Technical support to the adoption of delegated acts and Commission reports related to the new Batteries Regulation between 2024 and 2027

Task 3 draft final report
Available for collection (AfC) methodology

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Disclaimer

The drafts and suggestions presented here have not been adopted or endorsed by the European Commission; any recommendations shared in connection with this document are the views of Oeko-Institut and Fraunhofer IZM and may not in any circumstance be regarded as an official position of the European Commission.

Abbreviations

The following abbreviations are used throughout this report.

Abbreviation	Definition
AfC	Available for collection
AOM	Available on the market
BattReg	Batteries Regulation (Regulation (EU) 2023/1542, 2024)
CF	Complimentary flow(s)
Col	Collection
CR	Collection rate
DV	Default value(s)
EC	European Commission
EEE	Electric and electronic equipment
ESS	Energy storage system
Inh.	Inhabitant
JRC	Joint Research Centre of the European Commission
LMT	Light means of transport
MMW	Mixed municipal waste
MS	Member State of the European Union
MW	Municipal waste
P	Portable battery
PLEV	personal light electric vehicles
PRO	Producer responsibility organisation
R	Remanufactured / repurposed batteries
uEEE	Used electric and electronic equipment
WEEE	Waste electric and electronic equipment
WFD	Waste Framework Directive (Directive 2008/98/EC, 2024)
WG	Waste generated

1. Introduction and background

This project aims to elaborate further on how the Available for Collection (AfC) methodology can be implemented in preparation for the planned delegated acts in August 2027. See the following sub-chapter for more information. In order to best support the implementation of the AfC methodology, the project team is working to ensure that reliable data and information are used to calculate the complementary flows, particularly the amount of waste batteries that are not available for collection in a given year. It is important to ensure that implementing the AfC methodology does not lower the ambition of the collection targets to be achieved. A key task is to develop criteria for evaluating the robustness of values for complementary flows provided by Member States (MS). The earliest possible reference year for applying the AfC methodology would be 2028, with reporting taking place in 2030.

This interim report outlines the current status of the project work and sets out the research team's initial suggestions on how to approach the implementation of the AfC method for portable and light means of transport (LMT) batteries.

1.1. Batteries Regulation and purpose of the AfC methodology

The Batteries Regulation (EU) 2023/1542 (2024) empowers the European Commission (EC) to amend the methodology to calculate the collection rate of both portable batteries and LMT batteries from the existing methodology set out in Annex XI. In line with this change in methodology, the collection targets set for portable and LMT batteries can be adjusted while maintaining equivalent level of ambition and timelines. The relevant paragraphs in the Batteries Regulation are paragraph 7 of Article 59 for portable batteries and paragraph 8 of Article 60 for LMT batteries. These paragraphs repeat each other and state:

> In view of the expected development of the market and increase of the expected lifetime of rechargeable portable batteries, and in order to better ascertain the actual volume of waste portable batteries available for collection, the Commission is empowered to adopt, by 18 August 2027 delegated acts in accordance with Article 89 to amend the methodology to calculate the collection rate of portable batteries / LMT batteries set out in Annex XI and to amend the collection target laid down in paragraph 3 of this Article to adapt that collection target to the new methodology while maintaining equivalent ambition and timelines. (Regulation (EU) 2023/1542, 2024, Article 59(7) and Article 60(8))

The AfC methodology aims to adapt more effectively to the expected market developments and changes in battery properties, particularly the prolonged average lifetime of portable batteries and LMT batteries. The reasoning is laid out in Recital 108 of the Batteries Regulation:

> (…) Due to the expected development of the market for LMT batteries and portable batteries and increase in their expected lifetime, the methodology for calculating and verifying collection targets should be reviewed in order to better ascertain the actual volume of waste LMT batteries and waste portable batteries available for collection. (…) (Regulation (EU) 2023/1542, 2024)

The methodology is based on estimating the actual waste generated (WG) for a given year, which is used to calculate the collection rate (CR). Unlike the current methodology, which only considers batteries made available on the market (AOM) in the previous three years, WG calculates the total amount of waste batteries per year based on their average lifetimes.

Additionally, the WG methodology seeks to account for batteries that are not-available for collection (not-AfC). Not-AfC describes the fraction of waste batteries that are not available for collection, out of the total amount generated. There are multiple different factors that can lead to batteries not being available for collection and which are ending in different streams. In the AfC methodology, these streams are represented by complementary flows (CF). Waste batteries available for collection (AfC) are calculated as the difference between the total waste batteries generated and those not available for collection:

$$AfC = WG \; - not\ AfC$$

The collection rate (CR) is calculated as a percentage of the available waste batteries for collection (AfC) and the actual amount of waste batteries collected (Col).

$$CR = \left(\frac{Col}{AfC}\right)\, x\ 100$$

1.2. Starting point: JRC Reports

The AfC methodology was developed by the Joint Research Centre (JRC) and laid out in two reports:

- 2021: '"Available For Collection" study – on alternative collection targets for waste portable and light means of transport batteries'. (Huisman & Bobba, 2021)

- 2024: ‘Technical specification for a harmonized methodology to calculate appropriate collection rates for waste portable and Light Means of Transport batteries’. (Bobba et al., 2024)

In these publications, the JRC has developed the theoretical foundation for the AfC methodology, an equation and the general methodology. In addition, the JRC performed initial research on the availability of data in relevant streams, sensitivity analysis with different scenarios to predict the amount of waste batteries generated. In the reports, the JRC proposed different complementary flows to determine the batteries not-AfC. For each of these complementary flows, default values, potential deviations from the default values and maximum values (thresholds) were discussed.

2. Stakeholder consultations

Stakeholder feedback was collected to understand stakeholder perspectives for implementing the AfC method. Stakeholders were asked to share available data sources that could be used to support the implementation of the AfC method and to substantiate their concerns and opinions. The individual feedback is not intended for publication, but the statements are used to substantiate the methodological options presented.

The stakeholder consultation meeting was held digitally over WebEx. Various stakeholders were invited, representing Member State (MS) perspectives and needs for EU battery data reporting and including MS ministries, battery producers and recycler organisations. In the consultation meeting, the project team presented its current suggestions on how to approach AfC methodology implementation for portable and LMT batteries. After the stakeholder consultation meeting, stakeholders were given four weeks to submit their statements and opinions about the initial proposal. These consultation followed the schedule in Table 1.

Table 1 – Stakeholder consultation schedule

Stakeholder consultation activity	Deadline for participation
1st Stakeholder meeting	17 September 2025
Stakeholder responses to 1st meeting	13 October 2025

2.1. Stakeholder consultation meeting, 17 Sep 2025

The first stakeholder consultation meeting was held on Wednesday, 17 September 2025 (13:30-17:30), with 69 different stakeholders representing perspectives and opinions from e.g. EU Member States, battery PROs and recycler organisations (see Table 2). The meeting allowed participants to share their views on the aspects presented.

Table 2 – Participant summary, Stakeholder meeting 17 Sep 2025

Participant category	Participant count
European Commission	7
Member State	27
EU-level association	8
PROs, companies, recyclers, etc.	17
Project partner	5
Other	5

Participant category	Participant count
Total participation	**69**

Source: own compilation of stakeholder consultation from October 2025

2.2. Stakeholder responses after first workshop

Following the 1st Stakeholder consultation meeting, written statements could be submitted to the research team by 13 October 2025. Ten (10) statements — including position papers, data or related studies, etc. — were received by 22 October 2025. The categorisation of responses is summarised in Table 3 below.

Table 3 – Categorisation of stakeholder responses, October 2025

Respondent category	Respondent count
Member State	5
EU-level association	2
PRO	1
Producer	1
Consumer organisation	1

Source: own compilation of stakeholder consultation responses from October 2025

Stakeholders provided open statements and supporting documents as feedback to the proposal presented in the September 2025 stakeholder consultation meeting. These comments and information can be categorised into the following aspects.

Table 4 – Stakeholder response summary (10 respondents)

Response category	Stake-holders (count)	Response summary
Default values (DV), deviations and criteria	2	1x Supports possible deviation from DV and does not consider to impose a maximum values for deviations from the DV. 1x Does not support any deviation from DV.
Waste generated (WG)	2	1x WG value should be weighed on OEMs data. 1x Requires historic AOM data that does not exist.

Response category	Stake-holders (count)	Response summary
Battery categories	6	Portable 1x No requirement in the BattReg to report proposed subgroups of portable and LMT batteries. 2x No data on proposed subgroups of portable and LMT batteries available in MS. LMT 6x In favour to revise the proposed LMT subgroups and mainly to limit to less subgroups. 2x Could distinguish LMT data into 2 categories: E-cycle batteries (LMT2) and other LMT. 1x No data available for any LMT subgroups, except of historical data for LMT2 (from 2015 onwards). 1x Use default values for each of the four proposed LMT subcategories. 1x Lifetime the same for e-bikes and e-kickscooters as batteries are the same.
General comments on lifetime	6	No new data on lifetime received. 6x Essential to use the 'real' longer lifetime of batteries. 2x Ease of use of the method is important (not too complicated; not too much administrative burden). 2x Comparability is important. 1x Average lifetimes are too short and do not reward longer lifetimes (i.e. good engineering by OEMs). 1x Supports using weighted distribution model for lifetimes of batteries as basis to calculate WG.
Lifetime suggestions	5	2x One lifetime value for all portable batteries and one lifetime value for all LMT batteries (suggest portable 6yrs and LMT 8yrs). 1x Average lifetimes are too short and do not reward longer lifetimes (i.e. good engineering by OEMs). 1x 7-year lifetime for both e-bikes and e-kickscooters, applications use the same batteries. 1x Supports differentiated 'realistic' lifetimes.
WG lifetime average option preference	5	2x Option 1 (= 3 years). 2x Option 2 (= 5 Years). 1x Different approach (statistical distribution) would be better.
MS change average lifetime preference	1	1x EU-wide standardised values for the lifetime; MS cannot change the average lifetime.
Acceptable lifetime deviations preference	2	1x Deviations based on JRC reports (Bobba et al., 2024; Huisman & Bobba, 2021). 1x Individual lifetime values per OEM.
General comments on hoarding	4	2x Hoarding should not be incentivised and encouraged; end-user is obliged by the Batteries Regulation to discard batteries separately. 1x Hoarding has a significant impact and is underestimated. 1x Hoarding not an issue for certain LMT applications

Response category	Stake-holders (count)	Response summary
Hoarding option preference	5	2x Hoarding included in lifetime. 2x Separate DV for hoarding (P: 2y; LMT: 3y). 1x Hoarding needs to be accounted for somehow (P: +2y; LMT: +3y).
Complementary flows (CF) generally	4	3x Lack of data makes estimates and default values difficult to set and assess. 1x Suggest that third party collection is an issue resulting in significant losses of waste batteries that cannot be tracked. 1x CFs that can be documented and tracked should be subtracted from the AfC method. 1x PROs need information about the flow categories early enough ahead of reporting to ensure correct planning and reliable data collection. 1x Without reliable data, greenwashing can occur.
MMW	6	<u>LMT</u> 5x DV should be 0% without any deviation from DV = 0%. <u>Portable</u> 4x No deviation from DV. 3x DV should be 0% without any deviation from DV = 0%. 1x DV of 7% too high. 1x Low DV of e.g. 7%. 1x Maximum deviation of 15%. 1x DV must be substantially higher than proposed 7 % (waste batteries without differentiation into portable / LMT).
Remanufactured/ repurposed (R)	7	4x Deviation should be possible. 3x No maximum value for deviation needed. 3x Data needs to be validated, verified and approved. 2x R is an important parameter. 1x Maximum value for deviation needed (5 % of WG). 1x R should be indicated in the MS’s CR. 1x ‘closed loop’: a battery can only be counted as Not-AfC if it is documentarily proven that the same quantity (by weight) was reintroduced to the market (AOM). 1x Clarification needed on how OEMs or Economic Operator shall communicate the ‘Batteries being Remanufactured / Repurposed’. 1x Differentiation between definitions of ‘remanufacturing’ and ‘repurposing’ needed (e.g. ‘remanufacturing’ extends lifetime; ‘repurposing’ can lead to a change in category)
WEEE	5	4x clearly indicate DV of 0%. (fifth response is unclear.) 3x No batteries should be deducted from WG. The contractor interprets this to mean that no deviation from DV = 0% should be possible. 2x Support portable batteries and the possibility of deviating from the DV on the basis of an additional survey/ harmonized audits, including a maximum value for deviation.

Response category	Stake-holders (count)	Response summary
Import/ export	6	6x Support deducting exports as not-AfC. 2x DV = 0%. 2x DV > 0%. 3x Support possible deviation from the DV. 1x No maximum value for deviation is necessary. 1x Maximum value necessary, e.g. 5%. 1x No maximum value for intra-EU trade and a maximum value of 5% of WG for exports outside the EU. 2x Need for a 'balancing system' between MS' PROs (ensuring that transferred batteries are properly accounted for as AOM in the destination country).
Additional/ other CFs	4	1x unregistered exports (in metal scrap, commercial and industrial waste, incidents and theft = 4% WG (portable batteries) and up to 9% WG (LMT batteries), according to data provided.) 1x unregistered imports (e.g. online trade). 1x used batteries when entering other MS, are identified (if properly reported) as new AOM in the importing MS. 1x any additional waste flows should be included in the AfC.
Equivalent ambition and targets	6	3x targets challenging, even more so with AfC method and CFs 2x 'equivalent ambition' must be ensured 1x including hoarding times would reduce the ambition for collection and disincentivize current measures Portable 1x Data is needed; can use historical POM data LMT 1x Under-reporting of LMT exports will make collection target unattainable
Legality of proposal according to Batteries Regulation	2	2x Uncertainty whether the proposed AfC method, which is stricter for collecting and delivering data, is within the Batteries Regulation and can therefore be transposed into national law. 1x No subcategories for LMT specified in the Batteries Regulation.
Administrative burden/ effort	1	1x Current AfC proposal is too complex and requires too much administrative burden since it does not use actual data.

Source: own summary of stakeholder consultation responses from October 2025

3. Available for Collection (AfC) methodology

3.1. Implementation of the AfC methodology

Figure 1 provides a schematic overview of the main process steps of the AfC methodology. The AfC methodology's results—the collection rate (CR)—is based on the following four steps, also indicated in Figure 1:

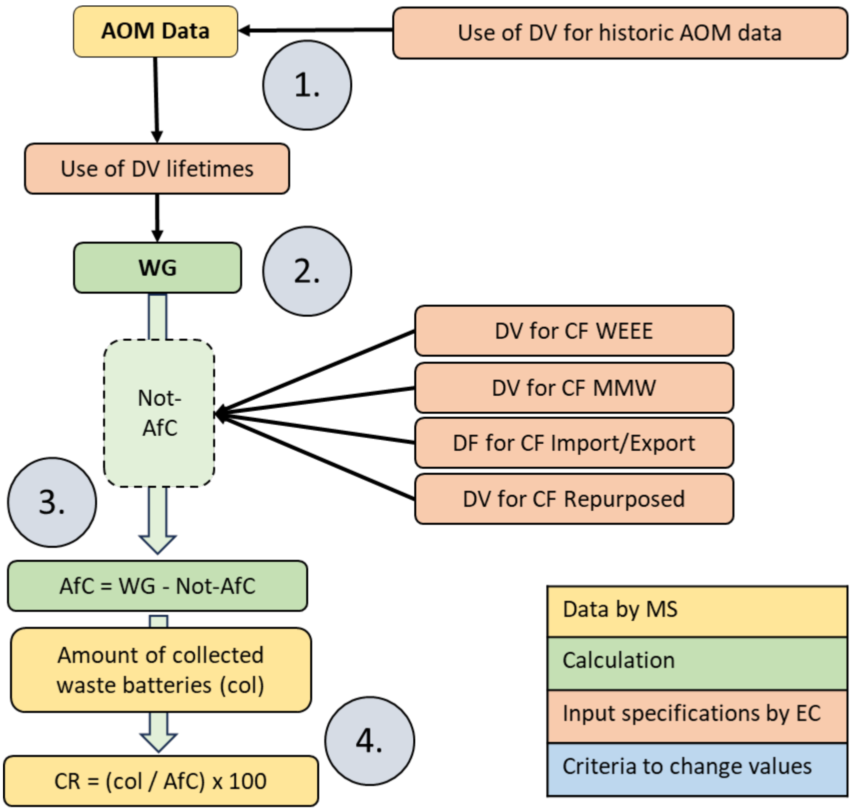
1. The starting point of the AfC methodology is data on batteries made available on the market (AOM). This AOM data is required to calculate waste generated in step 2.
2. The calculation of waste generated (WG) is based on AOM and average battery lifetimes. This means that, once batteries reach their end of life, they become waste.
3. The AfC methodology accepts that not all generated waste batteries are indeed available for collection. It is accepted that certain battery flows, known as complementary flows (CF), are not available for collection. These CF can be deducted from waste generated (WG). The waste batteries that remain after this deduction are the actual AfC batteries.
4. The final step involves calculating the collection rate (CR). This requires data on the amount of waste batteries collected at the Member State level. The CR represents the proportion of collected waste batteries (Col) to the waste batteries available for collection (AfC).

The AfC methodology in Figure 1 uses **default values (DV)** in several steps. DV means that certain data that is not readily available or easily obtainable but is absolutely crucial for the calculation and a harmonised approach, e.g. battery lifetime, is foreseen to be provided by the Commission so that the calculation may be performed.

The AfC methodology can be applied in the same way for portable as for LMT batteries. Differences between portable and LMT batteries are, where necessary, explained in separate sub-chapters.

The implementation of the AfC methodology is based on the JRC approach (Bobba et al., 2024) and therefore also takes into account a further differentiation into battery subgroups: P1 and P2 for portable batteries and LMT subgroups 1 to 4 for LMT batteries. A potential differentiation into battery subgroups requires that all other data, e.g. AoM, average battery lifetime, WG also be differentiated into the respective groups.[1] To simplify the diagram, Figure 1 does not display the additional differentiation into battery groups.

Figure 1 – Process flow chart of AfC methodology based on default values (DV)



Source: Own diagram (Oeko-Institut)

Details on how to implement the AfC methodology and the specific calculation steps are addressed in individual chapters of this report. In chapter 3.2, the basic calculation steps are explained. Chapter 4.1 addresses the calculation of waste batteries generated (WG). The approach for average battery lifetimes is explained in chapter 4.2. Next, the calculation of batteries data made available on the market is described in chapter 4.1 (AOM for portable batteries) and chapter 4.4 (AOM for LMT).

This report focuses on the complementary flows (CF) in chapter 5. Four different CFs are considered: batteries lost in mixed municipal waste (MMW in chapter 5.2), batteries ending up with waste electric and electronic equipment (WEEE in chapter 5.3), batteries being remanufactured or repurposed (R in chapter 5.4) and the import and export of used batteries (Import/ Export in

[1] WG, AfC and not-AfC principally consider the total values. However, the final results for total AfC and not-AfC need to take into account all CFs as well as all groups of portable (P1/P2) or LMT (LMT 1-4) batteries.

chapter 5.5). The results of the AfC methodology, including scenario calculations and calculation of collection rates, are discussed in chapter 7.

This chapter further below introduces two different, concretely defined alternatives as possible AfC implementation options:

- AfC option 1 – basic methodology in sub-chapter 3.1.1 and
- AfC option 2 – detailed advanced methodology in sub-chapter 3.1.2.

In the subsequent chapters where the detailed calculation of the AfC methodology steps is described, the suggestions for and the differences between AfC option 1 and AfC option 2 are explained.

3.1.1. AfC option 1 – basic methodology

AfC option 1 offers a basic methodology with a calculation method that is as simple as possible and, as a result, achieving the highest possible practicality in its application by the Member States. AfC option 1 shall also ensure the highest possible data comparability between national results and, at the same time, the best possible results transparency.

In order to achieve these goals, AfC option 1 implements the methodological approach in Figure 1 more or less directly, without any major deviations. In particular, countries are not expected to perform any additional calculations; rather, further simplifications will be introduced. Following characteristic apply:

- Use of default values (historic AOM, lifetimes, CF) provided by the Commission.
- No deviation from DV is possible (exemption: CF of repurposed LMT batteries).
- DV cannot be changed by MS.
- No differentiation into battery groups P1 and P2 for portable batteries and LMT 1 to 4 for LMT batteries. Therefore, the shares of the battery groups will already be incorporated in the default values (lifetimes and historic AOM data).[2]
- Historic country-specific AOM data for LMT batteries without differentiation into LMT 1 to 4.

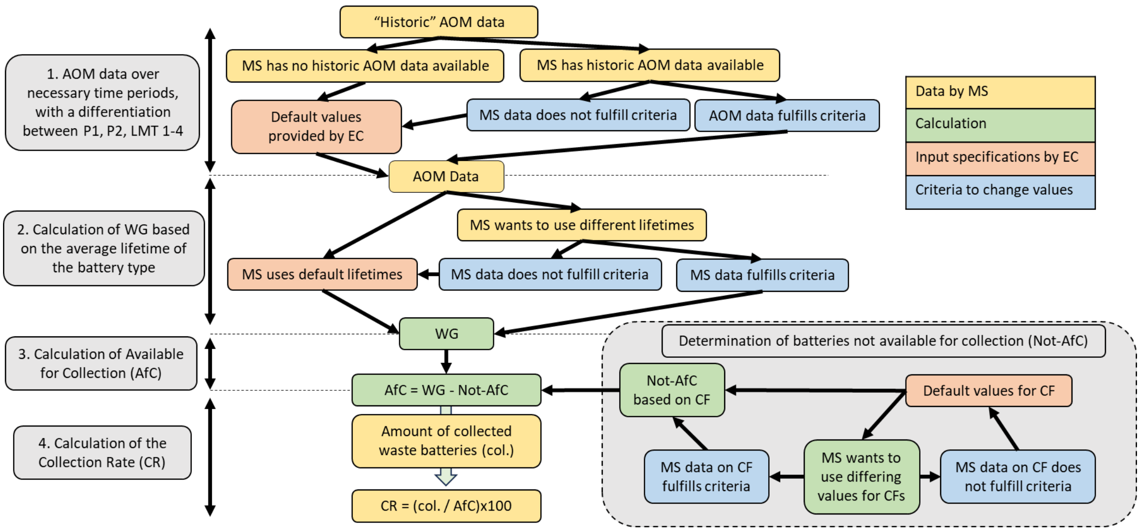
[2] One stakeholder also favours this approach.

3.1.2. AfC option 2 – detailed advanced methodology

'AfC option 2 – detailed advanced methodology' aims to create the best possible model of the reality of battery flows. This inevitably results in a very detailed approach. At the same time, the AfC option 2 is also intended to allow Member States to apply the method flexibly. This means that, where MS have their own specific information and data available, AfC option 2 can be used. Otherwise, the general approach will be used.

Figure 2 represents an overview of the process flow of 'AfC option 2 – detailed advanced methodology'. The process flow is based on the general approach in Figure 1. However, AfC option 2 is a more developed method from the general approach; the process steps of the general approach are calculated in much greater detail.

Figure 2 – Process flow chart of AfC option 2



Source: own diagram (Oeko-Institut)

The following characteristics apply for AfC option 2:

- Use of default values (historic AOM, lifetimes, CF) provided by the Commission.
- Deviation from DV is possible; however, for part of the CF only up to defined maximum values.
- Member States can individually decide where to deviate from DV.
- A possible deviation from the DV requires the fulfilment of certain criteria. Otherwise, a deviation will not be accepted and DV apply.
- Differentiation into battery groups P1 and P2 for portable batteries and LMT 1 to 4 for LMT batteries.

3.2. Data basis for AfC methodology

Changes or amendments to legislation as well as changes to the methodology to determine the collection rate create the need for additional data. The introduction of new battery categories (LMT) and consideration of longer average battery lifetimes require 'historical' available-on-the-market (AOM) data that does not exist. Furthermore, not-AfC is based on complimentary flows (CF) that did not need to be tracked so far.

To enable the calculation of a collection rate, default values (DV) will be provided to estimate historical AOM data and CF for Member States (MS). As one of the possibilities considered, DV can be changed to account for local conditions in MS, but only if certain criteria are fulfilled.

Overall, the implementation of the AfC method requires the following additional data compared to the current AOM calculation:

- battery lifetimes,
- shares of portable and LMT battery subgroups,
- historic AOM data,
- WG and AfC data (can be calculated from the other data),
- CF data not-AfC (DV, potential deviation from DV and maximum values for deviation),
- and all data needs to be differentiated into portable and LMT batteries.

(Regulation (EU) 2023/1542, 2024, Annex XI)

4. Calculation of AfC

4.1. Calculation of waste generated (WG)

Fundamental to changes in the AfC methodology is the calculation of the collection rate based on the estimated waste generated (WG) in that year. WG is based on the batteries made available on the market (AOM) in the past and considers longer realistic average battery lifetimes. It aims to estimate a realistic total amount of waste batteries that have amassed in the reference year based on an average battery lifetime.

A change to the parameter WG has become necessary due to the dynamic market development and the increased average lifetimes of rechargeable batteries in comparison to non-rechargeable batteries for both portable batteries and LMT batteries. In particular, LMT is a newly established battery category in the Batteries Regulation consisting of rechargeable batteries with a strong market increase.

WG is calculated from historic AOM data. The average lifetime of the battery is subtracted from the reference year (Y) to determine the relevant AOM years (X) for the calculation of WG, as depicted in Figure 3. The consultant suggests using the AOM data from a three-year timespan to calculate an ‘average’ WG:

$$WG_Y = \frac{AOM_{X-1} + AOM_X + AOM_{X+1}}{3}$$

Where:

X = Y – average lifetime; the year batteries were made available on the market (AOM)

Y: Reference year

WG_Y: Waste Generated in reference year Y

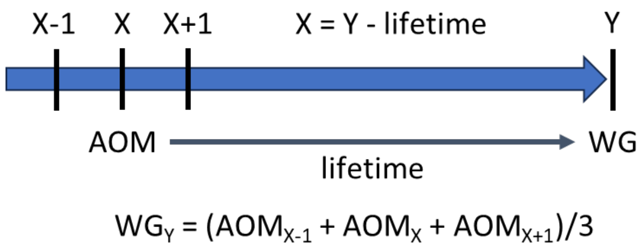
A three-year timespan seems sufficiently accurate to reflect the market development and account for statistical fluctuations while also not making the calculation unnecessarily complicated. The benefits of using a longer timespan (e.g. 5 years) or a different calculation method based on a statistical distribution (e.g. Weibull) do not outweigh the increased complexity. It also offers some form of continuity, as the current approach of calculating the collection rate is also based on a three-year timespan. This approach has also been discussed favourably in JRC’s report (Bobba et al., 2024). Furthermore, stakeholder feedback also encouraged this approach, as it is both relatively simple and a sufficiently accurate reflection of reality.

Figure 3 – Schematic for the calculation of waste generated based on average battery lifetime

Y: Reference year

WG_Y: Waste Generated in reference year Y

X: Years batteries were made available on the market (AOM)



Source: Own diagram (Oeko-Institut)

4.2. Average battery lifetimes

4.2.1. Default values (DV) for average lifetimes

As described in previous chapters, longer average battery lifetimes for both portable and LMT batteries are a fundamental aspect for the envisaged methodological change. Inclusion of the average lifetime parameter is necessary due to the dynamic market development and the significantly longer average lifetimes of rechargeable batteries in comparison to non-rechargeable batteries. Realistic average battery lifetimes are therefore needed to calculate WG. Depending on the AfC options 1 and 2 different average lifetime values will be required.

Hoarding of batteries can significantly influence the time between when a product is sold and when it is brought for recycling and becomes waste. For batteries, this could mean that an old laptop or e-bike battery is kept—even if it is not used anymore and regardless of whether it still works—and is not handed over to waste collection. While battery hoarding is common for numerous reasons, the data on it is very limited and it is often indistinguishable from the actual lifetime of the battery. This hoarding time can be seen as extending the use-phase of the product.

Concerning the uncertainty and lack **of data available**, JRC stated in their report from 2024 regarding hoarding related to small IT equipment:

> This consumer behaviour results in an extended lifetime of batteries that is not only difficult to quantify, but also highly dependent on the geographical boundaries of the study (e.g. the considered Member State),[…]

> Based on the developed work, the data on the volume of hoarded batteries is currently lacking and intrinsically difficult to obtain. Moreover, lifetime values include by definition a certain hoarding of the batteries, which is considered as part of the batteries' life-cycle.
>
> (Bobba et al., 2024)

Based on the JRC's reports and the consultant's own evaluation, it is impractical to consider hoarding separately from the average lifetime of batteries, as hoarding and lifetime are hardly distinguishable. The limited stakeholder feedback was also mixed. A stakeholder claimed that considering hoarding separately was impractical

and complicated. Two stakeholders argued that the average lifetime and hoarding should be considered separately to account for changes in technology (average lifetime) without changes in behaviour (hoarding). No stakeholder was able to provide any data on hoarding time or a way to distinguish average lifetime from hoarding. One stakeholder mentioned that hoarding is underestimated in recent lifetime studies and plays a larger role. In addition, a stakeholder stated that for certain commercial applications battery hoarding is not an issue, as they are confronted with large quantities of batteries and thus hoarding very quickly becomes an issue with regards to available storage. Even if considerable hoarding time may occur, it should not be overestimated and certainly not encouraged, as stated by two stakeholders.

From a security perspective, it is crucial to limit and reduce hoarding, as old batteries stored in households pose a fire hazard. The objective should therefore be to reduce hoarding time as much as possible and not accept it as something that cannot be influenced. Ongoing and future studies might provide new information and data on hoarding that could lead to changes in the average battery lifetime that includes hoarding. Overall, the consultant suggests that the average lifetime already include hoarding time.

Following stakeholder input, two potential options were rejected (see Table 7): 1. hoarding is included in the average lifetime of the battery, but the average lifetimes set as default values are increased; and 2. hoarding is considered separately and added to the average lifetime.

The average lifetimes suggested below already include some hoarding time and are based on the JRC reports (Bobba et al., 2024; Huisman & Bobba, 2021). They include no separate additional hoarding times. In their 2024 report, JRC suggested a hoarding time of 2 years for P1, 3 years for P2 and 1 year for all LMT batteries as a minimum (Bobba et al., 2024). Two Stakeholders suggested that hoarding times need to be longer for LMT, with 2 years for portable (P1 and P2) and 3 years for LMT batteries.

For batteries that have been remanufactured or repurposed, the same average lifetimes are supposed since there is no data available to set a different value.

This was supported by one stakeholder, which stated that it is an acceptable approximation given the probably small volume of remanufactured or repurposed batteries made AOM.

Stakeholders were critical of the proposed **battery subgroups** having different average lifetimes. Some stakeholders suggested having fewer subgroups (P1, P2, one LMT for e-bikes and one LMT for all other LMT batteries). Many stakeholders were against the subgroups altogether, as it would be more in line with the data, they have collected based on the old Battery Directive as well as being less complex. One stakeholder stated that applications of the subgroups LMT 2 and 3 use the same batteries with similar average lifetimes making the two subgroups redundant.

For AfC option 1, the calculation of WG does not include a differentiation into subgroups P1, P2 and LMT 1 to 4. Consequently, only one average lifetime is required for each category, i.e. for portable and for LMT batteries. Therefore, one combined average lifetime is calculated as a default value for each case under AfC option 1. The results are presented in Table 5, last column. The DV are based on the average lifetimes of each battery group from the JRC report (Bobba et al., 2024) (fourth column of Table 5) and the shares of P1 and P2 (see chapter 4.3) for LMT 1 to 4 (see chapter 4.4) of the year 2022. The shares are based on the year 2022 where the most reliable data is available[3]. The resulting DV are also in accordance with values from one stakeholder. No deviation from these default values is allowed under AfC option 1.

Table 5 – Default values for average lifetime of portable and LMT batteries

Category	Group	Application	AfC option 2: DV average lifetimes from JRC 2024 report [years]	Share of groups in %	AfC option 1: DV average lifetimes* [years]
Portable batteries	P1	Non-rechargable batteries	4	65%	6
	P2	Rechargable batteries	9	35%	
LMT batteries	LMT1	E-moped & e-motorcycle batteries	5	6%	8
	LMT2	E-cycle batteries	10	68%	
	LMT3	E-kickscooters batteries	2	23%	
	LMT4	Other LMT batteries	3	2%	

** rounded*

[3] Share from P1 and P2 are actually from 2020, confirmed by additional data of 2022 from other countries.

