



## Method for Calculation of the Recycling Efficiency (RE)

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$$RE = \Sigma (\text{mass of recycled fraction}) / \text{input mass into the recycling process}$$

-The **input mass** is defined as the weight of treated batteries (wet basis)

**Question: with / without water content**

-The **mass of recycled fraction** refers to the share of the product, material or substance being recycled originating from batteries input

-Calculation on an **elemental level**

All produced **elements** and **compounds** account for “recycling”, if these elements or compounds were components of the **new battery / spent battery**



# Method for calculation of recycling efficiencies

## Questions to Discuss

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### 1) SYSTEM BOUNDARIES

- 1.1) Scope of the duty to achieve the recycling efficiencies?
- 1.2) Process steps to be considered in the battery recycling process?
- 1.3) Black box approach / individual step approach?

### 2) INPUT REFERENCE VALUE

- 2.1) Components of waste batteries to be considered?
- 2.2) Reference elemental composition?
- 2.3) Characterisation of waste batteries input into a recycling process?
- 2.4) Water content?

### 3) OUTPUT TO BE ACCOUNTED FOR “RECYCLING”

- 3.1) Water?
- 3.2) Carbon and other potential reducing agents?
- 3.3) Slag?
- 3.4) Oxygen?



# 1) System boundaries

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## 1.1) At which level shall the recycling efficiency be achieved?

*“Recycling processes shall achieve the recycling efficiency” (Annex III, Part B)*

- A) each recycling process
- B) all recycling processes on average to which the batteries collected within a MS in accordance to Article 8 (Separate Collection) are handed over
- C) all recycling on average processes carried out within a MS

## 1.2) Process steps to be considered in the calculation of the RE?

- A) Recycling of fluids and acids, which have been separated from batteries, is taken into account for calculation of the recycling efficiency.
- B) Recycling of fluids and acids, which have been separated from batteries, is NOT taken into account for calculation of the recycling efficiency.



# 1) System boundaries

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## 1.3) Calculation Approach?

A) Black-Box-Approach

B) Individual-Step-Approach







## 2) Input Reference Value

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### 2.4) Water content?

- A) Input Reference = weight of waste batteries including all fluids and acids (wet weight)
- B) Input Reference = weight of waste batteries including all fluids and acids (dry weight)
- C) Input Reference = weight of drained waste batteries



### 3) Output to be accounted for “Recycling”

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#### 3.1) Water?

A) If input reference = wet weight (2.3.A)

Water content is accounted for “recycling” if it was part of the waste battery and if it is part of an output fraction being accepted for “recycling” (product, material, substance)

B) If input reference = dry weight (2.3.B)

Water content is NOT accounted for “recycling” if it was part of the waste battery and if it is part of an output fraction being accepted for “recycling” (product, material, substance)

#### 3.2) Carbon and other output fractions, which can be utilized as reducing agents (e.g. plastics)?

A) Carbon etc. used as a reduction agent within the battery recycling process is NOT accounted for “recycling”

B) Carbon etc. used as a reduction agent within the battery recycling process is accounted for “recycling”



## 3) Output to be accounted for “Recycling”

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### 3.3) Slag

- A) Battery materials in slag are accounted for “recycling” for the calculation of the RE if the slag is an approved product (→ by-product) according to the EU Waste Directive AND if it is actually used for purposes other than disposal
- B) Battery materials in slag are NOT accounted for “recycling” for the calculation of the RE

#### 3.3.1) Which battery materials contained in slag are accounted for “recycling” (if slag is accounted for “recycling” for the RE)

- A) Battery materials constituting undesired contamination for the particular application of the slag are not accepted for “recycling”
- B) All battery materials are accepted for “recycling”



