DG ENER Lot 37: Preparatory Study on Ecodesign and Energy Labelling of rechargeable electrochemical batteries with internal storage

Organization: **ECOS, Transport & Environment, the EEB and the Coolproducts campaign.**	**Name:** **Mélissa Zill**	**Date:** **18/01/2019**

Task #	Section #	line #	Topic	Comment	Proposed change	Reply study team
	General		Coherence between Tasks	In general, we believe the authors should improve the alignment and coherence between the tasks. There are several overlaps and, in some cases, contradictions (i.e. see our comment on §4.2). Furthermore, it seems that between Tasks 3, 4 & 5 the hypotheses on base cases are different. These should be aligned, and a summary of those base cases should be developed.		
	1.1		Definitions	Solid-state batteries should also be defined.	Add a definition for solid state batteries	
	1.2.2		Battery hierarchy	The difference between cell block and modules is not very clear in this definition.	Clarify definitions	
	1.4.1	Table 1	Rechargeable electrochemical batteries classified according to their chemistry	When comparing Li-Ion Pouch to Cylindrical geometry, Energy Density is mentioned for both as an advantage over the other.	Correct inconsistency	
	1.4.1		Rechargeable electrochemical batteries classified according to their chemistry	After stating different Li-Ion chemistries, the text makes a sudden jump from cell-level to battery system-level. It would also be interesting to compare other advantages/disadvantages of different Li-Ion chemistries other than energy density.	Insert table comparing advantages of chemistries different from Li-Ion other than energy density.	

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	1.4.1		Rechargeable electrochemical batteries classified according to their chemistry	The text focuses too much on Li-Ion chemistry and leaves aside other types of batteries such as Ni-Metal Hydride batteries that are common in hybrid vehicles. Other kinds of battery technologies should be further presented in the text, as in the case of Li-Ion batteries.	Give the same amount of detail for other types of batteries as for Li-Ion batteries	
	1.4.1		Rechargeable electrochemical batteries classified according to their chemistry	We do not understand why flow batteries have been excluded from the scope of the study. Although not explicitly mentioned, these are in no way excluded by the Battery Directive definition: "In addition to this non-exhaustive list of examples, any battery or accumulator that is not sealed and not automotive should be considered industrial." Flow batteries are regularly studied as an option for stationary applications, especially for grid support applications (such projects exist in Belgium and France). We believe that the question of the inclusion of flow batteries in the scope should be evaluated on the grounds of whether they can be massively produced for a certain application in the short term, and the related environmental impacts.	Consider including flow batteries in the scope of the study or better explain reasons for exclusion of the scope.	
	1.5		Definition of a battery system and a battery application system for use in this study	We do not see any reference to passive or active cell balancing systems, although these are well mentioned in the definition of cell electronics. We believe that this is an important component of the battery system and should be considered in the scope of the study, in particular since balancing systems are essential in preserving battery longevity.	Elaborate on cell balancing systems.	

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	1.5		Definition of a battery system and a battery application system for use in this study	We believe that an explicit mention should be made of Battery Management Systems (BMS's) and their specific components (software, central units, slave units), since these are essential battery system components for several reasons: 1) they control safety systems but also cell balancing systems (as mentioned in previous comment); 2) they represent a crucial aspect in the reuse of the battery; 3) they constitute a key challenge in interoperability with other systems (i.e. Energy Management Systems);	Elaborate on BMS components.	
	1.6		Definition of the primary functional parameter and unit	It is important to underline that any stationary battery can also be used as a UPS in a logic of application stacking. For example, a building can use a Li-Ion stationary battery that is primarily destined to serve as a UPS to provide peak-shaving or grid services, or vice-versa, the UPS can be a secondary application. It should be clarified how the UPS application should be considered in this framework.	Clarify how UPS application will be considered in the context of application stacking.	

