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Recycling of Steel, Aluminum, Paper and Glas and Their Energy-Economic Scope

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Outline

- Introduction and Objectives of the Study:
  Circular Economy, Recycling and Sustainable Consumption and Production Patterns (SDG 12)
- Data and Methodology
- Results
- Conclusions and Outlook for Recycling

Introduction: Circular Economy

Concept of **Circular Economy (CE)** aims at

minimizing resource use/improving resource efficiency w.r.t.

- using the **environment as a sink for waste disposal** regarding waste materials from industrial production and consumption
- **primary raw material use** in the production of goods and services

Rationale:

In a world with **planetary boundaries** and **finite resources** only processes that are conducted in a **material cycle** can be regarded as **sustainable.**

Objective: Circular Economy and Recycling

UNSDG12

Objective of CE:

Shifting away from current **linear model** of

„take, make, dispose" by

closing two loops:

One loop fosters the **reuse** and the **extension of service life** (challenge planned obsolescence) of products through e.g. **repair, remanufacture, upgrades, retrofits** and **eco-design** so that products do not become waste or only in the long-term.

The other loop turns **old goods/wastes into new resources by recycling** materials into **secondary resouces** and thus keeping materials in the value chain which would otherwise be wasted.

Objective of Study

…is to investigate/to quantify the impacts of recycling on **energy use and the economy** in Austria

Recycling increases resource efficiency and saves energy and CO_2 emissions.

But does recycling also contribute to **economic value** and **job creation** and to what extent?

So far, these contributions have not been quantified for Austria and have therefore remained vague.

The Study

…is an **explorative study** dealing with **4 energy-intensive material groups** in 2014 addressing **key energy-economic indicators:**

- Gross value added • Employment • Global GHG emissions

GLASS **PAPER** **STEEL** **ALUMINIUM**

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What is the scope of recycling in our study?

Collecting, sorting, processing of waste...

...but also

input of secondary raw materials in production/manufacturing

trade in secondary raw materials

Data approach to economic impact analyis: Interlinking physical and monetary data

- Construction of a **new data sets** combining
  - **Physical data [t]** (Waste statistics)
    - Supply & use of secondary resources (scrap)
    - Trade flows in secondary resources
    - Material/energy flows in production processes of primary and secondary production
  - **Economic data [€]**
    - Monetary flows within the economy
    - Prices of primary and secondary materials

      (London Metal Exchange, World Bank, EUWID)

→ This approach allows to single out the material-specific activities from highly aggregated I-O tables

Data Example: Steel

Material streams and values of iron and steel scrap, 2014

		€/ton
Price of iron and steel scrap		246.90
	tons	m €
Domestic amount	2,320,986	573.05
Exports	1,014,819	250.56
Imports	1,200,149	296.32
Net imports	185,330	45.76
Total domestic amount	2,506,316	618.81
Production input of secondary feedstock	2,534,763	625.83
Difference/stock	-28,447	
		percentage
Production of crude steel	7,876,000	
Share of secondary feedstock in production		32.2%
Production blast furnace route	7,185,000	91.2%
Production electric steel plants	693,088	8.8%

Methodology (1): Model-based approach with WIFO.DYNK

- Investigation with WIFO.DYNK model
- **Macroeconomic model**
- **Hybrid approach (Input-Output, CGE)**
- Production activity (**62 industries & commodities**)
- Consumption (Public, Private, Export, Invest.)
- Behaviour based on econometric estimations

→ Used for simulations (tax policies, shocks,…)

→ Calculates effects on value added and employment

Methodology (2): Scenario „no-recycling“

Change the structure of the economy as if **NO RECYCLING** would take place but the same level of production output would be generated (counterfactual)

„No-recycling“-assumptions built into the model

- No collection, sorting, processing of scrap and waste
- No use of secondary materials in manufacturing
- No trade in scrap

