Carl Vadenbo is a project manager responsible for mission activities at the ecoinvent Association, a not-for-profit organization based in Switzerland. The ecoinvent Association is the publisher of the ecoinvent life cycle inventory (LCI) database. In his main role at the ecoinvent Association, Carl develops and leads projects and activities aimed at promoting the use and good practice of LCI worldwide. Other tasks include the coordination and support of various projects related to data entry and the continuous development of the ecoinvent database.

Life-cycle-based indicators for a sustainable circular economy

Carl Vadenbo

project manager

ecoinvent Association

What is the ecoinvent Association?

- A **not-for-profit organisation** founded by five Swiss research institutes
  - Financed mainly through license income
  - Management team (16 persons): data/database management and analytics, technical support, IT, mission activities and services, product development, sales, marketing, and communication, administration, …
- Publisher of the ecoinvent database – **life cycle inventory (LCI) data**
  - Used for life cycle assessment (LCA) and environmental footprints (water, carbon, etc.), ecodesign, environmental product declarations (EPDs), and other quantitative sustainability assessments.
  - Data providers come from industry, public institutions, academia and research, consultants, etc.
  - Reviews, consistency checks, user support, training and capacity building, …

Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra

Swiss Confederation

Federal Department of Economic Affairs, Education and Research EAER
Agroscope

EMPA
Materials Science & Technology

ÉCOLE POLYTECHNIQUE FÉDÉRALE DE LAUSANNE

ETH
Eidgenössische Technische Hochschule Zürich
Swiss Federal Institute of Technology Zurich

PAUL SCHERRER INSTITUT
PSI

Outline of presentation

- Performance indicators for a circular economy
- Resource efficiency vs. (environmental) sustainability
- Life cycle assessment (LCA) for a more sustainable circular economy

Performance indicators for a circular economy

- The circular economy offers a great framework, but how to measure performance and progress towards sustainability?
  - What do we want/need to measure?
  - Cover all three pillars of sustainability
- No single indicator adequate. Instead, for example EU groups sets of indicators into:
  - Sustainable resource management
  - Societal behavior
  - Business operation

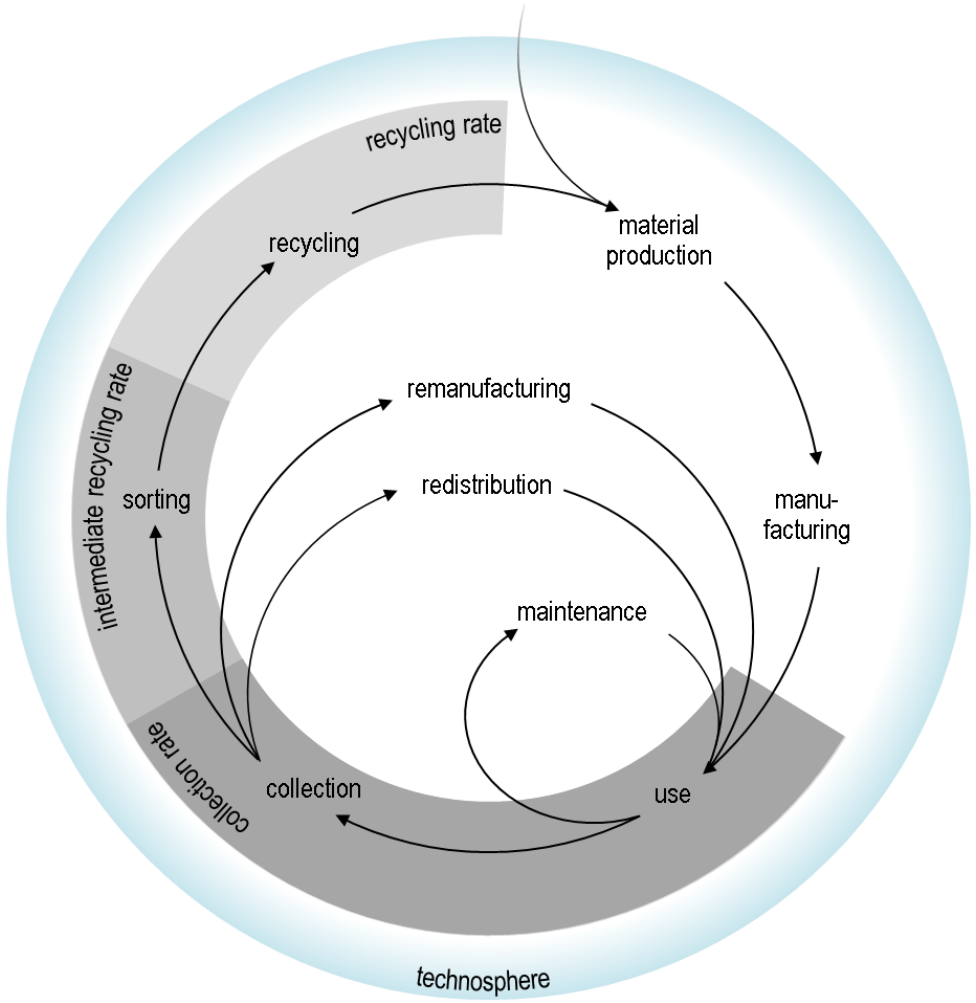


Figure adapted from Haupt & Hellweg (2019)