Source: Calculation by Oeko-Institut, based on JRC's report (Bobba et al., 2024)

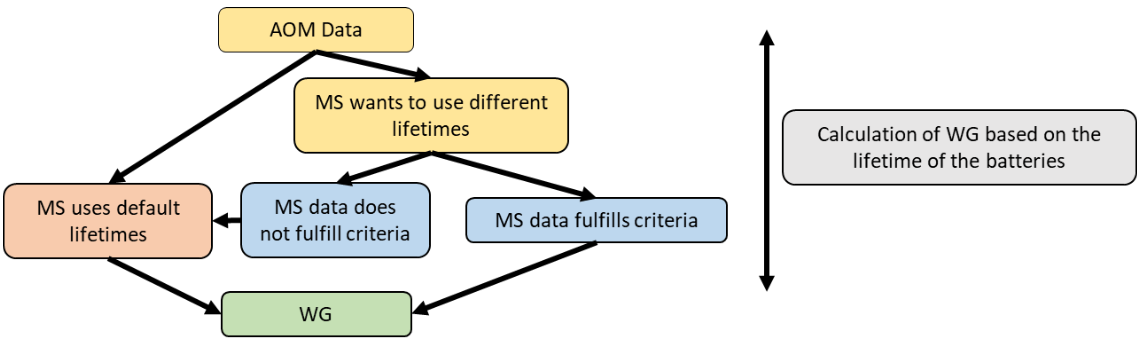
For AfC option 2, average lifetimes are proposed independently and separately for all subgroups of portable and LMT batteries and defined as default values. This means the two average lifetimes for P1 and P2 and the four average lifetimes for LMT 1 to 4 are be needed to calculate WG for portable and LMT batteries. Using the specific DV average lifetimes for each battery group generates a more accurate calculation of WG. The suggested average lifetimes DV as adopted from the JRC's 2024 report are presented in the fourth column of Table 5. In AfC option 2, MS may deviate from the given default values, but only if certain criteria are fulfilled; see the next sub-chapter.

The DV average lifetimes under AfC option 1 and 2 do not vary over the years. The DV also include hoarding time without adding an additional number of years.

4.2.2. Deviation from DV and maximum value of deviation

Generally, AfC option 1 does not allow any deviation from the DV. In contrast, AfC option 2 allows for MS to deviate from the given default values for the average battery lifetimes to reflect the situation in their own country, however, only if certain criteria are fulfilled. Figure 4 schematically summarises how the WG is determined based on average battery lifetimes and possible deviations from given default values in case data fulfils certain criteria. This deviation from DV would be on the level of the total average lifetime that includes hoarding. Average lifetime and hoarding are not individually adaptable.

Figure 4 – Schematic overview of the determination of WG based on the average battery lifetimes and possible deviations from given default values



Source: Own diagram (Oeko-Institut)

Using AfC option 2, MS can adapt the average lifetimes of batteries they use to calculate WG only under certain conditions and criteria. The following **criteria for deviation from the average lifetime DV** would apply:

1. Average lifetimes shall be modified per battery subgroup (P1, P2 and LMT 1 to 4).

2. The average lifetime can only be changed within a certain range to avoid abrupt methodological changes and ease the comparability of results between MS (maximum values apply).
3. Different average lifetimes can only be applied once every five years.
4. Options for deviation from DV apply to the average lifetimes that include hoarding.
5. Changes in the average lifetime need to be justified and properly documented (e.g. granularity, representativeness, transparency).

The degree by which the average battery lifetime could be changed shall be limited by a maximum value for the deviation. Other options presented at the first stakeholder meeting in September 2025, e.g. not to allow any deviations from DV or not to limit a potential deviation, were rejected; see Table . The primary reasons are that future or ongoing studies might provide new information and data on average lifetimes and hoarding and to avoid abrupt changes and ease the comparability of results between Member States.

The **maximum value of deviation** shall be based on a certain percentage of the original average battery lifetime (i.e. the average lifetime DV), an approach also suggested in JRC's report (Bobba et al., 2024). However, stakeholder feedback was mixed. One stakeholder was in favour of using the minimum, medium and maximum values of the average lifetimes from the scenario calculations in JRC's 2024 study as a basis for deviation (Bobba et al., 2024). Another stakeholder was in favour of using 25 % as a maximum value for deviation, while yet another stakeholder suggested individual deviations for individual OEMs to encourage technological advancements with regards to average battery lifetime. The consultant proposes allowing a maximum DV deviation of +/- 25%. The maximum lifetimes in which the average could be changed would then be calculated in the following way:

$$lifetime_{max/min} = \frac{(100 \pm 25)}{100} \times lifetime_{av}$$

Table 6 summarises the resulting average lifetimes when different percentage deviations are applied. The results for the proposed maximum deviation of +/- 25% are presented in the highlighted column '25%'. The calculation is based on the DV of the average lifetimes ($lifetime_{av}$) under AfC option 2 in Table 5, fourth column.

Table 6 – Maximum deviation from DV of lifetimes

Source: Own diagram (Oeko-Institut)

Battery group	DV of average lifetime (years)	Updated lifetime by x%					
		10%	20%	25%	30%	40%	50%
P1	4	4.4	4.8	5	5.2	5.6	6
P2	9	9.9	10.8	11.25	11.7	12.6	13.5
LMT1	5	5.5	6	6.25	6.5	7	7.5
LMT2	10	11	12	12.5	12	14	15
LMT3	2	2.2	2.4	2.5	2.6	2.8	3
LMT4	3	3.3	3.6	3.75	3.9	4.2	4.5

The alternative option was rejected that allowed deviation from the default value for the average lifetime, which was based on the low / medium / high scenarios of the 2024 JRC report (Bobba et al., 2024, Annex I, p. 82) and was also introduced at the first stakeholder workshop in September 2025. The approach based on a percentage seems simpler, more consistent and would not limit further changes in the future.

Table 7 summarises the various options introduced at the first stakeholder workshop in September 2025 for considering the hoarding time directly in the DV for a battery's average lifetime, for deviation from the DV lifetimes and for maximum values of deviation.

Table 7 – Initial options for hoarding, deviation from DV average lifetime and maximum values for deviation from DV

Topic	Options
Options for considering the hoarding time in the DV of average battery lifetime:	**Option 1: Hoarding is already included in the average lifetime of the battery and not added or considered separately (e.g. P1: DV = 4 years)** Option 2: Hoarding is included in the average lifetime of the battery, but the average lifetimes set as default values are increased (e.g. P1: DV = (4+1) = 5 years) Option 3: Hoarding is considered separately and added to the average lifetime; separate hoarding times need to be defined (e.g. P1: DV = 4 years + additional hoarding time of e.g. 2 years)
Options for deviation from the DV average lifetime	Option a) MS cannot change the average lifetime **Option b) MS can change the average lifetime inside a certain range if justified** Option c) MS can change the average lifetime if justified
Maximum values for deviation from DV lifetimes	**Option 1: deviation from DV maximum value X = 25 %: $\text{lifetime}_{max/min} = 1 \pm X\,\% * \text{lifetime}_{av}$** Option 2: Maximum values for deviation from DV lifetimes are based on the low / medium / high scenarios of (Bobba et al., 2024, Annex I, p. 82)

Options in **bold letters** are selected.

Source: Own diagram (Oeko-Institut)

4.3. Portable batteries – historic AOM data for P1 and P2

4.3.1. AOM of portable batteries

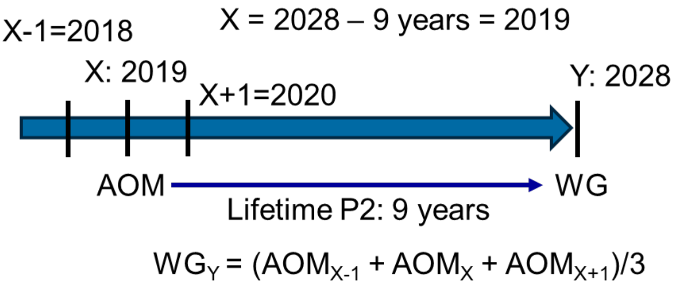
Member State reporting to the Commission under Article 76 of the Batteries Regulation is planned to begin for data about reference year 2026, which is to be reported in 2028. Changing to a new AfC methodology would require calculating the amount of waste batteries generated (WG) and would create the need for additional data requirements. Under AfC option 2, calculating WG including the optional introduction of new battery subgroups for non-rechargeable (P1) and non-rechargeable (P2) portable batteries with individual average lifetimes would demand 'historical' data for portable batteries made available on the market (AOM) differentiated into P1 and P2. Furthermore, the adapted definition of portable batteries from the Batteries Regulation, with the battery weight set as 5 kg or less (Regulation (EU) 2023/1542, 2024 Article 3, paragraph 2, point 9), would have to be considered.

Data on portable batteries differentiated into the subgroups non-rechargeable (P1) and rechargeable (P2) is not mandatorily reported or collected. Likewise, the collection target set in the Batteries Regulation encompasses all portable batteries and does not differentiate between P1 and P2 (Regulation (EU) 2023/1542, 2024). As P1 and P2 data is not mandatory and not available at the EU level, the AfC methodology requires developing such data: P1 and P2 for portable batteries made available on the market (AOM), and their average lifetimes (see chapter 4.2 for average lifetimes). Therefore, default values for AOM data differentiated into P1 and P2 would need to be determined. Member States could use this AOM data based on P1 and P2 and the average lifetimes to calculate WG.

Figure 5 demonstrates the 'historical' AOM data needed to calculate WG for the example of rechargeable (P2) portable batteries with an assumed average lifetime of 9 years for the reference year Y = 2028. When using the average AOM from three years as the basis for WG, this would mean AOM data from the years 2018, 2019 and 2020 would be needed to calculate WG in reference year 2028.

Figure 5 – Calculation of WG based on the average lifetime and AOM data from three years

Y: Reference year
WG_Y: Waste Generated in reference year Y
X: Years batteries were made available on the market (AOM)

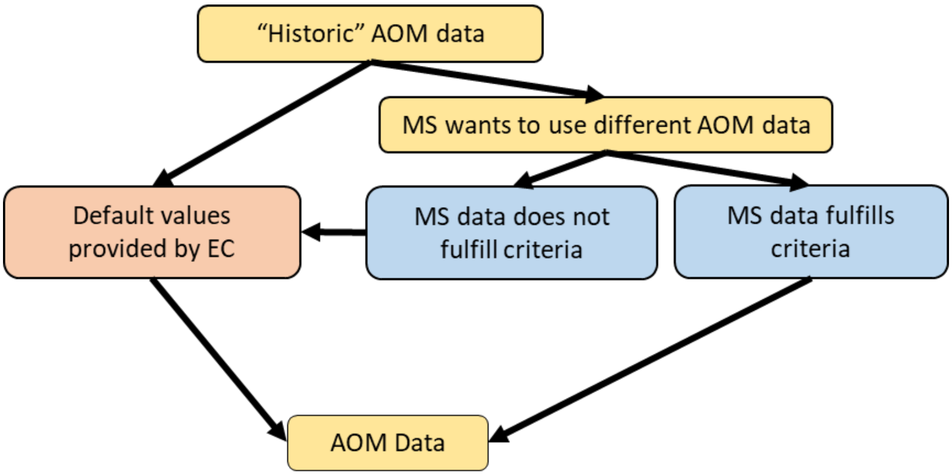


Source: Own diagram (Oeko-Institut)

Thus, Member States would use the P1 and P2 default values (DV) to calculate their historic AOM data and subsequently their WG data. MS would also have the possibility to deviate from those default values and use their own AOM differentiated into P1 and P2, if available. However, they could do so only if certain criteria are fulfilled, see sub-chapter 4.3.3. P1 and P2 default values actually means the P1 and P2 shares of the total portable batteries. The shares could be used to calculate AOM data differentiated into non-rechargeable and rechargeable portable batteries. AOM data differentiated into P1 and P2 is only required for AfC option 2. AfC option 1 does not include such a differentiation and is based only on total portable batteries.

Figure 6 schematically summarises the process for how historic AOM data could be generated. If an MS wanted to use its own available data and this data fulfilled certain criteria (see sub-chapter 4.3.3), it could use the AOM data as shown in Figure 6. In cases when the default value should be used, either because the MS does not have its own AOM data or the data does not fulfil the criteria, AOM data would be determined using default values.

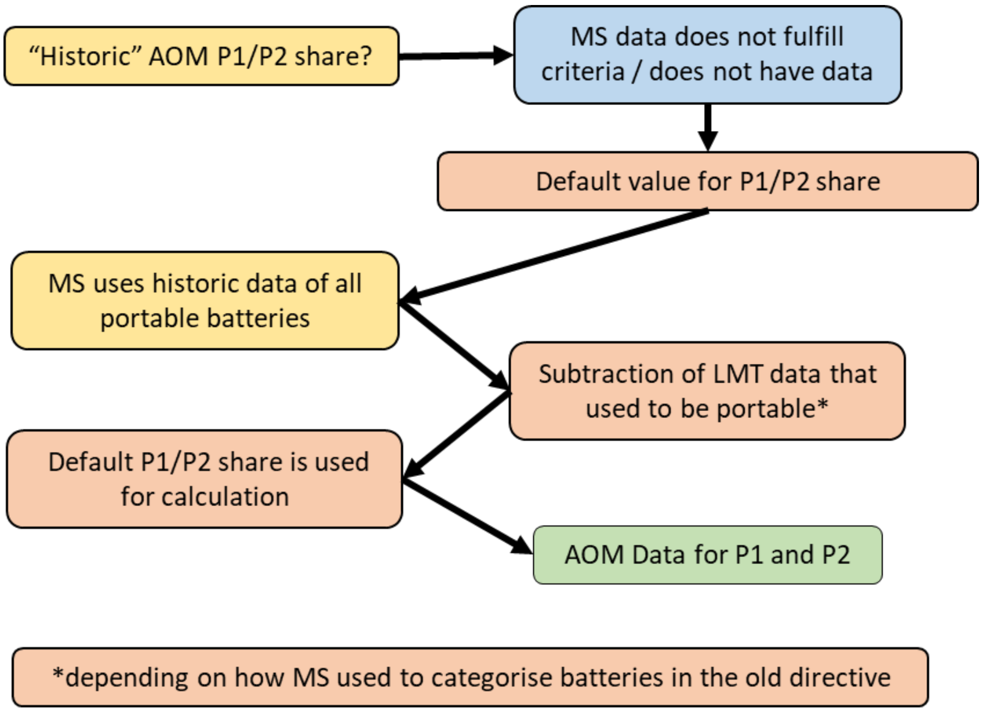
Figure 6 – General development of AOM data



Source: Own diagram (Oeko-Institut)

Figure 7 schematically shows the process steps that apply if an MS uses the default values to generate AOM data differentiated into P1 and P2. It is not a decision tree but rather steps in a process to determine AOM data for P1 and P2. The calculation would be based on the AOM data for all portable batteries by that MS. The calculation also considers the possibility that an MS has included AOM data on LMT batteries in the historic AOM data. The Batteries Regulation requires separate reporting for LMT batteries for the first time in reference year 2026, which is to be reported in 2028 (Regulation (EU) 2023/1542, 2024). Older historic portable-battery data, however, could include some LMT batteries depending on the MS's practices. Therefore, relevant LMT batteries should be deducted from portable batteries AOM at the MS level if LMT batteries were categorized as portable and not industrial batteries (before 2026). After that, using a default value for the share of P1 and P2 portable batteries, historic AOM data separated by P1 and P2 could be calculated.

Figure 7 – Process steps to generate historic AOM data based on P1 and P2 shares



Source: Own diagram (Oeko-Institut)

4.3.2. P1 and P2 market overview of chosen countries 2011-2022

Although there is no AOM data on non-rechargeable and rechargeable portable batteries available at the EU level, there are some MS and PROs that collect data on portable batteries differentiated by P1 and P2 or differentiated by chemistry which would allow for a categorization into non-rechargeable and rechargeable batteries. As not all of these organisations publish their data in with such a detailed breakdown, it is unclear how many MS would have such AOM data differentiated into P1 and P2. It is therefore necessary to develop representative default values for the shares of P1 and P2 batteries that MS could use to calculate their 'historical' AOM data for P1 and P2.

Figure 8 differentiates AOM data on portable batteries from several MS (Germany, France, Spain and Sweden) by chemistry, which allows categorization into P1 and P2. The data is based on exemplary battery technology AOM market shares from 2011-2022 from various national collection schemes (success control reports such as by GRS, Ademe, El-Kretsen, etc.).

Figure 8 – AOM data on portable batteries differentiated by chemistry

Data from Germany, France, Spain and Sweden for the years 2011 – 2020

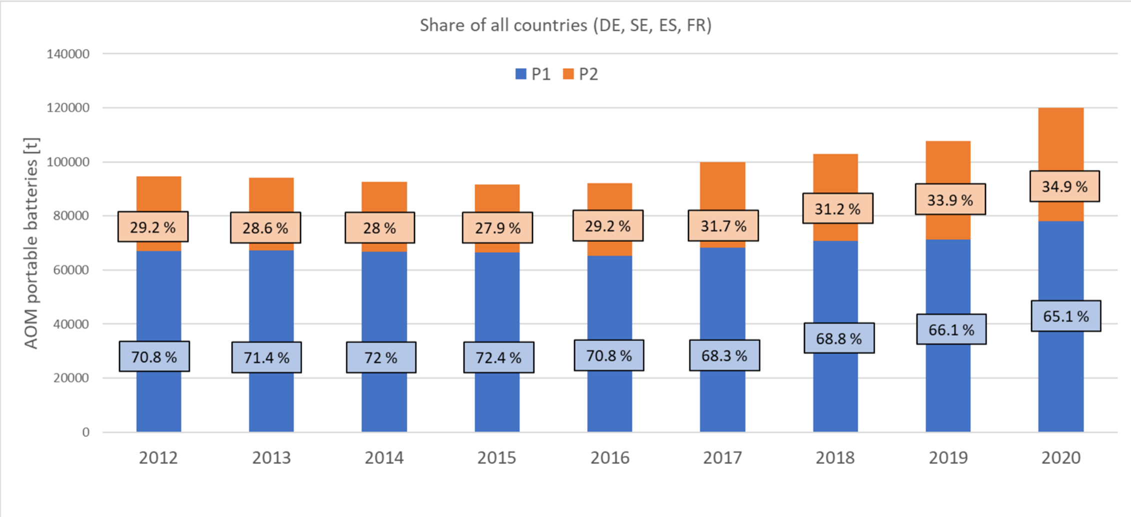
In % of total portable batteries AOM

Source: Fraunhofer IZM based on success control reports from GRS, Ademe, El-Kretsen, etc.

Figure 9 aggregates the data from Figure 8 for all countries and subgroups P1 and P2 from 2012-2020. The figure shows both the total amount AOM in tonnes as well as the shares between P1 and P2. The overall tonnes of portable batteries made available on the market (AOM) increased through 2020, especially from 2016 to 2020. At the same time, the shares of P2 increased from below 30 % in 2012 to about 35 % in 2020.

Figure 9 – Portable batteries made available on the market (AOM)

Amount of portable batteries AOM in DE, SE, ES and FR in tonnes and P1 and P2 shares from 2012 till 2020

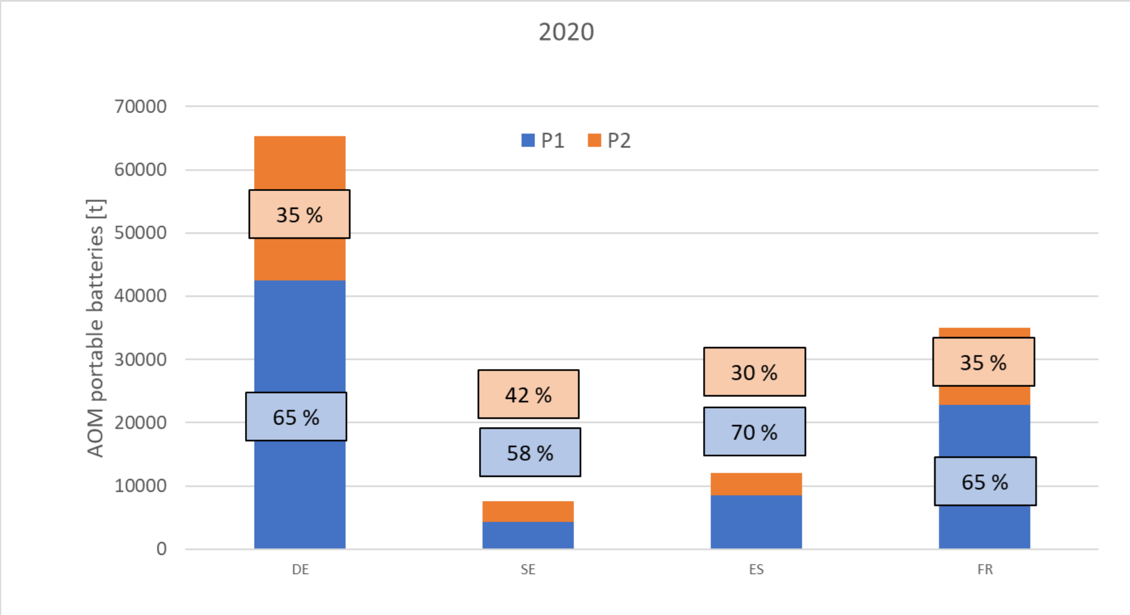


Source: Fraunhofer IZM

To get a better understanding of the variations in the shares between different countries, Figure 10 shows the total amount AOM in tonnes as well as the share between P1 and P2 in Germany, France, Spain and Sweden for the year 2020. Germany and France have the same P1 / P2 share of 65 % / 35 %, which is also similar to the average shown in Figure 9 (2020). In Spain the share of non-rechargeable portable batteries (P1) is higher (70 %). In Sweden the portion of rechargeable portable batteries is higher, with a P1 / P2 share of 58 % / 42 %. As expected, slight variations in the shares exist between MS. Nevertheless, a representative share for the EU level of 65 % P1 and 35 % P2 could be determined.

Figure 10 – Total amount AOM of portable batteries and P1 and P2 shares in Germany, France, Spain and Sweden

Year 2020



Source: Own data compilation is based on exemplary battery technology AOM market shares from various national collection schemes

4.3.3. AfC option 2: P1 and P2 default values, deviation from DV and maximum values

As already explained further above, AOM data differentiated into P1 and P2 is only required for AfC option 2. AfC option 1 does not require such a differentiation and is based on the total portable batteries with an average lifetime of 6 years that already includes the P1 and P2 shares; see Table 5.

Under AfC option 2, default values (DV) for the shares between non-rechargeable (P1) and rechargeable (P2) portable batteries are given in %. The shares encompass a sufficiently long timeseries to calculate WG based on the longer average lifetimes of P2 (9 years). Furthermore, the share of rechargeable portable batteries (P2) increases steadily over time to reflect market developments. The DV for the P1 and P2 shares apply equally for all Member States. Future P1 and P2 shares were also determined and are based on the consultant’s assumption of a P2 growth rate. The share of P2 batteries is assumed to grow initially by 2% per year in 2025. Over the years, it is assumed that the grow rate of the P2 share declines and reches 1.5% in 2040. An alternative approach, as mentioned in the JRC report (Bobba et al., 2024), that would keep the share of rechargeable portable batteries constant in future years was not considered very likely and was therefore rejected. In Table 8 the suggested default values for the P1 and P2 shares of portable batteries are shown starting from 2015 up to 2035.

Table 8 – Default values for P1 and P2 shares of portable batteries

First reference year in 2028

	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2025
% P1	70	69	68	67	66	65	64.3	63.5	62.8	62	61.3	60.5	59.8	59	58.3	57.5	56.8	56	55.3	54.5	53.8
% P2	30	31	32	33	34	35	35.8	36.5	37.3	38	38.8	39.5	40.3	41	41.8	42.5	43.3	44	44.8	45.5	46.3

Source: Own diagram (Oeko-Institut)

Under AfC option 2, MS may replace the P1 and P2 default values only if certain criteria are met. There are two possibilities when MS are allowed to deviate from the P1 and P2 default values and use their own country-specific data. The first possibility is:

- Data submitted to MS authorities by PRO; e.g. data that is included in success control reports of battery collection schemes or data that is provided when producers register their portable batteries made available on the market.

The second possibility for deviation from the DV is only accepted when the first possibility does not apply:

- Data from (national) battery associations / official market surveys, however, only if scope of data is identical and scope and origin of data is described.

No other data sources apart from the two possibilities above will be allowed for deviation from the historic as well as the future P1 and P2 default values. MS can replace the historic P1 and P2 default values only once with its own country-specific data. Apart from these criteria above, the general criteria for deviation from DV in chapter 6.2 apply.

Furthermore, country-specific P1 and P2 DV can only be changed by a certain degree to avoid abrupt changes and ease the comparability of results between MS. Therefore, a **maximum value for deviation from DV** applies: MS own historic data may not vary more than **± 10% from DV** in AfC option 2.

4.4. Light Means of Transport (LMT) batteries – historic AOM data for LMT 1-4

4.4.1. Historic AOM data of LMT batteries

Generally, the AfC methodology requires AOM data of LMT batteries for calculating WG. The year from which AOM data must be available depends on the specific DV lifetime of the battery in the respective LMT group 1 to 4. If, for example, data from reference year 2028 is reported, it would mean that, for example, for LMT Group 1, which is assumed to have an average battery lifetime of 5 years, historic AOM data for 5 years prior to the reference year, i.e. for 2023, is required. However, since a 3-year average for AOM is chosen as a model for the AOM data (see sub-chapter 4.1), not only is AOM data required for 2023, but also for the year before and after, i.e. for 2022 and 2024.

Thus, depending on the DV average lifetime of the LMT group 1-4 (see Table in chapter 4.2), the first years of historic AOM data that are required (i.e. the first year for calculating the 3-year average of AOM when based on the example of reference year 2028) would be:

- LMT 1: reference year 2022 (ref. year 2028 – 5 years – 1 year)[4]
- LMT 2: reference year 2017 (ref. year 2028 – 10 years – 1 year)
- LMT 3: reference year 2025 (ref. year 2028 – 2 years – 1 year)
- LMT 4: reference year 2023 (ref. year 2028 – 3 years – 1 year).

JRC AOM data for EU27 separated into LMT groups 1-4 is available starting with reference year 2020 data (Bobba et al., 2024). Thus, additional historic AOM LMT group 2 data would be needed for the years 2017 to 2019, since JRC data only starts in 2020. Furthermore, all LMT group 1-4 data must be country-specific, as LMT data varies largely between countries.

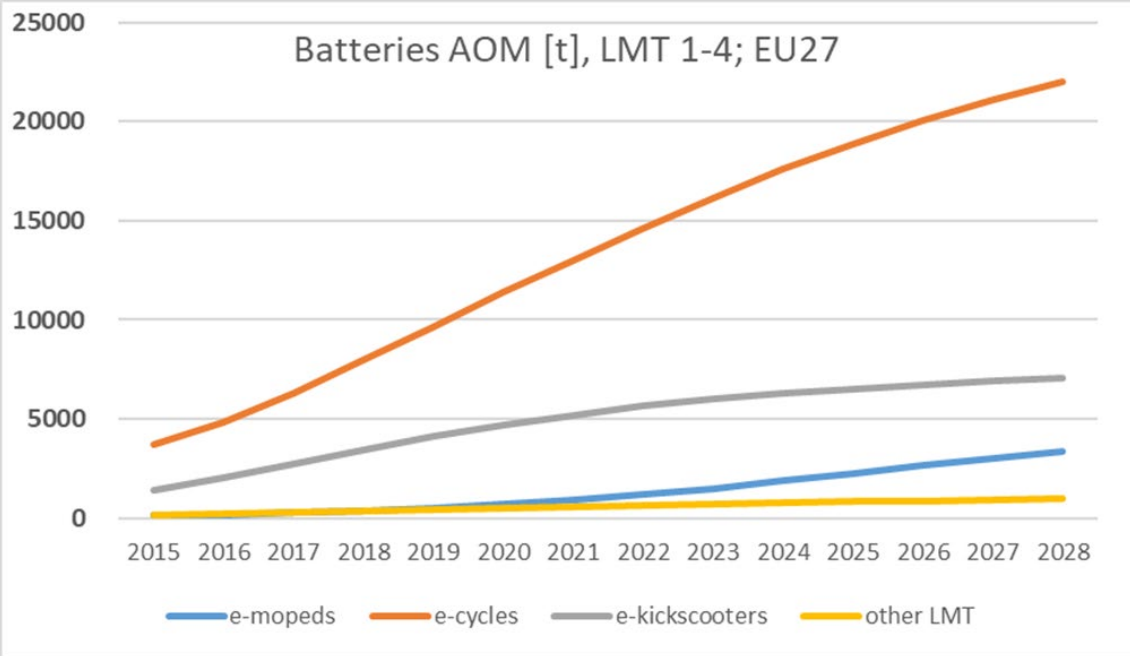
Overall, this means that historical AOM data for LMT 1-4 would be required separately for each Member State, starting with the reference year 2017 (for LMT 2). MS may collect their own AOM data for each LMT group 1-4 beginning with, for example, the reference year 2028.

4.4.2. Calculation of default values (DV)

The calculation of historic AOM data for LMT group 1 to 4 on the level of EU27 is based on JRC data (Bobba et al., 2024) and differentiates between each of the LMT groups 1-4; see Figure 11. Total LMT AOM data for the EU27 (sum of all four LMT subgroups 1 to 4 in tonnes) starting from reference year 2015 and projected to 2040 is provided in Annex Table 28. As can be seen from Figure 11, further country shares to calculate historic AOM data specific to each individual MS and going back to the year 2015 are needed.

[4] Reference year is 2028; minus battery lifetime of 5 years; minus 1 to begin the 3-year average calculation.

Figure 11 – Batteries AOM for EU27 (in t of batteries); differentiation between LMT 1-4, 2015 to 2028



Source: own diagram (Fraunhofer IZM)

To estimate the values on a national level, country shares for the different LMT groups 1 to 4 are applied. For e-bikes, CONEBI (the Confederation of the European Bicycle Industry) provides the number of units POM from 2008-2021 on a national level, which allows the share of each country to be calculated. For e-mopeds, another stakeholder provides the number of units POM from 2010 to 2021 on a national level. These values again lead to calculating the share from each country. The country shares can then be used to calculate national AOM values in mass (tonnes of batteries). Furthermore, Eurostat provides national AOM data on motorcycles and mopeds with engines other than with petroleum products in number of units. As the ACEM data is more accurate, it is used. (Confederation of the European Bicycle Industry, 2016, 2017, 2018, 2019, 2020, 2021)

To estimate the national share of e-scooters, Statista provides the number of users of shared e-scooters on a national level for the years 2017-2021 with predictions until 2028 (Statistica Market Insights, 2024). Furthermore, THOR AVAS market research provides data on the percentage of users for personal e-scooters and users for shared e-scooters (THOR AVAS, 2022). To calculate the share back to 2010, personal and shared data are summed up and calculated back to 2010 using growth assumptions from 50% to 80%. With this information, a national share for EU Member States can be assumed in order to calculate national historic AOM values. The Eurostat figures do not provide a share for e-scooters for Luxembourg, hence the share of e-scooters from Belgium personal scooters were taken instead. It should also be mentioned that the amount of e-scooters may vary nationally in the future due to their popularity or their prohibition in single countries or cities. As no data exists for small personal light electric vehicles (PLEVs), the EU country share of e-bikes was taken.

Further details on the calculation and the concrete data for each MS are provided in the annexed tables in chapter 0. Annex Table 29 gives the country-specific share (%) of the total LMT batteries for each Member State, while Annex Table 30 presents the country-specific shares (%) of all four LMT groups 1, 2, 3 and 4 separately for each MS. Based on the data from Annex Table 28, Annex Table 29, and Annex Table 30, the **historic country-specific AOM data differentiated into LMT 1-4 (in tonnes) can be calculated as default values (DV) for the 'AfC option 2 – detailed advanced methodology'** for the reference years up to 2028. No values according to Annex Table 29 and Annex Table 30 are available for the years after 2028. For the sake of simplicity, it is therefore proposed to use the same shares of Annex Table 29 and Annex Table 30 for the reference year 2028 also for all years from 2029 onwards without any changes to 2028 values.

