A-LCA IWG SG5

EoL modelling in the EF Method: the Circular Footprint Formula (CFF)

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European Commission

Agenda

- The challenge of the end-of-life modelling in LCA
- The Circular Footprint Formula (CFF) in the Environmental Footprint (EF)
- The CFF applied to the carbon footprint rules of EV batteries

Joint Research Centre – European Commission

As the science and knowledge service of the European Commission, the Joint Research Centre's mission is to support EU policies with independent evidence throughout the whole policy cycle.

As a Commission service independent from national or corporate interests, the JRC builds trust by providing evidence to support the definition of policies - from their design to implementation, monitoring and evaluation.

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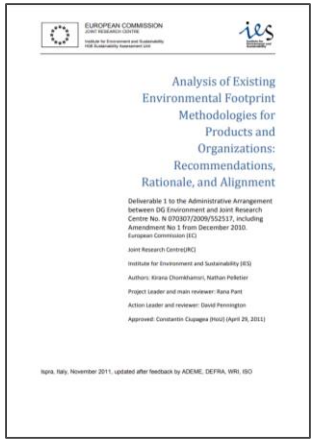
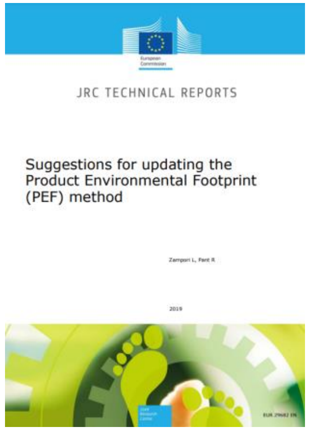




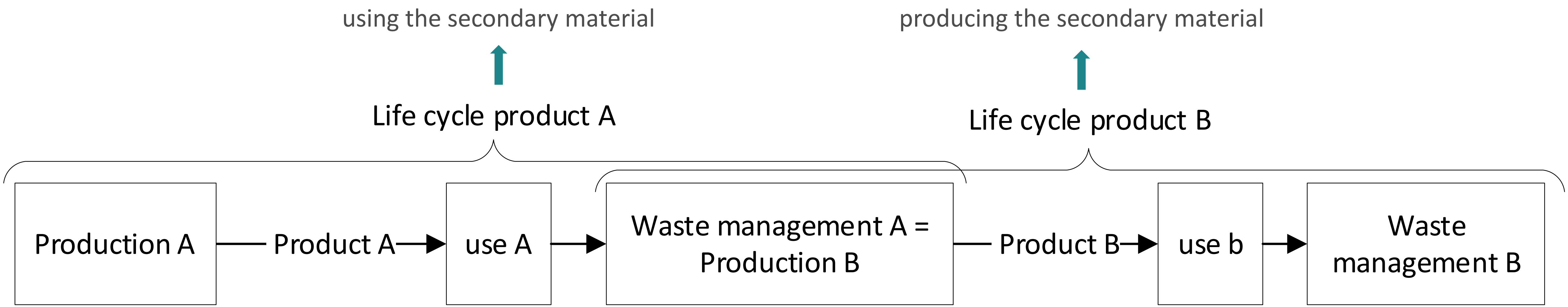
Pilot phase (2013–2018)

Transition phase (2019–2023)

- **2003** – Integrated product policy
- **2005** – **International Reference Life Cycle Data System (ILCD)**
- **2008** – Sustainable Consumption and Production and Sustainable Industrial Policy (SCP/SIP) Action Plan
- **2010** – **International Reference Life Cycle Data System (ILCD) guidance**
- **2011** – A resource-efficient Europe
- **2013** – **Environmental Footprint methodology**; Building the Single Market for Green Products
- **2015** – Closing the loop – An EU action plan for the Circular Economy
- **2018**
- **2019** – European Green Deal
- **2020** – A new Circular Economy Action Plan; A Farm to Fork Strategy for a fair, healthy and environmentally-friendly food system; EU Biodiversity Strategy for 2030
- **2021** – **Recommendation 2021/2279**; EU Action Plan: 'Towards Zero Pollution for Air, Water and Soil'
- **2022** – Adoption by COM of the Green Claims Initiative
- **2023**

