Hochschule Fulda
University of Applied Sciences

BIFAS

Economic Conditions for Recycling of Waste

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CEC4Europe – Circular Economy Coalition for Europe

Table of Contents

1. Economy: Benefit or Harm

It's the economy, stupid!

vs.

It is stupid not to analyze economic consequences and knock-on effects without considering them when making decisions (e.g. actions, strategies or legislation).

→ Otherwise: Misallocation, dissatisfaction, disappointment

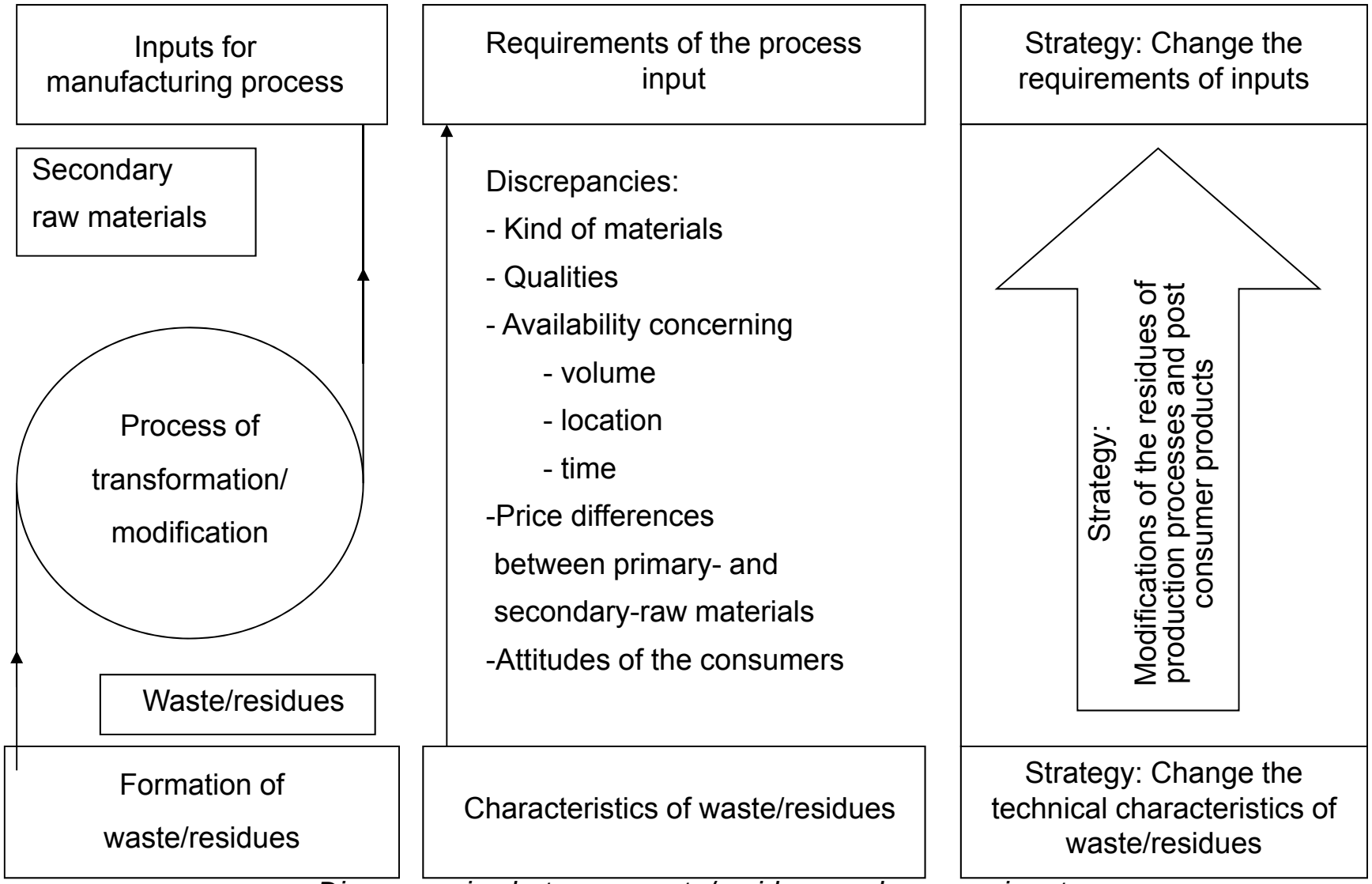
2. Thesis pertaining to Recycling

- Recycling is the talk of the town– worldwide
- Recycling is assessed as a miracle weapon allowing
  - Circular economy–model
  - Cradle to cradle (C2C)-principle

  to be applied.
- Applications of Recycling

→ Re-integration of waste, past-consumer-products, demolished buildings and infrastructure, capital goods into the business cycle again!