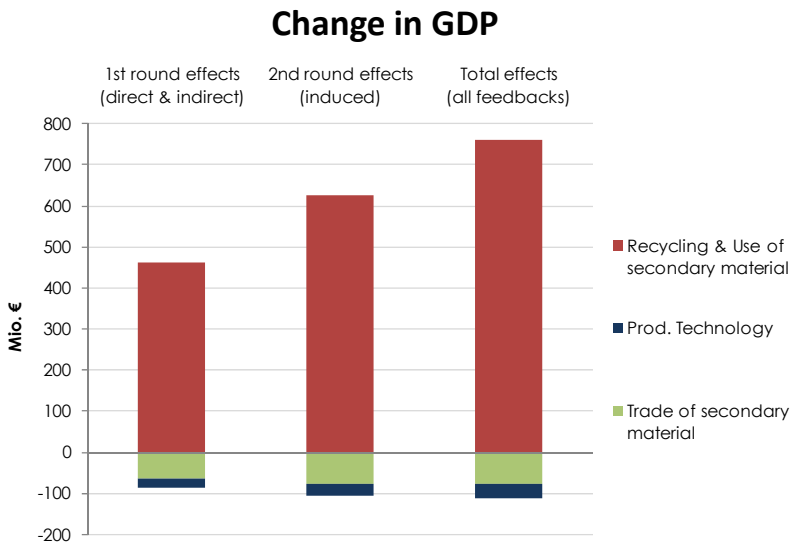
Instead material-specific assumptions

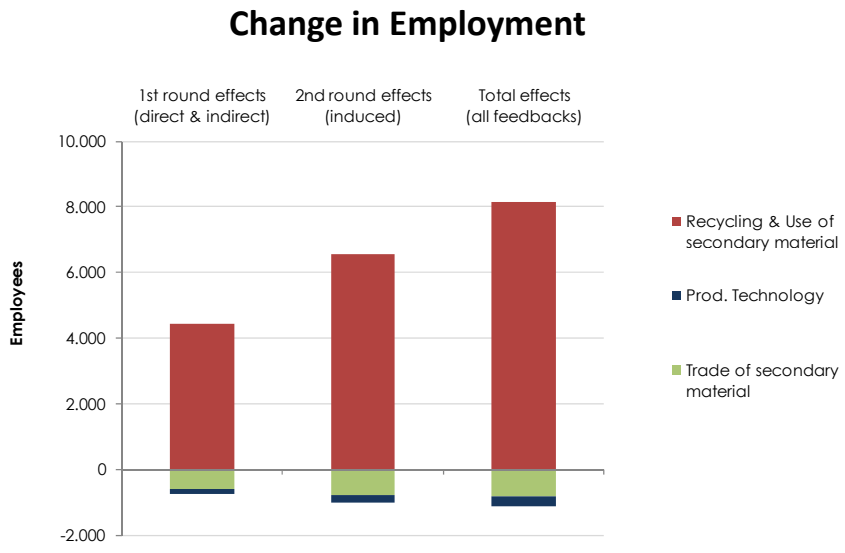
- Steel: Primary production (→ import of iron ore)
- Alu: Import of primary products (→ no primary production of Alu in Austria)
- Paper: Primary production (→ import of wood and pulp)
- Glass: Primary production (→ domestic mining activities)

Results: decomposed effects

- **3 macroeconomic loop effects**
  - Direct & indirect (Production & intermediate prod‘)
  - Induced (Private household consumption)
  - Total effects (Price feedbacks, Labour market, Public spending, Investment)
- **3 recycling effects**
  - Recycling (change in material flows)
  - Production technology (change in technolog- only steel)
  - Trade (change in imports/exports)
- Results display the contribution of recyling activities

Results for recycling of Steel





- Estimated contribution to
  - GDP : ~0.2% (net effect: 654 Mio. €)
  - Employment : ~0.2% (net effect: 7,083 jobs)
  - CO_{2e} Savings : ~ 4.5 Mt