European Commission

The challenge of the end-of-life formula



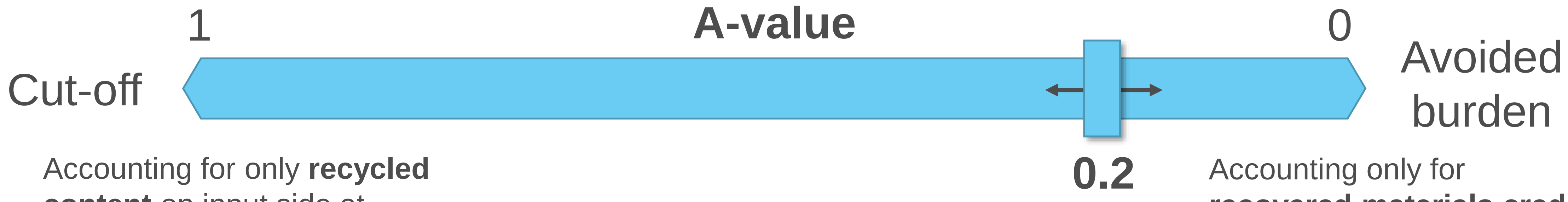
- Who is responsible of the impacts due to recycling?
- Who is responsible of the avoided primary resources?
- How do we avoid that both take the credit (i.e. double-counting)?

"There exists no purely natural-science-based approach to separate the different products in an overall system where recycling occurs." (Schrijvers, 2016)

EoL Modelling in the EF Method

Circular Footprint Formula (CFF)

- Balance between cut-off and avoided burden approach via the factor '*A*'
- A = 1 -> cut-off; A = 0 -> avoided burden. '*A*' values are material dependent and related to the market
- A factor values shall be in the range **0.2 ≤ A ≤ 0.8**:
  - A = 0.2 – low supply of recycled materials compared to a high demand: focus on recyclability at EoL
  - A = 0.8 – high supply of materials recycled at the EoL and low demand: focus on recycled content.
  - A = 0.5 – equilibrium between supply and demand: focus both on recyclability and recycled content.
- Default A-values: 0.5 for plastics, 0.2 for metals



Accounting for only **recycled content** on input side at beginning of life

Accounting only for **recovered materials credit** on output side at end-of-life

The Circular Footprint Formula (CFF)

- Aimed at achieving a balance between accounting of recycled material at input side (secondary material input) and end-of-life credits (recovered material after recycling)
- Applied per material, with material-specific parameters

Material production

$$(1 - R_1)E_V + R_1 \times \left(A \times E_{recycled} + (1 - A)E_V \times \frac{Q_{Sin}}{Q_P}\right)$$

Waste recycling

$$+ (1 - A)R_2 \times \left(E_{recyclingEoL} - E_V^* \times \frac{Q_{Sout}}{Q_P}\right)$$

Energy recovery

$$(1 - B)R_3 \times (E_{ER} - LHV \times X_{ER,heat} \times E_{SE,heat} - LHV \times X_{ER,elec} \times E_{SE,elec})$$

Disposal

$$(1 - R_2 - R_3)E_D$$

Parameters ↖ Process ↗

$(1 - R_1) * E_v$

CFF – Material production – per material per FU

Mass of primary material

$$(1 - R_1) x E_V$$

- Recycled content
- Default = 0
- **May be company-specific**

- Impacts of producing primary material
- It could be a process from EF database (or primary data, if available)

Mass of secondary material

Allocated secondary mass *Allocated primary mass*

$$R_1 x (A x E_{recycled} + (1 - A) x E_V x \frac{Q_{Sin}}{Q_p})$$

- Allocation factor – market based
- Per material per application
- Annex C of the EF method
- It shall be between 0.2 – 0.8
- 0.2 if demand is higher than supply
- 0.8 if supply is higher than demand
- 0.5 if balanced (or unknown)

- Ration between the quality
- Difficult to quantify (mainly based on economic factors)
- Annex C of the EF method

- Impacts of collecting, sorting and recycling the secondary material
- It could be a process from EF database

Material recycling

Mass of material being recycled

$$(1 - A) x \, R_2 \, x \left(E_{recyclingEoL} - E_V^* \, x \, \frac{Q_{Sout}}{Q_P} \right)$$

- Recycling rate
- Annex C of the EF method

- Impacts of collecting, sorting, and recycling the waste.
- It could be a process from EF database

- Impacts of producing the avoided secondary material.
- For simplicity, if Ev and Ev* are the same material, you can assume Ev=Ev*.