2. Thesis to the Recycling



Discrepancies between waste/residues and process input

2. Thesis to the Recycling

→ Recycling is only a means to an end.

Thus: Recycling is an instrument, but not an objective.

→ Consequently, maximization of recycling activities

- makes no sense (respectively)
- can be counterproductive

→ Consider a UNEP-report from 2013:

Cradle to cradle (C2C)-concepts are useful psychological tools for drawing people‘s attention to recycling, but should not to be used as a basis for policies.

(Source: Metal Recycling – Opportunities, Limits, Infrastructures, A Report of the Working Group on the Global Metal Flows to the International Resource Panel)

3. Recycling is not an Objective but an Instrument

Recycling is an option in terms of

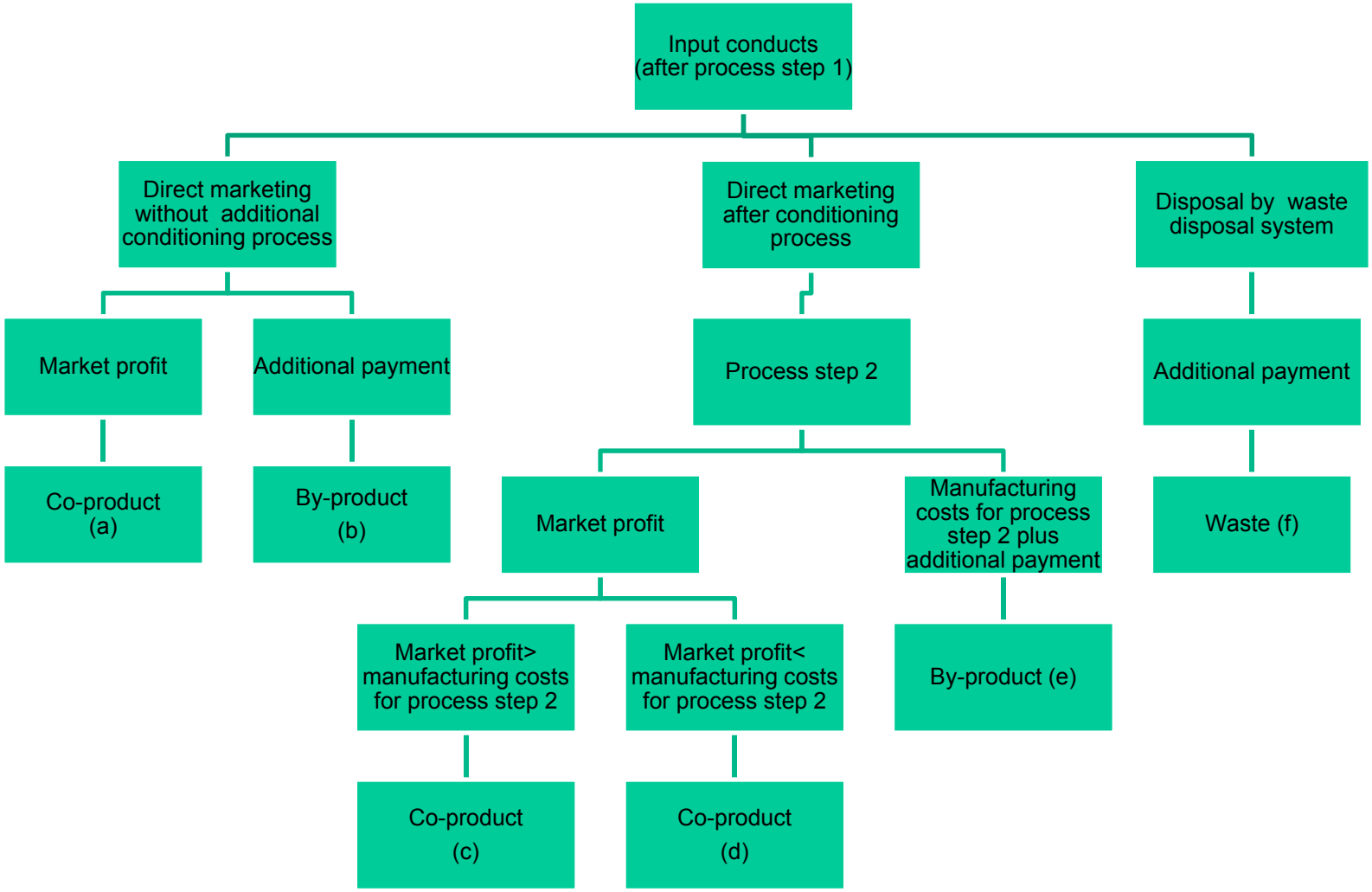
- Measures for waste disposal (municipal waste, end-of- life-products, demolition waste)
- Procedures for linked productions

i.e.: Description of linked productions:

Desired outputs = products

Undesired outputs = conducts:
- co-product (positive market value)
- by-product (negative market value)
- waste (disposal fee)

Recycling of Waste



→ (a) competing against (c)

→ (b) competing against (d) and (e)

→ (a), …., (e) competing against (f)

Note: In addition to the direct cost of the process step 2 (~ processing and marketing), additional investment costs may still occur :

- development costs of the processing method
- transaction costs (i.e. in particular market development costs, negotiation costs, securing permanent purchase,...)

