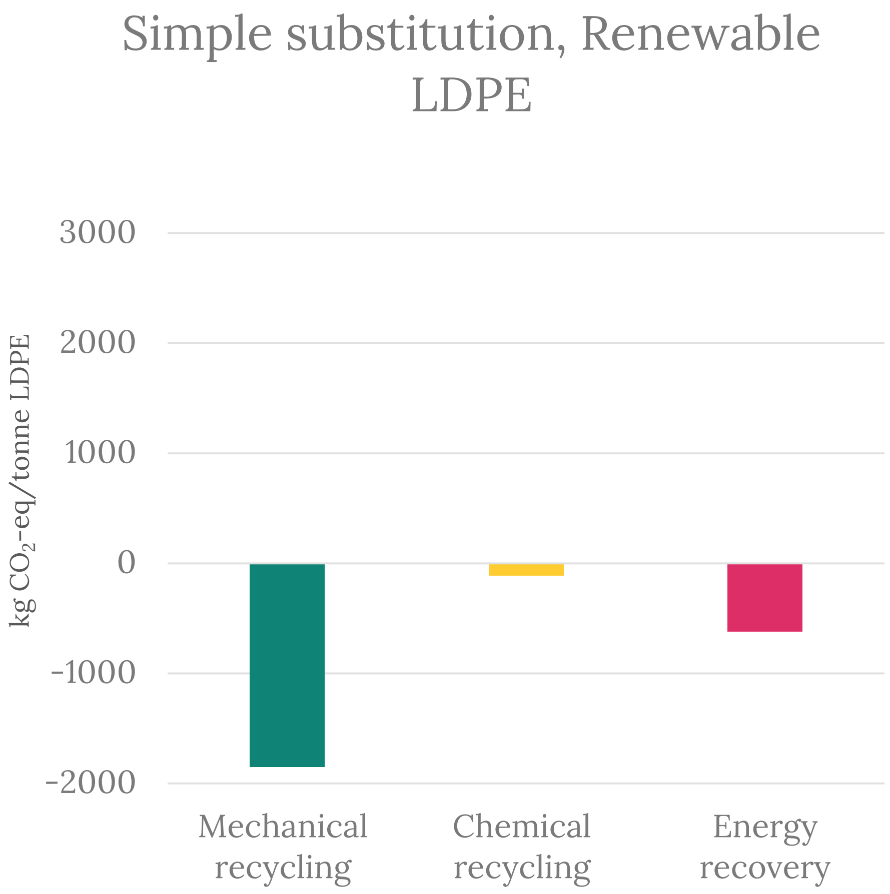


Correct incentive – until E^*_E +40%

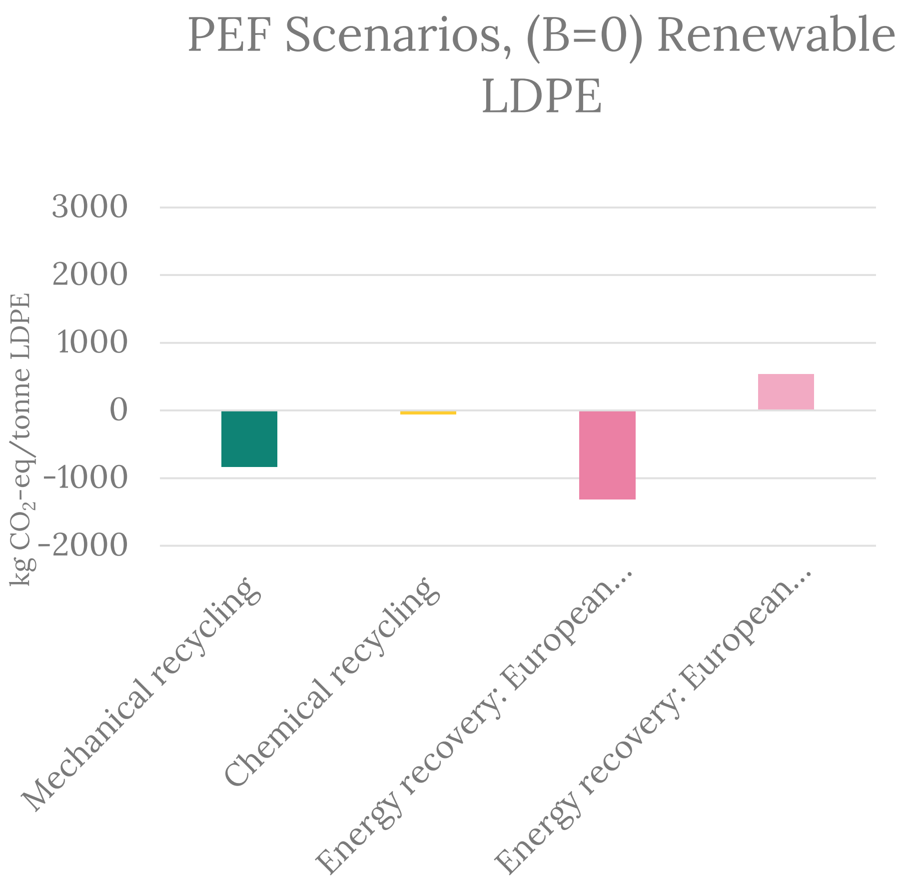
Mechanical recycling better until E^*_E +200%