## Output to be accounted for “Recycling”

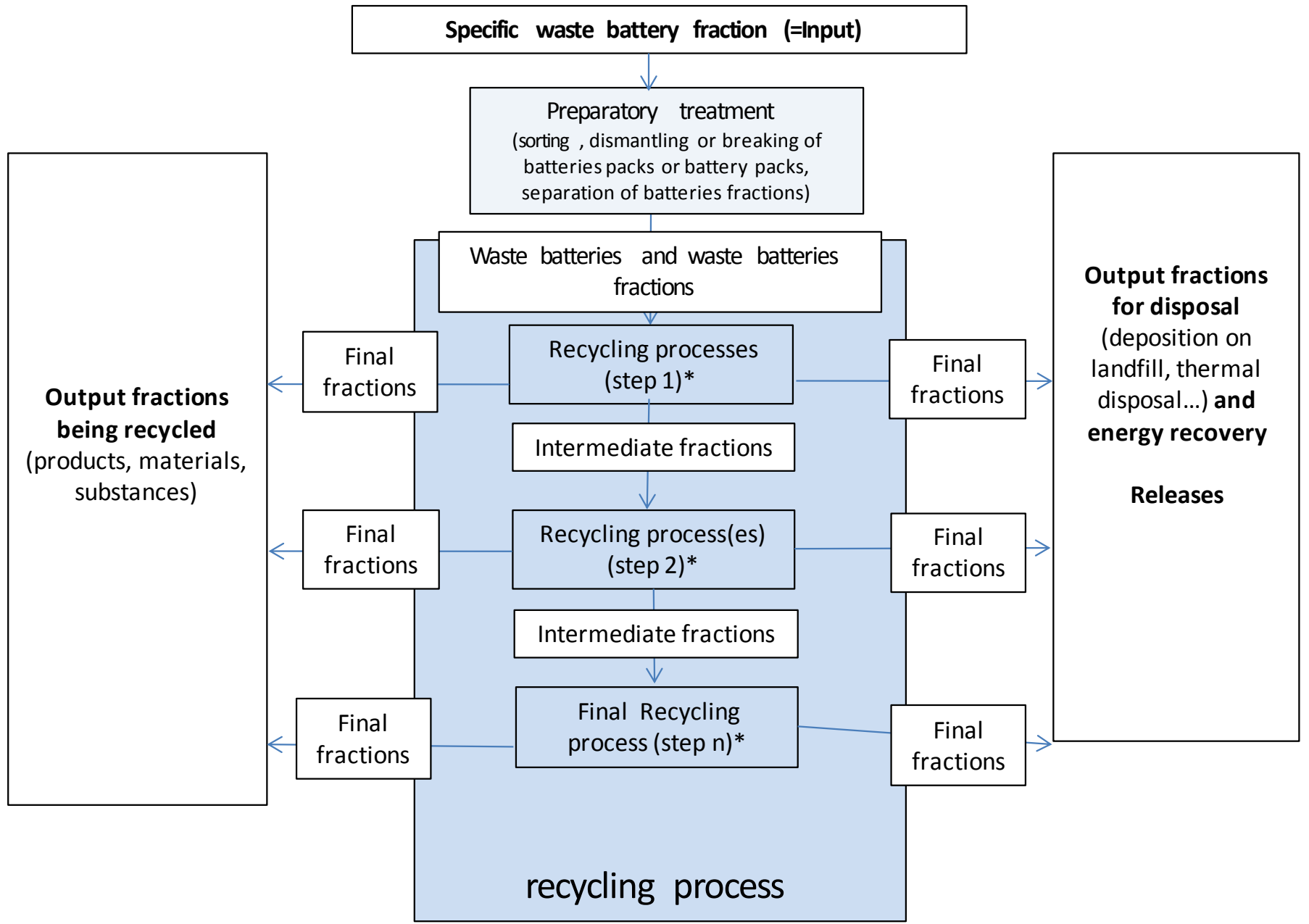
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### 3.4) Oxygen?

Oxygen is accounted for “recycling”

-if it was part of the waste battery and

-if it is part of an output fraction being accepted for “recycling” (product, material, substance)



\* Subsequent Treatment/Recycling processes might be carried out by one treatment facility or several facilities either in the same country or in further countries (waste batteries and accumulators exported out of the EC [...] shall count towards the fulfilment of the efficiencies only if there is sound evidence that the recycling operation took place under conditions equivalent to the requirements of Directive 2006/66/EC)