4. Benefits and Limits to Recycling – selected Aspects

- Intergenerational justice (availability of resources & environmental quality for future generations)
- Emissions reduction & climate protection
- Recycling as „backstop-technology“ in view of actual scarcity of resources and unavailability of substitutes.
- Security of supply in conection with geopolitical risks.
  (e.g. quasi-monopoly of China in rare earth metals
  ⇨ market share > 90%)

4. Benefits and limits of recycling – selected Aspects

- Fluctuation in the degree of purity reduce the value and usability of recyclate.
  ⇨ In extreme (but not uncommon) cases (e.g. contamination with hazardous substances) the recyclate becomes hazardous waste
  ⇨ The higher the actual recycling rate the higher the degree of contamination with foreign matter.

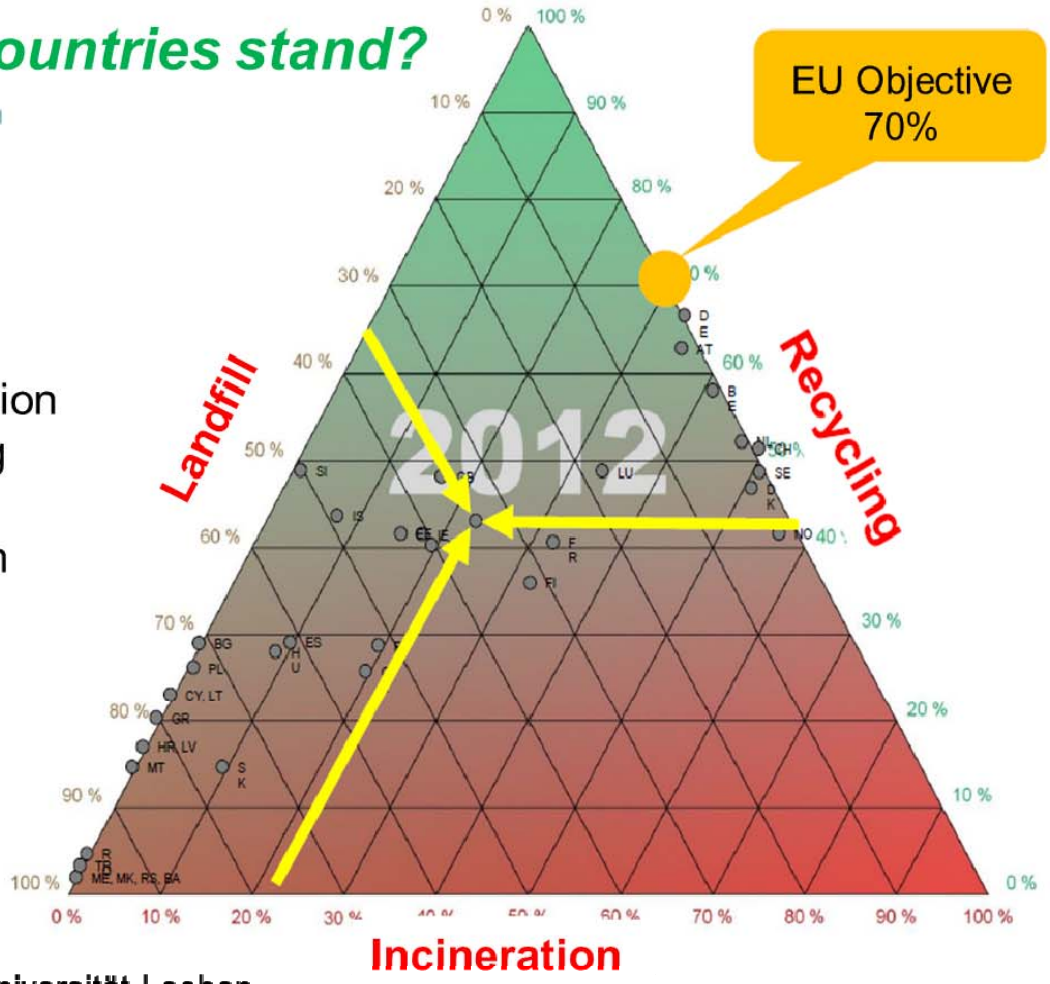
- Specific problems with plastics (composites / fiber laminates):

- Miniaturization: Very little recycable fractions (e.g. in mobile devices)
  ⇨ Extraction of resources is complex and expensive.