It is possible that MS collect their own AOM data differentiated into LMT 1-4 beginning with reference year 2028. However, should no specific data become available in the MS that is differentiated into LMT 1-4 but instead only total LMT AOM data (in tonnes), MS shall use the country-specific shares of LMT groups 1-4 provided in Annex Table 30. The country-specific shares (%) of LMT 1, 2, 3 and 4 for reference year 2028 (the value of 2028 is used as an approximation for all years from 2029 onwards) represent the **default values for 'AfC option 2 – detailed advanced methodology'** for the year 2028 up to 2040.

AfC option 1 – basic methodology

As already indicated in sub-chapter 3.1.1 further simplification is foreseen for 'AfC option 1 – basic methodology'. Default values for historic country-specific AOM data for LMT batteries are provided without differentiation into LMT 1 to 4. Therefore, the country-specific share (%) of the total LMT batteries for each Member State in Annex Table 29 are used and multiplied by the total LMT AOM data for the EU27 (in tonnes) in Annex Table 28. The results of this multiplication not further differentiated into LMT 1 to 4 are used as default values (DV) for historic country-specific AOM data of AfC option 1. AfC option 1 does not allow any deviation from the default values.

Furthermore, total country-specific LMT AOM data[5] shall be used for future years up to 2040 without differentiation into LMT 1 to 4 in the case of 'AfC option 1 – basic methodology'.

[5] It is assumed that total AOM data will have to be reported by the Member States to the Commission anyway.

4.4.3. AfC option 2: deviation from historic country-specific LMT AOM DV

In the previous sub-chapters, the use of historic country-specific AOM data differentiated into LMT groups 1-4 was derived as the default values (DV). These DV are required to be able to apply AfC option 1. In AfC option 2, however, MS may replace these DV and use their own historic, country-specific LMT AOM data up to the first reference year when LMT data is available in the MS.

However, MS may replace the DV only if certain criteria are fulfilled. There are two options for when MS are allowed to deviate from the historic AOM default values and use their own country-specific data. The first is:

1. Data submitted to MS authorities by PROs and/or data that is provided when producers register their LMT batteries made available on the market.

The second option for deviation from the DV would only be permitted when the first option does not apply:

2. Data from (national) LMT associations (on products) and/or official market surveys, only if the scope of the data is identical and the scope and origin of the data is described. Calculations based on market, registration, etc. data would have to use a default value for the respective battery weights.

No other data sources apart from the options 1 and 2 above would be allowed for deviation from the historic country-specific LMT AOM default values. MS can replace the default values for each individual LMT group[6] or for all four LMT groups 1-4. In addition, an MS could replace the default values only once with its own country-specific data (option 1 or 2 from above).

Furthermore, country-specific DV may only be changed to a certain degree to avoid abrupt changes and ease the comparability of results between MS. Therefore, a **maximum value for deviation from DV** applies: MS's own historic data may not vary more than **± 25% from the DV**.

Apart from the criteria specified above, the general criteria for deviation from DV in chapter 6.2 would still apply.

Figure 12 describes the process flow for the AfC option 2. Starting with the use of the DV for historic AOM data, the chart shows a potential deviation from the DV. The 'YES' and 'NO' arrows indicate the steps that apply when the criteria for deviation are or are not fulfilled.

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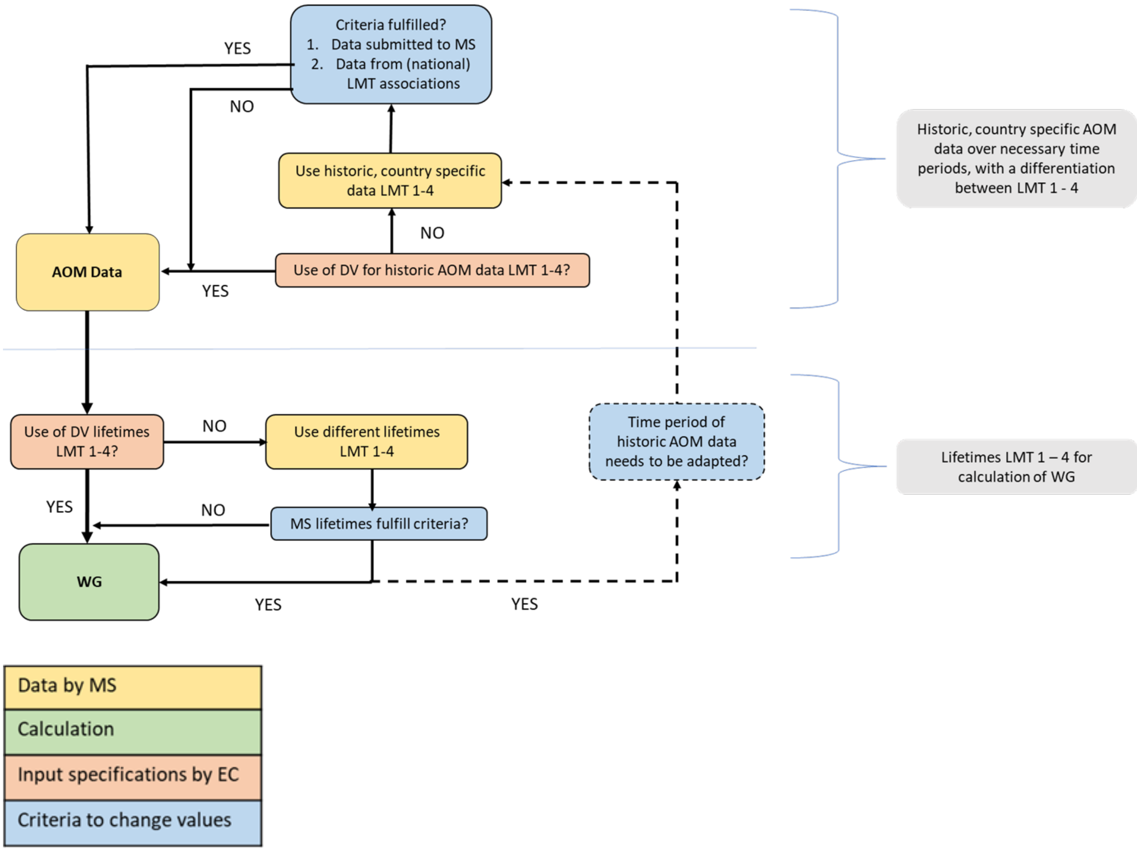
[6] If only one or not all LMT groups are replaced, the shares of the remaining groups have to be adapted (based on their original ratios to each other) so that the total again adds up to 100%.

The second part of the figure adds the application of the LMT average battery lifetimes to the process flow chart. The average battery lifetimes, their default values and potential deviations are described in sub-chapter 4.2.

AfC option 1 results when only default values are used. Then, all alternative process steps would not be applicable, and the remaining process flow chart would become much simpler.

Figure 12 – Process flow chart for historic AOM data and average lifetimes of LMT



AOM, WG consider the total values for all groups of LMT (LMT1-4) batteries.

Source: Own diagram (Oeko-Institut).

5. Complementary flows (CF)

5.1. Determination of batteries not available for collection (Not-AfC)

As part of the AfC methodology, the amount of batteries not available for collection (not-AfC) is subtracted from the total amount of waste batteries generated in a given reference year. The batteries not-AfC are the amount of waste batteries generated that are not available for collection for multiple reasons and consist of several complimentary flows (CF).

Table 9 gives an overview of the complementary flows (CF) not-AfC is based on.

Table 9 – Overview of complementary flows (CF) introduced by JRC

Abbreviation	Complementary Flow (CF)	Description
MMW	Batteries in Mixed Municipal Waste	tonnes of batteries of a certain category in MMW in the year t
Remanufactured / Repurposed (R)	Batteries being Remanufactured / Repurposed	tonnes of batteries of a certain category addressed to remanufacturing / repurposing in the year t (before obtaining the status of 'waste')
WEEE	Batteries not removed from waste products	tonnes of batteries of a certain category not removed from waste products in the year t
Exports	Batteries exported (2nd hand)	tonnes of batteries of a certain category exported for second-hand market, and that become waste batteries in the year t
Imports	Batteries imported (2nd hand)	tonnes of batteries of a certain category imported for second-hand market, and that become waste batteries in the year t

Source: Own compilation (Oeko-Institut) based on (Bobba et al., 2024)

The complementary flows from the table above will be addressed in subsequent parts of this report; see chapters 5.2 to 5.5.

Waste batteries available for collection (AfC) is the difference between waste generated (WG) and Not-AfC. Figure 13 shows the whole formula for calculation of AfC, WG and not-AfC.

Figure 13 – Calculation of batteries available for collection

AfC: Available for collection.
Not-AfC: Not available for collection
WG: Waste generated in given year
Complimentary Flows (CF): Exports, Imports, WEEE, MMW, R – see Table 9

$$AfC = WG - Not - AfC$$

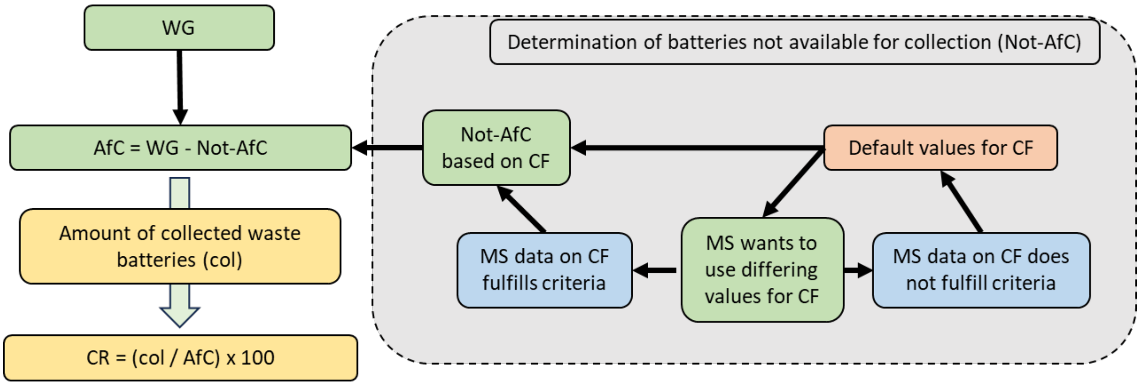
$$Not - AfC = CF\ Export - CF\ Import + WEEE + MMW + R$$

Source: Own diagram (Oeko-Institut) based on (Bobba et al., 2024)

Figure 14 gives and schematic overview of the calculation of not-AfC, AfC and the collection rate (CR) based on CFs.

Figure 14 – Calculation of not-AfC, AfC and the CR

WG: Waste generated in given year
AfC: Available for collection.
Not-AfC: Not available for collection
CR: collection rate



Source: Own diagram (Oeko-Institut)

5.1.1. Additional batteries AfC and not-AfC

As described in the previous sub-chapter, the AfC-methodology considers several complementary flows (CF) not-AfC. In this context, the AfC-methodology represents a necessary simplification that takes into account only the main complementary flows as determined in the 2024 JRC report (Bobba et al., 2024). However, when tracing the real-life battery flows more aspects need to be considered. Those further battery flows may add additional batteries to the amount of collectable batteries or further reduce the amount of waste batteries not available for collection. In the following examples of such additional battery flows are briefly introduced:

- Online sales of batteries or products with batteries incorporated but not registered and thus not accounted for AOM (free-riders); but will be collected as waste batteries and account for the collection rate

- Separately collected WEEE that is send to recycling in other MS, during WEEE treatment waste batteries are removed and accounted for the collection rate of another MS; but not for collection rate where the batteries were originally AOM
- Used batteries AOM in a MS but not completely registered in this MS; e.g. privately bought used EEE or e-bikes from another MS or private imports of 'new' EEE which were purchased while travelling abroad. Those batteries are not-AfC in the original MS but will be collected and account for the collection rate where the batteries are transferred to
- Industrial batteries misleadingly collected as portable batteries; those batteries will additionally account for the portable battery collection rate
- Waste batteries going directly to recycling (B2B) without being registered by a PRO as collected waste batteries; thus, not being accounted for the collection rate.

5.2. Complementary flows (CF) – mixed municipal waste (MMW)

5.2.1. Legal context, research, data and information

Legal context

First and foremost, waste batteries must be discarded separately from other waste streams, including from mixed municipal waste (MMW), as stated in Batteries Regulation (2024), Article 61. Nonetheless, the reality today often depicts a different picture, in which batteries do end up wrongfully discarded in MMW due to numerous reasons. This realisation needs to be acknowledged for further contemplations within this CF. To tackle this issue and to take steps for improvements, the Batteries Regulation already paves a legislative way to address a potential complementary flow assessment in the context of the AfC methodology. Hereby, in Article 69, it is stated that

> by 1 January 2026 and every five years thereafter, Member States shall carry out a compositional survey of collected mixed municipal waste [...] for the preceding calendar year to determine the share of waste portable batteries and waste LMT batteries therein. (Regulation (EU) 2023/1542, 2024, Article 69)

For such a survey, the Batteries Regulation further gives guidance, whilst not being legally binding, in recital 106:

> In order to verify and improve the effectiveness of the collection network and related information campaigns, regular compositional surveys at least at NUTS 2 level, which is provided for in Regulation (EC) No 1059/2003 of the European Parliament and of the Council (29) should be carried out on mixed municipal waste and waste electrical and electronic equipment collected to determine the amount of waste portable batteries therein. (Regulation (EU) 2023/1542, 2024, Recital 106)

Data on waste batteries in MMW from literature

To support the various aspects of the MMW CF as concern the AfC methodology, numerous reports by different producer responsibility organisations, institutes as well as the information from the JRC report the have been analysed. The 2024 JRC report states that awareness among the EU population is inadequate. In 2015, approximately 35,000 tons of batteries were incorrectly disposed of in MMW, representing about 20% of the waste generated from portable batteries. A survey conducted by Erion in Italy in 2022 revealed that 8% of respondents did not know how to properly dispose of waste batteries. Similar findings have been reported in other regions, although the studies generally involved a limited number of participants. (Bobba et al., 2024)

The following reports have been taken into account as listed in Table 10.

Table 10 – Reports on waste analyses of MMW

Report #	Organization	Member State	Date of publication	Date of analysed year
1	ABF/BOKU (Beigl, 2020)	Austria	2020	2018/2019
2	UBA (Dornbusch et al., 2020)	Germany	2020	2018
3	OVAM (OVAM, 2022)	Belgium	2022	2019-2021
4	Riyjkswaterstaat (Rijkswaterstaat, 2022)	Netherlands	2022	2021

Source: compilation of data from (Beigl, 2020; Dornbusch et al., 2020; OVAM, 2022; Rijkswaterstaat, 2022)

Although some data for the MMW complementary flow has been identified and utilized in this analysis, it is clear that the number of reports is still limited. Consequently, the few reports available do not represent the entirety of the European Union and should be considered as guidance only. In the analysed reports, most did not differentiate between P1 and P2. Additionally, the reports varied in how they presented the quantities of batteries ending up in municipal waste (MMW). For instance, some reports provided total battery amounts, while others expressed these figures as a percentage of MMW or in kilograms per inhabitant.

5.2.2. Methodological approach for quantification of CF

To gain a clearer overview and understand the current status of batteries improperly discarded in municipal waste (MMW), the findings from various reports have been compiled in Table 11. Not all metrics listed in Table 11 were provided by the reports, and some values were calculated to allow for uniform comparison. In the following the different indicators are briefly explained:

- Batteries kg/inh.*a in MMW: Kilograms of batteries wrongfully discarded in MMW divided by the number of inhabitants of relevant MS per year
- Total batt. in MMW [t]: Total mass in tonnes of batteries wrongfully discarded in MMW in relevant MS
- Tot. batt. in MMW / AOM (avrg. t-4, t-3, t-2): Total mass of batteries wrongfully discarded in MMW in relevant MS divided by the average mass of batteries AOM in the three proceeding years
- % of collected: Total mass of batteries wrongfully discarded in MMW divided by the total amount of batteries collected in relevant MS
- CF (% of WG): Total mass of batteries wrongfully discarded in MMW in relevant MS divided by the waste generated using the AfC methodology

Table 11 – Results on batteries in MMW from various reports

Organization	Country	Batteries kg/inh.*a in MMW	Tot. batt. In MMW [t]	Tot. batt. in MMW / AOM (avrg. t-4, t-3, t-2)	% of collected	CF (% of WG)
ABF/BOKU	Austria	0.10	852	17%	30%	21%
UBA	Germany	0.067	5500	13%	11%	14%
OVAM	Belgium	0.05	577	12%	18%	14%
Riyjkswaterstaat	Netherlands	0.1672	2916	32%	64%	37%

Source: Fraunhofer IZM

This table shows that the indicators for batteries improperly discarded in municipal waste (MMW) can vary significantly between Member States, both in relative terms and absolute numbers. Belgium along with Germany have the lowest ratio of batteries in MMW relative to waste generated, while the Netherlands has the highest. Conversely, Belgium records the fewest batteries ending up in MMW when assessed per inhabitant per year.

To better understand the calculation of the complementary flow (CF) as a percentage of waste generation (WG), the consultant conducted an exemplary calculation for Germany. Given that the lifespan for P1 is 4 years and for P2 is 9 years, the following P1/P2 split in Table 12 is assumed to facilitate the calculation.

Table 12 – Assumption for the P1/ P2 share for '% of WG' calculation

Category	Year							
	2008	2009	2010	2011	2012	2013	2014	2015
P1	77%	76%	75%	74%	73%	72%	71%	70%
P2	23%	24%	25%	26%	27%	28%	29%	30%

Source: Fraunhofer IZM

Table 13 – Exemplary calculation of P1/P2 shares of Germany

Cate-gory	Year										
	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Total AOM [t]	34000	37298	42531	43334	43549	42441	43979	43902	45511	50643	52159
P1 [%]	77%	76%	75%	74%	73%	72%	71%	70%	69%	68%	67%
P2 [%]	23%	24%	25%	26%	27%	28%	29%	30%	31%	32%	33%
P1 [t]	26180	28346	28914	32070	31790	30557	31236	30731	31403	34437	34947
P2 [t]	7820	8951	9638	11268	11758	11883	12758	13171	14108	16206	17212

Source: Fraunhofer IZM

With Table 12 and Table 13 the following calculation can be done.

Exemplary calculation Germany:

- Total batteries in MMW in tonnes: 5500 t (2018)
- $WG_{2018} = \frac{(P1_{2013}+P1_{2014}+P1_{2015})}{3} + \frac{(P2_{2008}+P2_{2009}+P2_{2010})}{3} = 39644\ t$
- $CF = \frac{Batt.\ in\ MMW}{WG_{2018}} = 13.87\%$

This results in a complementary flow for portable batteries (P1 and P2 combined) of 14% of waste generated in Germany in the year 2018.

5.2.3. Default value (DV), criteria and maximum values of deviation from DV

Determination of DV and deviation from DV

The JRC's 2024 report states that studies indicate that many citizens in the EU are unaware of the proper disposal methods for waste batteries and waste electrical and electronic equipment (WEEE). In 2015, approximately 35,000 tonnes of batteries were incorrectly disposed of, representing about 20% of the waste generated from portable batteries. A 2022 survey in Italy revealed that 8% of respondents did not know how to properly dispose of waste batteries. Similar findings were noted in other regions, although most studies were conducted with a limited number of participants. The JRC suggests setting the DV for MMW at half of the European average, amounting to 10% of WG discarded in MMW. (Bobba et al., 2024)

It is proposed to accept the JRC's recommended DV of 10% of WG for **AfC option 2 – detailed methodology,** as no country could be identified already performing better. For **'AfC option 1 – basic methodology'** a more ambitious approach is suggested, using the average of the three best performing countries that could be identified in regards to batteries wrongfully discarded in MMW and dividing by two, amounting to 8%

The stakeholder feedback to the first stakeholder meeting in September 2025 suggested a stricter default value. Three out of 6 stakeholders favoured DV = 0% of WG without a possibility for deviation from DV, and only one stakeholder indicated a preference for the DV being substantially higher than the proposed 8% of WG. Therefore, a DV of 8% of WG is considered a compromise, as it cannot be ruled out that certain amounts of batteries are currently lost in MMW and measures for changing user behaviour require time until they become effective. Furthermore, the consultant also proposes that the default value should decrease after a certain time as a regulatory measure, that Member States take action to tackle the problem of batteries being discarded in MMW.

After a **transition time of 5 years** the default value in **AfC option 1 is reduced to DV = 0% of WG**. Taking into account the simple approach of **AfC option 1 no possibility to deviate from DV = 8% and DV = 0% of WG** respectively is allowed.

AfC option 2 differs from AfC option 1 in regard to the evolution over time of the default value as well as a in regard to a potential deviation from DV. Under **AfC option 2 the default value of 10% of WG is reduced to DV = 3% of WG only**

after 10 years. As the approach of AfC option 2 allows for deviations from the DV, this would compel all countries to either improve their performance regarding batteries discarded in MMW or justify their divergence from the DV. Member States may, under certain criteria deviate from the default values, see the next sub-chapter for the criteria that apply. This means that MS can replace the DV by the results of the mandatory compositional survey of MMW – however, only up to a maximum value, see further down. The possibility to deviate from DV under certain criteria is limited to a 5 years' time period. After 5 years a DV = 10% of WG without deviation applies and after another 5 years a DV = 3% of WG without deviation applies.

Considering the larger size of **LMT batteries** compared to portable batteries and the greater potential harm LMT batteries can cause to waste management infrastructure, it is deemed less acceptable for LMT batteries to end up in MMW. Therefore, a stricter default value (DV) for **LMT batteries is proposed: DV = 0% of WG for AfC option 1 and AfC option 2**. Any deviation from this DV for LMT batteries is not allowed neither under AfC option 1 nor AfC option 2. This approach is in accordance with the input from stakeholders related to the first stakeholder workshop where 5 out of 6 stakeholders stated that DV should be 0% without any deviation from DV = 0%. Overall, the stakeholder feedback clearly suggests that LMT batteries should not be subtracted from the calculation (DV = 0%) without a possibility to deviate from DV = 0%. The same tendency applies for portable batteries although somewhat lessened. Only one stakeholder requested a substantially higher DV than the proposed 8% of WG.

Criteria for deviation from DV

The starting point for the DV is set at 10% of WG for portable batteries and 0% of WG for LMT batteries. Member States may utilize the results of compositional surveys to modify the DV for portable batteries under AfC option 2. However, if a Member State intends to make such a change, it must provide documentation that includes detailed information on the sampling and sorting analysis to substantiate that their data is robust and that the change is justified. The proposal allows a MS to deviate from the DV only during the first 5 years, but no longer than that, and any change must be supported by the results of a compositional survey. It is important to note that deviations from the DV are permitted only to a limited extent, with a maximum value of portable batteries in MMW not-AfC of 16% of WG, see below for further details.

The process for conducting compositional surveys requires the establishment of a minimum number of samples. These samples must be randomized to ensure regional and socioeconomic coverage, dividing them into predominantly rural, intermediate, and predominantly urban areas, while also taking into account tourism regions. Compositional surveys should be conducted at least at the NUTS 2 level as proposed in the Batteries Regulation, and the sorting analysis must encompass temporal coverage by being performed throughout all four seasons.

When analysing batteries, portable batteries can be counted as a total or differentiated between categories P1 and P2, whereas LMT batteries must be analysed separately. There is a strong emphasis on the transparency of the sorting analysis, with documentation of the methodology and results required to be submitted to the European Commission (EC). Additionally, it is necessary to analyse batteries embedded in WEEE found in MMW. Lastly, the considered weight of battery casing should be consistent with the AOM and collected data. For a better overview, the criteria are again listed in the following:

- Minimum number of samples to be set
- Regional and socioeconomic coverage: randomized samples with division into predominantly rural, intermediate, and predominantly urban areas, as well as consideration of tourism regions.
- Compositional surveys should be conducted at least on NUTS 2 level[7]
- Temporal coverage: sorting analysis should be conducted during all four seasons
- Portable batteries can be counted as total or differentiated between P1 and P2; LMT batteries need to be analysed separately
- Batteries embedded in WEEE in MMW should be analysed as well and are part of the total results of the compositional survey
- Transparency of sorting analysis; documentation of methodology and results have to be submitted to the EC
- Considered weight of battery casing should be consistent with AOM and waste batteries collected

Maximum value of deviation from DV

Generally, deviation from DV is only possible under AfC option 2 and is permitted only to a limited extent, with a maximum value of portable batteries in MMW not-AfC. First and foremost, the **maximum value of deviation from the DV should not be higher than 16%,** which represents the average of the three best performing countries identified. It is proposed that this maximum value should decrease after five years as a regulatory measure, that Member States take action to tackle the problem of batteries being discarded in MMW.

[7] A stakeholder stated that NUTS2 level is not meaningful in regards to a survey. However, the consultant considers NUTS2 level as a complementation of the foregoing bullet point (Regional and socioeconomic coverage).

A deviation from the DV = 10% of WG for portable batteries must be substantiated by the amounts of portable batteries found in mixed municipal waste (MMW), as determined by the results of the Member State compositional survey. The following order of priority applies:

- Portable batteries results from the MS compositional survey can be used as CF not-AfC if they are below 16% of WG.
- However, if the results of the survey indicate that portable batteries comprise more than 16% of the WG, a maximum value of 16% of WG for portable batteries in MMW must be applied.
- Additionally, this deviation from the DV will only be permitted during a transition period of five years. After this period, no deviations from the default values will be accepted.

In principle, other options for determining maximum values for deviation from DV would also have been possible. These options were presented at the first stakeholder workshop in September and are listed in Table 14. Default value and no deviation from DV for LMT batteries were adopted from the stakeholder workshop. In case of portable batteries the DV = 8% of WG including no deviation from DV is slightly increased in comparison to the 7% presented at the workshop. The maximum value of deviation of 16% of WG for AfC option 2, however, differs from the options presented at the stakeholder workshop. Initial proposals of 15% or 20% of WG were considered as too high. Most stakeholder feedback supported the option for no possibility to deviate from the default value. In this respect, a maximum deviation of 10 % of WG for a transition time could be considered a compromise taking into account that measures for changing behaviour of users (no disposal of waste batteries in MMW) require time until they become effective.

Table 14 – Rejected options for maximum values for deviation from DV of MMW

Default values not-AfC	Maximum values (for deviation from DV)	Criteria (for deviation from DV)
	Portable batteries	
Portable batteries DV = 7 % of WG	Portable batteries Option 1: No deviation from DV accepted Option 2: 15% of WG Option 3: 20% of WG	Mandatory compositional/additional survey (and criteria thereof) of the amount of batteries in MMW Documentation should fulfill criteria set out
	LMT batteries	

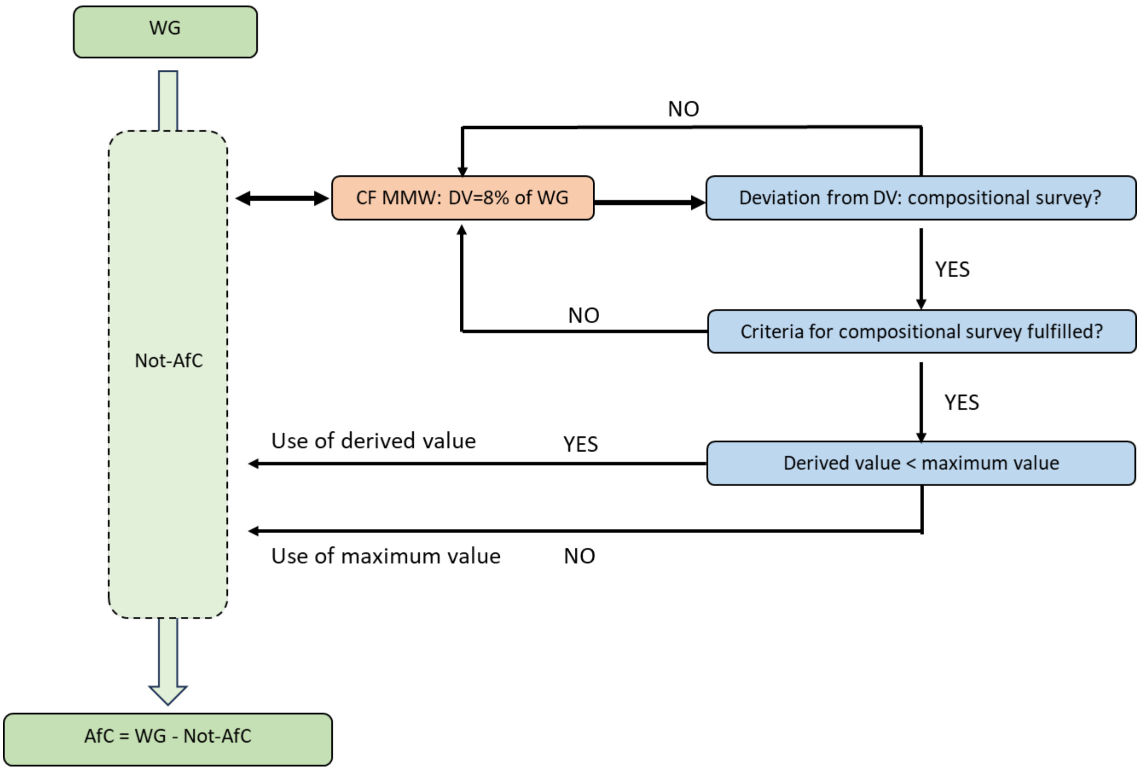
Default values not-AfC	Maximum values (for deviation from DV)	Criteria (for deviation from DV)
LMT batteries DV = 0 % of WG	LMT batteries Option LMT-A: No deviation from DV accepted Option LMT-B: results from survey limited to 4% of WG Option LMT-C:Transition time; option LMT-B for five years. Afterwards, no deviation from DV accepted	Option LMT-A: No criteria required Option LMT-B: Results of survey (and criteria thereof) of LMT batteries in MMW; criteria for deviation and documentation apply Option LMT-C: See Option LMT-B. Afterwards, no criteria required

Source: Own diagram (Oeko-Institut and Fraunhofer IZM)

Process flow chart of CF of batteries in MMW not-AfC

The following process flow chart provides an overview and represents the procedure of how the amount of waste batteries not-AfC in mixed municipal waste is determined.

Figure 15 – Process flow chart for the complementary flow of MMW (not-AfC)



Source: Own diagram (Oeko-Institut and Fraunhofer IZM)

WG, AfC and not-AfC principally consider the total values. However, the final results for total AfC and not-AfC also need to take into account all other CFs, as well as all groups of portable (P1/P2) or LMT (LMT 1-4) batteries.

5.2.4. Overview

The following table provides a summary of the results for both options, 'AfC option 1 – basic methodology' and 'AfC option 2 – detailed advanced methodology', and for both for portable and for LMT batteries not-AfC. In the case of LMT batteries in MMW AfC options 1 and 2 are identical.

Table 15 – Overview CF MMW

Default values not-AfC	Maximum values (for deviation from DV)	Criteria (for deviation from DV)
AfC option 1 – basic methodology		
Portable batteries DV = 8 % of WG. After 5 years DV= 0% of WG.	Portable batteries: No deviation from DV accepted	---
LMT batteries DV = 0 % of WG	LMT batteries: No deviation accepted	---
AfC option 2 – detailed advanced methodology		
Portable batteries DV = 10 % of WG. After 10 years DV = 3% of WG	Portable batteries: Results from the survey, limited to a maximum value of 16% of WG. After 5 years, no deviation from DV accepted.	Mandatory compositional survey (and criteria thereof) of the amount of batteries in MMW Documentation should fulfil criteria set out
LMT batteries DV = 0 % of WG	LMT batteries: No deviation accepted	---

Source: Own diagram (Oeko-Institut and Fraunhofer IZM)

5.3. Complementary flows (CF) – waste electric and electronic equipment (WEEE)

5.3.1. Legal context, research, data and information

Legal context

The European legislation provides some important information for the derivation of the complementary flow of waste batteries in waste electric and electronic equipment (WEEE) not available for collection (not-AfC).

The Batteries Regulation requires a compositional survey of WEEE that would determine the amount of waste batteries in separately collected WEEE.

> By 1 January 2026 and every five years thereafter, Member States shall carry out a compositional survey of collected mixed municipal waste and waste electrical and electronic equipment streams for the preceding calendar year to determine the share of waste portable batteries and waste LMT batteries therein […] (Regulation (EU) 2023/1542, 2024, Article 69(5))

The WEEE Directive, in turn, specifies that all batteries must be removed as part of the treatment of WEEE.