- Ratio between the quality of the secondary material and the quality of the primary material.
- Difficult to quantify
- Annex C of the EF method.

Energy recovery and disposal

- All the material not recycled (after collection, sorting and recycling) is either incinerated with energy recovery or sent to disposal (i.e., incineration without energy recovery and landfill).
  - The benefit of the incinerations plant (i.e., the avoided impact of producing the energy that would have been produced without the incineration) are subtracted to the impacts of the incineration (e.g., the direct emissions)
  - The allocation factor of the energy is currently 0, meaning that all the credits of the incineration are given to the product being incinerated and none to the product using the energy from incineration.
- All the impacts of incineration and landfilling are a burden on the product generating the waste.

From PEF to CFB

The **Environmental Footprint (EF)** is an LCA-based method developed by EC in the last decade.

The EF has been recommended by the EC to quantify the environmental impacts of products (goods or services) and organisations (PEF/OEF).

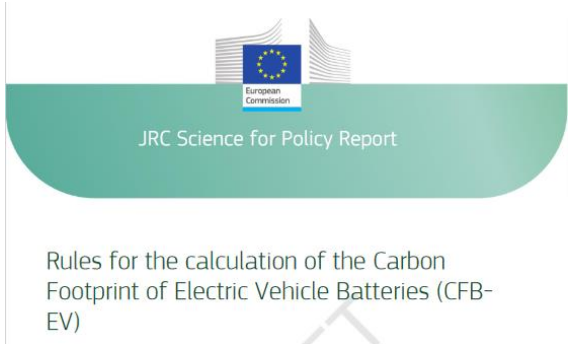
The PEF is a **multi-criteria measure** of the environmental performance of a good or service throughout its life cycle.

PEFCR have been developed for a broad set of different products, among them batteries. The **PEFCR for batteries** is currently being revised

The use of PEF is being discussed or proposed in EU legislations as:

- Battery Regulation Proposal (art. 7 Carbon footprint of batteries)
- EU Taxonomy
- Green Claims Directive
- Ecodesign Directive
- Ecodesign for Sustainable Products Regulation

CFB-EV Rules



JRC "**Science for policy report**" was developed in support to the definition of the methodology, for the calculation of the carbon footprint for EV batteries **(CFB-EV rules - June 2023)**[1]**.**

- **Open dialogue with stakeholders**
- This document will serve as the basis for the adoption of rules according to Article 7 for EV batteries
- This document is expected to be also the basis for building future similar rules for other types of batteries, including flow batteries.