Resource efficiency vs. (environmental) sustainability

- Example: key macro-level indicators measuring performance of resource management in EU Member States
  - **Material footprint,** as domestic material consumption (DMC) [tonne/capita]
  - **Resource productivity,** as GDP/DMC [EURO/tonne]
  - **Municipal solid waste (MSW) generation and recycling,** [kilogram/capita]
- BUT what do these indicators say about environmental sustainability? And, do they support setting the 'right' priorities?
  - For example, are higher recycling or recovery rates always environmentally beneficial?
  - At which cost?

https://ec.europa.eu/environment/ecoap/indicators/sustainable-resource-management_en

Case study: resource efficiency of the Swiss MSW management system

Study by Haupt et al. (2017):

- Detailed material flow analysis (MFA) of Swiss waste management in 2012
- In-depth analysis of collection and recycling of:
  - paper and cardboard
  - PET bottles
  - glass
  - aluminum and tinplate
- Official 'recycling rates' vs. MFA results

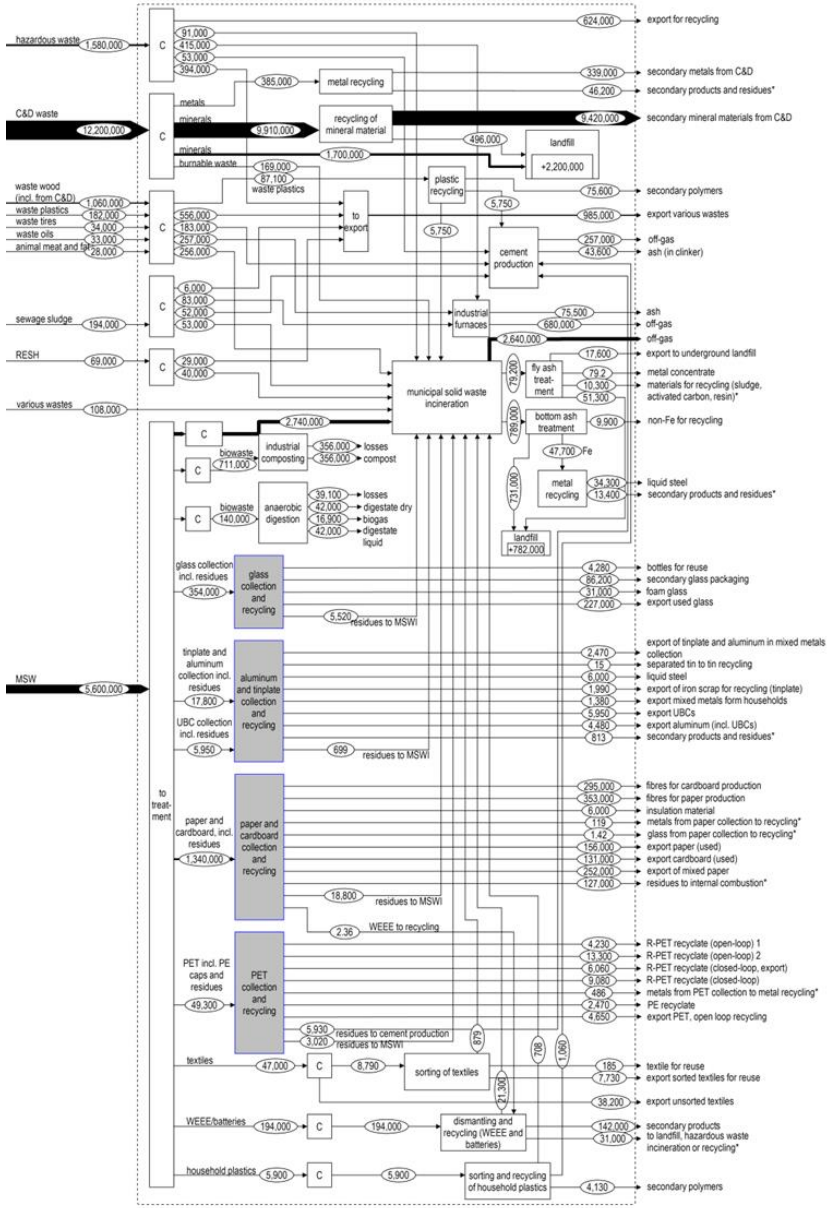
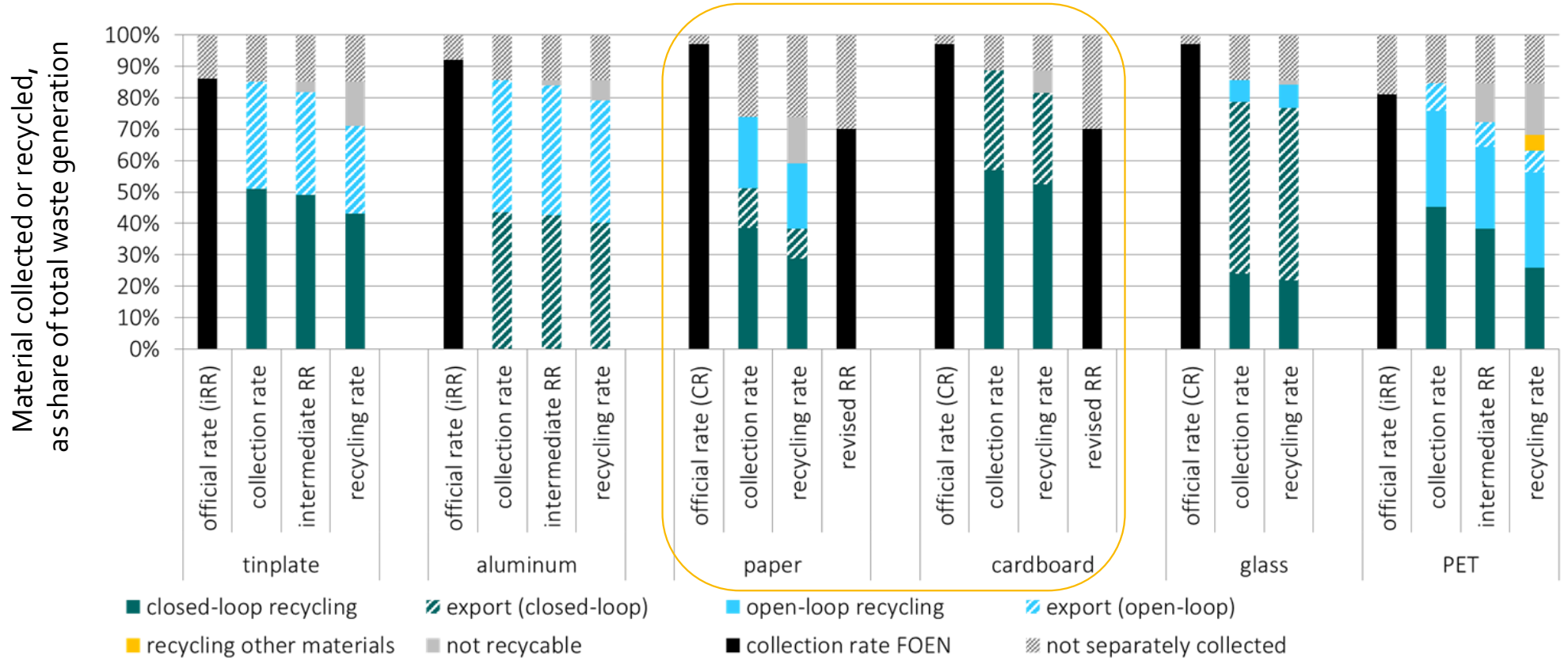


Figure adapted from Haupt et al. (2017)

Case study: resource efficiency of the Swiss MSW management system - *results*



Case study: resource efficiency of the Swiss MSW management system

- Official collection rates or «Verwertungsquoten» are/were optimistic and often only a measure of separation efficiency in households
- Recycling rates can be used as indicator of circularity of a system
- Open- and closed-loop recycling should be considered separately

Resource efficiency indicators based on material flow accounts are necessary, BUT <u>not sufficient,</u> to measure and monitor progress of sustainable development

Life cycle assessment (LCA) for a more sustainable circular economy

- The concept of *Retained Environmental Value (REV;* Haupt & Hellweg 2019)
- $REV = \frac{Env.value\ maintained\ through\ R}{Env.impact\ of\ original\ product}$
- What is 'environmental value'?
- Full life cycle perspective prevents burden-shifting
- REV applicable to all levels, e.g.:
  - Individual materials or product systems
  - Industries or sectors
  - Regional, national or global scale
- Understanding and quantifying substitution crucial!