> 1. Member States shall ensure that all separately collected WEEE undergoes proper treatment.
>
> 2. Proper treatment, other than preparing for re-use, and recovery or recycling operations shall, as a minimum, include the removal of all fluids and a selective treatment in accordance with Annex VII.
>
> Annex VII, 1. As a minimum the following substances, mixtures and components have to be removed from any separately collected WEEE:
>
> - batteries
>
> (Directive 2012/19/EU, 2024, Article 8)

However, certain products are not in the scope of the WEEE Directive, e.g. specific medical devices and also e-mopeds.

> 4. In addition to the equipment specified in paragraph 3, from 15 August 2018, this Directive shall not apply to the following EEE:
>
> (d) means of transport for persons or goods, excluding electric two-wheel vehicles which are not type-approved;
>
> (g) medical devices and in vitro diagnostic medical devices, where such devices are expected to be infective prior to end of life, and active implantable medical devices.
>
> (Directive 2012/19/EU, 2024, Article 2)

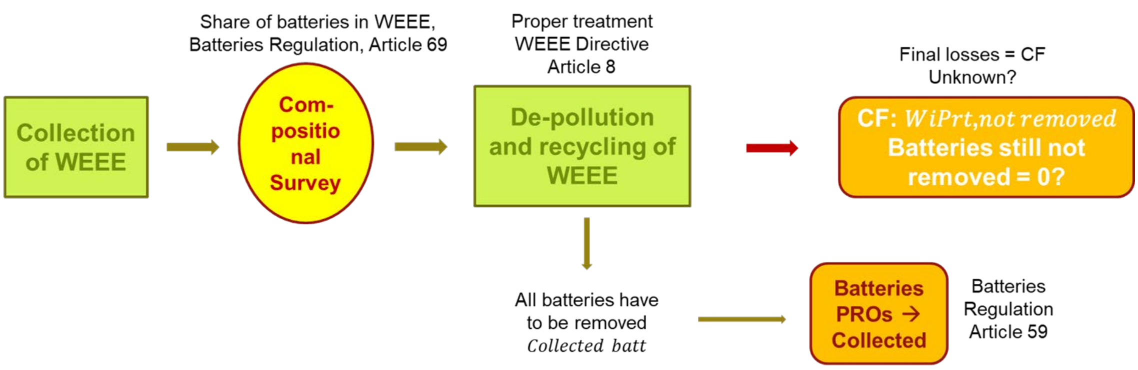
Collection, treatment of WEEE and removal of batteries

The following Figure 16 illustrates the relationship between collection, treatment of waste electrical and electronic equipment (WEEE) and removal of waste batteries from WEEE in regard to the complementary flows of batteries in WEEE.

It is important to note that the Batteries Regulation stipulates that a compositional survey shall be carried out for the collected waste electrical and electronic equipment streams (Regulation (EU) 2023/1542, 2024, Article 69(5)). This would allow to determine the amounts of batteries in WEEE and at the same time the amount that should be removed from WEEE. Only after the compositional survey treatment of WEEE at the WEEE recycling facilities takes place. Treatment includes de-pollution (removal of waste batteries) and final recycling of WEEE. Batteries removed by WEEE recyclers shall be collected by battery PROs at the place of the WEEE recyclers. The batteries collected by the battery PROs are taken into account in the calculation of the batteries collection rate. Although no batteries should still be remaining in WEEE after de-pollution it cannot be ruled out that certain amounts of batteries are currently not removed and thus finally lost in WEEE. These potential amounts of waste batteries represent the complementary flow (CF) not-AfC.

CF considers batteries still not removed after depollution of WEEE but the compositional surveys consider batteries in separately collected WEEE before the depollution step. Therefore, compositional surveys of WEEE alone are not sufficient for the determination of CF of batteries in WEEE.

Figure 16 – Overview batteries in WEEE and compositional survey



Source: Own diagram (Oeko-Institut)

Figure 16, however, does not present a potential flow of WEEE that is transferred to another Member State for WEEE recycling. In such a case, batteries incorporated in that WEEE are not-AfC in the MS of the origin of WEEE but will add additional batteries in the MS to which WEEE is transferred to and where the batteries are removed from WEEE during de-pollution and WEEE recycling (although the batteries are not AOM in this MS). A balancing mechanism between Member States could be considered to take properly account of such WEEE flows and the batteries incorporated.

Data on WEEE and waste batteries

The analyses of the individual steps described in the figure shows that concrete data on battery amounts is very scarce.

Data on the amounts of waste batteries removed from household WEEE is published for France (In Extenso Innovation Croissance et al., 2022), see Table 16. 2,133 tonnes of waste batteries were removed in 2021 in France. This amount of batteries relates to 993,987 tonnes of separately collected WEEE in France (Eurostat). The amount of batteries removed corresponds to a share of 0.2% in relation to the amount of WEEE.

Table 16 – Changes in the tonnage of batteries removed from household WEEE, France

2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
686	631	711	823	973	990	1295	1340	1385	1462	2133

Source:(In Extenso Innovation Croissance et al., 2022)

Some data on waste batteries collected from WEEE is also available from Ireland.

An analysis of WEEE is available for Switzerland (SENS, Swico, 2022). The results for 2021 show that WEEE intended for treatment contains 0.609% of waste batteries. Based on the consultant's own calculations this means that 127,100 tonnes of WEEE going to treatment contain ca. 774 t of waste batteries.

Overall, research (i.e. public literature, JRC reports, stakeholder feedback) indicates that there is only very limited or no information available on:

- amounts of batteries in separately collected WEEE,
- amounts of batteries removed from WEEE and collected by PROs,
- potential amounts of batteries still not removed / remaining in WEEE during final treatment.

As PROs are obliged to collect the waste batteries that have been removed by the WEEE recyclers, these quantities should be available at PRO level. However, it remains unclear, if and in which Member States PROs inform authorities or publish this data.

5.3.2. Methodological approach for quantification of CF

The previous chapters explained that there are currently no apparent ways of determining the quantities of waste batteries that have not been removed from WEEE before final treatment. These waste batteries would be finally lost and thus represents the complementary flow that is not-AfC. However, an option that could allow to determine those waste batteries not-AfC would be an additional survey or analysis at WEEE recycling facilities of the amount of batteries still not removed after depollution and during treatment of WEEE. Such an additional analysis would have to differentiate between portable and LMT batteries. For several reasons, an additional survey could be considered a challenging task:

- Harmonised surveys are necessary but might be challenging due to different recycling processes in MS / EU
- Harmonised standards: At what point of the treatment processes should samples for the analyses be taken? How to identify incorporated batteries that might already be destroyed?)
- WEEE recyclers generally try to follow the legal requirements. If a survey is announced, the data collected may not reflect the average treatment process and instead may reflect a more legally conforming situation.

While an additional survey might be challenging there is a potential check that MS authorities could perfom for a rough estimate of the waste batteries from WEEE not-AfC. Therefore, battery PROs would have to inform the MS authorities about the total amount of batteries they collected from WEEE recyclers. MS authorities could compare these amounts of batteries from WEEE recyclers with the data from the compositional survey according to (Regulation (EU) 2023/1542, 2024, Article 69(5)). However, this would require that after the compositional survey the separately collected WEEE directly goes to the WEEE recyclers and that waste batteries are only removed at WEEE recycling facilities where the batteries are collected by the battery PROs.

The difference between compositional survey and amounts collected from WEEE would mathematically correspond to the final losses (CF of batteries in WEEE not-AfC); see the equation below:

Compositional Survey (% of batteries in separately collected WEEE) − **Batteries PROs collected** (from depollution, recycling) = **CF:** $WiPrt{,}not\ removed$ (after depollution, recycling)

The result of the equation, taking into account that this is only a mathematical check, would allow for a simple evaluation of the battery losses:

A) ‘Compositional survey’ – ‘Batteries PROs collected’ = 0. This would indicate that all batteries were removed and no final losses would occur (CF = 0)
B) ‘Compositional survey’ – ‘Batteries PROs collected’ > 0. This would indicate that not all batteries were removed and final losses would occur (CF > 0)

5.3.3. Default value (DV), criteria and maximum values of deviation from DV

Determination of DV and deviation from DV

Considering that the legal requirement demands that all batteries are removed from WEEE the **default value (DV) for CF should be '0' for portable and LMT batteries and should apply equally for both options, 'AfC option 1 – basic methodology' and 'AfC option 2 – detailed advanced methodology'**. This is clearly supported by the stakeholder feedback of the first stakeholder meeting. However, is has to be accepted that in today's practice not all waste batteries might be really removed. Therefore, a differentiation between AfC option 1 (no deviation from DV) and AfC option 2 (deviation from DV is possible) is introduced. Thus, a deviation from DV should be allowed for 'AfC option 2 – detailed advanced methodology' but only under certain conditions. Such a differentiated approach can also be justified by the stakeholder feedback. Three stakeholders clearly say that not any batteries should be deducted from WG. The contractor interprets this to mean that no deviation from DV = 0% should be possible. Two stakeholders are for portable batteries in favour of the possibility of deviating from the DV on the basis of an additional survey / harmonized audits and a maximum value of deviation.

Specifically, deviation from DV is only possible if additional surveys / analysis (at WEEE recycling facilities) of the amount of batteries (separately for portable and LMT batteries) still not removed after depollution and during treatment of WEEE is performed. Results of additional surveys and thus deviation from DV are only accepted if specific criteria of the additional survey are fulfilled.

A possible deviation from DV should not provide a wrong incentive not to increase collection and removal of waste batteries from WEEE as much as possible. Therefore, deviation from DV in the case of AfC option 2 is only allowed to a certain extend and a maximum value of batteries in WEEE not-AfC is determined.

Criteria for deviation from DV

In the following, the specific criteria for additional analyses of batteries still not removed after depollution from WEEE are introduced. They shall support a harmonized sampling procedure and thus, comparability between MS:

- Minimum amount of samples to be set
- Minimum number of different WEEE recyclers
- Minimum number of different types of WEEE recycling processes (process steps where batteries are removed)

- Regional and socioeconomic coverage: randomized samples with division into predominantly rural, intermediate, and predominantly urban areas, as well as consideration of tourism regions.
- Temporal coverage: sorting analysis should be conducted during different seasons
- Calculation of the result based on the %-share of batteries in the WEEE input (in tonnes) into the recycling facility:
  %-share of batteries x total input of small equipment = tonnes of batteries not-AfC
- The point of the WEEE treatment process when the analyses take place has to be clearly defined; Only after all process steps during which batteries are normally removed.
- Transparency of sorting analysis; documentation of methodology and results have to be submitted to the EC

In addition, the general requirements for deviation from default values in chapter 6.2 apply.

Maximum value of deviation from DV

Maximum values of deviation from DV are generally derived on the basis of a %-share of waste generated (WG). When deriving the maximum value for the CF of batteries in WEEE, it must be taken into account that, due to the lack of data, a robust data-based approach is not possible and assumptions must be made.

The maximum value should not be in favour of a non-effective separate collection of waste batteries from WEEE. It should, however, provide an incentive to remove as many batteries as possible and it should also consider over time an approximation or adjustment to the legal requirements.

No Member State has data on batteries not removed from WEEE. However, one MS in the stakeholder feedback provided an estimate based on estimates from WEEE PRO on the mass of batteries not removed from WEEE. These estimates would amount to a value of about 1% of WG. Following this approach, however, also to allow for a clear distinction between AfC option 1 and 2 the mass of waste batteries not removed from WEEE and not-AfC shall be limited to 2% of WG. Therefore, **2 % of WG is proposed as a maximum value of deviation from DV for portable batteries for 'AfC option 2 – detailed advanced methodology'**.

Taking into account that measures for changing behaviour of users and recyclers of WEEE require time until they become effective a transition time for further improvements is proposed. Therefore, the initial maximum value shall be reduced after five years to 0 % of WG for portable batteries.

Given the size of LMT batteries compared to portable batteries it is considered less likely and less acceptable that LMT batteries are not removed from WEEE. Therefore, deviation from DV for LMT batteries should be stricter. **No deviation from DV for LMT batteries is accepted under 'AfC option 2 – detailed advanced methodology'**.

In principle, other options for determining maximum values for deviation from DV would also have been possible. These options were presented at the first stakeholder workshop in September and are listed in Table 15. However, all of the possible options were rejected for the following reasons. In general, the quantities not-AfC (0.4% of WG and less) are very small in all options and are insignificant compared to other CFs. Such low maximum values would have been disproportionate to the effort required to determine the deviation from DV.

Table 17 – Rejected options for maximum values for deviation from DV

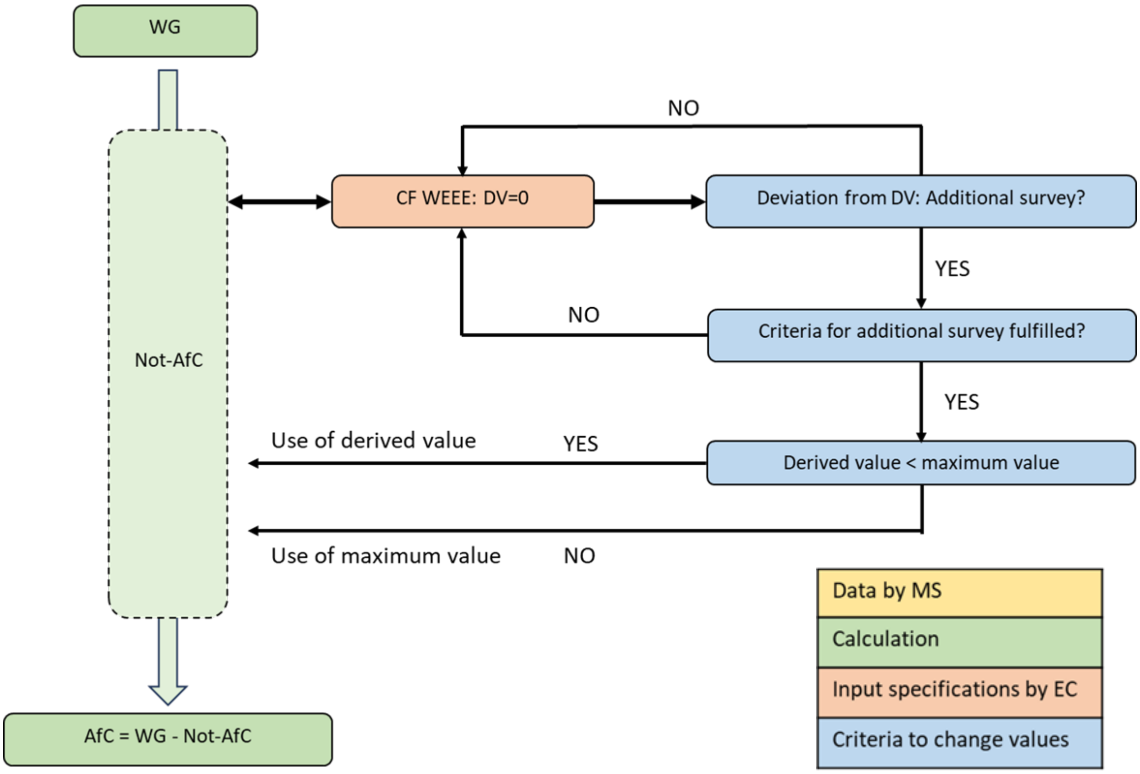
Default values not-AfC	Maximum values (for deviation from DV)	Criteria (for deviation from DV)
Portable batteries		
DV = 0 % of WG	Option 1: No deviation from DV accepted Option 2: 5% of batteries removed from WEEE Option 3: 0.4% of WG (FR: 5% of batteries removed from WEEE) Option 4: 0.2% of WG (1% of batteries derived from compositional survey Switzerland) Option 5: 0.4% of WG (1% of batteries AOM embedded in EEE, Switzerland) Option 6: option 2 or 3; 5% of batteries removed from WEEE after 5 years is reduced to e.g. 2%	Additional survey (and criteria thereof) of the amount of batteries still not removed from WEEE after depollution.
LMT batteries		
DV = 0 % of WG	Option LMT-A: No deviation from DV accepted Option LMT-B: maximum value of 0.2% of WG Option LMT-C: Transition time; for five years threshold = 0.2% of WG; afterwards no deviation from DV accepted	Option LMT-A: No criteria required Option LMT-B: Additional survey (and criteria thereof) of the amount of LMT batteries still not removed from WEEE Option LMT-C: See LMT-B; afterwards, no criteria required

Source: Own diagram (Oeko-Institut)

Process flow chart of CF of batteries in WEEE/products not-AfC

The following process flow chart provides an overview and represents the procedure of how the amount of waste batteries not-AfC in WEEE is determined. A potential deviation from DV = 0% of WG is only possible for portable batteries in case of AfC option 2. For all other cases (LMT batteries and AfC option 1), these process steps are not possible and the DV directly applies.

Figure 17 – Process flow chart for the complementary flow of WEEE (not-AfC)



Source: Own diagram (Oeko-Institut)

WG, AfC and not-AfC principally consider the total values. However, the final results for total AfC and not-AfC also need to take into account all other CFs, as well as all groups of portable (P1/P2) or LMT (LMT 1-4) batteries.

5.3.4. Overview

The following table provides a summary of the results for both options, 'AfC option 1 – basic methodology' and 'AfC option 2 – detailed advanced methodology', and in each case for both for portable and for LMT batteries not-AfC.

Table 18 – Overview CF WEEE

Default values not-AfC	Maximum values (for deviation from DV)	Criteria (for deviation from DV)
AfC option 1 – basic methodology		
Portable batteries DV = 0 % of WG	No deviation accepted	---
LMT batteries DV = 0 % of WG	No deviation accepted	---
AfC option 2 – detailed advanced methodology		
Portable batteries DV = 0 % of WG	Portable batteries: 2% of WG; after 5 years 0% of WG	Additional survey (and criteria thereof) of the amount of batteries still not removed from WEEE after depollution.
LMT batteries DV = 0 % of WG	LMT batteries: No deviation accepted	---

Source: Own diagram (Oeko-Institut)

5.4. Complementary flows (CF) – Remanufactured / Repurposed (R)

5.4.1. Legal context, research, data and information

One of the aims of the Batteries Regulation is to strengthen remanufacturing and repurposing and support this developing market. As stated in Recital (118): '…specific rules should thus be established to allow responsible repurposing of used batteries while taking into account the precautionary principle and ensuring safety of use for end-users.' Furthermore, '[b]atteries that are found to be suitable for a purpose other than their original purpose should ideally be repurposed.' (Regulation (EU) 2023/1542, 2024, Recital 118)

Furthermore, definitions can be found in the Batteries Regulation in paragraph 1 of Article 3 for repurposing, remanufacturing and producer:

> (31) 'repurposing' means any operation that results in a battery, that is not a waste battery, or parts thereof being used for a purpose or application other than that for which the battery was originally designed;
>
> (32) 'remanufacturing ' means any technical operation on a used battery that includes the disassembly and evaluation of all its battery cells and modules and the use of a certain number of battery cells and modules that are new, used or recovered from waste, or other battery components, to restore the battery capacity to at least 90 % of the original

> rated capacity, and where the state of health of all individual battery cells does not differ more than 3 % between cells, and results in the battery being used for the same purpose or application as the one for which the battery was originally designed;
>
> (47) 'producer' means any manufacturer, importer or distributor or other natural or legal person that, irrespective of the selling technique used, including by means of distance contracts, …
>
> (Regulation (EU) 2023/1542, 2024, Article 3, paragraph 1)

The Batteries Regulation also states in Article 38 - Obligations of manufacturers:

> 11. Economic operators that carry out preparation for re-use, preparation for repurposing, repurposing or remanufacturing, and place on the market or put into service a battery that has undergone any of those operations, shall be considered to be manufacturers for the purposes of this Regulation.
>
> (Regulation (EU) 2023/1542, 2024, Article 38)

Based on literature research and stakeholder consultations, the JRC reported reaching the following assessments and conclusions:

- So far only few examples of repurposing and remanufacturing of portable batteries exists, and this will probably remain like that in the foreseeable future
- Repurposing and remanufacturing of LMT batteries might become very relevant and possibly grow in the near future.
- This includes the recovery of individual cells from an old battery to be used again in various applications. This selective process implies that the lifetime of a portion of the original battery can be prolonged.
- Repurposed batteries will change application, and this could lead to a complete change of category, subtracting batteries from a certain category to destine it to another.
- Remanufacturing and Repurposing can happen in two ways: A private 'Do it Yourself' (DIY) way and an industrial commercial way.
- DIY: for example, a private individual that purchases old laptop batteries to build a home energy storage system (ESS). This flow is nearly impossible to track and could lead to a significant leakage of batteries from the corresponding battery category.

- With regards to industrial commercial remanufacturing and repurposing several examples exist.
- This flow can potentially increase over time, especially for larger batteries (e.g. belonging to LMT1 and LMT2).
- The traceability of such flows is conceived as relevant and key in determining the volume of waste batteries not-AfC.
- But for batteries destined to be remanufactured and repurposed before obtaining the status of waste, no explicit data reporting requirements are set in the Batteries Regulation.

(Bobba et al., 2024)

Various examples for repurposing of LMT and portable batteries exist. A large variety of companies and websites offering used batteries can be found online. Some are from commercial industrial corporations. Some are aimed at private individuals looking for DIY solutions.

Stakeholder feedback was clear, that this a complimentary flow that is potentially significant and impacts the amount of batteries that are available for collection. Furthermore, stakeholders agreed that it is a CF that should be encouraged and therefore MS should not be penalised for having a high amount of repurposed batteries.

Statistical reliable information and data on the amounts that enter and leave this 'flow' do not exist. Stakeholders confirmed that there is no reliable data available on the amount of batteries that are not collected as waste batteries but rather directly go to remanufacturing / repurposing. Regardless, multiple stakeholders stressed, that while not quantifiable, there is a flow of batteries that goes directly to a second life application without being collected as waste by a PRO. Stakeholders reported that in the case of e-bike batteries, it is not uncommon for batteries to get bought by private individuals directly from the bike shops that collect them and therefore, are not available for collection by the PRO. One stakeholder estimated that in 2024 overall around 400 tonnes of batteries (LMT and portable batteries, waste/non waste) are going through a second life process (1.3% of WG) and that most of this volume is LMT waste, without knowing a precise share. Predictions and estimations on the development and future role of repurposed and remanufactured batteries vary strongly in literature. Furthermore, it is possible that there will be large regional differences in the remanufacturing and repurposing market, making it difficult to set one representative value for all MS, these possible regional variations was underlined by a stakeholder.

5.4.2. Methodological approach for quantification of CF

In the context of the complimentary flows that are not available for collection (not-AfC), it is important to emphasise that only batteries that are referred to as remanufactured or repurposed before becoming waste are relevant. Batteries that are destined for remanufacturing or repurposing after having been collected as waste batteries, defined in the Regulation as 'preparation for remanufacturing' and 'preparation for repurposing', have been counted as collected and therefore shall not be considers as not-AfC. Batteries that are re-used are not part of the CF as they are used again for the same original purpose and therefore are practically an extension of the battery's lifetime.

The JRC 2021 and 2024 reports on the AfC have always looked at remanufacturing and repurposing as one CF (Bobba et al., 2024; Huisman & Bobba, 2021). But there is a fundamental difference in their definitions in the Batteries Regulation. Remanufactured batteries defined in the Batteries Regulation as 'being used for the same purpose or application as the one for which the battery was originally designed' (Regulation (EU) 2023/1542, 2024, Article 3(1)(32)), meaning that batteries that have been remanufactured are used for the same purpose again and therefore enter the market and waste stream in the same category as originally intended but almost as new. In contrast, the Regulation defines repurposed batteries as 'being used for a purpose or application other than that for which the battery was originally designed'(Regulation (EU) 2023/1542, 2024, Article 3(1)(31)). Thus, repurposing describes a battery is used for a different purpose and might as a result enter a different waste stream at its end of life (EOL) than the category under which it was originally placed on the market (e.g.: P2 becomes industrial; LMT 1 becomes P2). Therefore, a differentiation with regards to the CF might be necessary, as remanufactured batteries will remain in the same battery category when made AOM anew. In contrast, repurposed batteries are probably, but not necessarily, made AOM in a different battery category than the original battery category. Consequently, from a collection perspective remanufacturing is considered an extension of the batteries lifetime and will be collected in the same category at a later stage. Repurposed batteries that are made AOM in a different battery category, will also be collected in a different battery category and are therefore not available for collection in the original category. Two stakeholders stated the need for differentiation between remanufactured and repurposed batteries. One stakeholder did not see a need to differentiate between remanufacturing and repurposing.

Therefore, the complimentary flow R only encompasses the amount of batteries that have not yet obtained the status of 'waste batteries' and are made available on the market again in a different battery category after being repurposed. It should also be noted that in theory, these batteries shall end up in waste treatment and recycling at some point even though in a different (waste) battery category.

Currently, no significant quantities of portable batteries are repurposed, and the market is likely to remain limited due to the properties of these batteries. The repurposing potential for LMT batteries is much larger and the market is predicted to grow significantly by some actors. No historic statistically meaningful data on the quantities of repurposed batteries is available, but it is considered to be relatively low anyway. Stakeholders confirmed that most of the batteries considered for second life are LMT batteries rather than portable batteries.

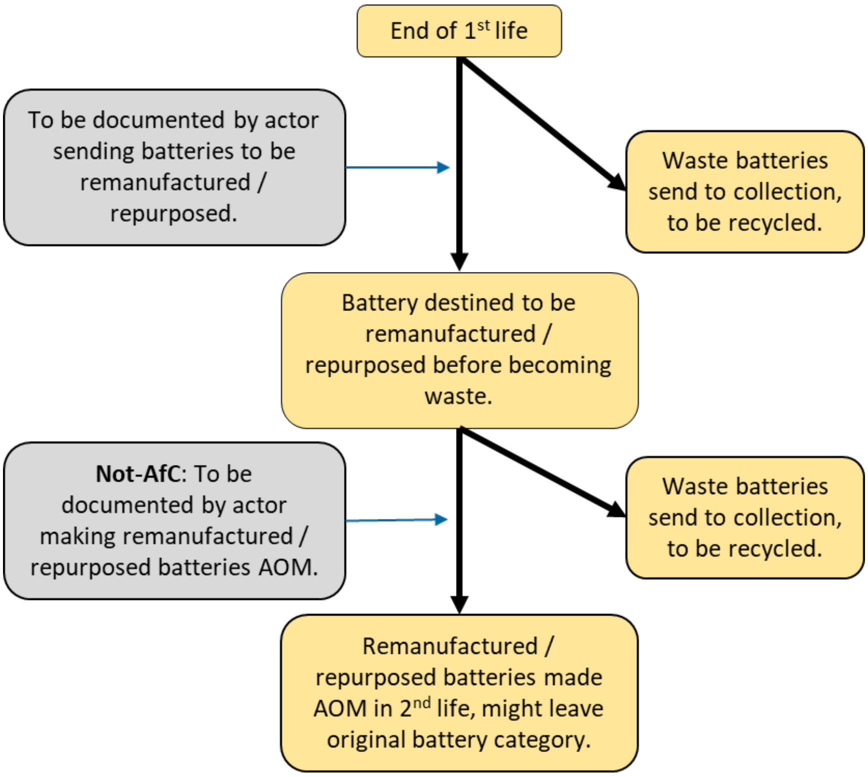
Proper documentation is needed to ensure that batteries declared as not-AfC based on repurposing are truly entering that stream and are made AOM anew after repurposing. Therefore, documentation of batteries being repurposed needs to be done by:

- Actor who sends batteries to be repurposed
- Actor who places a battery on the market after repurposing

When made available anew in the same battery category, the batteries will be collected in the same (waste) battery category but later. Repurposed batteries might permanently leave original battery category in that case they do not need to be collected in this (waste) battery category. It has to be ensured that only those batteries that are finally repurposed and made AOM again are considered as being not-AfC. Figure 18 gives an overview of the batteries destined for repurposing and the points at which actors would need to document the quantity of these batteries. The amount of repurposed batteries being subtracted from WG as not-AfC must be equal to the amount of remanufactured / repurposed batteries being made AOM. Batteries that are exported after being repurposed also need to be considered.

Stakeholders expressed concern how documentation on repurposed batteries for not-AfC will work and how it will impact repurposing activities and clarity on documentation is needed. It was emphasized by stakeholders, that it is important to ensure that a battery can only be counted as not-AfC if it is documentarily proven that the same quantity (by weight) was reintroduced to the market (AOM) in another battery category. Stakeholders also stated that this data needs to be validated, verified and approved. One stakeholder mentioned that they are planning on implementing reporting on MS level on the total of batteries being re-used, remanufactured or repurposed but have concerns. They also stated, that PROs should now ask producers to register repurposed batteries as made available on the market anew.

Figure 18 – Batteries destined for remanufacturing or repurposing



Source: Own diagram (Oeko-Institut)

5.4.3. Default value (DV), criteria and maximum values of deviation from DV

Determination of DV and deviation from DV

There is not enough statistically significant data available to quantify the batteries not-AfC due to remanufacturing and repurposing. Furthermore, data could vary between MS making it impossible to set one representative default value.

As no data is available and situations are probably different locally stakeholders were in favour of a DV of 0 % of WG. Only one stakeholder was in favour of setting a larger DV for this CF. Sakeholders stressed, that it is important that MS can account for batteries not-AfC due to being repurposed and therefore were in favour of allowing a deviation from the DV. stakeholder input also suggested that repurposing of batteries should have no maximum value for the deviation. One stakeholder argued in favour of a maximum value for the deviation of 5 % of WG. One stakeholder also argued that it should be indicated in the CR of the MS in case repurposed batteries were declared as being not-AfC, this is also in line with concerns by other stakeholders with regards to comparability between MS.

In Option 1 a default value of 0% of WG is suggested for both LMT and portable batteries, this is in line with the 2024 JRC report that also proposed a default value of 0 % (Bobba et al., 2024). For portable batteries, no deviation from this default value is possible. For LMT batteries, MS can deviate from the default value and thus consider batteries being repurposed in what is not-AfC. No maximum value is set for the deviation for LMT batteries.

In Option 2, a default value of 0% of WG is suggested for portable batteries and 2 % of WG for LMT batteries. In case data exists on MS level, it would be possible to deviate from the suggested DV for both LMT and portable batteries. To deviate from the suggested default values, the flow of batteries needs to be traced, documented and verified. No maximum value is set for the deviation from the DV.

Documentation and verification: Data should be documented by the actors (PRO, Recycler, etc.) who send batteries to be repurposed as well as the actors who place repurposed batteries on the market and verified through collaboration with the authorized authority in the MS. This is to ensure that every battery that counts as being not available for collection (not-AfC) is made AOM as a repurposed (R) battery and will be collected in the future.

In principle, other options for the DVs, maximum values and deviation from DV would also have been possible. These options were presented at the first stakeholder workshop in September, see Table 19. The DV of 0 % WG remained the same except for LMT batteries in AfC option 2, there the default value was changed to 2% of WG. The option to allow no deviation from the DV was rejected and no maximum value for deviation was set.