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	1.7		The basic secondary product performance parameters	**End of life:** As mentioned in the JRC study [8], there is a lack of clear definitions in standards on durability, SoH, End-of-Life and the real-life testing (among others), including IEC 62660-1. This study should therefore not define a SoH value below which the batteries should be considered as "end of life"'. For electric vehicle applications, although the 80% value is a market-recognized critical threshold, it doesn't mean that batteries at 79% should already be treated as end-of-life, especially as this value has been introduced as a "study team's own definition". We therefore suggest not to include any threshold related to performance and durability parameters.	Eliminate any threshold related to performance and durability parameters.	
	1.7		The basic secondary product performance parameters	**Calendar life:** The study mentions that the calendar life is an absolute value, yet in the parenthesis it is mentioned as a percentage.	Correct the typo	
	General 1,8 Scope			In general, it is very important to define whether this study applies also to second-life batteries. These often undergo an important re-manufacturing procedure, so it is very important to define the perimeter of application of this study (and the forthcoming directive) in respect to the fabrication process of second-life batteries.	Include this aspect in the description of the scope.	

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	General 1,8 Scope		Scope	Battery electric buses are not considered in the scope of this study even though LiB demand for electric buses is very significant: 16 GWh in 2016 and 12.5 GWh in 2017[1]. In the near future European cities are likely to procure a very large number of electric buses, creating a large market in Europe.	Include electric buses in the scope of the MEErP tasks for EV application, in particular for key parameters, market analysis, demand forecast, repurposing for ESS, BOM and LCA.	
	1.8		Discussion of the proposed scope of this study	In this paragraph the study refers to Table 4 regarding energy density (although the author probably wanted to refer to Table 2), mentioning that it should leave out of scope any battery that has an energy density lower than 100Wh/kg. We believe that this threshold is unacceptable in that it excludes technologies such as NiMH or Ni-Cd that are very common in the industry (in particular NiMH that are very common in HEV). In general, as discussed in the 20/12/2018 workshop, we believe that fixing this kind of arbitrary threshold creates a perverse effect in many ways: 1) It might discriminate without evident reason batteries that are used for the same applications *(i.e. different battery models using the same chemistry and used in the same application but with slightly different energy density);* 2) It incentivizes manufacturers to aim for an energy density lower than 100kWh/kg, which is largely against the whole spirit of the directive. We suggest to define the scope based on the applications.	The scope should be more oriented around applications and other criteria, and not energy density. Re-assess the proposed scope.	

[1] https://c40-production-images.s3.amazonaws.com/other_uploads/images/1726_BNEF_C40_Electric_buses_in_cities_FINAL_APPROVED_%282%29.original.pdf?1523363881

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	1.10.9		The European Ecodesign Directive (2009/125/EC) and its implementing regulations	EV (including HEV) batteries are one of the key products to be addressed in this study; whether these are included or not in the Ecodesign Directive should in no case be used as grounds to exclude them from the scope of this study. Furthermore, thanks to the Vehicle-to-Grid (V2G) technology, EV batteries will be used as electricity storage for buildings and have a different nature than the solely transport-related one.		
	2.2.2		Market stock and forecast for xEVs in Europe	The demand for Li-ion batteries from e-buses should be considered more accurately. We do not agree with the following statement "*E-buses as well as light and heavy commercial vehicles still do not play a major role in terms of installed capacity.*" which does not reflect the reality.	Reconsider the importance of e-buses in the analysis, and in particular perform a market analysis and forecast of the demand for batteries for e-buses at European level.	
	2.3.4		LIB demand by applications – Figure 27: Global LIB demand (in GWh and share in %) by segment	The graph does not highlight the fact that the major part of the demand for Li-ion batteries from heavy-duty vehicles is for electric buses rather than electric trucks.	Perform a detailed analysis of the demand forecast for battery electric buses and split the current bus / truck (heavy duty) category in figure 27 to better highlight the case of electric buses.	
	2.3.4.2		LIB markets for stationary (ESS) applications	Second-life applications are key to reducing the cost and the environmental impact of EV batteries. These applications should be considered in the report, and the market status and growth of second-life applications should be explored further. As correctly suggested in 2.4.5.1, second-life batteries are most likely to be used in low-load applications (in most cases this implies ESS applications) so it would be pertinent to consider the use of second-life batteries for ESS applications and their growth estimations.	Consider the market for second-life batteries for stationary (ESS) applications in particular, and in general in all the sections of the report.	