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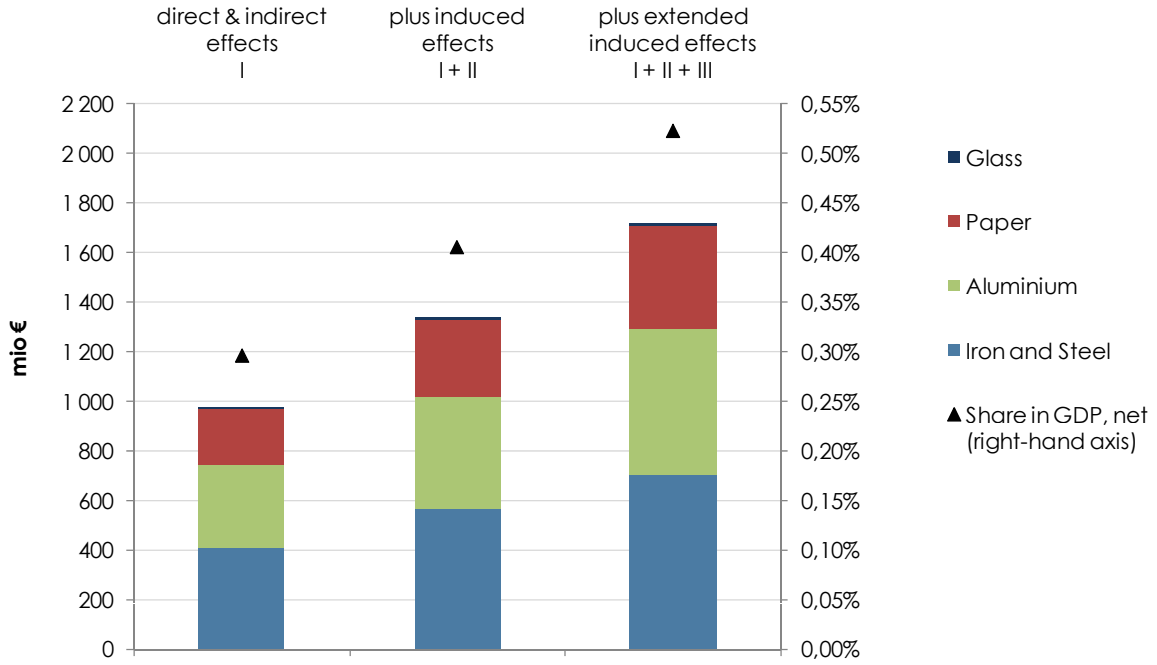
Summary results: recycling of the 4 material groups - economic indicators



The investigated recycling activities generate about **0.5%** of the **GDP** and **0.4%** of the **employment** in Austria in 2014, **and…**

Summary results: recycling of the 4 material groups – GHG emissions saved

…saves about **8 Mt CO_{2e}** on a **global scale**

Steel: -4.5 Mt CO_{2e} - Alu: -2.7 Mt CO_{2e} -

Paper: -0.7 Mt CO_{2e} - Glass: -0.1 Mt CO_{2e}

calculated on a **consumption-based approach**, including *inter alia* mining, transportation and waste deposition.

If calculated on **production-based approach** (national accounts, omitting mining activites abroad) GHG emissions may be higher due to recycling activities

Lessons Learned

- Substantial contribution of recycling to value and job creation in Austria
- **Metals** figure as **driving force of impacts** (high prices and high energy use in primary raw materials)
- **Results** are considered as **lower bound of impacts** because a substantial amount of scrap/secondary materials is processed in industries and never declared as waste in statistics
- Fostering the national collection, sorting and processing of scrap may increase economic impacts due to decrease in net imports but may also raise national GHG emissions

  but not global GHG emissions that are relevant for climate change mitigation

Outlook for research in recycling

- Investigate other materials/resource groups:

  other metals, rare earth metals, electronic waste, plastics, and phosporous etc.

- Assess **policy instruments** to incentivise demand for products based on secondary raw materials (e.g. consumption taxes→sustainable consumption)
- Conduct **dynamic analysis** in order to assess the scope of impacts from future anthropogenic resource stocks
- Assess the impacts of **variable resource prices** → results are price sensitive

Thank you!

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Link to full report (in German):

https://www.bmlfuw.gv.at/umwelt/nachhaltigkeit/ressourceneffizienz/ressourcen_aktivitaeten/WIFO-Recycling.html

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