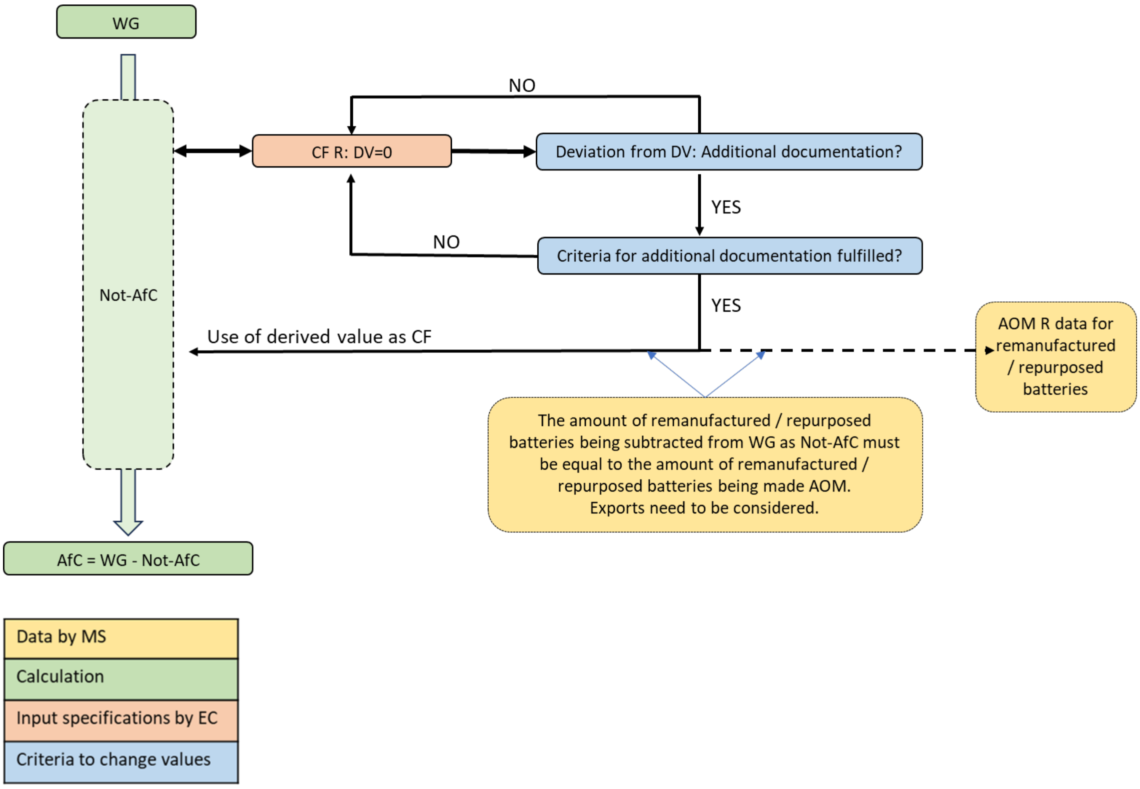
Table 19 – Rejected options for maximum values for deviation from DV of Remanufactured / Repurposed (R)

Default values not-AfC	Maximum values (for deviation from DV)	Criteria (for deviation from DV)
Portable and LMT DV = 0 % of WG	Option 1: No deviation from DV accepted Option 2: No maximum value	Additional documentation by waste management operators and actors making remanufactured / repurposed batteries AOM

Source: Own diagram (Oeko-Institut)

Figure 19 depicts the process flow chart of the CF of repurposed and remanufactured batteries. The process flow chart provides an overview and represents the procedure of how the amount of waste batteries not-AfC in R is determined.

Figure 19 – Process flow chart of CF of repurposed and remanufactured batteries



Source: Own diagram (Oeko-Institut)

WG, AfC and not-AfC principally consider the total values. However, the final results for total AfC and not-AfC also need to take into account all other CFs, as well as all groups of portable (P1/P2) or LMT (LMT 1-4) batteries.

5.4.4. Overview

The following table provides a summary of the results for both options, ‘AfC option 1 – basic methodology’ and ‘AfC option 2 – detailed advanced methodology’, and in each case for both for portable and for LMT batteries not-AfC. The amount of repurposed batteries being subtracted from WG as Not-AfC must be equal to the amount of repurposed batteries being made AOM in a different category than portable batteries. Remanufacturing is considered as an extension of lifetime, similar to re-use, as the purpose of the batteries does not change and therefore is not considered to be not-AfC.

Table 20 – Overview of CF R

Default values not-AfC	Maximum values (for deviation from DV)	Criteria (for deviation from DV)
AfC option 1 – basic methodology		

Default values not-AfC	Maximum values (for deviation from DV)	Criteria (for deviation from DV)
Portable batteries DV = 0 % of WG	No deviation accepted Remanufacturing is considered as an extension of lifetime, similar to re-use, as the purpose of the batteries does not change and therefore is not considered to be not-AfC.	---
LMT batteries DV = 0% of WG	Deviation possible No maximum value Remanufacturing is considered as an extension of lifetime, similar to re-use, as the purpose of the batteries does not change and therefore is not considered to be not-AfC.	Additional documentation by waste management operators and actors making repurposed batteries AOM. The amount of repurposed batteries being subtracted from WG as not-AfC must be equal to the amount of repurposed batteries being made AOM in a different category than LMT batteries. As a prerequisite for permission to deviate from DV data on repurposed batteries must be equally reported (subtracted from WG as not-AfC and AOM in same / different category).
AfC option 2 – detailed advanced methodology		
Portable batteries DV = 0 % of WG	Deviation possible No maximum value Remanufacturing is considered as an extension of lifetime, similar to re-use, as the purpose of the batteries does not change and therefore is not considered to be not-AfC.	Additional documentation by waste management operators and actors making repurposed batteries AOM. The amount of repurposed batteries being subtracted from WG as not-AfC must be equal to the amount of repurposed batteries being made AOM in a different category than portable batteries. As a prerequisite for permission to deviate from DV data on repurposed batteries must be equally reported (subtracted from WG as not-AfC and AOM in same / different category)
LMT batteries DV = 2% of WG	Deviation possible No maximum value Remanufacturing is considered as an extension of lifetime, similar to re-use, as the purpose of the batteries does not change and therefore is not considered to be not-AfC.	Additional documentation by waste management operators and actors making repurposed batteries AOM. The amount of repurposed batteries being subtracted from WG as not-AfC must be equal to the amount of repurposed batteries being made AOM in a different category than LMT batteries. As a prerequisite for permission to deviate from DV data on repurposed batteries must be equally reported (subtracted from WG as not-AfC and AOM in same / different category)

Source: Own diagram (Oeko-Institut)

5.5. Complementary flows (CF) – Import / Export

5.5.1. Legal context, research, data and information

Legal context

For an adequate analysis of this CF, it is necessary to make a distinction between imports and exports and trade within the EU. Hereby, the following definitions or rather wording shall be used in the following contemplation:

- Imports: used batteries (not yet waste) imported from a third country (outside the EU)
- Exports: used batteries (not yet waste) exported to a third country (outside the EU)
- Transfer from another EU MS (trade): used batteries (not yet waste) transferred from another EU Member State
- Transfer to another EU MS (trade): used batteries (not yet waste) transferred to another EU Member State.

This differentiation[8] is crucial due to the fact, that any batteries e.g. exported outside the EU, are deemed lost to the domestic recycling market and materials cannot be recovered. This of course also holds for other R-strategies such as reuse, repurpose and remanufacturing. Furthermore, imported batteries add materials to the domestic EoL recovery potential and must be carefully reported and collected.

Batteries Regulation

In the Batteries Regulation (2024, Recital 16) it is stated that ‘in accordance with the Union framework on product regulation, a used battery that has been imported from a third country is considered to be placed on the market when it enters the Union for the first time.’

WEEE Directive (2012/19/EU)

Since batteries that are exported are most likely to be incorporated into electrical and electronic equipment (EEE), it is essential to include the WEEE

[8] For simplicity's sake, the term and spelling ‘import/export’ is used as a synonym for all four flows in the title and in the text. This ‘abbreviation’ explicitly includes all four battery flows: import, export, transfer from and transfer to another MS.

Directive in this analysis. The directive mandates that WEEE cannot be exported without restrictions and is subject to regulatory oversight. In general, only used EEE (uEEE) is permitted for export, and it must be demonstrated that the equipment is still functional. The following legal text in the WEEE Directive addresses this issue:

> 2. Member States shall ensure that shipments of used EEE suspected to be WEEE are carried out in accordance with the minimum requirements in Annex VI and shall monitor such shipments accordingly.
>
> 4. In order to ensure uniform conditions for the implementation of this Article and of Annex VI, the Commission may adopt implementing acts establishing additional rules on inspections and monitoring and in particular uniform conditions for the implementation of Annex VI, point 2. Those implementing acts shall be adopted in accordance with the examination procedure referred to in Article 21(2)
>
> (Directive 2012/19/EU, 2024, Article 23)

WEEE Directive, ANNEX VI: Minimum requirements for shipments (summarized from (Directive 2012/19/EU, 2024, Annex VI))

The minimum requirements for shipping used electrical and electronic equipment (uEEE) mandate that senders provide documentation to prove the items are intended for direct reuse and are fully functional. This includes a copy of the invoice, testing evidence, and a declaration confirming that the shipment is not waste according to Directive 2008/98/EC. Appropriate packaging to prevent damage is also necessary.

Exceptions apply for business-to-business returns for repair, where some documentation may not be required. Testing and record-keeping procedures must be followed, including functionality tests and detailed records of the equipment.

Every shipment must include relevant transport documents and a liability declaration. Failure to provide the necessary documentation may result in items being classified as waste electrical and electronic equipment (WEEE), which is treated as an illegal shipment. These requirements ensure that only functional devices are shipped and maintain transparency in the shipping process.

(Directive 2012/19/EU, 2024, Annex VI)

Data and information on import / export

According to the JRC report,portable and LMT batteries made AOM for the first time in a Member State can as used batteries be transferred to or from another Member State (MS) or imported/exported out of the EU before reaching their end-of-life. There are different options why such used battery flows take place. Main examples are transfer to/from another MS and import and export from/to third countries of batteries incorporated in used EEE products or in used LMT products. (Bobba et al., 2024)

Well known examples for the trade in used EEE are smartphones and laptops. Internationally active online portals or websites offer a wide range of such ‘refurbished’ products, which are then sold (and procured) across national borders including the embedded batteries. The importance of this used EEE market is also reflected in the fact that major electronics retail chains meanwhile also offer such used refurbished products.

An example of flows of used LMT batteries are companies offering shared mobility. Such companies offer mobility with e.g. e-bikes or e-scooters in different cities. Depending on their business model and how it develops in different countries they move their LMT including the embedded battery that they have made available on the market in one country at a later time to another country.

As another example the JRC report mentions used batteries or products that are send to another country for repair. If it turns out that repair is no longer possible, the battery remains in that country:

> […] batteries or products containing batteries transferred/exported for repair could be considered not repairable, and hence be replaced in a different MS or out of EU borders. In such cases, both the non-repairable battery and its substitution would be made AOM in a certain MS and then collected in a different one or not collected in the EU. (Bobba et al., 2024)

The 2024 JRC report describes a fast-growing market of second-hand electronic products and also provides explanations and more detailed background information. However, the report also shows that there are only a few studies that quantify the market volume or even show the flows between individual countries. Specific quantities of used batteries that are imported or exported or transferred within the EU cannot be derived from this. With regard to the data requirements for the AfC method, it must be taken into account that flows can vary greatly between individual Member States. Depending on the MS, more used EEE may be imported and transferred from than exported and transferred to another Ms, or vice versa. Overall, it must be noted that there is still no data available on the import/export of used batteries to determine the complementary flows not-AfC. (Bobba et al., 2024)

Similar conclusions can be drawn for LMT batteries. The JRC describes a fast-growing market of private LMT and the use of shared mobility and based on this a potentially very relevant flows of used LMT-products. However, once again concerning the used LMT batteries, there is no data available on flows of second-hand products transferred to/from MS or imported / exported from outside the EU. (Bobba et al., 2024)

The only data that could be found from publicly accessible and referenceable data sources regarding uEEE exports, is the ‘First Dutch Battery Flows Monitor – 2020’ by UNITAR (Forti & Baldé, 2020). This report presents a baseline study of portable battery waste flows in the Netherlands for the year 2019, utilizing a replicable methodology aligned with the Dutch WEEE Flows 2020 study. The primary objective is to provide evidence-based information to assess the collection rate of waste batteries and monitor previously undocumented battery flows. (Baldé et al., 2020)

Key findings from the study for the year 2019 include:

- A total of 9.3 kilotonnes (kt) of batteries were placed on the market (POM) in the Netherlands.
- There were 24.2 kt of batteries in use or hibernating in households, companies, and the public sector.
- Approximately 9.5 kt of batteries became waste batteries.

In terms of battery waste flows from the 9.5 kt generated:

- 4.6 kt was compliantly declared in 2019:
    - 3.7 kt was separately collected by StiBat (the PRO for batteries in the Netherlands).
    - 0.9 kt was reported by other recyclers and collectors.
- 2.6 kt was disposed of in residual solid waste:
    - 1.8 kt as loose batteries.
    - 0.8 kt embedded in WEEE.
- 0.9 kt was embedded in WEEE but not compliantly recycled or declared.
- **0.4 kt was embedded in exported used electrical and electronic equipment (uEEE) and WEEE**

This complementary flow of 0.4 kt was transferred to the EU level and compared to the total WG (EU27). The recalculation results in 4.2 % of WG.

These findings for the Netherlands can be used as rough orientation. No data could be retrieved for LMT batteries.

5.5.2. Methodological approach for quantification of CF

Transfers of used LMT and portable batteries take place within the EU, alongside imports and exports outside the EU; however, the quantities involved are currently not quantifiable. For imports and transfers from another MS, it is important to note that batteries 'made available on the market for the first time in the territory of a Member State' shall be properly registered and reported by producers/PROs, in line with Article 75 of the Batteries Regulation (2024), and therefore data on new batteries AOM should be available. It also needs to be considered that batteries transferred from a MS (within EU) and imported from third countries (outside EU) are not distinguished between used or new battery AOM. This means importers and transferrers of used batteries are required to register with a Producer Responsibility Organization (PRO), regardless of whether the batteries are used or new. Consequently, the number of new batteries AOM should also consider imported used batteries. Nonetheless, it is acknowledged that in practice, particularly for batteries transferred within the EU, there is a possibility that batteries entering a receiving Member State may bypass the registration process. However, without sufficient data, quantifying this number for further consideration is not possible. Overall, imports and transfers from another MS of used batteries do not require a default value or deviation from a DV as these flows are already covered by the AOM data.

This leaves the development of an approach to determine the volume of used batteries exported and transferred to other MS. It should be kept in mind that this is not a net trade approach – as imports are already covered by AOM – but solely concerns quantities exported and transferred to another MS. Generally, it is assumed that all MS export and transfer to another MS a certain amount of used EEE and LMT. It therefore seems justified to establish a default value that applies to all Member States. In line with a conservative approach, i.e. to avoid declaring excessive quantities as not-AfC, this value should be based on low export flows. However, in order to be able to represent the different and actual export flows of the countries as realistically as possible, deviations from the DV should be possible. Permission to deviate from DV should only be granted when trade flows are traced, properly documented and verified. The JRC report describes the justification of a potential deviation from DV as follows:

> Concerning batteries freely traded and moved between Member State for second-hand market ($IsHt$,$Category$ and $EsHt$,$Category$), data on such two CFs should be derived tracing the flows of trade between Member States or from/to third Countries. To replace the default values, these two CFs shall be properly documented and verified (…). Moreover, in

case of internal trade of batteries within the EU, these flows should be verified by trade actors, i.e. the destination of batteries should be identified and properly documented by producers/PROs to justify the deduction/addition. In this case, no thresholds are needed for the calculation of the amount of waste batteries AfC. (Bobba et al., 2024)

5.5.3. Default value (DV), criteria and maximum values of deviation from DV

Determination of DV and deviation from DV

Batteries transferred from MS (within EU) and imported from third countries (outside EU) are assumed to be registered and recorded in the receiving MS (included in AOM). Therefore, no default value and no deviation from DV for imports and transfers from another MS is necessary for portable and LMT batteries.

However, for exports outside EU and transfers to another MS it has to be acknowledged that such flows of used batteries generally take place. The amount of used batteries exported or transferred to another MS will depend on the MS. In line with a conservative approach and not to deduct too many batteries as not-AfC, a DV of 3% of WG is proposed, which remains below the value derived from (Baldé et al., 2020). A compensation for a not complete registration of all used batteries imported and transferred to a MS (no registration by private end-users, unregistered imports: online trade / ‘free-riders’) is already included in this DV of 3% of WG.

No data on import / export of used batteries is available that would justify any difference between portable and LMT batteries. Therefore, the same DV = 3% of WG shall be applied for portable and LMT batteries.

Following the simplified approach of AfC option 1 no deviation from the DV for exports outside EU and transfers to another MS is foreseen for option 1. However, if the real conditions are to be better reflected, country-specific differences must be taken into account. Therefore, MS may deviate from the DV in AfC option 2 and deduct the country-specific data on exports and transfers to another MS. Any deviation from the DV requires a comprehensive documentation of the trade flows.

Generally, all stakeholder feedback supports the deduction of exports as not-AfC. Regarding the default values the feedback is not clear. An equal number of stakeholders preferred DV = 0 and DV > 0. However, at least three stakeholders are in favour of a possible deviation from the DV.

Criteria for deviation from DV

Any deviation from DV for batteries transferred to MS (within EU) and exported to third countries (outside EU) in AfC option 2 shall be derived by tracing the trade flows of used batteries.

Generally, all trade flows should be documented in a transparent, understandable and plausible manner. The basic approach and a prerequisite for permission to deviate from DV is balanced trade data between MS. This means that data shall equally cover all potential transfers from and to MS (inside EU) and imports and exports (outside EU). A kind of a 'balancing system' between MS' PRO (ensuring that transferred batteries are properly accounted for as AOM in the destination country) was also mentioned by two stakeholder feedbacks. Therefore, the destination of used batteries (transfers to / exports) should be identified and properly documented by producers/PROs to justify a deduction.

For EU-internal trade, matching of individual trade flows between MS (at PRO level) shall be done through a strong collaboration. This is to ensure that those batteries which from the perspective of the receiving PRO are transferred from another MS are equally considered as AOM in the receiving MS. As a consistency check the documentation shall also confirm that indeed all imports and transfers to MS are completely included in the AOM data.

An independent 'third party' could generally take over the task to verify the trade data that shall be used for the deduction of country-specific exports and transfers to other MS. Such an inspection body was also requested by a stakeholder feedback for a general verification of 'updated values'.

The required documentation as a criterion for the acceptance of a deviation from DV can be done on the level of individual battery groups (P1-2, LMT 1-4) or as total amounts of portable or LMT batteries. Furthermore, a deviation from DV can only be done every 5 years.

In addition, the general requirements for deviation from default values in chapter 6.2 apply.

Maximum value of deviation from DV

Generally, no maximum value should be imposed upon transfers within the EU. There is also no need for a maximum value for imports into the EU as imports as well as transfers from another EU Member State are assumed to be registered in the receiving MS. What remains is a potential development of a maximum value of deviation from DV for export outside the EU in AfC option 2.

Such a maximum value would take into account a restriction on potential waste and resources losses due to shipments to third countries. An aspect that was also mentioned by a stakeholder as feedback to the first stakeholder workshop. Such a limitation would support the EU's strategic and political concept of circular economy. At the same time, such a restriction of trade would be contrary to the principle of free trade. Therefore, it is assumed that a maximum value of deviation that represents a restriction of free trade cannot be implemented. Consequently, no maximum values for exports outside the EU are proposed.

The stakeholder feedback on the application of maximum values is not straight forward. On the one hand, there were only two responses to this specific point, one in favour of a maximum value and one against.

In principle, options for determining maximum values for deviation from DV would have been possible. These options were presented at the first stakeholder workshop in September 2025 and are listed in Table 21. However, due to a higher priority of the free trade principle, these options and generally a maximum value that limits import/export were rejected.

Table 21 – Rejected options for maximum values for deviation from DV of import / export

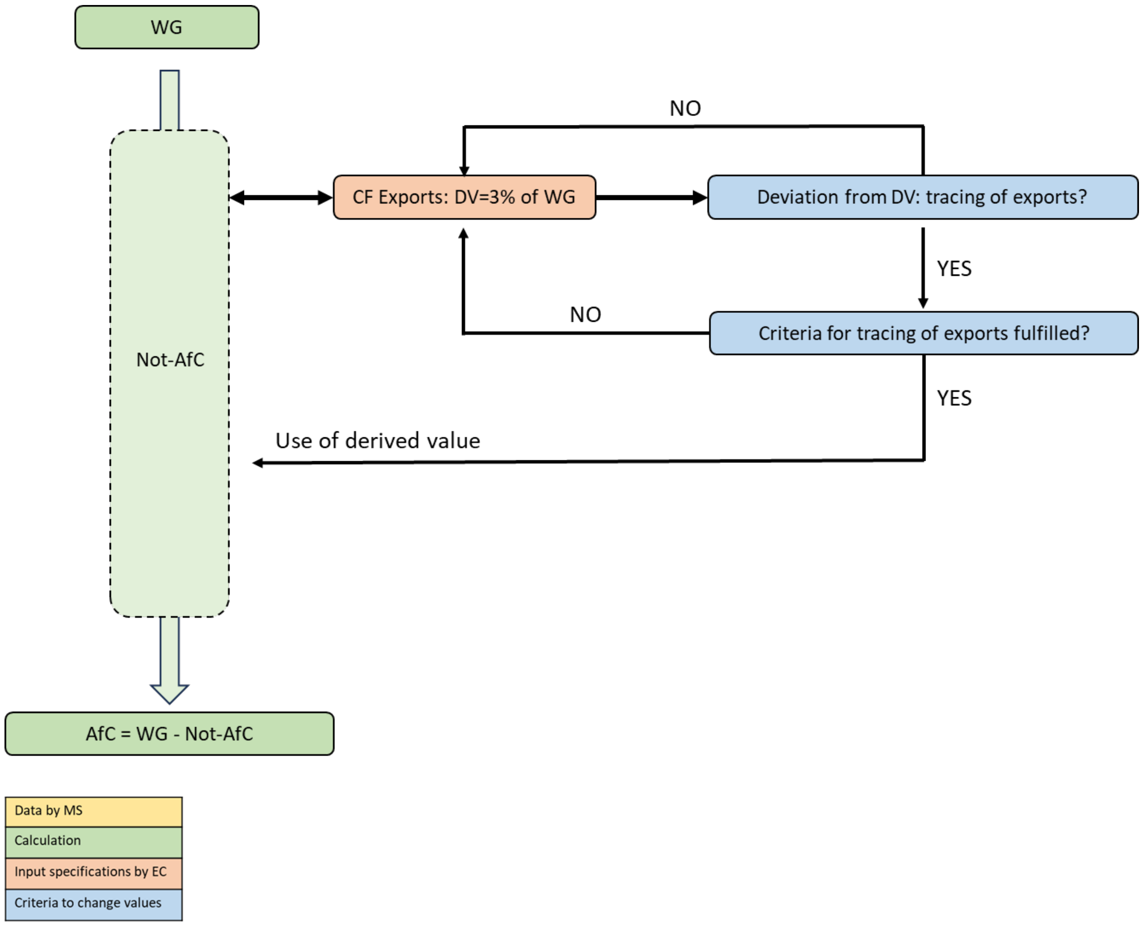
Default values not-AfC	Maximum values (for deviation from DV)	Criteria (for deviation from DV)
Portable and LMT DV = 0% of WG for imports / exports and transfers within EU	No maximum values for trade within EU and imports into EU Option 1: No deviation from DV accepted Option 2: 5% of WG for batteries exported outside EU Option 3: option 2 decreases over time; e.g. 3% of WG after 5 years	Deviation shall be derived by tracing the trade flows of used batteries Trade needs to be properly documented and verified. Data shall equally cover all potential transfers from AND to MS (inside EU) and imports AND exports (outside EU)

Source: Own table (Oeko-Institut)

Process flow chart of CF of batteries exported not-AfC

The following process flow chart provides an overview and represents the procedure of how the amount of used batteries not-AfC is determined.

Figure 20 – Process flow chart for the complementary flow of batteries exported (not-AfC)



Source: Fraunhofer IZM

Note: WG, AfC and not-AfC principally consider the total values. However, the final results for total AfC and not-AfC also need to take into account all other CFs, as well as all groups of portable (P1/P2) or LMT (LMT 1-4) batteries.

5.5.4. Overview

The following table provides a summary of the results for both options, ‘AfC option 1 – basic methodology’ and ‘AfC option 2 – detailed advanced methodology’, and for both for portable and for LMT batteries not-AfC. In the case of imports/exports no distinction is made between portable and LMT batteries.

Imports of used batteries (not yet waste) into an EU Member State and transfers from another EU Member State have no default value, since these are assumed to be registered at a PRO. However, it remains unclear if imports / transfers from another MS are always properly and completely registered. Therefore, a balanced approach to equally document imports and exports (outside EU) and transfers from and to MS (inside EU) is a prerequisite for deviating from the default value of 3% of WG.

Table 22 – Overview CF Import / Export

Default values not-AfC	Maximum values (for deviation from DV)	Criteria (for deviation from DV)
AfC option 1 – basic methodology		
Portable and LMT DV = 3% of WG for exports and transfers to another MS	Exports outside EU and transfers to another MS: no deviation from DV accepted (No DV, no maximum values for imports and transfers from another MS)	---
AfC option 2 – detailed advanced methodology		
Portable and LMT DV = 3 % of WG for exports and transfers to another MS	No maximum values for trade within EU and exports outside EU[9] (No DV, no maximum values for imports and transfers from another MS)	Deviation shall be derived by tracing the trade flows of used batteries. Trade needs to be properly documented and verified. Balance trade data between MS: data shall equally cover all potential transfers from AND to MS (inside EU) and imports AND exports (outside EU) and are a prerequisite for permission to deviate from DV

Source: Own diagram (Oeko-Institut and Fraunhofer IZM)

[9] A maximum value of e.g. 5% of WG for batteries exported outside EU would support the EU's circular economy concept. However, due to trade regulations, no limit (maximum value) on exports should be defined.

6. AfC methodology – Further aspects and requirements

6.1. Calculation of one final collection rate (CR)

In the Batteries Regulation collection targets for the collection rate (CR) are set for all portable batteries and all LMT batteries. There are no individual targets for the subgroups P1 and P2 and LMT 1-4.

In AfC option 1 one CR is calculated per battery category (portable and LMT batteries). The CR is based on the batteries AfC and the collected waste batteries per category. When presenting the results of the collection rate achieved the CR, for those MS that have batteries not-AfC coming from the complimentary flow of repurposed batteries, could be marked or flagged to increase compatibility and transparency between MS[10].

In the case of AfC option 2, AOM data and furthermore WG and AfC will be calculated per battery subgroup. Therefore, an approach how to calculate one final collection rate per battery category is necessary. First WG is calculated separately for all battery subgroups P1/P2 and separately for LMT 1/2/3/4 based on their individual average lifetime. The CFs can also differ for P1/P2 and for LMT 1/2/3/4, resulting in differing AfC values per battery subgroup.

The data on collected batteries is not necessarily specific for the different battery subgroups. Therefore, the CR can be determined in two different ways.

If MS have the collection data not separated into subgroups but rather for all portable and all LMT batteries, they first need to determine the total amount of batteries AfC. Adding up AfC(P1) and AfC(P2) for portable batteries and AfC(LMT1), AfC(LMT2), AfC(LMT3) and AfC(LMT4) for all LMT batteries. Based on these total amounts of batteries AfC MS can determine the CR for portable and LMT batteries.

Example for portable batteries:

$$AfC(P1) + AfC(P2) = AfCtot(P)$$

$$CR(P) = \frac{col(P)}{AfCtot(P)} \times 100$$

[10] A stakeholder feedback proposed that the collection rate should provide information on whether individual values were used for a CF.

Where:

AfC(P1): portable batteries available for collection, subgroup P1 non-rechargeable batteries

AfC(P2): portable batteries available for collection, subgroup P2 rechargeable batteries

AfCtot(P): total portable batteries available for collection

CR(P): collection rate of portable batteries

col(P): portable batteries collected

If MS have data on collected waste batteries available per subgroup, they could calculate CR for the differing battery subgroups. In addition, it would be necessary to calculate one final CR based on the weight percentage and the CR of the individual subgroup.

Example for portable batteries:

If col(P1) and col(P1) are available:

1. Calculate AfC(P1) and AfC(P2) separately based on WG(P1), WG(P2), not-AfC(P1) and not-AfC(P2)
2. Calculate CR(P1) and CR(P2) separately and combine to one CR for all portable batteries:

$$CR(P1) = \frac{col(P1)}{AfC(P1)} \times 100$$

$$CR(P2) = \frac{col(P2)}{AfC(P2)} \times 100$$

$$CR(P) = CR(P1) \times W\%(P1) \; + \; CR(P2) \times W\%(P2)$$

Where:

AfC(P1): portable batteries available for collection, subgroup P1 non-rechargeable batteries

AfC(P2): portable batteries available for collection, subgroup P2 rechargeable batteries

col(P1): portable batteries collected, subgroup P1

col(P2): portable batteries collected, subgroup P2

CR(P1): collection rate of portable batteries, subgroup P1

CR(P2): collection rate of portable batteries, subgroup P2

CR(P): collection rate of portable batteries, total

W%(P1): share of portable batteries, subgroup P1

W%(P2): share of portable batteries, subgroup P2

3. Finally, when multiple producers and/or PROs calculate CRs in one MS, a final CR for the MS needs to be calculated based on the weight-based share of waste batteries collected by each of the producers/ PROs in the reference year.

6.2. Requirements for deviation from default values (DV)

The following chapters gives an overview on the applicable general criteria for deviation from the default values (DV). Specific criteria for the individual default values were already explained in the previous chapters. In case a Member States / PRO wants to deviate from a DV, it can only be done if a more specific and/or updated value is available. Any deviation from a DV shall be based on relevant data and evidence, verified by the competent authorities of the MS and properly documented and sent to the EC for approval. While PRO may provide data, information and relevant evidence on a national level, the MS authorities shall be responsible for any documentation, verification and potential approval towards the EC. In case of deviation from the DV, evidence needs to be provided by the MS that demonstrates that also with the revised values an equivalent ambition, see chapter 7, is maintained.

The following overview lists the main criteria to accept deviation from the default values. It essentially reflects the minimum requirements already set out in the 2024 JRC report (Bobba et al., 2024).

Representativeness:

- The sample shall be representative of the entire territory of the Member State.
- It shall provide results based on recent data (no more than 2 years prior to the year of presentation of the relevant data and evidence).

Suitability of adopted methods:

- Sampling method: define the sampling approach.
- Average value: define how the average is calculated.

- Uncertainty: assess and report the uncertainty of the average data used in the calculation.
- The relevant data and evidence shall include the calculation of the WG and the AfC using both the default values and the proposed updated values.

Evidence and validation:

- Provide evidence such as official market surveys, officially reported data (or data documentation), audit results, or analyses if new values are to be accepted as replacements or deviations from DV.

Changes of default values (DV):

- DV can be changed only to a limited extent to avoid abrupt changes and to ease comparability of results between MS (maximum values apply).

Data documentation quality:

- Granularity, transparency, and analysis of coverage, precision, representativeness, completeness, consistency, reproducibility, sources, and uncertainty of the values used are criteria for data documentation to the EC.

Timing considerations:

- Until the EC/MS confirms the request to replace certain values, default values shall be used.
- A request to accept data variation can be submitted only once every 5 years.

7. Scenario calculations, collection targets, equivalent ambition

7.1. Scenario calculations

The results of scenario calculations for portable and LMT batteries are discussed below. The calculations are presented separately for AfC option 1 and AfC option 2 and show the results of the amount of batteries (in tonnes) of EU27. The calculations are mainly based on the data and default values that are determined in the chapters 4 and 5. More details are provided in the following chapters on the specific calculations.