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	3.1		General structure of section 3.1	The structure of this section is not very logical, and it complicates the analysis of the report.	Revise the structure of section 3.1.	
	3.1.1 .2		Standards for battery testing and testing conditions	**Capacity C and Rated capacity C_n** The definition for C_n (rated capacity) is somewhat confusing when compared to capacity (C). The two definitions should be more aligned in the text, except for the final phrase of the definition of C_n.	Reword the definition for Rated Capacity C_n	
	3.1.1 .2.1		Key parameters for the calculation of direct energy consumption of batteries (affected energy)	**Calendar life L_{cal}/ Storage life (a)** The definition of Calendar life L_{Cal}/storage life should also mention load conditions.	Mention the load conditions within the list of conditions to assess the calendar life.	
	3.1.1 .2.1		Key parameters for the calculation of direct energy consumption of batteries (affected energy)	**Affected energy AE** No real definition is provided, only a description of the formula to be used to calculate the affected energy.	Add a general explanation of the concept of affected energy.	
	3.1.1 .2.2		Key parameters for the calculation of battery energy efficiency	**Battery energy efficiency**: It is unclear why a new definition for the “battery energy efficiency“has been introduced here; in literature, the Coulombic efficiency or Voltaic efficiency are the only parameters used to describe the energy efficiency, therefore introducing a new metric is questionable.	Explain why the introduction of this new metric was needed or stick to existing definitions.	

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	3.1.1 .2.4		Definition of base cases	Off-grid applications should be mentioned in this section of the report. As mentioned in our comments for Task 1, UPS is also an application that can be combined with others (be it for primary or secondary application). In any case, we believe that it is important to underline the possibility to combine different applications for a single ESS battery.	Mention off-grid applications.	
	3.1.1 .2.4		Definition of base cases	In the sentence *"Since for PV battery systems, referred to as* ***residential ESS*** *and the provision of grid services, referred to as* ***commercial ESS,*** *seem to have the highest market potential (see Thielmann et al. (2015) and Task 2) they will be in the scope of this study."* the terms "residential" and "commercial" are misleading, since most of the time (also in this study) these terms refer to the buildings in which ESS batteries are installed (i.e. homes VS office buildings or other tertiary sector). Furthermore, the mention of PV battery systems having the highest market potential is largely at odds with what is mentioned in Task 2, Section 2.2.3.4 where it is projected that large storage systems will have a much steeper growth than residential systems.	Revise the definition of residential ESS and commercial ESS and improve coherence between the analysis made in different tasks so that the report does not contain contradictions.	
	3.1.1 .2.5		Base cases for EV applications	Figure 13 should mention for which type of EV this profile is relevant (BEV? LCT?).	Specify in the title of Figure 13 for which type of EV the profile presented is relevant.	

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	3.1.1 .2.5		Base cases for EV applications	**Calendar and cycle life battery** It would be interesting to mention the end-of-life criteria seen from a user's perspective. The 80% SoH value mentioned in Task 1 surely represents a market average but does not necessarily reflect user experience (some batteries might be replaced earlier or later than the moment they reach 80%).	Discuss user's perspective when it comes to end of life of batteries.	
	3.1.1 .2.6		Base cases for ESS applications	As EV batteries can be reused for ESS applications, it would be interesting to make an estimation of the remaining life capacity and efficiency of second-life batteries in relation to number of cycles or calendar life in EV's. This is a crucial element to assess impact of their reuse.	Consider the reused EV batteries in the base case for ESS applications	
	3.1.1 .2.5		Base cases for EV applications	The report should include a summary describing the base cases retained, including for ESS applications. We also noted that the base cases had different features in Task 3 and Task 4, so an effort should be made to harmonise the information presented in the task reports.	Provide a summary of the base cases.	
	3.3		End of Life Behaviour	The rationale for setting EoL values of 50% and 70% for residential and commercial ESS is not mentioned, and these values cannot be simply assumed. In general, and as stated in the comments on Task 1, we are not in favour of using thresholds related to the end of life: the longer batteries last, the better.	Eliminate any threshold related to performance and durability parameters.	