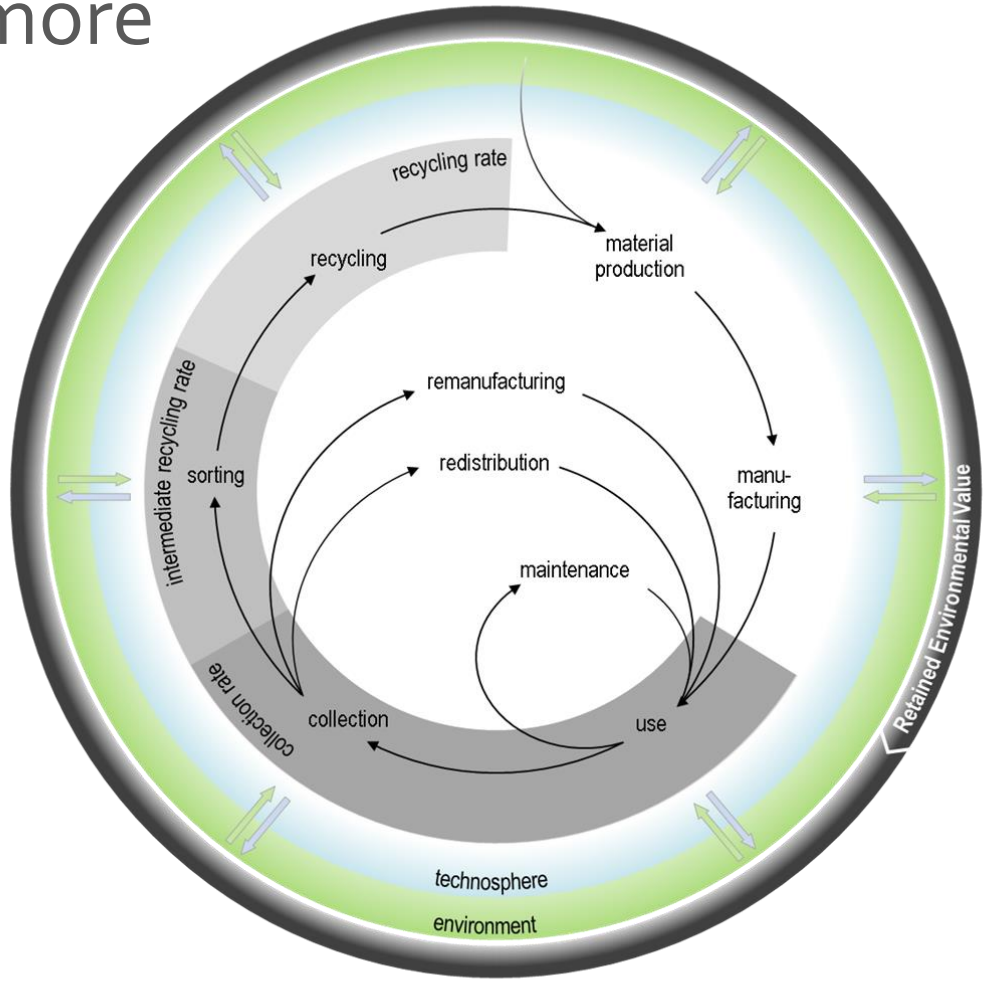


Figure adapted from Haupt & Hellweg (2019)

So, what is life cycle assessment (LCA)?

- An evaluation of environmental impacts of products, processes, designs, consumption patterns, organizations, etc. over the full life cycle ('cradle-to-grave') or parts thereof
  - **Quantitative:** determine flows of materials, energy, pollutants, resources etc. first, then translation into impacts on different environmental aspects
  - **Modular**: process data collected in inventories; different impact categories quantified based on the same inventories
- A **standardized methodology** (ISO 14044:2006)
- A **'data hungry'** endeavor… but databases reduce the effort
  → *presentation in Parallel Session on LCA*

Concluding remarks

- **Material and energy accounts** (of products/processes/industries/industrial parks/regions/nations…) **necessary, <u>but not sufficient</u>,** as indicators for a circular economy
- Sets of complementary CE indicators need to **reflect environmental, social, and economic performance** of increased circularity
- Environmental sustainability indicators must be based on a **full life cycle perspective**
  - **Avoid burden-shifting** up/down the supply chains or between impact categories
  - Understanding and quantifying **substitution crucial**!
  - **Data-intensive** with large uncertainties
- National LCA databases are an important tool towards **mainstreaming life cycle thinking**
  - **Build local capacity and expertise**
  - **Support local decisionmakers** in business and public policy
  - **Maintain competitiveness** in global markets

International Conference on Resource Efficiency and Circular Economy

Thank You...!

ecoinvent Association

www.ecoinvent.org

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