7.1.1. Portable batteries

AfC option 1 – basic methodology

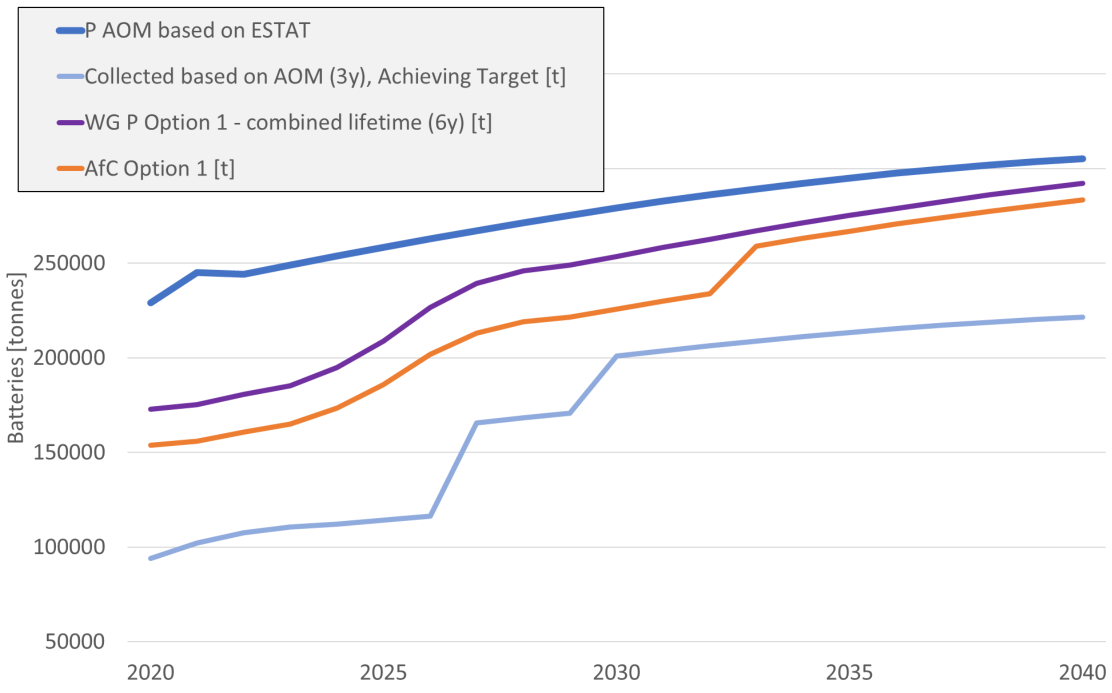
Figure 21 shows the scenario calculation of portable batteries based on AfC option 1. The figure provides the results of the amounts of portable batteries (in tonnes) for EU27 starting in year 2020 up to 2040. Amounts are given for the total portable category not differentiated into subgroups P1 and P2. Data on portable batteries made available on the market (AOM) shows a more or less constant increase from the starting year up to 2040 ('P AOM based on ESTAT'). The years during the Covid-19 pandemic period at the beginning of the timeline represent an exception. Waste batteries generated (WG) is calculated based on AOM and takes into account the default value (DV) of the average lifetime for portable batteries.

Table 23: complementary flows (CF) not available for collection (not-AfC) In the basic AfC option 1 for portable batteries

CF	Portable batteries not-AfC in % of WG
MMW	8%, after 5 years 0%
WEEE	0%
Repurposed	0%
Exports	3%
Average lifetime	6 years

The CFs are based on the DV for MMW, WEEE, Repurposing and Exports, which do not allow for any deviation from the DV. Thus, portable batteries not available for collection in total account for 11% of WG, and 3% of WG when the DV of MMW is reduced to 0% of WG after 5 years. These amounts for not-AfC are subtracted from WG. Subsequently, the amounts of portable batteries available for collection (AfC) account for 89% of WG (AfC = WG – not-AfC; respectively 97% of WG). Both graphs in Figure 21, WG (‘WG Option 1 - combined lifetime (6y)’ and AfC (‘AfC Option 1’), are very similar; however, AfC is characterized by the complementary flow of MMW and the reduction of its DV from 8% to 0% of WG by the year 2033.

Figure 21 – Portable batteries (tonnes): AfC option 1 scenario calculation, EU27



Source: Own diagram (Oeko-Institut)

Figure 21 also shows the amount of portable batteries (‘Collected based on AOM (3y), Achieving target’) that correspond to the waste batteries that need to be collected in order to fulfil the AOM collection target (calculation based on (Regulation (EU) 2023/1542, 2024, Annex XI)). The collection target of portable batteries increases from 45 % by 31 December 2023 to 63 % by 31 December 2027 and further to 73 % by 31 December 2030 (Regulation (EU) 2023/1542, 2024, Article 59). The figure shows that during the entire timeline the amount of batteries AfC (‘AfC Option 1’) exceeds considerably the amount of batteries necessary to be collected for achieving the AOM collection target (‘Collected based on AOM (3y), Achieving target’).

The scenario calculation also includes collection targets based on the AOM methodology. ‘Collected based on AOM (3y), Achieving target’ represents the amount of waste batteries that would need to be collected to achieve the AOM collection targets according to the AOM target values in the Batteries

Regulation (2024) Article 59 (45%, 63% and 73%). It is clear, then when the AOM target values of article 59 are applied the amount of waste batteries that would have to be collected is below the AOM collection targets according to the Batteries Regulation during the entire timeline. Therefore, the AfC target values need to be higher than the AOM targets in BattReg (2024) Article 59 when the same amounts of waste batteries collected shall be achieved.

AfC option 2 – detailed advanced methodology

Figure 22 shows the results of the scenario calculation of portable batteries based on AfC option 2. Amounts are given for the total amounts of portable batteries (in tonnes). The figure does not display the separate subgroups P1 and P2. The AOM data ('P AOM based on ESTAT') is identical with the AOM data of AfC option 1 in Figure 21.

Waste batteries generated (WG, see 'WG P DV lifetimes') is calculated based on AOM and takes into account the default values of the specific average lifetimes of the portable battery subgroups P1 and P2. If WG were calculated based on the maximum average lifetimes (DV + 25%) instead of the DV average lifetimes, portable batteries would only become waste only later. In that case, the graph of WG would be lower than the 'WG P DV lifetimes' graph and would shift to later years.

In this detailed AfC option 2 scenario, two different variations of the amount of the complementary flows (CF) that are not available for collection (not-AfC) were considered. The first variation makes use of the default values for all CF (see 'AfC Option 2 DV'):

Table 24: complementary flows (CF) not available for collection (not-AfC) In the detailed AfC option 2 with default values for portable batteries

CF	Portable batteries not-AfC in % of WG
MMW	10 %, after 10 years 3%
WEEE	0%
Repurposed	0%
Exports	3%
average lifetimes	P1 = 4 years, P2 = 9 years

The CF are based on the DV of MMW, WEEE, Repurposing and Exports without deviation from the DV. Thus, the total amount of portable batteries not available for collection accounts for 13% of WG, whereas the amount of portable batteries not available for collection when the DV of MMW is reduced to 3% of WG after 10 years accounts for 6% of WG. These not-AfC amounts are subtracted from the WG. The amounts of portable batteries available for collection (AfC) (see ‘AfC Option 2 DV‘) account for 87% of the WG (AfC = WG – not-AfC; respectively 94% of WG).

The second variation for the amounts of the complementary flows (CF) that are not available for collection (not-AfC) considers the maximum values for deviation from the DV. The following values for the CF apply (see ‘AfC Option 2 - Maximum values’):

Table 25: complementary flows (CF) not available for collection (not-AfC) In the detailed AfC option 2 with maximum values for portable batteries

CF	Portable batteries not-AfC in % of WG
MMW	16%, after 5 years 10%, after 10 years 3%
WEEE	2%; after 5 years 0%
Repurposed	0%
Exports	3%
Average lifetimes	P1 = 5 years, P2 = 11.25 years

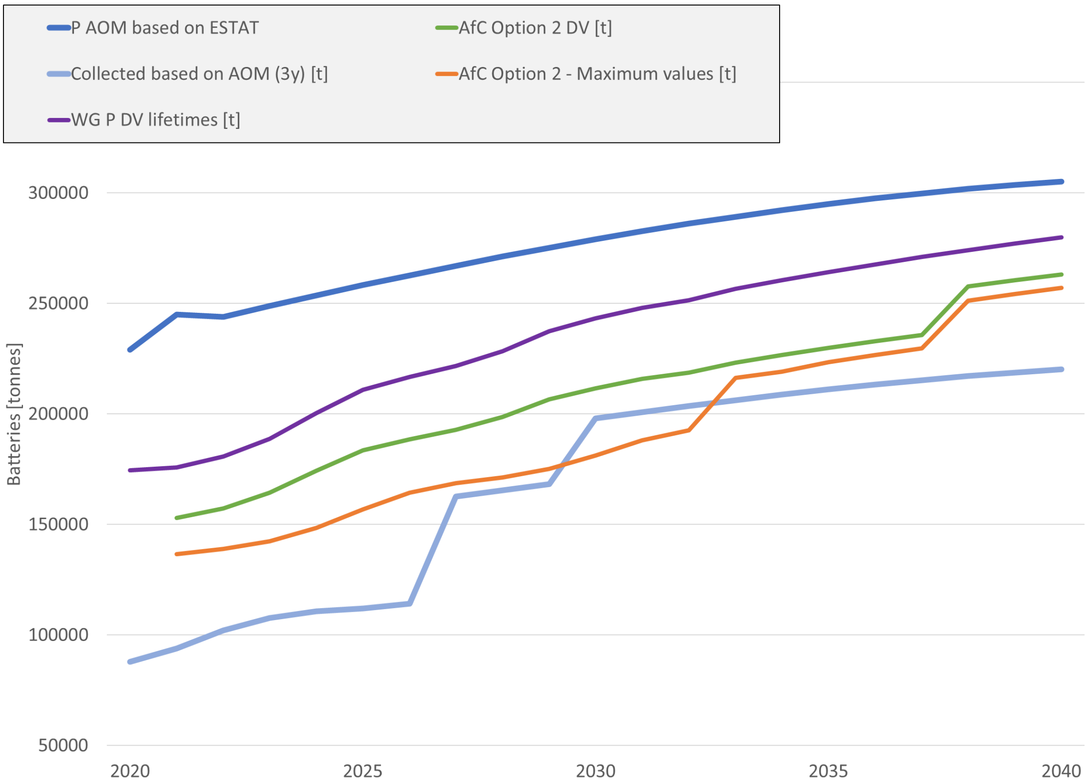
In case of the second variation, the CF are based on the DV of Repurposing and Exports. However, the maximum values for deviation from DV are set for MMW (16% of WG) and WEEE (2% of WG) (and also for the average lifetimes). Therefore, portable batteries not available for collection in total account for 21% of WG and are step-wise reduced to 6% of WG after 10 years. These amounts not-AfC are subtracted from WG. Subsequently, the amounts of portable batteries available for collection (AfC) (see ‘AfC Option 2 - Maximum values‘) account for 79% of WG (AfC = WG – not-AfC; respectively 94% of WG).

Both AfC graphs in Figure 22, ‘AfC Option 2 DV’ and ‘AfC Option 2 - Maximum values‘, are similar, however, they differ in the reduction of the complementary flow of MMW. The figure also shows the amount of portable batteries (‘Collected based on AOM (3y)’) that correspond to the waste batteries that need to be collected in order to fulfil the AOM collection targets of 45%, 63% and 73% (Regulation (EU) 2023/1542, 2024, Article 59); calculation based on (Regulation (EU) 2023/1542, 2024, Annex XI).

Figure 22 shows that during the entire timeline the amount of batteries AfC based on the default values for the complementary flows (‘AfC Option 2 DV’) exceeds clearly the amount of batteries necessary to be collected for achieving the AOM collection target (‘Collected based on AOM (3y)’). In case of the second variation based on the maximum values, the amount of batteries AfC ‘AfC Option 2 - Maximum values‘ is partly lower (between the years 2030 and 2033) than the amounts of batteries necessary for achieving the AOM collection target (‘Collected based on AOM (3y)’).

When comparing these AfC amounts of portable batteries with the AOM amounts of batteries necessary to be collected for achieving the AOM collection target it needs to be considered that so far, no AfC collection targets are applied on the AfC amounts. Any AfC collection target with a target value of less than 100% would reduce the values of the graphs of ‘AfC Option 2 DV’ and ‘AfC Option 2 - Maximum values’.

Figure 22 – Portable batteries (tonnes): AfC option 2 scenario calculation, EU27



Source: Own diagram (Oeko-Institut)

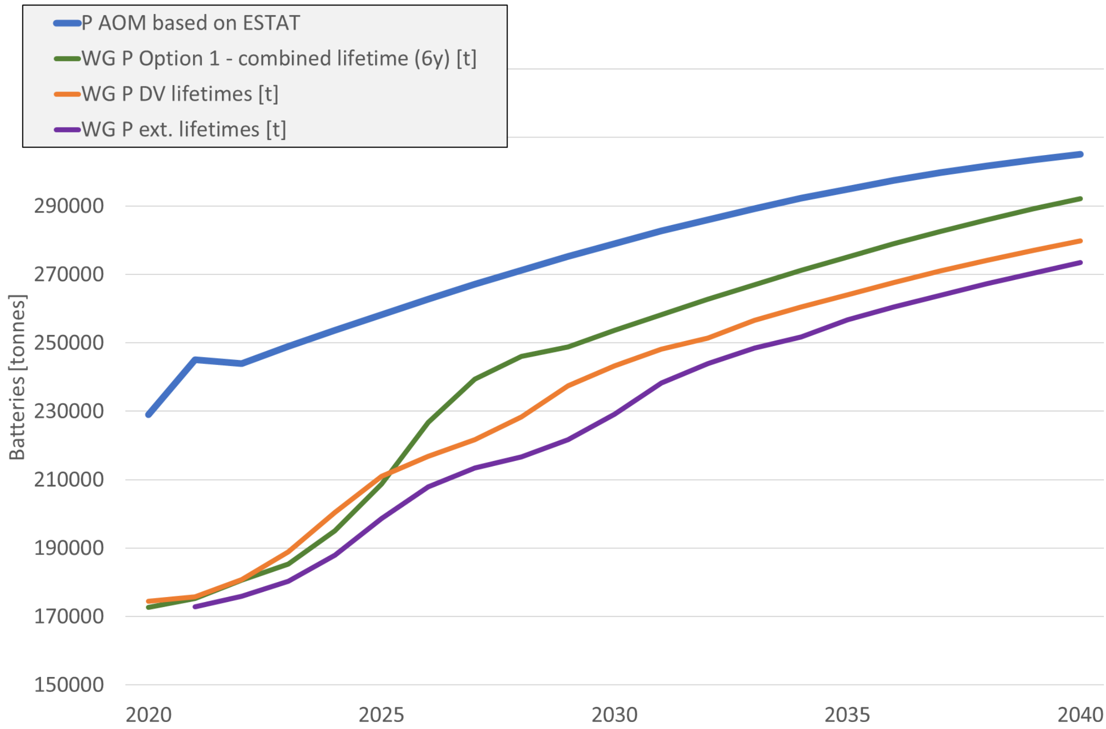
Comparison of different lifetimes of portable batteries

The impact of the average lifetime on the generated waste was considered for portable batteries. Three scenarios are compared here, see Figure 23. The first is a scenario with a combined average lifetime of 6 years for portable batteries (see ‘WG P Option 1 – combined lifetime (6y)’ for AfC option 1). A scenario with two separate average lifetimes of 4 years for P1 and 9 years for P2 (see ‘WG P DV lifetimes’ for AfC option 2). And a scenario with two separate longer average lifetimes for P1 (5 years) and P2 (11.25 years), represented by ‘WG P ext. lifetimes’.

Looking at Figure 23 it becomes clear that the longer average lifetimes reduce the amount of waste batteries generated in a given year, as it is based on older lower AOM data. A separate consideration of the battery average lifetimes of P1 and P2, in contrast to one combined average lifetime, also reduces the amount of waste batteries generated from 2025 onwards. Consideration of two separate average lifetimes also accounts for the assumed increase of rechargeable portable batteries (P2) in the total share, therefore the amount of generated waste batteries per year also stays lower in the future. As no complimentary flows (CFs) were considered in these calculations it should be mentioned that the longer average lifetimes lead to a postponement of the collection of waste batteries. These waste batteries will, in theory, be collected but at a later stage.

Figure 23 – WG and batteries collected for different average lifetimes

Collected is based on the collection targets set in the Batteries Regulation



Source: Own diagram (Oeko-Institut)

7.1.2. LMT batteries

AfC option 1 – basic methodology

Figure 24 shows the scenario calculation of LMT batteries based on AfC option 1. The figure provides the results of the amounts of LMT batteries (in tonnes) for EU27 starting in year 2020 up to 2040. Amounts are given for the total LMT category not differentiated into LMT subgroups 1 to 4. Data on LMT batteries made available on the market (AOM, see 'AOM LMT EU-27') in this calculation is demand driven and therefore includes sales data of new LMT, however, also repurposed and imported LMT batteries. The AOM growth rate is slowing down over the years. Waste batteries generated (WG, see 'WG LMT Option 1 (DV, 8y)') is calculated based on AOM and takes into account the LMT default value (DV) of the average lifetime.

In this basic scenario, the amounts of the complementary flows (CF) not available for collection (not-AfC) are given as follows:

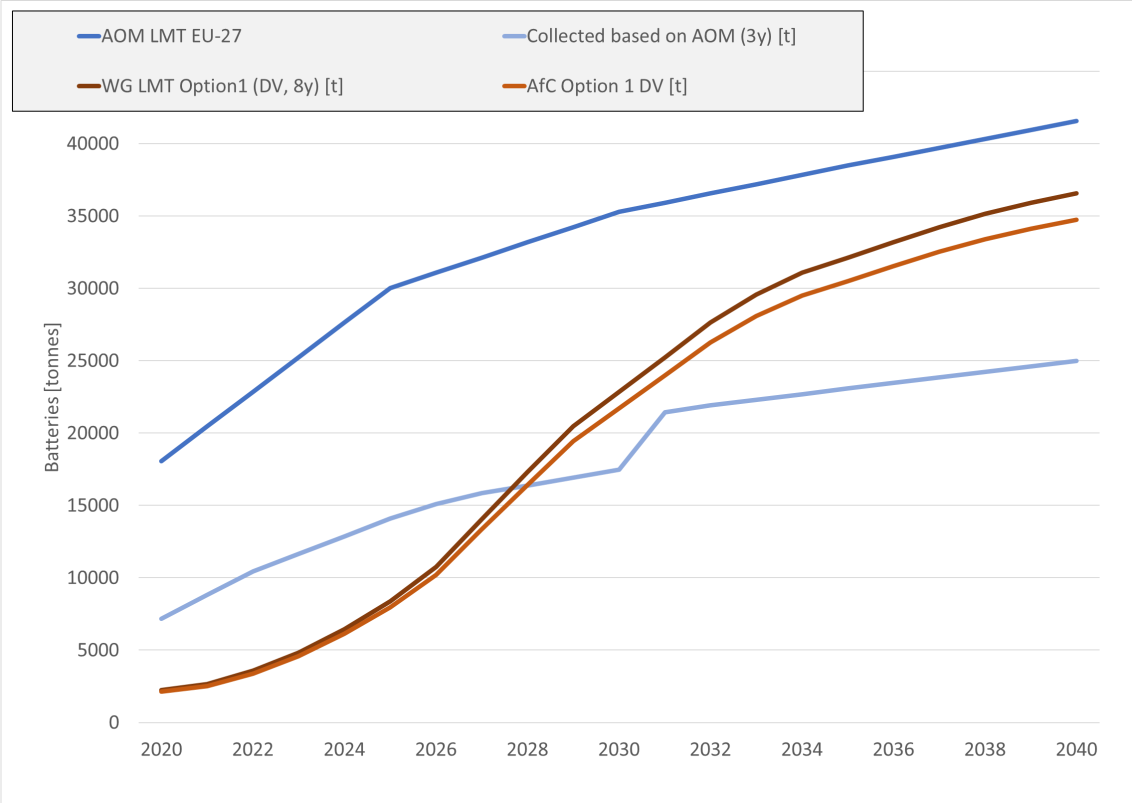
Table 26: complementary flows (CF) not available for collection (not-AfC) In the basic AfC option 1 for LMT batteries

CF	LMT not-AfC in % of WG
MMW	0%
WEEE	0%
Repurposed	2%
Exports	3%
average lifetime	8 years

The CF are based on the DV of MMW, WEEE and Exports. For the CF of repurposed batteries, a deviation from DV of 2% of WG is taken into account. Thus, LMT batteries not-AfC in total account for 5% of WG. These amounts not-AfC are subtracted from WG. Thus, the amounts of LMT available for collection (AfC, see 'AfC Option 1 DV') account for 95% of WG (AfC = WG – not-AfC) and are very similar to the graph of WG ('WG LMT Option 1 (DV, 8y)') in Figure 24.

The figure also shows the amount of LMT batteries ('Collected based on AOM (3y)') that correspond to the waste batteries that need to be collected in order to fulfil the AOM collection target (calculation based on Annex XI, Batteries Regulation). The LMT collection target (Regulation (EU) 2023/1542, 2024, Article 60) increases from 51 % by 31 December 2028 to 61 % by 31 December 2031. The figure shows that up to about 2028, fewer waste batteries will be generated than would be necessary to achieve the AOM collection target of 51%. Only in the years beyond 2028 the amount of batteries AfC ('AfC Option 1 DV') exceeds the amount of batteries necessary to be collected ('Collected based on AOM (3y)') for achieving the AOM collection target.

Figure 24 – LMT batteries (tonnes): AfC option 1 scenario calculation, EU27



Source: Own diagram (Oeko-Institut)

AfC option 2 – detailed advanced methodology

Figure 25 shows the results of the scenario calculation of LMT batteries based on AfC option 2. Amounts are given for the total amounts of LMT batteries (in tonnes). The figure does not display the separate subgroups LMT 1 to 4. The demand driven AOM data (sales, including repurposing, imports/exports), see 'AOM LMT EU-27', is identical with the AOM data of AfC option 1.

Waste batteries generated (WG, see 'WG LMT DV lifetimes') is calculated based on AOM and takes into account the default values of the specific average lifetimes of the LMT groups LMT 1 to 4. A second WG, see 'WG LMT ext. lifetimes', is calculated based on the maximum average lifetimes (DV + 25%) instead of the DV average lifetimes. In this second scenario, the LMT batteries become waste only some time later. The graph of second WG ('WG LMT ext. lifetimes') is clearly lower than 'WG LMT DV lifetimes' respectively it is shifted to later years.

In this detailed advanced scenario two different variations for the amounts of the complementary flows (CF) not available for collection (not-AfC) were considered. The first variation makes use of the default values for all CF (see 'AfC Option 2 DV'):

Table 27: complementary flows (CF) not available for collection (not-AfC) In the detailed AfC option 2 with default values for LMT batteries

CF	LMT not-AfC in % of WG
MMW	0%
WEEE	0%
Repurposed	2%
Exports	3%
average lifetimes	LMT1 = 5 years, LMT2 = 10 years, LMT3 = 2 years, LMT4 = 3 years

These values are identical with the CF values of AfC option 1 further above. They differ in their default values of the average lifetimes. In AfC option 1 a general default value of the average lifetime of 8 years was used for all LMT batteries. In this AfC option 2 scenario the default values for the individual average lifetimes per LMT group 1 to 4 were used. Therefore, the resulting AfC graph (‘AfC Option 2 DV‘) of this AfC option 2 is similar (but shifted to future years) to the graph ‘AfC Option 1 DV’ of the AfC option 1 scenario in Figure 24.

The second variation for the amounts of the complementary flows (CF) not available for collection (not-AfC) considers the maximum values for deviation from DV. Following values for the CF apply (see ‘AfC Option 2 - Maximum values’):

Table 28: complementary flows (CF) not available for collection (not-AfC) In the detailed AfC option 2 with maximum values for LMT batteries

CF	LMT not-AfC in % of WG
MMW	0%
WEEE	0%
Repurposed	10%
Exports	10%
average lifetimes	LMT1 = 6.25 years, LMT2 = 12.5 years, LMT3 = 2.5 years, LMT4 = 3.75 years

The CF are based on the DV of MMW and WEEE. For the CF of repurposed batteries, a deviation from DV of 10% of WG is taken into account. For exports, a deduction of 10% of WG is set which is also considerably higher than the DV of exports. Thus, LMT batteries not-AfC in total account for 20% of WG. These amounts not-AfC are subtracted from WG. Subsequently, the amounts of LMT available for collection (AfC, see ‘AfC Option 2 - Maximum values’) in this scenario account for 80% of WG (AfC = WG – not-AfC).

Figure 25 also shows the amount of LMT batteries (‘Collected based on AOM (3y)’) that correspond to the waste batteries that need to be collected in order to fulfil the AOM collection targets (51% and 61%, calculation based on Annex XI, Batteries Regulation).

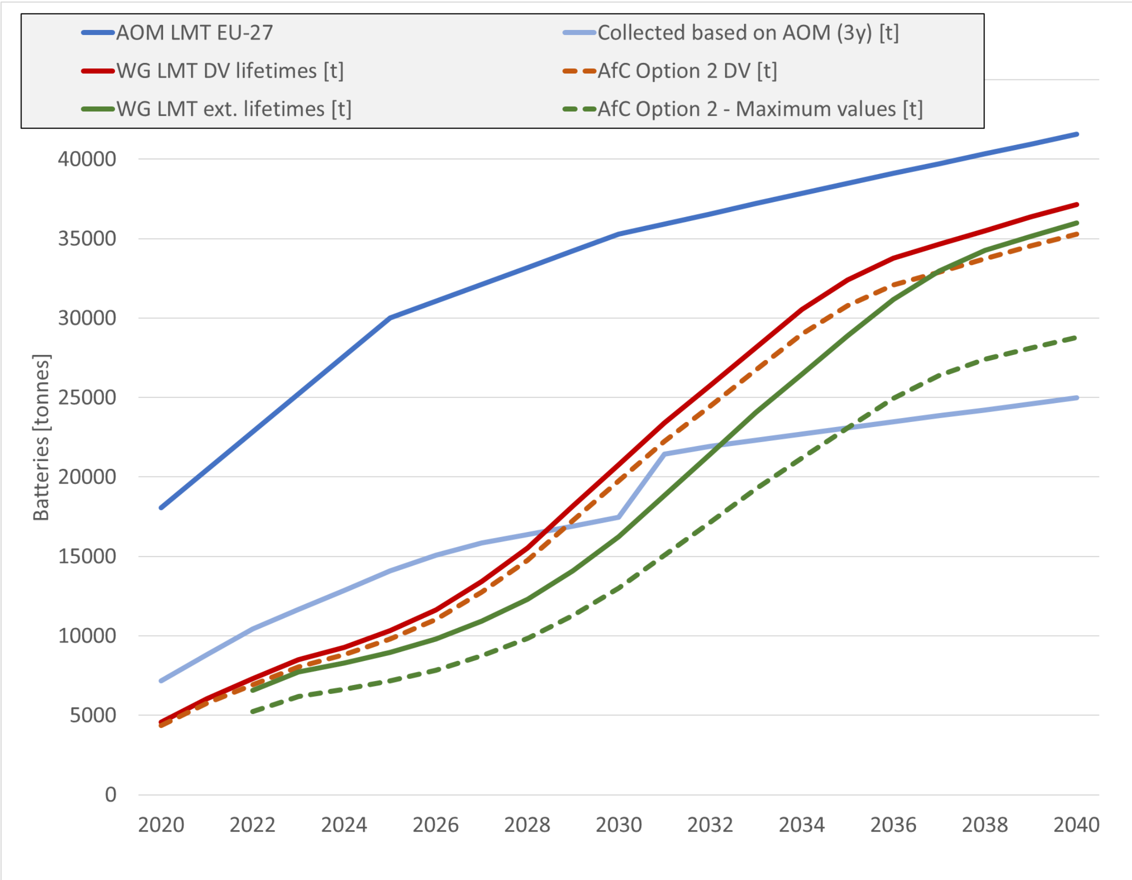
For WG (‘WG LMT DV lifetimes’) based on the DV of the average lifetimes, Figure 25 shows that up to about 2028, fewer waste LMT batteries will be generated than would be necessary to achieve the AOM collection target of 51% and 61% (‘Collected based on AOM (3y)’). Only in the years beyond 2028 the amount of WG exceeds the amount of batteries necessary to be collected for achieving the AOM collection target.

The second WG (‘WG LMT ext. lifetimes’) based on the maximum average lifetimes (DV + 25%) only exceeds the amount of batteries necessary for achieving the AOM collection target in the years beyond 2032.

In the case of the scenario calculation based on the default values, the amount of LMT batteries AfC (‘AfC Option 2 DV‘) is similar to the corresponding graph of WG (‘WG LMT DV lifetimes’). In the years after 2028 sufficient batteries would be available for collection to reach the AOM target levels.

In the case of the scenario based on the maximum values (with a deduction of 20% of WG), the AfC graph (‘AfC Option 2 - Maximum values’) is considerably lower than WG (‘WG LMT ext. lifetimes’). Therefore, not until after about 2035 will there be enough waste batteries available to achieve the AOM collection target of 61%.

Figure 25 – LMT batteries (tonnes): AfC option 2 scenario calculation, EU27



Source: Own diagram (Oeko-Institut)

7.2. Equivalent ambition and collection targets

7.2.1. Objective of the equivalent ambition

For portable batteries, the Batteries Regulation introduces the requirement of an ‘equivalent ambition’:

> […] to amend the methodology to calculate the collection rate of portable batteries set out in Annex XI and to amend the collection target laid down in paragraph 3 of this Article to adapt that collection target to the new methodology while maintaining equivalent ambition and timelines. (Regulation (EU) 2023/1542, 2024, Article 59(7))

The consultant understands this to mean that the total amount of waste batteries collected over the years (in order to fulfill a future AfC collection target) should not be less than the amount of batteries collected that correspond to the current AOM collection target (minimum amount to fulfill the AOM target). Therefore, the sum of all waste batteries collected over a longer time period (depending on the average lifetime of the batteries) defines the ‘equivalent ambition’. As a minimum requirement when applying the AfC collection target, the sum of waste batteries collected by a PRO in an MS in a longer time period may not be smaller than the sum of batteries calculated based on the current AOM collection target calculation in the Batteries Regulation (2024, Annex XI).

7.2.2. Maintain the equivalent level of ambition

As stated in the Batteries Regulation, it must be ensured that changes to the methodology lead to an equivalent level of ambition, as is laid out in the Batteries Regulation with the current methodology. The collection targets for all portable batteries set out in Article 59(3) of the Batteries Regulation are:

> (a) 45 % by 31 December 2023;
>
> (b) 63 % by 31 December 2027;
>
> (c) 73 % by 31 December 2030.
>
> (Regulation (EU) 2023/1542, 2024, Article 59(3))

Based on these targets and the AOM methodology set out in the Batteries Regulation, the amount of waste batteries that should be collected as a minimum as foreseen by the Regulation can be estimated. The line graphs in the figures in this chapter are called ‘Collected based on AOM’ and are based on these collection targets under the assumption, that MS achieve these targets.

Based on the current AOM targets and the quantities of waste batteries to be collected, the consultant calculated corresponding AfC targets that maintain an equivalent ambition (i.e. same quantities of waste batteries to be collected).

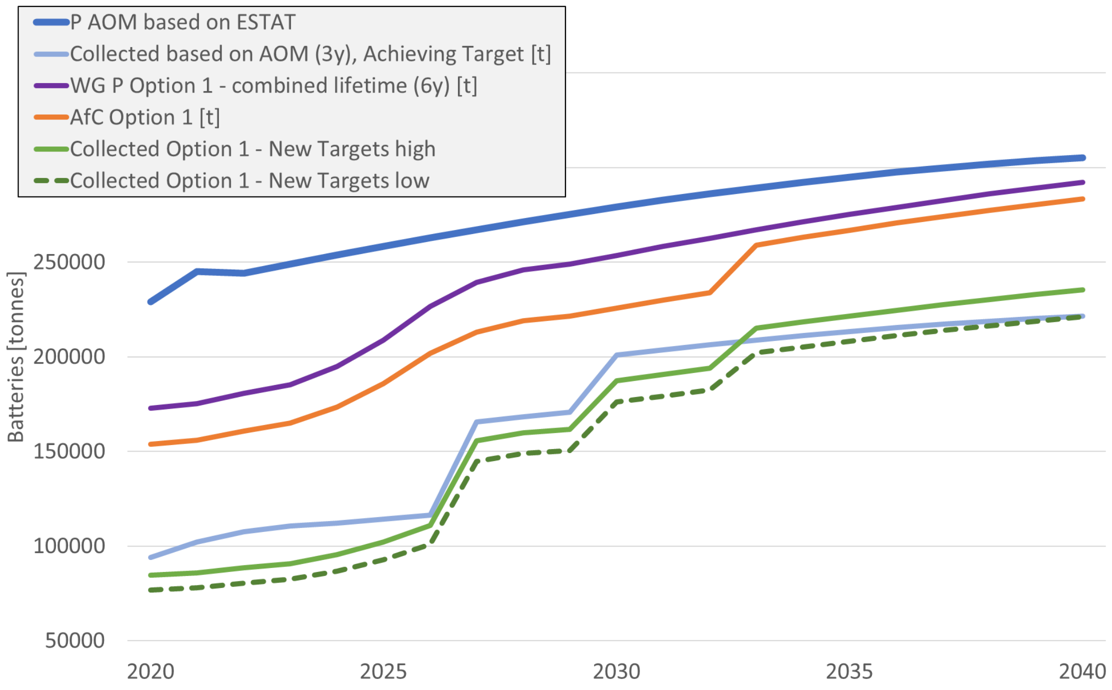
In Figure 26, the actual amounts of collected waste batteries are compared for different targets. The level of ambition is set by the AOM targets laid out in the Batteries Regulation. The light blue line (‘collected based on AOM’) is the amount of waste portable batteries that would be collected when the targets set in the Batteries Regulation are met using the AOM calculation methodology described in the Batteries Regulation. The amount of collected waste portable batteries using the basic AfC option 1 approach while maintaining the targets set in the Regulation is much lower than the level of ambition set by the Regulation. It becomes clear that, in this scenario, the actual amount of collected waste portable batteries in the EU27 is consistently lower than the amount aimed for by the Regulation until 2040 and beyond. The solid and dashed green lines in Figure 26 show the amount of collected waste portable batteries for two different sets of targets (AfC option 1 low and AfC option 1 high), adapted to the basic AfC option 1 methodology, that aim to maintain an equivalent ambition with regards to collected waste batteries. The table below summarises the targets.