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	3.3.1		Product use & stock life	The conclusion that passenger batteries are not suitable for reuse is questionable. First, it is not confirmed by market trends, since most car manufacturers are actively seeking to reuse their passenger EV batteries in second-life applications. Second, reuse in ESS applications is less demanding than in EV applications (lower C-rates, lower temperature ranges) which means that calendar life in ESS applications should be longer than in EV applications; especially since EV batteries are built for tougher conditions than for standard ESS batteries.	Reconsider the conclusion stating that passenger cars batteries are not suitable for second-life use on the basis of evidence from market trends.	
	3.3.2		Repair- and maintenance practice	It should be mentioned that EV batteries are also not designed to be opened; access to modules or even other ancillary systems of the battery is only possible by destroying the battery's casing since these are sealed. This is even worse for access to cells, which is practically impossible without destroying a major part of the modules and possibly the cells themselves. This is mentioned in Task 4 and should be mentioned here too.	Beyond the mention of the high effort required to access and repair the batteries, it should also be mentioned that generally EV batteries are not designed to be opened and that accessing or replacing cells means destroying the casing and a major part of the modules.	
	3.3.2		Repair- and maintenance practice	The report fails to mention that access to information from the BMS is critical to maintain but also to reuse a battery. BMS are proprietary to the manufacturers who generally do not allow access or interfacing with third party software. This is a major hurdle for testing and reusing batteries, since BMS components cannot be reused in second-life applications and need to be systematically replaced which is costly and induces risks for the second-life user. Open BMS systems (or at least interfaceable ones) could significantly lower refurbishing costs for batteries and enable direct reuse.	Introduce in the report the notion that for EV Batteries, BMS are usually proprietary and that second life applications such as ESS are only possible after a costly replacement of the BMS which also implies a change of material (e.g. printed circuit boards).	

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	3.3.3		Collection rates, by fraction (consumer perspective)	This section should mention that the ELV Directive currently in force dates from 2000 and is in the process of being revised. In its current version, the specificities of electric vehicles are not considered.	Mention in this section that the current legislation on end of life vehicles does not set any requirements regarding the batteries of electric cars.	
	4.1.2		Discussion on battery technology improvement (design) options	One of the major axis of improvement is the replacement of rare and expensive minerals. We believe there should be a comprehensive overview of these minerals, their level of extractable resources (in years of marketability) together with a summary of main technology improvements that are envisaged to reduce their use or replace them together with their maturity or time-to-market.	Add in this section the notion that one major axis for improvement is to replace rare and expensive minerals currently essential to the manufacture of batteries	
	4.1.2 .6.3		Compatibility of electronics for automotive and stationary applications	For second-life applications it is not so much application-compatibility that is sought, but rather interoperability. It is not expected from BMS systems to integrate ESS EMS functions, but rather to be able to interface with ESS EMS's (as also mentioned in our comment on 3.3.2). This is rather an issue of standardisation of communication protocols and accessibility of software interfaces given by manufacturers, and the technology is already available.	Modify the title of 4.1.2.6.3 and the whole paragraph considering that the issue does not lie with the compatibility of the electronics but rather with the interoperability.	
	4.2		Subtask 4.2 - Production, distribution and end-of-life	Some of the data presented here does not match what is presented in other sections of the report (i.e. application life cycles). An effort to align data throughout the study should be made.	Align the data between the different parts of the report.	
	4.2.5 .1.		Second-life applications	The claim that EV batteries reach their EoL at 80% of capacity should be substantiated. In principle we disagree with setting such a threshold. See our comment on 1.7.	Eliminate any threshold related to performance and durability parameters.	