5. Empirical Findings regarding Recycling

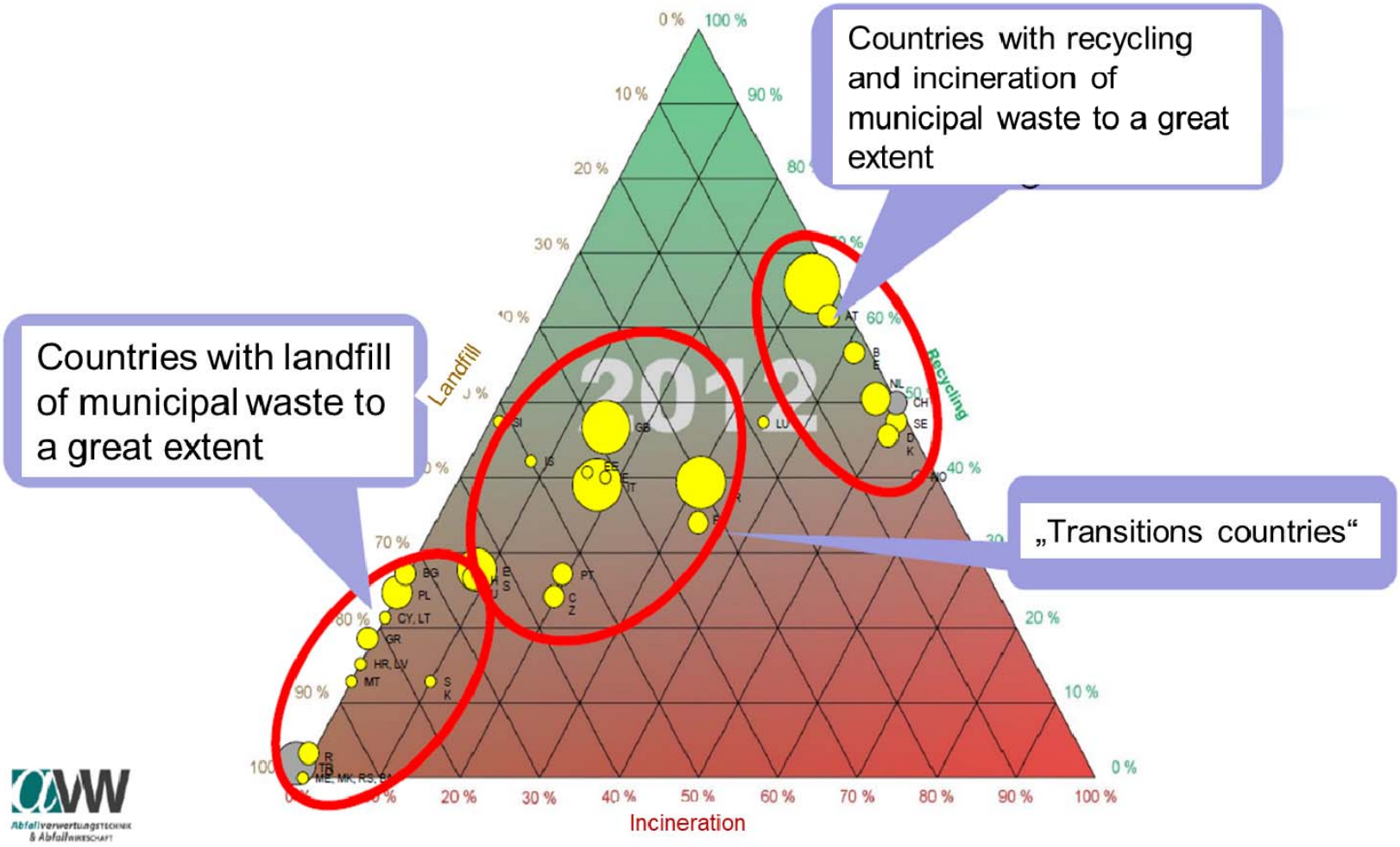
Where do the EU countries stand?