Table 29: AfC collection targets considered for portable batteries AfC option 1

Portable batteries targets	2023	2027	2030
Batteries Regulation	45%	63%	73%
AfC option 1 low	50%	68%	78%
AfC option 1 high	55%	73%	83%

The set of lower AfC targets are 50%, 68% (2027) and 78% (2030). The amount of collected waste portable batteries in line with those targets remains below the level set by the Batteries Regulation in the near and mid-term, but it reaches this level by around 2040. These increased targets would ensure that a similar amount of batteries is collected long-term, while giving MS more time to adapt to the ambitious targets set in the Batteries Regulation. The set of higher AfC targets are 55%, 73% (2027) and 83% (2030). Again, the amount of collected waste portable batteries in line with those targets is initially lower than the level set by the Regulation but surpasses that level around 2033.

Figure 26 - Portable batteries AfC Option 1, actual amount of collected batteries based on targets, EU27



Source: Own diagram (Oeko-Institut)

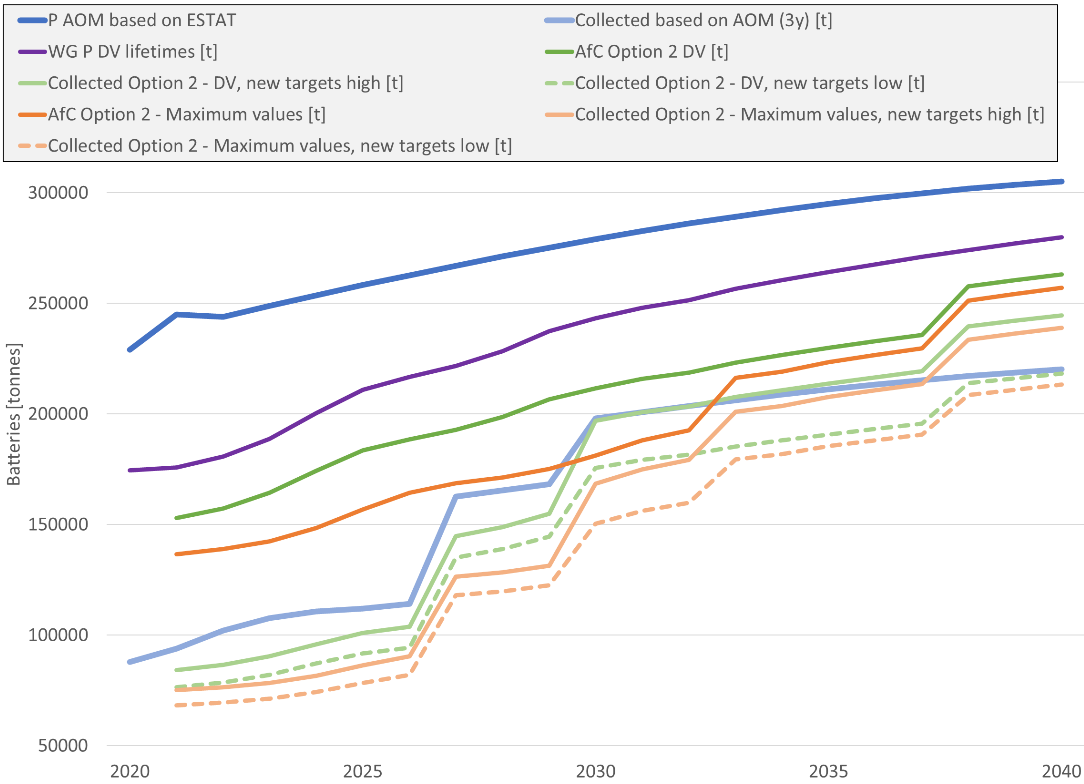
With regards to AfC Option 2, Figure 27 shows the amounts of portable batteries available for collection in the EU27 for two different scenarios DV (solid green line) and maximum values (solid red line) as described in the previous chapter. Again, the amount of collected waste portable batteries for two different set of targets adapted to AfC option 2 are shown, which aim to maintain equivalent ambition with regards to collected waste batteries. The solid light green line (DV) and the solid light red line (maximum values) are the associated amounts of collected batteries for the set of higher targets. The dashed lines are the corresponding amounts of collected batteries for the set of lower targets. The table below gives an overview of the targets.

Table 30: AfC collection targets considered for portable batteries AfC option 2

Portable batteries targets	2023	2027	2030
Batteries Regulation	45%	63%	73%
AfC option 2 low	50%	70%	83%
AfC option 2 high	55%	75%	93%

With the set of lower AfC targets, the amount of collected waste batteries stays just below the level set by the AOM targets in the Batteries Regulation until 2040. With the set of higher AfC targets, the level set by the AOM targets in the Batteries Regulation are reached earlier: for the DV scenario, around 2030; and for the maximum value scenario, around 2037.

Figure 27 - Portable batteries AfC Option 2, actual amount of collected batteries based on targets, EU27



Source: Own diagram (Oeko-Institut)

LMT Batteries

The collection targets of waste LMT batteries as set in Article 60(3) are:

(a) 51 % by 31 December 2028;

(b) 61 % by 31 December 2031

(Regulation (EU) 2023/1542, 2024, Article 60(3))

Again, for both AfC options, different sets of AfC targets are compared to the amounts of waste LMT batteries to be collected in order to fulfill the AOM collection targets in the Batteries Regulation. The line graphs called 'Collected' are based on these collection targets, assuming MS achieve the set targets.

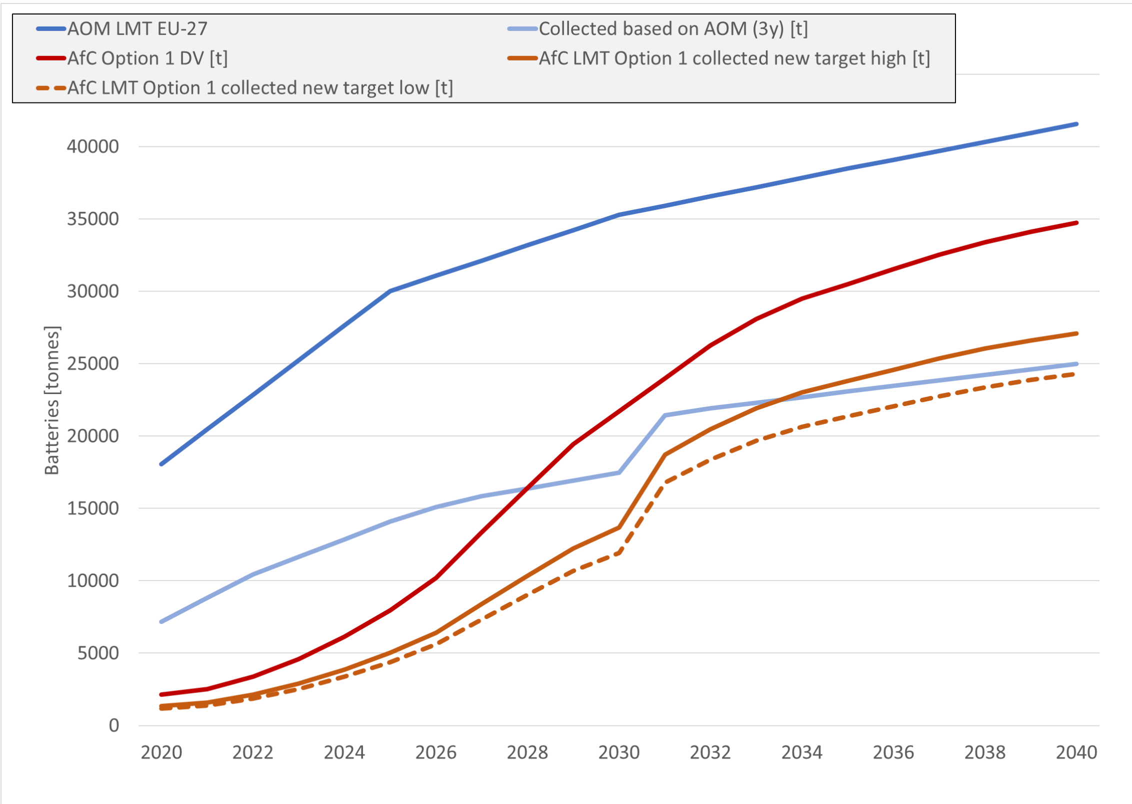
Table 31: AfC collection targets considered for LMT batteries AfC option 1

LMT Battery Targets	2028	2031
Batteries Regulation	51%	61%
AfC option 1 low	55%	70%

LMT Battery Targets	2028	2031
AfC option 1 high	63%	78%

The amount of collected waste LMT batteries (solid red line) corresponding to the set of lower AfC targets (dashed line) remains below the amount of batteries to be collected in order to fulfil the AOM targets in the Batteries Regulation, however, almost reaching the AOM target level in 2040. For the set of higher AfC targets (solid light red line), the amount of collected batteries surpasses the amount of batteries required to achieve the AOM collection target of 61% in the Batteries Regulation around 2033.

Figure 28 – LMT batteries AfC Option 1, actual amount of collected batteries based on targets, EU27



Source: Own diagram (Oeko-Institut)

For AfC option 2 for LMT batteries, the set of targets to maintain equivalent ambition are as follows.

Table 32: AfC collection targets considered for LMT batteries AfC option 2

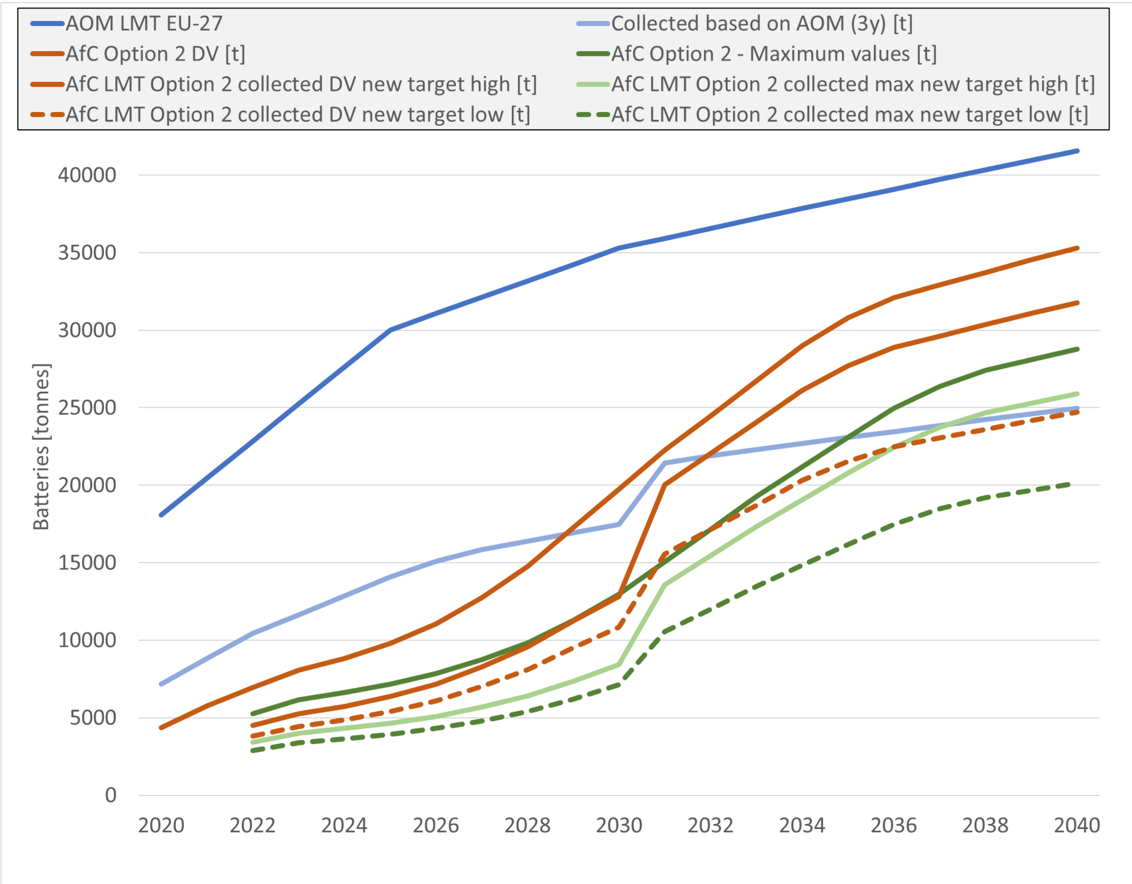
LMT Battery Targets	2028	2031
Batteries Regulation	51%	61%
AfC option 2 low	55%	70%
AfC option 2 high	65%	90%

For the set of lower AfC targets for the scenario with DV values, the amount of annually collected waste LMT batteries reaches the amount of batteries to be collected to fulfill the AOM target of 61% (year 2031) only close to 2040. While applying the set of higher AfC targets, the amount of collected waste LMT batteries already surpasses the amount of batteries to be collected to achieve the AOM target around 2032.

For the scenario with maximum values, using the set of higher AfC targets, the amount of waste LMT batteries collected annually that corresponds to the AOM target of 61% is reached around 2037. Using the set of lower targets, the amount of waste LMT batteries collected annually stays for the whole period considered way below the amount to be collected in order to achieve the AOM targets of the Batteries Regulation.

As can be seen below in Figure 29, the amount of waste batteries available for collection in the AfC option 2 maximum value scenario (solid dark green line) only reaches the amount to be collected in order to achieve the AOM targets of the Batteries Regulation (solid light blue line) around 2035. This means, that in this scenario up until about 2035, there are not enough batteries even available for collection to fulfill the targets set by the Batteries Regulation. In this ‘maximum value’ scenario, it is assumed that 20% of waste batteries generated go into the CF Export and Repurposing (10% each). While these batteries might not be available for collection anymore in the MS or the battery category (LMT) in which they were made available on the market originally, they are still intended to be collected and recycled inside the EU.

Figure 29 - LMT batteries AfC Option 2, actual amount of collected batteries based on targets, EU27



Source: Own diagram (Oeko-Institut)

In order to ensure that in the future the amount of collected waste batteries in a certain category based on the AfC methodology maintains equivalent ambition as required in the Batteries Regulation based on the AOM targets and methodology, the collection targets need to be adjusted together with the methodology. At the same time, multiple aspects impact and reduce the amount of batteries to be collected in a given year. This can lower the amount of collected waste batteries in the short-term and give MS more time to reach the amounts of batteries to be collected to achieve the (increasing) AOM targets in the Batteries Regulation. Short- to mid-term, the consideration of longer average battery lifetimes in the AfC methodology reduces the amount of waste batteries generated (WG) in a given year, as the point in which they become waste is postponed. Individual average lifetimes for battery subgroups also have the effect of reducing the calculated amount of waste batteries generated (WG) in a given year, as they factor in the increasing amount of rechargeable batteries. Therefore, longer average lifetimes give MS time to adapt to the increasing AOM collection targets. In addition, complimentary flows (CF) reduce the total amount of batteries available for collection. Depending on the AfC collection targets defined the CF lower the amount of waste batteries that need to be collected. At the same time, higher AfC targets (in comparison to the AOM targets) are necessary to ensure that in the future the amount of collected waste batteries based on the AfC methodology corresponds to amounts to be collected based on the AOM targets in the Batteries Regulation.

8. Summary of AfC option 1 and AfC option 2

The consolidated proposals for the two AfC options 1 and 2 are summarised in the sub-chapters below. In developing the two options, emphasis was placed on presenting two different approaches that clearly differ from one another or even pursue contrasting goals. The first option is seen as the simpler option to implement, requiring less data collection; the second option allows for a more refined calculation with more data input. A third option mixing aspects from AfC option 1 and 2 could be possible, though not presented here. This third option, in which individual features might be selected from AfC option 1 or AfC option 2, could also be identified as the most suitable version of the AfC methodology.

The two options presented here are adaptable. In principle, it is possible that specific values of e.g. DV of average lifetime, CFs etc. can still be changed or adapted based on stakeholder feedback or if new data sources become available. Also, the possibility to adapt default values over time based on future (market) developments could be considered. For example, repurposing could be a business model that becomes more important over time, or it might be extended to more/ other battery applications and battery categories. Therefore, a need to adapt the default value for repurposed batteries not-AfC might become necessary in case the situation significantly changes.

8.1. Overview and suggestions for AfC option 1

Table 23 represents the consultant’s suggestions for default values for portable batteries, and the respective suggestions for LMT batteries are given in Table 24.

As already described in sub-chapter 3.1.1 the main focus of AfC option 1 is on a most simple implementation of the AfC methodology. Therefore, AfC option 1 does not require any differentiation into battery groups P1 and P2 or LMT 1-4. Rather, the average default values (DV) for lifetimes and historic AOM data already take into account the different shares of those battery groups.

The calculation of the collection rate based on AfC option 1 requires as input data by the Member States two sets of data: total AOM data and total amount of waste batteries collected. All other data is provided by the Commission as default values. A deviation from the default values is only possible for the complementary flow of repurposed LMT batteries. If a Member State wishes to deviate from this DV additional data input would be required and certain criteria would have to be fulfilled.

Three main calculation steps remain:

1. Waste generated (WG): $WG_Y = (AOM_{X-1} + AOM_X + AOM_{X+1})/3$; with x representing the average lifetime (DV)
2. Waste batteries available for collection (AfC) is the difference between waste generated (WG) and not-AfC: AfC = WG_y – not-AfC; not-AfC represents the DV for waste batteries lost in mixed municipal waste (MMW)
3. Collection rate (CR): CR = (col / AfC) * 100; with col representing the amount of waste batteries collected.

If on a country level separate collection rates are provided by different PROs, a final collection rate needs to be calculated by the national authority based on the share of waste batteries collected by each producer/ PRO.

In the case of portable batteries, only the default values for waste batteries in MMW and for exports can be deducted as CF from WG. For LMT batteries, the default value for exports and potentially a deviation from the DV for repurposed batteries can be deducted from WG.

The DV for the complementary flow of waste batteries in MMW represents a main difference between the AfC option 1 for portable batteries and for LMT batteries. While the DV for portable batteries is DV = 8% of WG, the DV for LMT batteries is DV = 0% of WG. LMT batteries may deviate from the DV for repurposed batteries not-AfC, which is not possible for portable batteries.

Compared to the current AOM methodology for the calculation of the collection rate (Regulation (EU) 2023/1542, 2024, Annex XI), the 'AfC option 1 – basic methodology' proposed here differs in its use of the DV for the average lifetime and the deduction of the CF of waste batteries in MMW and exports (not-AfC). For LMT batteries, the use of the DV for the average lifetime, the deduction of the CF of exports and potentially of repurposed batteries (not-AfC) are the differences to the AOM methodology.

When considering replacing the current AOM methodology, one should be aware that a new calculation methodology also requires adapting the collection target.

Table 33 – Main results for AfC option 1 – basic methodology: portable batteries

Default values (not-AfC)	Maximum values (for deviation from DV)	Criteria (for deviation from DV)
AOM No DV required, use of total AOM	---	

Default values (not-AfC)	Maximum values (for deviation from DV)	Criteria (for deviation from DV)
Average lifetime DV = 6 years (weighted average based on P1=4 years, P2=9 years)	No deviation from DV accepted	---
CF MMW DV = 8% of WG After 5 years: DV = 0% of WG	No deviation from DV accepted	---
CF WEEE DV = 0% of WG	No deviation from DV accepted	---
CF Repurposed/ remanufactured DV = 0% of WG	No deviation from DV accepted Remanufacturing is considered as an extension of lifetime, similar to re-use, as the purpose of the batteries does not change and therefore is not considered to be not-AfC.	---
CF Imports/ exports DV = 3% of WG for exports and transfers to another MS	Exports outside EU and transfers to another MS: no deviation from DV accepted Imports and transfers from another MS: no DV, no maximum values.	---

Source: Own diagram (Oeko-Institut and Fraunhofer IZM)

Table 34 – Main results for AfC option 1 – basic methodology: LMT batteries

Default values (not-AfC)	Maximum values (for deviation from DV)	Criteria (for deviation from DV)
AOM Calculation of historic country-specific AOM DV	No deviation from DV accepted	---
Average lifetime DV = 8 years (weighted average based on LMT1=5 years, LMT2=10 years, LMT3=2 years. LMT4=3 years)	No deviation from DV accepted	---
CF MMW DV = 0% of WG	No deviation from DV accepted	---
CF WEEE DV = 0% of WG	No deviation from DV accepted	---

Default values (not-AfC)	Maximum values (for deviation from DV)	Criteria (for deviation from DV)
CF Repurposed/ remanufactured DV = 0% of WG	Deviation possible. No maximum value. Remanufacturing is considered as an extension of lifetime, similar to re-use, as the purpose of the batteries does not change and therefore is not considered to be not-AfC.	Additional documentation by waste management operators and actors making repurposed batteries AOM. The amount of repurposed batteries being subtracted from WG as not-AfC must be equal to the amount of repurposed batteries being made AOM in a different category than LMT batteries. As a prerequisite for permission to deviate from DV data on repurposed batteries must be equally reported (subtracted from WG as not-AfC and AOM in same / different category).
CF Imports/ exports DV = 3% of WG for exports and transfers to another MS	Exports outside EU and transfers to another MS: no deviation from DV accepted. Imports and transfers from another MS: no DV, no maximum values.	---

Source: Own diagram (Oeko-Institut and Fraunhofer IZM)

The following strengths and weaknesses of the proposed ‘AfC option 1 – basic methodology’ are noted.

Strengths of AfC option 1 – basic methodology:

- Simple calculation method
- High practicality in the application of the calculation methodology
- High comparability of the results between MS
- High transparency of the calculations
- Low effort for national authorities and PRO for data collection and calculation of collection rates

Weaknesses of AfC option 1 – basic methodology:

- Simplifications unavoidably will lead to ‘inaccuracies’ or uncertainties in the results of the collection rates.
- Simplifications do only to a very limited extend reflect real-life battery flows
- Differences between Member States are only taken into account in the data on AOM, waste batteries collected and potentially the amounts of repurposed batteries not-AfC

8.2. Overview and suggestions for AfC option 2

The next tables provide summarise the main features of 'AfC option 2 – detailed advanced methodology'. Table 25 represents the consultant's suggestions for default values for portable batteries, and the respective suggestions for LMT batteries are given in Table 26Table .

As already described in sub-chapter 3.1.2, the focus of AfC option 2 is on creating the best possible model of real-life battery flows. In contrast with AfC option 1, this AfC option 2 requires portable batteries to be split into battery groups P1 and P2 and LMT split into groups 1-4 for the average lifetimes and for the historic AOM data. The main difference between AfC option 1 and 2, however, is the possibility to deviate in many cases from the default values of the complementary flows. Thus, Member States can provide their own data on the battery streams not-AfC, allowing the data to much better reflect the real situation in their countries. Therefore, AfC option 2 requires as input data by the Member States not only AOM data and amounts of waste batteries collected but also country-specific data and information on the complementary flows (if an MS wishes to deviate from a default value of not-AfC).

The main calculation steps of the AfC option 2 are:

- *Waste generated (WG)*:
$$WG = \frac{AOM_{X-1} + AOM_X + AOM_{X+1}}{3}$$
with X representing the average lifetime (DV); potential use of country-specific AOM and average lifetime data that deviate from DV.
- *Waste batteries available for collection (AfC)* is the difference between waste generated (WG) and not-AfC:
$$AfC = WG - not - AfC$$
with not-AfC = CF MMW + CF WEEE + CF repurposed + CF export
- *Complementary flows (CF) and deviation from DV:* Country-specific calculation of not-AfC: potential determination of CF MMW, CF WEEE, CF repurposed and CF export (different for portable and LMT batteries).
- *Collection rate (CR):*
$$CR = \frac{col}{AfC} \times 100$$
with col representing the amount of waste batteries collected.

If on the country-level separate collection rates are provided by different PROs, a final collection rate needs to be calculated by the national authority based on the share of waste batteries collected by each of the producers/ PROs.

The methodological differences between portable batteries and LMT batteries of AfC option 2 are comparably small, since for portable as well as LMT batteries the complementary flows (not-AfC) can be deducted from WG. Therefore, the amounts of batteries not-AfC will determine the result of the collection rate.

The ‘AfC option 2 – detailed advanced methodology’ differs widely from the current AOM methodology for calculating the collection rate (Regulation (EU) 2023/1542, 2024, Annex XI) and, unlike AfC option 1, is not comparable with the AOM methodology.

Table 35 – Main results for AfC option 2 – detailed advanced methodology: portable batteries

Default values (not-AfC)	Maximum values (for deviation from DV)	Criteria (for deviation from DV)
Average lifetimes P1: 4 years P2: 9 years	1 ± 25 % * average lifetime	Once in 5-years and verified by a scientific study
AOM DV of P1 and P2 shares (timeline) for calculation of historic AOM	Variation of not more than ± 10% from DV	Data submitted to MS authorities or official market survey (identical scope; justification and verification with transparent documentation).
MMW DV = 10 % of WG. After 10 years DV=3% of WG	Results from the survey, limited to a maximum value of 16% of WG. After 5 years, no deviation from DV accepted	Mandatory compositional survey (and criteria thereof) of the amount of batteries in MMW. Documentation should fulfil criteria.
WEEE DV = 0% of WG	2% of WG; after 5 years, 0% of WG	Additional survey (and criteria thereof) of the amount of batteries still not removed from WEEE after depollution.
Repurposed/ remanufactured DV = 0% of WG	Deviation possible No maximum value Remanufacturing is considered as an extension of lifetime, similar to re-use, as the purpose of the batteries does not change and therefore is not considered to be not-AfC.	Additional documentation by waste management operators and actors making repurposed batteries AOM. The amount of repurposed batteries being subtracted from WG as not-AfC must be equal to the amount of repurposed batteries being made AOM in a different category than portable batteries. As a prerequisite for permission to deviate from DV data on repurposed batteries must be equally reported (subtracted from WG as not-AfC and AOM in same / different category)
Imports/ exports DV = 3 % of WG for exports and transfers to another MS	No maximum values for trade within EU and exports outside EU. Imports and transfers from another MS: no DV, no maximum values.	Deviation shall be derived by tracing the trade flows of used batteries. Trade needs to be properly documented and verified. Balance trade data between MS: data shall equally cover all potential transfers from AND to MS (inside EU) and imports AND exports (outside EU) and are a prerequisite for permission to deviate from DV.

Source: Own diagram (Oeko-Institut and Fraunhofer IZM)

Table 36 – Main results for AfC option 2 – detailed advanced methodology: LMT batteries

Default values (not-AfC)	Maximum values (for deviation from DV)	Criteria (for deviation from DV)
Average lifetimes LMT1: 5 years LMT2: 10 years LMT3: 2 years LMT4: 3 years	1 ± 25 % * average lifetime	Once in 5-years and verified by a scientific study
AOM Historic country-specific AOM DV based on MS shares of AOM EU27, country-specific shares of LMT groups 1-4, and JRC's report (Bobba et al., 2024)	Variation of not more than ± 25% from DV.	Data submitted to MS authorities or official market survey (identical scope; justification and verification by a transparent documentation)
MMW DV = 0% of WG	No deviation from DV accepted	---
WEEE DV = 0% of WG	No deviation from DV accepted	---
Repurposed/ remanufactured (R) DV = 2% of WG	Deviation possible No maximum value Remanufacturing is considered as an extension of lifetime, similar to re-use, as the purpose of the batteries does not change and therefore is not considered to be not-AfC.	Additional documentation by waste management operators and actors making repurposed batteries AOM. The amount of repurposed batteries being subtracted from WG as not-AfC must be equal to the amount of repurposed batteries being made AOM in a different category than LMT batteries. As a prerequisite for permission to deviate from DV data on repurposed batteries must be equally reported (subtracted from WG as not-AfC and AOM in same / different category)
Imports/ exports DV = 3 % of WG for exports and transfers to another MS	No maximum values for trade within EU and exports outside EU. (No DV, no maximum values for imports and transfers from another MS)	Deviation shall be derived by tracing the trade flows of used batteries. Trade needs to be properly documented and verified. Balance trade data between MS: data shall equally cover all potential transfers from AND to MS (inside EU) and imports AND exports (outside EU) and are a prerequisite for permission to deviate from DV.

Source: Own diagram (Oeko-Institut and Fraunhofer IZM)

The following strengths and weaknesses of the proposed 'AfC option 2 – detailed advanced methodology' are noted.

Strengths of AfC option 2 – detailed advanced methodology:

- Member States can individually decide where to deviate from DV
- Calculations reflect to a good extend real-life battery flows

- Differences between Member States can be taken into account

Weaknesses of AfC option 2 – detailed advanced methodology:

- High effort for national authorities and PRO for data collection and calculation of collection rates
- Low transparency of the calculations
- Limited comparability of the results between MS
- Possibilities for validation and reproducing of results and calculations by the Commission are limited
- Complex and therefore potentially error-prone calculations.

8.3. Comparison of AfC option 1 and 2

To directly note differences between the options, the following Table 27 provides a summary of the two options ‘AfC option 1 – basic methodology’ and ‘AfC option 2 – detailed advanced methodology’, differentiated into portable and LMT batteries.