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	4.2.5 .1.		Second-life applications	Repurposing of EV batteries for stationary applications would require less new materials/components if the BMS was not proprietary and interoperability could be ensured without needing to replace the material.	Mention in the paragraph that repurposing of EV batteries for stationary applications would be facilitated by improving the interoperability of the BMS.	
	4.2.5 .1.		Second-life applications	*"Adding a repurposed battery in a building where no batteries have been used before does not bring any benefits.".* This claim is misleading as instead of comparing the benefit of a repurposed battery vs a new battery, it compares the benefit of installing a repurposed battery vs no battery. We strongly oppose this claim as formulated. A repurposed battery can be installed: 1) in a building that would otherwise install a new battery, in which case it spares the impact of the production of a new battery. This is also implied in further sentences; 2) In replacement of a UPS and/or generator system, in which case it spares the impact of installing new UPS and/or generators.	Remove the sentence.	
	4.2.5 .1.		Second-life applications	*"…the subsequent service life for the second use is very sensitive to the second life cycle…".* Service life is dependent on the first life cycle, not the second.	Correct the mistake.	
	4.2.5 .1.		Second-life applications	"*Furthermore, it was reported, that technician labour is a significant cost factor for the repurposing that need to be minimised*." The cost could be minimised if EV batteries were designed to facilitate repurposing.	Add that optimising EV batteries design for repurposing would minimise the cost of technician labour.	

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	4.2.5 .1.		Second-life applications	*“Therefore, it is not economically viable to replace defective cells within modules, and therefore it is critical to minimize the purchase of modules with defective cells."* The conclusion drawn here is questionable. Instead of the purchase of modules with defective cells, it should be mentioned that the replacement of defective cells within modules could be facilitated.	Rephrase this sentence and the conclusion to reflect that replacement of defective cells could be facilitated.	
	4.2.5 .1.		Second-life applications	The study should also consider the regulatory aspect of second-life: The Battery Directive (2006/66/EC) mentions that it is the first entity that imports a battery into a country that is responsible for its recycling. Although there is no clarification on second-life batteries, EU Members States have implicitly concluded that the recycling responsibility is passed on to the second-life reseller. This is an important aspect in the value chain as recycling costs for LIB are quite high.	Mention the issue of the responsibility of the recycling in this section.	
	5.		General	We believe that the study should have a stronger focus on the impact of resource mining, and on battery manufacturing. Task 5 clearly highlights that this is where the main environmental impacts occur. Focusing only on CO_2 and energy efficiency would lead to underestimating the main concerns associated with batteries and the objective to drive sustainable battery production would be missed.	Investigate further elements like sourcing of critical raw materials (especially methods), as well as social and ethical concerns linked to metal sourcing. The LCA results are a good starting point and could be deepened.	
	5.0		General introduction	We believe that there could also be a use case for “intermediate” stationary batteries that are reused for applications as peak shaving, energy arbitrage in combination with other services. Not doing so would exclude a large part of existing battery models (i.e. Tesla Powerpack).	Mention the case of intermediate stationary batteries in the general introduction.	

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	5.2.1		Eco Report LCA results BC1 – passenger car BEV	As outlined in the general comment on Task Report 5 (see above), Figure 1 demonstrates that 70-80% of environmental impact (i.e. water, energy use, waste and emissions) of BC1 batteries occur in the production phase. This aspect should be fully taken on board, and we support the inclusion of measures regarding the sustainability of the production of resources such as CRMs as policy options for Task Report 6 & 7.	We support the inclusion in Task 6 and 7 of policy options addressing the sustainability of the sourcing of materials entering the production processes for batteries. Given concerns around extra-territoriality, referencing the currently devised UN list of banned hazardous materials can be done as a minimum.	
	5.1.2 .4		Battery system service life and link to the economic life time of the application	As noted in the report the battery lifetime seems indeed very low compared to what is known in the market.		