- „Ternary diagram“
- EU average
  - appr. 35 % landfill
  - appr. 25 % incineration
  - appr. 40 % recycling
- Each country has its own positioning



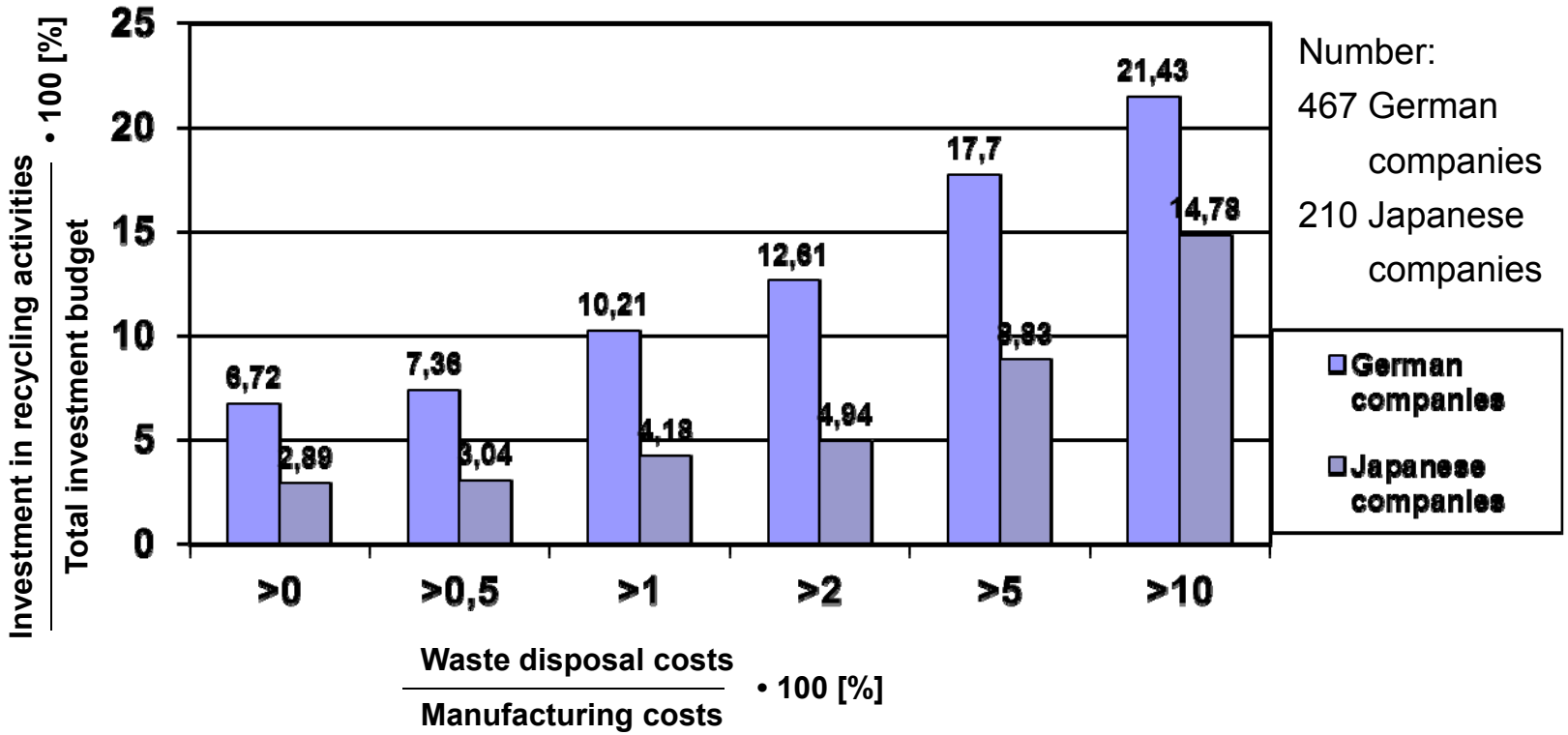
Source: Pomberger, R., Montanuniversität Leoben

5. Empirical Findings regarding Recycling



Source: Pomberger, R., Montanuniversität Leoben

Does the price level of waste disposal services stimulate recycling activities? (Company survey in Germany and Japan; Baum/Sakai/Ueta)



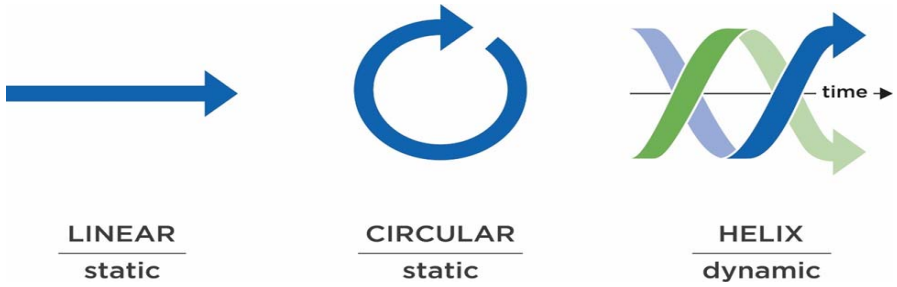
Relative waste disposal costs to the relative recycling investment (own research)

Main result: The higher the relative price/fee for waste disposal services; the higher the relative recycling activities

→ The price mechanism does really work in the field of waste management indeed!