Table 37 – Overview of AfC option 1 and 2 in comparison

Variable	Portable batteries		LMT batteries	
	AfC Option 1	AfC Option 2	AfC Option 1	AfC Option 2
AOM	No DV required, use of total AOM	DV of P1 and P2 shares (timeline) for calculation of historic AOM Variation of not more than ± 10% from DV. Data submitted to MS authorities or official market survey (identical scope; justification and verification with transparent documentation).	Calculation of historic country-specific AOM DV No deviation from DV accepted	Historic country-specific AOM DV based on MS shares of AOM EU27, country-specific shares of LMT groups 1-4, and JRC's report (Bobba et al., 2024) Variation of not more than ± 25% from DV. Data submitted to MS authorities or official market survey (identical scope; justification and verification by a transparent documentation).
Lifetime	DV = 6 years (weighted average based on P1=4 years, P2=9 years) No deviation from DV accepted	P1: 4 years P2: 9 years 1 ± 25 % * average lifetime Once in 5-years and verified by a scientific study	DV = 8 years (weighted average based on LMT1=5 years, LMT2=10 years, LMT3=2 years. LMT4=3 years) No deviation from DV accepted	LMT1: 5 years LMT2: 10 years LMT3: 2 years LMT4: 3 years 1 ± 25 % * average lifetime Once in 5-years and verified by a scientific study

Variable	Portable batteries		LMT batteries	
	AfC Option 1	AfC Option 2	AfC Option 1	AfC Option 2
CF MMW	DV = 8% of WG After 5 years: DV = 0% of WG No deviation from DV accepted	DV = 10 % of WG. After 10 years DV = 3% of WG Results from the survey, limited to a maximum value of 16% of WG. After 5 years, no deviation from DV accepted. Mandatory compositional survey (and criteria thereof) of the amount of batteries in MMW. Documentation should fulfil criteria.	DV = 0% of WG No deviation from DV accepted	DV = 0% of WG No deviation from DV accepted
CF WEEE	DV = 0% of WG No deviation from DV accepted	2% of WG; after 5 years, 0% of WG Additional survey (and criteria thereof) of the amount of batteries still not removed from WEEE after depollution.	DV = 0% of WG No deviation from DV accepted	DV = 0% of WG No deviation from DV accepted

Variable	Portable batteries		LMT batteries	
	AfC Option 1	AfC Option 2	AfC Option 1	AfC Option 2
CF Repurposed/ remanufactured	DV = 0% of WG No deviation from DV accepted Remanufacturing is considered as an extension of lifetime, similar to re-use, as the purpose of the batteries does not change and therefore is not considered to be not-AfC.	DV = 0% of WG Deviation possible No maximum value Remanufacturing is considered as an extension of lifetime, similar to re-use, as the purpose of the batteries does not change and therefore is not considered to be not-AfC. Additional documentation by waste management operators and actors making repurposed batteries AOM. The amount of repurposed batteries being subtracted from WG as not-AfC must be equal to the amount of repurposed batteries being made AOM in a different category than portable batteries. As a prerequisite for permission to deviate from DV data on repurposed batteries must be equally reported (subtracted from WG as not-AfC and AOM in same / different category)	DV = 0% of WG Deviation possible. No maximum value. Remanufacturing is considered as an extension of lifetime, similar to re-use, as the purpose of the batteries does not change and therefore is not considered to be not-AfC.	DV = 2% of WG Deviation possible No maximum value Remanufacturing is considered as an extension of lifetime, similar to re-use, as the purpose of the batteries does not change and therefore is not considered to be not-AfC. Additional documentation by waste management operators and actors making repurposed batteries AOM. The amount of repurposed batteries being subtracted from WG as not-AfC must be equal to the amount of repurposed batteries being made AOM in a different category than LMT batteries. As a prerequisite for permission to deviate from DV data on repurposed batteries must be equally reported (subtracted from WG as not-AfC and AOM in same / different category)

Variable	Portable batteries		LMT batteries	
	AfC Option 1	AfC Option 2	AfC Option 1	AfC Option 2
CF Imports/ Exports	DV = 3% of WG for exports and transfers to another MS Exports outside EU and transfers to another MS: no deviation from DV accepted Imports and transfers from another MS: no DV, no maximum values.	DV = 3 % of WG for exports and transfers to another MS No maximum values for trade within EU and exports outside EU. Imports and transfers from another MS: no DV, no maximum values. Deviation shall be derived by tracing the trade flows of used batteries. Trade needs to be properly documented and verified. Balance trade data between MS: data shall equally cover all potential transfers from AND to MS (inside EU) and imports AND exports (outside EU) and are a prerequisite for permission to deviate from DV.	DV = 3% of WG for exports and transfers to another MS Exports outside EU and transfers to another MS: no deviation from DV accepted. Imports and transfers from another MS: no DV, no maximum values.	DV = 3 % of WG for exports and transfers to another MS No maximum values for trade within EU and exports outside EU. (No DV, no maximum values for imports and transfers from another MS) Deviation shall be derived by tracing the trade flows of used batteries. Trade needs to be properly documented and verified. Balance trade data between MS: data shall equally cover all potential transfers from AND to MS (inside EU) and imports AND exports (outside EU) and are a prerequisite for permission to deviate from DV.

Source: Own diagram (Oeko-Institut and Fraunhofer IZM)

9. Initial conclusions before the second stakeholder workshop

How to read this chapter

In this chapter, some initial conclusions from the consultant's based on the work done, taking into account the data and input received during and after the first stakeholder workshop in September 2025 are presented to provide a picture on the current line of thinking. This serves as an input to the second stakeholder workshop and will undergo changes and adaptations after the second stakeholder workshop, as appropriate.

Approach for implementing the AfC methodology

The consultant's research confirms that the AfC methodology is based on a complex model that allows two possible approaches for implementation. The two options—AfC option 1 and AfC option 2—for implementing the AfC methodology represent contrasting approaches for fulfilling a diverse range of goals.

The first option, 'AfC option 1 – basic methodology', is seen as the simpler option to implement and still has a certain similarity to the current AOM methodology for the calculation of the collection rate. Its main advantages include ease of application of the calculation methodology, high comparability of the results between MS and high transparency in the calculations. The simple calculation method also requires lower effort for national authorities and PROs for data collection and calculation of collection rates. The disadvantages of AfC option 1 are that simplifications could lead to inaccuracies or uncertainties in the results of the collection rates; the data reflects real-life battery flows only to a very limited extent. Furthermore, the differences between Member States in data input are rather limited (data on made available on the market (AOM), waste batteries collected and amounts of repurposed batteries not available for collection (not-AfC)).

The second option, 'AfC option 2 – detailed advanced methodology', focuses on better reflecting the real-life battery flows in a country. It therefore allows for more refined calculation while requiring a broader set of input data. Its main advantage is that it allows differences between Member States to be taken into account and MS can individually decide where to deviate from default values (DV). The disadvantage of AfC option 2 is its low calculation transparency that limits data comparability between MS. Furthermore, AfC option 2 is more complex, more data demanding and contains potentially error-prone calculations.

During the development of the AfC methodology in recent years, it has become clear that only very limited data on complementary flows is available, particularly for import/export and also for waste batteries in waste electric and electronic equipment (WEEE) and remanufacturing/ repurposing. Due to the lack of data, determining default values, e.g. for the amounts of batteries not available for collection, involves a certain degree of uncertainty. The DV represent an essential cornerstone for simple implementation of the method and for promoting data comparability between Member States.

Low and zero default values for battery complementary flows mixed municipal waste (MMW) and waste electric and electronic equipment (WEEE) not available for collection reflect the requirements of the Batteries Regulation and the WEEE Directive and at the same time take into account real life conditions by allowing for a transition time until the DV reaches zero.

In the case of the complementary flow (CF) for remanufactured/ repurposed batteries, the possibility to deviate from the default value without a limitation supports second-use especially of LMT batteries and the EU’s circular economy concept.

The possibility to deviate from the default values of the CF exports takes into account that trade within the EU and exports to third countries cannot be limited.

The AfC method is based on default values. Deviations from the DV and maximum values of deviation allows the calculation steps to be finetuned by adapting the parameters. Future developments, new studies and new data and information might create a need to adapt the current default value, for example, for the lifetimes of portable or LMT batteries. Generally, it is recommended that the EC periodically reviews and adapts the default values, maximum values and possibilities for deviation, as appropriate.

The possibility to deviate from the DV allows Member States to better reflect their country-specific realities of battery flows. However, this possibility requires Member States to obtain and verify the necessary data and information at a national level and present it transparently to the EC. This is expected to involve considerable effort on the part of the MS, but the EC also has additional work in assessing Member States' requests for deviations from the DV. Regardless of the effort involved, the main challenge for Member States (given the existing data gaps) may be simply in obtaining the required data and proving to the EC that the criteria are met.

When a decision is made between the two AfC options 1 and 2, the strengths and weaknesses of both options should be considered. While two AfC options were developed within this report, also a third option that combines aspects from AfC option 1 and 2 could be possible and could be identified as the most suitable version of the AfC methodology to be implemented.

With regard to future reporting of collection targets based on the AfC methodology by MS to the EC, it should be noted that based on the current set of reporting requirements the more parameters and options are included in the collection rate calculation, the lower the possibility for the EC to properly check and validate the results.

AfC scenario calculations

In the context of this assessment, 'maintaining equivalent ambition' means that the total amount of collected waste batteries over a longer time period based on the AfC methodology is equal to the amount of collected waste batteries based on the AOM methodology and targets laid out in the Batteries Regulation. However, waste batteries might be collected over a longer timeframe to take into account longer battery lifetimes and dynamic market developments.

The AfC collection targets are critical for the actual amount of waste batteries to be collected under the AfC methodology. The AfC targets should account and consider the amounts of waste batteries available for collection in the short-term. Long-term the AfC targets need to ensure, that the amount of collected waste batteries corresponds to amount of batteries to be collected in order to achieve the AOM based targets set in the Batteries Regulation (maintaining equivalent ambition). In general, the target values applying to the AfC methodology need to be higher than the target values defined for the AOM methodology. Further assessment of the targets and the amount of collected waste batteries should be done some time in the future to inform possible adjustments to the AfC methodology, as appropiate.

Portable batteries

The scenario calculations for portable batteries, principally show that more waste batteries are available for collection (AfC) based on the AfC methodology than are required to be collected to achieve the current AOM based targets of the Batteries Regulation. This applies for AfC option 1, and also for AfC option 2, although, with some limitations when considering maximum values for deviation from default values (21 % deduction from DV and extended battery lifetimes). In this scenario with maximum values of AfC option 2, in the years around 2030 not sufficient batteries will be AfC to achieve the same amount of batteries collected that corresponds to the increased target value (73%) of the AOM methodology in the Batteries Regulation.

For AfC option 1 the AfC targets need to be raised compared to the AOM based targets in the Batteries Regulation so that the amount of collected waste portable batteries corresponds to the amount of batteries to be collected in order to maintain equivalent ambition compared to the AOM based targets. When the AfC targets are raised by 10% (compared to the AOM target value in the Batteries Regulation) the amount of waste portable batteries to be collected would by 2033 reach the same amount of batteries collected that corresponds to the AOM target value.

In AfC option 2 the AfC targets would need to be higher than in AfC option 1 so that the amount of collected waste portable batteries maintains an equivalent ambition as set in the Batteries Regulation based on AOM. When applying AfC targets of 50% (+5% compared to the AOM target in the Batteries Regulation), 70% (+7% compared to the AOM target) and 83% (+10%) for 2023, 2027 and 2030 the amount of waste portable batteries to be collected would by 2040 reach the same amount of batteries to be collected to achieve the AOM target of the Batteries Regulation. While in the scenario with maximum values in AfC option 2, the amount of waste portable batteries to be collected stays just below the level set by the AOM targets in the Batteries Regulation until 2040.

LMT batteries

The scenario calculations of LMT batteries first of all show that for both AfC options 1 and 2 the amount of waste generated will up to at least 2028 be below the amounts required to be collected in order to achieve the current AOM targets. With extended battery lifetimes this date would even be postponed to about 2032.

Considering a scenario with maximum values that can be deducted from WG (20% deduction from WG and extended battery lifetimes) in AfC option 2 the amount of batteries AfC is considerably reduced compared to the amount of waste batteries generated. In this case, the amount of batteries AfC only beyond around 2035 will exceed the amount of batteries to be collection in order to achieve the AOM collection target (61%) of the Batteries Regulation.

For AfC option 1 the AfC collection targets need to be raised compared to the AOM based targets in the Batteries Regulation so that the amount of collected waste LMT batteries corresponds to the amount of batteries to be collected in order to maintain equivalent ambition compared to the AOM based targets. When raising the AfC targets to 55% (+4% compared to the AOM target in the Batteries Regulation) in 2028 and 70% (+9%) in 2031, the amount of waste LMT batteries to be collected would by 2040 reach the same amount of batteries to be collected in order to achieve the 61% AOM based target of the Batteries Regulation. Raising the AfC targets to 63% (2028) and 78% (2031) would mean the amount of waste portable batteries to be collected would earlier around 2033 reach amount of batteries corresponding to the AOM based target (61%).

In AfC option 2, two scenarios were considered one with DV values and one with higher CF values (maximum values). When considering AfC targets of 55% and 70% the waste LMT batteries to be collected in the DV scenario would just about by 2040 reach the amount of batteries to be collected in order to maintain equivalent ambition compared to the 61% AOM based target set by the Batteries Regulation, while for the scenario with the maximum values the amount of waste LMT batteries to be collected would stay significantly lower.

Effects of different average lifetimes

The consideration of longer average lifetimes in the AfC methodology postpones the point in time at which batteries are counted as waste generated (WG). Individual average lifetimes for portable and LMT battery subgroups (P1, P2 and LMT1-4) in comparison to a total average lifetimes per battery category (portable, LMT) also have the effect of postponing the calculated amount of waste batteries generated (WG), as they factor in the increasing amount of rechargeable batteries with longer average lifetimes.

Considerations for a total limit on the maximum deviation from DV for complementary flows

Due to the various possibilities to deduct batteries that are not available for collection from WG (e.g. no maximum values for deviation for CF repurposed and CF exports), very large quantities of batteries not-AfC could be included in the sum of all four complementary flows. Consequently, extreme scenarios are conceivable in which the remaining amount of batteries is too small to achieve the collection target and an equivalent ambition. While this is less likely for portable batteries, under AfC option 2 for LMT batteries a total of 30% (or more) of WG could be deducted as batteries not-AfC. This would result in the situation where even with an AfC collection rate of 100%, the amount of waste batteries collected would not reach the amount of batteries required to be collected for achieving the AOM collection targets set in the Batteries Regulation. In order to avoid such a scenario, setting a maximum value of total deduction from WG for all four CF could be considered, similar to setting a maximum value of deviation from a default value for an individual complementary flow.

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11. Annexes

Annex Table 38 – Total LMT batteries AOM (sum of LMT 1-4) of EU27 in tonnes, for 2015-2040

[t]	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027
EU27	5044	6272	8068	10827	13326	18071	20460	22850	25239	27628	30018	31071	32125

[t]	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
EU27	33178	34231	35285	35924	36563	37202	37842	38481	39098	39715	40332	40950	41567

Source: Own calculation (Fraunhofer IZM and Oeko-Institut)

Annex Table 39 – Default values for country-specific share (%) of total LMT batteries of EU27, for 2015-2028

Country	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
AT	5%	5%	5%	5%	5%	4%	4%	4%	4%	4%	4%	4%	4%	4%
BE	9%	8%	9%	8%	7%	5%	5%	5%	5%	5%	5%	5%	5%	5%
BG	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
CY	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
CZ	0%	1%	1%	0%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%
DE	37%	35%	33%	34%	37%	41%	39%	38%	37%	37%	36%	36%	35%	35%
DK	4%	3%	3%	3%	3%	2%	2%	2%	2%	2%	2%	2%	2%	2%
ES	4%	4%	5%	6%	6%	6%	5%	5%	6%	6%	6%	6%	6%	6%
EE	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
FI	2%	2%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%
FR	12%	13%	17%	16%	15%	14%	15%	16%	16%	15%	15%	15%	15%	15%
EL	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
HR	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
HU	0%	0%	0%	0%	0%	0%	1%	0%	0%	0%	1%	1%	1%	1%
IE	0%	0%	0%	0%	0%	0%	1%	1%	1%	1%	1%	1%	1%	1%
IT	4%	7%	6%	6%	5%	7%	6%	7%	7%	7%	8%	8%	8%	8%
LT	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
LU	0%	1%	1%	1%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
LV	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
MT	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
NL	16%	13%	11%	11%	9%	10%	8%	8%	8%	8%	9%	9%	9%	9%
PL	2%	2%	2%	3%	3%	2%	3%	3%	3%	3%	3%	3%	3%	3%
PT	1%	1%	1%	2%	1%	1%	2%	2%	2%	2%	2%	2%	2%	2%

Country	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
RO	0%	0%	0%	0%	0%	0%	1%	1%	1%	1%	1%	1%	1%	1%
SK	0%	0%	0%	0%	0%	1%	1%	1%	1%	1%	1%	1%	1%	1%
SI	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
SE	4%	4%	4%	5%	4%	3%	3%	3%	3%	3%	3%	2%	2%	2%
EU27	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%

Source: Own calculation (Fraunhofer IZM and Oeko-Institut)

Annex Table 40 – Default values for country-specific amount of LMT batteries (t) of EU27, for 2015-2028

Country	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
AT	280	360	495	596	687	729	830	911	1009	1106	1192	1272	1346	1411
BE	468	611	825	994	1024	896	929	1036	1153	1276	1390	1498	1600	1692
BG	1	1	1	2	2	10	22	25	32	39	44	49	54	58
CY	4	5	5	5	2	11	12	16	21	27	31	35	39	41
CZ	5	51	55	57	250	268	394	445	506	565	619	668	712	751
DE	2007	2533	3143	4060	5457	6997	7552	8412	9106	9757	10303	10791	11221	11592
DK	204	225	272	311	383	363	430	466	516	564	594	621	654	683
ES	191	304	483	665	852	995	1018	1201	1359	1514	1651	1779	1904	2016
EE	1	7	9	10	5	10	12	16	20	24	28	31	33	36
FI	87	125	103	152	183	211	282	285	304	323	337	351	363	375
FR	647	931	1588	1914	2261	2466	3030	3454	3806	4077	4391	4677	4940	5179
EL	5	9	9	9	8	26	26	36	43	50	57	63	67	71
HR	2	5	4	6	12	25	36	42	54	65	75	85	94	102
HU	5	9	14	18	16	32	99	106	121	131	149	159	168	178
IE	11	17	21	24	33	32	129	148	165	181	194	207	218	228
IT	229	480	594	694	801	1157	1240	1467	1714	1952	2163	2356	2529	2684
LT	10	14	23	32	16	21	17	22	28	33	38	42	46	49
LU	25	57	73	90	21	25	31	34	38	43	47	50	54	57
LV	1	4	4	4	4	11	18	22	28	34	39	43	47	51

Country	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
MT	0	4	4	4	6	4	6	7	8	10	11	13	14	15
NL	873	923	1006	1323	1374	1646	1540	1773	2012	2243	2521	2775	2973	3140
PL	94	150	233	315	400	428	547	604	647	696	737	777	816	851
PT	49	76	133	186	178	148	387	454	497	537	569	600	632	656
RO	7	12	16	22	18	50	134	153	180	202	218	232	243	254
SK	7	8	13	17	44	94	185	213	241	267	291	313	332	349
SI	2	4	11	11	26	36	54	64	75	85	94	103	111	117
SE	190	289	411	563	567	561	593	666	693	719	734	748	766	782
EU27	5407	7216	9547	12085	14629	17250	19555	22077	24373	26516	28518	30339	31975	33418

Source: Own calculation (Fraunhofer IZM and Oeko-Institut)

Annex Table 41 – Country-specific shares of LMT groups 1, 2, 3, and 4 separately for each MS in %

Country	Category	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
AT	LMT 1	2%	4%	2%	2%	2%	4%	6%	6%	7%	8%	9%	10%	11%	11%
AT	LMT 2	77%	73%	75%	74%	73%	73%	72%	74%	74%	73%	73%	73%	72%	72%
AT	LMT 3	18%	20%	20%	21%	22%	21%	19%	17%	16%	16%	15%	15%	14%	14%
AT	LMT 4	3%	3%	3%	3%	3%	3%	3%	3%	3%	3%	3%	3%	3%	3%
AT	Total LMT	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
BE	LMT1	1%	2%	6%	8%	11%	12%	13%	14%	15%	17%	19%	21%	22%	23%
BE	LMT2	85%	83%	79%	76%	72%	70%	67%	68%	68%	67%	66%	65%	64%	63%
BE	LMT3	11%	12%	12%	12%	15%	15%	17%	15%	14%	13%	12%	12%	11%	11%

Country	Category	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
BE	LMT4	3%	3%	3%	3%	3%	3%	3%	3%	3%	3%	3%	3%	3%	3%
BE	total LMT	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
BG	LMT1	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
BG	LMT2	0%	0%	10%	15%	89%	15%	36%	37%	32%	28%	27%	25%	24%	24%
BG	LMT3	100%	100%	89%	84%	8%	84%	63%	61%	67%	70%	72%	74%	74%	75%
BG	LMT4	0%	0%	0%	1%	4%	1%	2%	2%	1%	1%	1%	1%	1%	1%
BG	total LMT	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
CY	LMT1	1%	1%	10%	15%	72%	13%	21%	20%	20%	21%	21%	22%	23%	25%
CY	LMT2	72%	67%	63%	55%	19%	15%	11%	9%	8%	7%	6%	6%	6%	6%
CY	LMT3	24%	29%	24%	28%	8%	71%	68%	70%	72%	72%	72%	72%	71%	70%
CY	LMT4	3%	3%	3%	2%	1%	1%	0%	0%	0%	0%	0%	0%	0%	0%
CY	total LMT	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
CZ	LMT1	15%	3%	3%	5%	3%	4%	5%	5%	6%	7%	7%	8%	8%	9%
CZ	LMT2	54%	89%	90%	87%	94%	87%	84%	84%	82%	79%	78%	76%	75%	75%
CZ	LMT3	29%	4%	4%	4%	0%	5%	8%	7%	9%	11%	12%	12%	13%	13%
CZ	LMT4	2%	4%	4%	4%	4%	4%	4%	4%	4%	3%	3%	3%	3%	3%
CZ	total LMT	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
DE	LMT1	0%	0%	0%	0%	0%	0%	0%	0%	1%	1%	1%	1%	1%	1%
DE	LMT2	75%	72%	70%	71%	73%	72%	71%	72%	74%	75%	76%	77%	78%	79%
DE	LMT3	22%	25%	27%	26%	24%	24%	25%	24%	23%	21%	20%	19%	18%	17%
DE	LMT4	3%	3%	3%	3%	3%	3%	3%	3%	3%	3%	3%	3%	3%	3%
DE	total LMT	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
DK	LMT1	0%	0%	0%	1%	1%	2%	3%	4%	4%	5%	5%	6%	6%	7%
DK	LMT2	69%	60%	56%	52%	52%	54%	62%	65%	65%	65%	66%	67%	67%	67%

Country	Category	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
DK	LMT3	28%	37%	41%	45%	45%	42%	32%	29%	28%	28%	26%	24%	24%	24%
DK	LMT4	3%	2%	2%	2%	2%	2%	3%	3%	3%	3%	3%	3%	3%	3%
DK	total LMT	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
ES	LMT1	3%	4%	7%	8%	9%	11%	9%	10%	12%	13%	14%	16%	17%	18%
ES	LMT2	35%	40%	46%	49%	49%	56%	59%	57%	55%	54%	53%	52%	51%	51%
ES	LMT3	60%	54%	46%	42%	40%	31%	30%	31%	31%	31%	30%	30%	30%	29%
ES	LMT4	1%	2%	2%	2%	2%	2%	3%	2%	2%	2%	2%	2%	2%	2%
ES	total LMT	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
EE	LMT1	34%	3%	1%	1%	6%	6%	8%	7%	7%	8%	8%	8%	9%	9%
EE	LMT2	0%	82%	87%	86%	89%	41%	43%	38%	33%	30%	28%	27%	26%	26%
EE	LMT3	66%	12%	9%	10%	2%	52%	47%	53%	58%	61%	62%	63%	64%	64%
EE	LMT4	0%	3%	4%	4%	4%	2%	2%	2%	1%	1%	1%	1%	1%	1%
EE	total LMT	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
FI	LMT1	1%	1%	2%	2%	3%	4%	5%	7%	8%	9%	11%	12%	14%	15%
FI	LMT2	48%	48%	18%	29%	27%	31%	38%	42%	44%	45%	46%	47%	48%	49%
FI	LMT3	49%	49%	79%	68%	69%	64%	55%	49%	46%	43%	41%	38%	36%	35%
FI	LMT4	2%	2%	1%	1%	1%	1%	2%	2%	2%	2%	2%	2%	2%	2%
FI	total LMT	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
FR	LMT1	4%	5%	5%	5%	5%	4%	6%	8%	9%	10%	12%	13%	14%	15%
FR	LMT2	44%	43%	54%	52%	50%	54%	58%	58%	58%	59%	59%	59%	58%	58%
FR	LMT3	50%	50%	39%	41%	43%	39%	33%	32%	31%	28%	27%	26%	25%	25%
FR	LMT4	2%	2%	2%	2%	2%	2%	2%	2%	2%	3%	3%	3%	3%	3%
FR	total LMT	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
EL	LMT1	10%	11%	3%	2%	10%	6%	10%	10%	11%	11%	12%	13%	14%	15%

Country	Category	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
EL	LMT2	61%	66%	75%	72%	84%	51%	51%	43%	39%	36%	35%	33%	33%	32%
EL	LMT3	27%	20%	19%	23%	2%	41%	37%	46%	49%	51%	52%	52%	52%	52%
EL	LMT4	2%	3%	3%	3%	4%	2%	2%	2%	2%	2%	2%	1%	1%	1%
EL	total LMT	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
HR	LMT1	69%	12%	8%	35%	25%	23%	26%	29%	30%	31%	33%	34%	35%	36%
HR	LMT2	0%	65%	69%	46%	72%	52%	37%	36%	31%	28%	26%	24%	23%	22%
HR	LMT3	31%	21%	20%	17%	1%	23%	35%	33%	37%	39%	40%	40%	40%	40%
HR	LMT4	0%	3%	3%	2%	3%	2%	2%	2%	1%	1%	1%	1%	1%	1%
HR	total LMT	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
HU	LMT1	4%	5%	1%	1%	2%	2%	1%	1%	1%	2%	2%	2%	2%	2%
HU	LMT2	57%	64%	79%	79%	93%	48%	63%	66%	64%	64%	61%	60%	60%	59%
HU	LMT3	37%	28%	17%	16%	1%	48%	34%	30%	32%	31%	35%	35%	35%	36%
HU	LMT4	2%	3%	3%	3%	4%	2%	3%	3%	3%	3%	3%	3%	3%	3%
HU	total LMT	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
IE	LMT1	0%	0%	0%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%
IE	LMT2	49%	52%	47%	42%	47%	45%	84%	82%	81%	81%	81%	80%	80%	80%
IE	LMT3	49%	46%	51%	55%	50%	52%	12%	14%	14%	15%	15%	15%	15%	15%
IE	LMT4	2%	2%	2%	2%	2%	2%	4%	4%	4%	3%	4%	4%	4%	4%
IE	total LMT	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
IT	LMT1	3%	2%	2%	4%	5%	7%	6%	7%	8%	9%	10%	10%	11%	12%
IT	LMT2	69%	78%	76%	73%	71%	63%	64%	61%	58%	55%	53%	52%	51%	50%
IT	LMT3	25%	17%	19%	20%	21%	28%	27%	29%	32%	34%	35%	35%	36%	36%
IT	LMT4	3%	3%	3%	3%	3%	3%	3%	3%	2%	2%	2%	2%	2%	2%
IT	total LMT	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%

Country	Category	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
LT	LMT1	1%	1%	1%	1%	3%	5%	10%	10%	11%	12%	13%	13%	14%	14%
LT	LMT2	88%	87%	91%	92%	92%	63%	47%	41%	36%	33%	31%	30%	29%	28%
LT	LMT3	8%	8%	4%	4%	1%	29%	41%	47%	51%	54%	55%	56%	56%	56%
LT	LMT4	3%	3%	4%	4%	4%	3%	2%	2%	2%	1%	1%	1%	1%	1%
LT	total LMT	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
LU	LMT1	1%	1%	0%	1%	6%	10%	13%	16%	18%	22%	24%	26%	28%	29%
LU	LMT2	11%	16%	13%	10%	48%	53%	52%	53%	53%	51%	51%	50%	49%	48%
LU	LMT3	87%	83%	87%	89%	44%	35%	32%	29%	27%	25%	23%	22%	21%	20%
LU	LMT4	0%	1%	1%	0%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%
LU	total LMT	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
LV	LMT1	12%	2%	3%	4%	27%	20%	21%	21%	22%	25%	26%	27%	29%	30%
LV	LMT2	0%	75%	76%	71%	68%	36%	46%	41%	36%	33%	30%	29%	28%	27%
LV	LMT3	88%	20%	18%	22%	2%	43%	32%	36%	40%	41%	42%	42%	42%	42%
LV	LMT4	0%	3%	3%	3%	3%	2%	2%	2%	2%	1%	1%	1%	1%	1%
LV	total LMT	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
MT	LMT1	41%	13%	5%	17%	74%	23%	26%	27%	30%	33%	35%	37%	39%	40%
MT	LMT2	0%	77%	85%	73%	25%	35%	48%	44%	40%	37%	34%	33%	32%	31%
MT	LMT3	59%	7%	7%	8%	0%	41%	25%	26%	28%	29%	29%	29%	28%	28%
MT	LMT4	0%	3%	3%	3%	1%	1%	2%	2%	2%	2%	2%	1%	1%	1%
MT	total LMT	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
NL	LMT1	7%	7%	6%	5%	6%	9%	12%	14%	16%	18%	20%	21%	22%	24%
NL	LMT2	89%	89%	89%	91%	89%	87%	83%	82%	80%	78%	74%	72%	70%	69%
NL	LMT3	0%	0%	1%	1%	1%	1%	1%	1%	1%	1%	3%	4%	4%	4%
NL	LMT4	3%	4%	4%	4%	4%	4%	4%	3%	3%	3%	3%	3%	3%	3%

Country	Category	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
NL	total LMT	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
PL	LMT1	1%	2%	2%	4%	5%	9%	12%	13%	15%	17%	20%	22%	24%	26%
PL	LMT2	12%	20%	30%	33%	33%	30%	34%	35%	36%	37%	37%	37%	37%	38%
PL	LMT3	86%	78%	67%	62%	61%	59%	52%	50%	47%	44%	41%	39%	37%	35%
PL	LMT4	0%	1%	1%	1%	1%	1%	1%	2%	2%	2%	2%	2%	2%	2%
PL	total LMT	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
PT	LMT1	0%	0%	0%	0%	0%	1%	1%	1%	1%	1%	1%	1%	1%	1%
PT	LMT2	6%	12%	31%	38%	21%	21%	67%	64%	65%	65%	66%	67%	66%	67%
PT	LMT3	94%	88%	67%	60%	77%	77%	30%	33%	32%	31%	30%	30%	30%	29%
PT	LMT4	0%	0%	1%	2%	1%	1%	3%	3%	3%	3%	3%	3%	3%	3%
PT	total LMT	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
RO	LMT1	2%	4%	1%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
RO	LMT2	41%	49%	66%	68%	93%	34%	60%	59%	56%	54%	54%	54%	54%	54%
RO	LMT3	56%	45%	31%	29%	3%	64%	37%	38%	42%	43%	43%	44%	43%	43%
RO	LMT4	2%	2%	3%	3%	4%	1%	3%	3%	2%	2%	2%	2%	2%	2%
RO	total LMT	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
SK	LMT1	3%	5%	2%	2%	4%	3%	3%	3%	3%	4%	4%	5%	5%	5%
SK	LMT2	77%	72%	83%	84%	92%	83%	87%	86%	84%	82%	81%	80%	79%	78%
SK	LMT3	16%	20%	12%	11%	0%	10%	6%	8%	10%	11%	12%	12%	13%	13%
SK	LMT4	3%	3%	3%	3%	4%	3%	4%	4%	4%	4%	4%	3%	3%	3%
SK	total LMT	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
SI	LMT1	8%	3%	31%	9%	6%	8%	9%	9%	10%	11%	12%	13%	14%	15%
SI	LMT2	59%	69%	58%	78%	90%	72%	74%	71%	67%	64%	62%	61%	59%	58%
SI	LMT3	31%	25%	9%	11%	0%	17%	13%	17%	19%	21%	23%	23%	24%	24%

Country	Category	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
SI	LMT4	2%	3%	2%	3%	4%	3%	3%	3%	3%	3%	3%	3%	3%	3%
SI	total LMT	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
SE	LMT1	0%	1%	0%	0%	0%	0%	0%	0%	0%	1%	1%	1%	1%	1%
SE	LMT2	44%	47%	50%	54%	44%	44%	41%	41%	44%	46%	48%	50%	51%	52%
SE	LMT3	54%	51%	48%	44%	54%	54%	57%	57%	54%	52%	49%	47%	46%	44%
SE	LMT4	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%
SE	total LMT	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%

Source: Own calculation (Fraunhofer IZM and Oeko-Institut)

Annex Table 42 – Total portable batteries AOM in EU27 in tonnes, for 2015-2040

[t]	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027
EU27	177000	177000	188000	191000	206000	229000	245000	244000	248880	253638	258263	262745	267072

[t]	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
EU27	271236	275224	279029	282640	286048	289245	292223	294973	297489	299764	301792	303567	305085

Source: Own calculation (Fraunhofer IZM and Oeko-Institut)

Annex Table 43 – Default values for P1 / P2 share of portable batteries in EU27 (%), for 2015-2040

[%]	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027
P1	70.0%	69.3%	68.7%	68.0%	67.3%	66.7%	66.0%	65.3%	64.7%	64.0%	63.3%	62.7%	62.0%
P2	30.0%	30.7%	31.3%	32.0%	32.7%	33.3%	34.0%	34.7%	35.3%	36.0%	36.7%	37.3%	38.0%

[%]	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
P1	61.3%	60.7%	60.0%	59.1%	58.2%	57.3%	56.4%	55.5%	54.5%	53.6%	52.7%	51.8%	50%
P2	38.7%	39.3%	40.0%	40.9%	41.8%	42.7%	43.6%	44.5%	45.5%	46.4%	47.3%	48.2%	50%

Source: Own calculation (Fraunhofer IZM and Oeko-Institut)

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