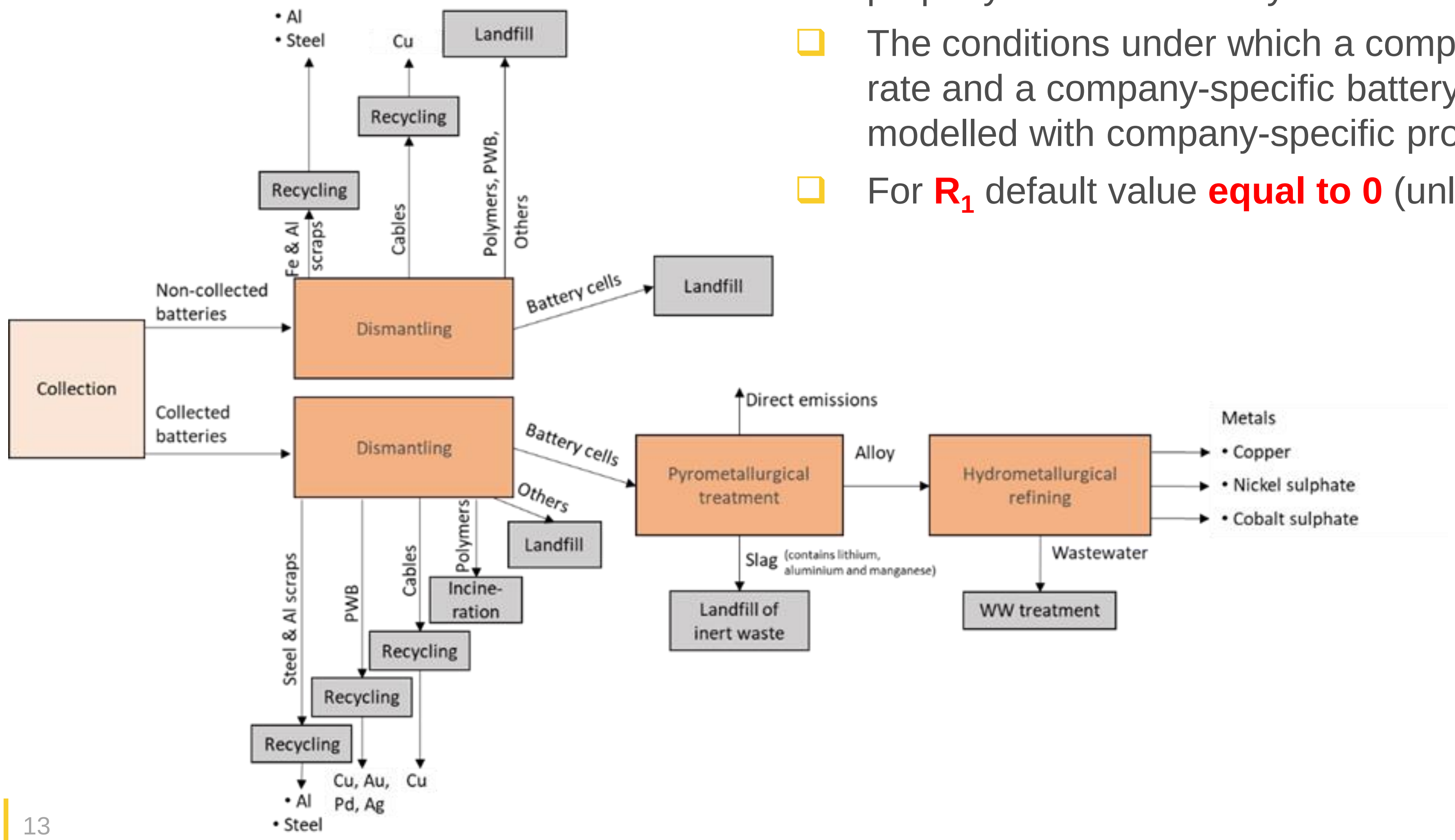
Link to the latest version of the CFB-EV Rules:

[1] https://eplca.jrc.ec.europa.eu/permalink/battery/GRB-CBF_CarbonFootprintRules-EV_June_2023.pdf

Also accessible from:
https://eplca.jrc.ec.europa.eu/projects.html
https://eplca.jrc.ec.europa.eu/EU_BatteryRegulation_Art7.html

EoL Modelling - CFB

- The rate of **properly collected battery (70%)** was made explicit in the formula
- A different fate was assumed for properly and non-properly collected battery waste
- The conditions under which a company-specific collection rate and a company-specific battery cell recycling may be modelled with company-specific process were clarified.
- For **R_1** default value **equal to 0** (unless differently proved)



Concluding Remarks

- CFF aims a defining a holistic approach for EoL modelling (taking into account both recycled content and recyclability)
- A-factor allows to adjust between cut off or avoided burden approach. But: Currently used EF datasets are based on a determined A-value (e.g. 0.2 for metals)
- Trade-off between simplicity and accuracy, primary and secondary data
- Quality aspects difficult to consider

- Temporal mismatch as general problem of EoL modelling for long living products
- CFB models EoL treatment based on default process model -> simplification.
- CFB considers additional parameter (collection rate)

Thank you

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