6. An Economic Model fixing an appropriate Recycling Quota

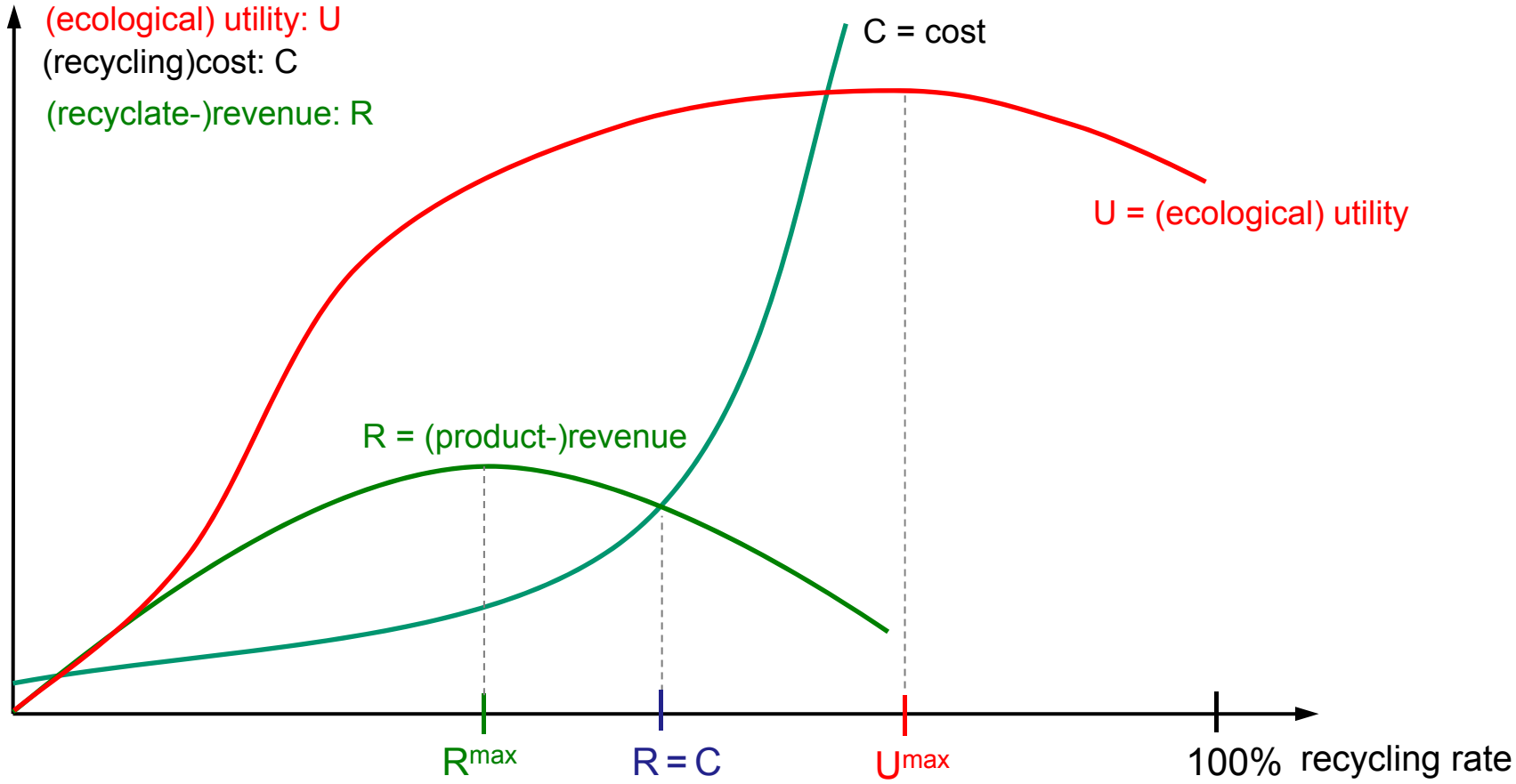
Transformation:
From a **linear** to a **circular** thinking
From a **static** to a **dynamic** thinking
→ New potentials, targets and actions!