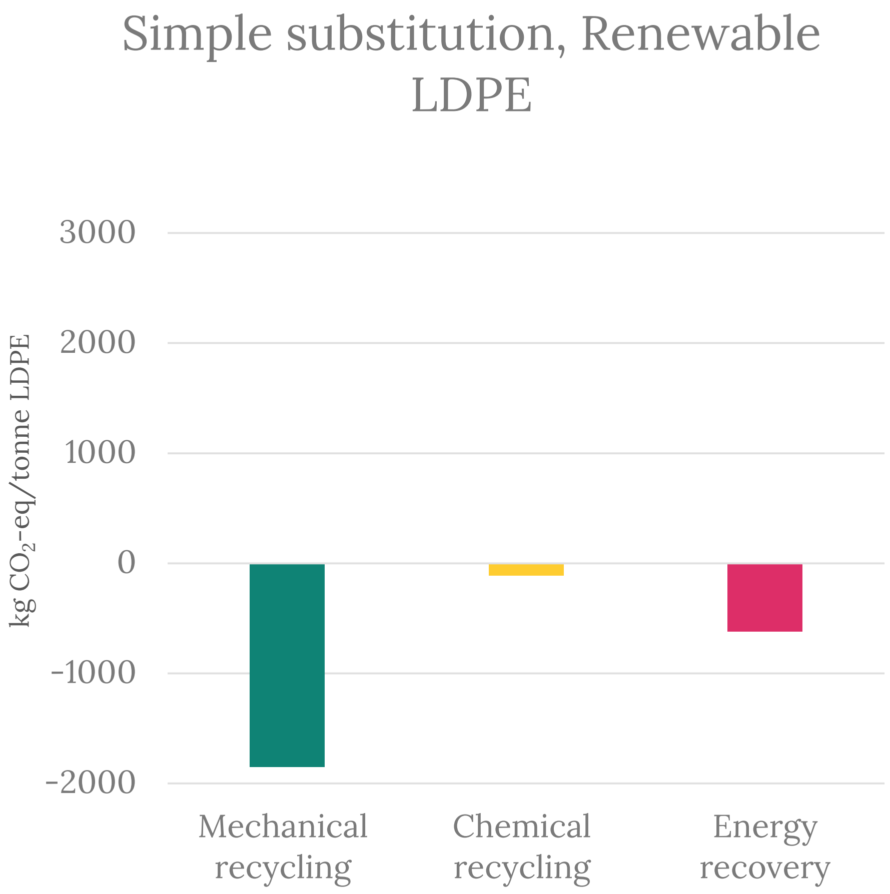
Wrong incentive when E^*_E 40-200% higher than Swedish average





Almost no risk for incorrect incentive
…for waste polymers





Unclear conclusion?

Alternative solutions

- Why not use simple substitution (cf. end-of-life approach)?

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- Why not combine simple substitution with burden-free scrap input?

Alternative solutions

- Why not use simple substitution (cf. end-of-life approach)?
- Why not combine simple substitution with burden-free input scrap?
- Why not jointly assess supply and use of secondary materials?

QUESTIONS?

THANK YOU

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