Essential empirical knowledge:
Secondary raw material is basically not suitable for re-utilization in the original field of application!
(e.g.: Secondary raw materials based on food packagings can‘t be re-used as food packaging, (forbidden due to hygenic and microbiological issues))

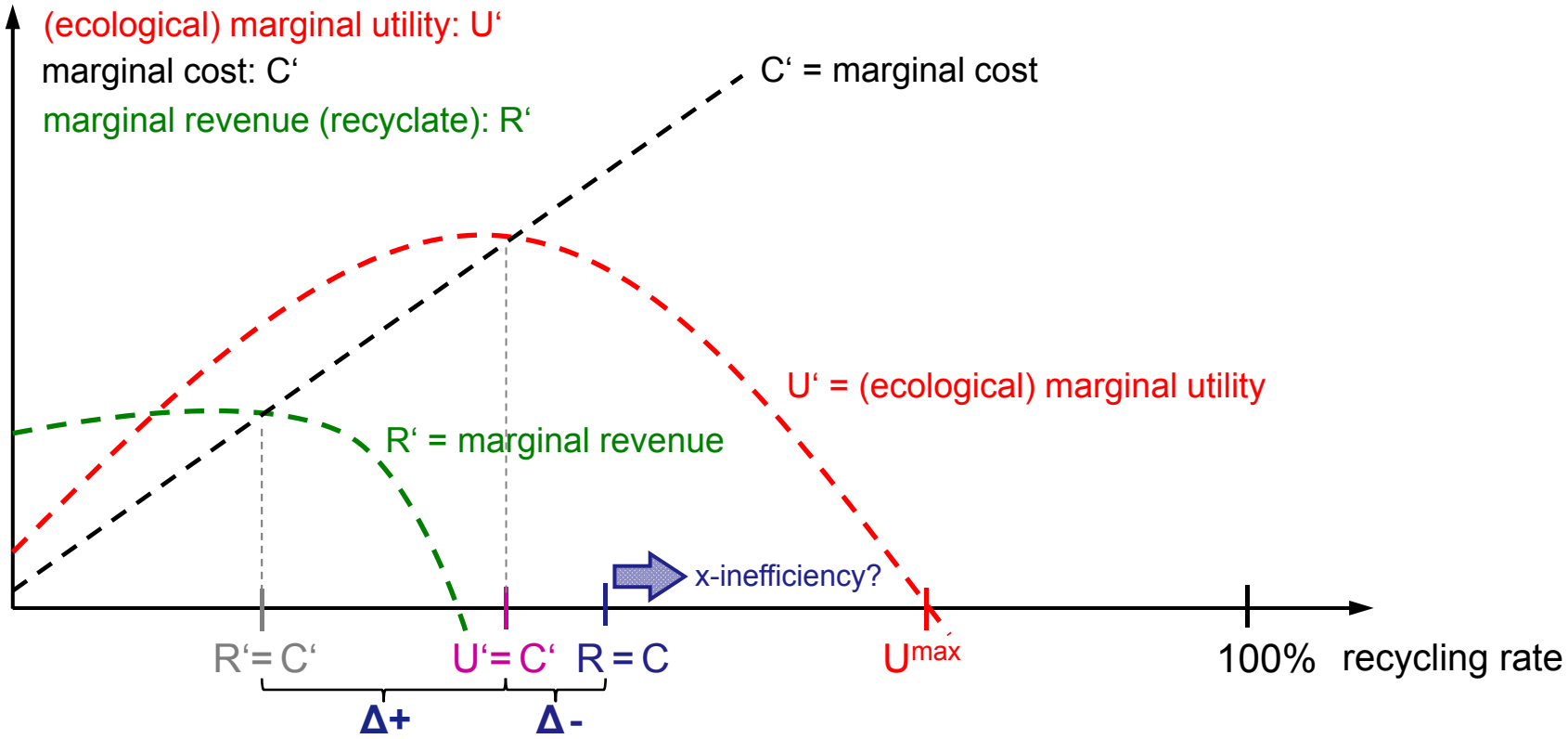
→ Re-utilizations require a mix of primary and secondary raw materials!
→ Re-utilizations require a special investment to create new markets (new applications, new customers)!

6. An Economic Model fixing an appropriate Recycling Quota



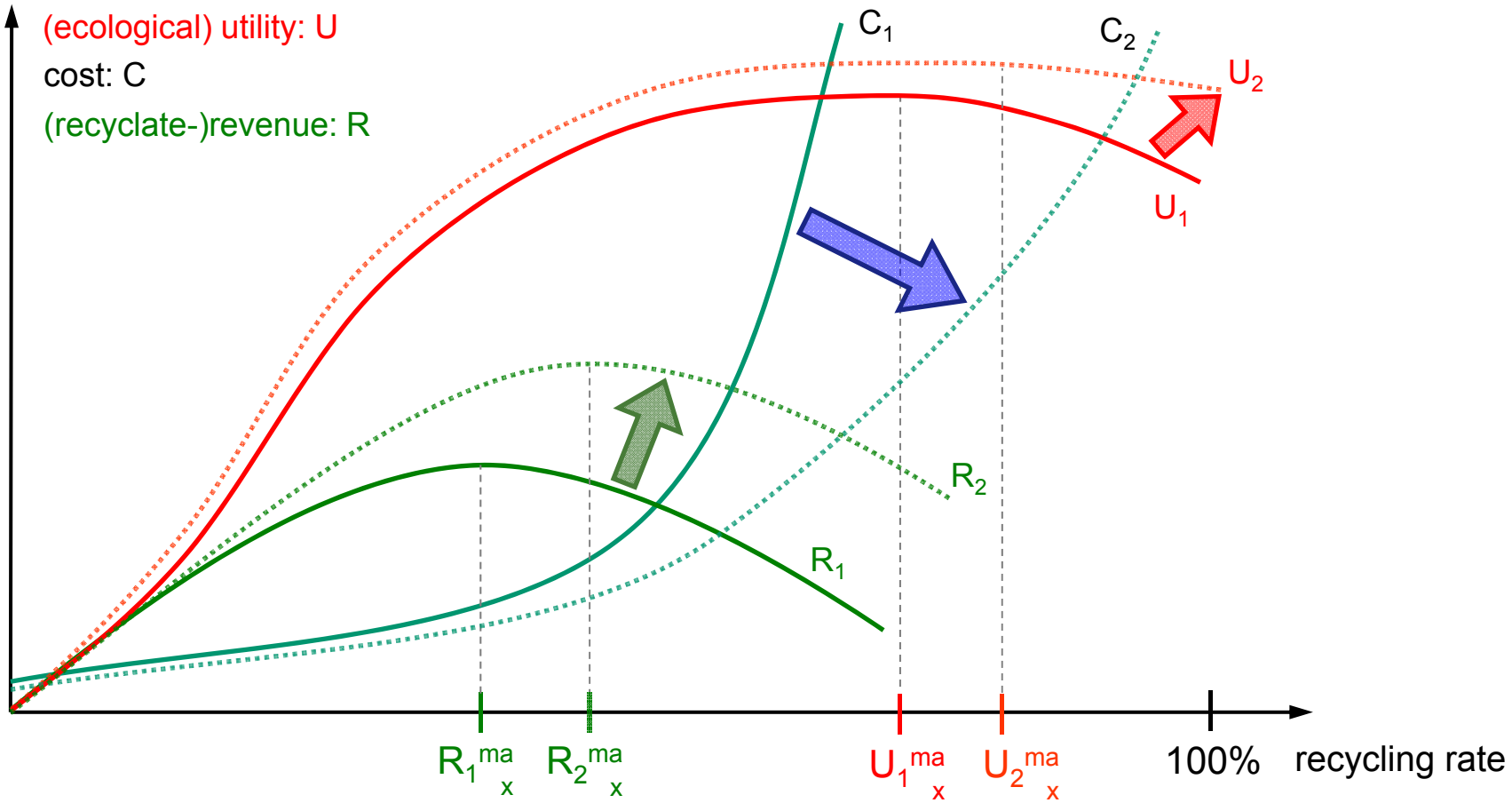
- U^{max} = ecological maximum
- R^{max} = revenue maximum
- R = C = cost-covering budget maximum / sales (recyclate revenues)

Marginal Analysis to identify optimal Recycling Quota



- U^{max} = ecological maximum
- R‘= C‘ = (business) profit maximum (product revenues = recyclates)
- R = C = cost-covering budget maximum / sales (recyclate revenues)
- U‘= C‘ = overall (economic and social) optimum
- **Δ+ to be closed by regulatory measures (taxes, binding recycling rates etc) / Δ- also to be closed**

The Dynamics of Recycling – Learning Process



- U_1 ⇨ U_2 = emissions reduction in the scope of collecting & recycling (e.g. renewable energy)
- C_1 ⇨ C_2 = cost reduction due to process innovation and competition
- R_1 ⇨ R_2 = innovation (higher quality of recyclates) & development and exploitation of new markets

7. Conclusion (1)

- Generally, there isn‘t any business model of recycling created only by the forces of a free market.
  Regulatory instruments (as directives, fees, obligatory recycling rates, …) are necessary.
- But: The price mechanism can help to promote the circular economy based essentially on secondary raw material.
- Recycling is an option and not an objective. After a certain number of loops the generated secondary raw material has been generally enriched with a higher degree of contamination and the quality has deteriorated essentially (Exception: metals). That means: Waste disposal is an unevitable part of a recycling economy.

7. Conclusion (2)

- Maximization of the recycling quota isn‘t a reasonable target, but optimization is the proper way!
- Carbon based primary resources (as coal, gas, oil, …) aren‘t really scarce for the next several hundred years. But the climate change due to greenhouse gas is the challenge.
- Sustainability of recycling requires competitivness and substitution of primary resources. This process can be encouraged by subsidies and innovative circumstances.