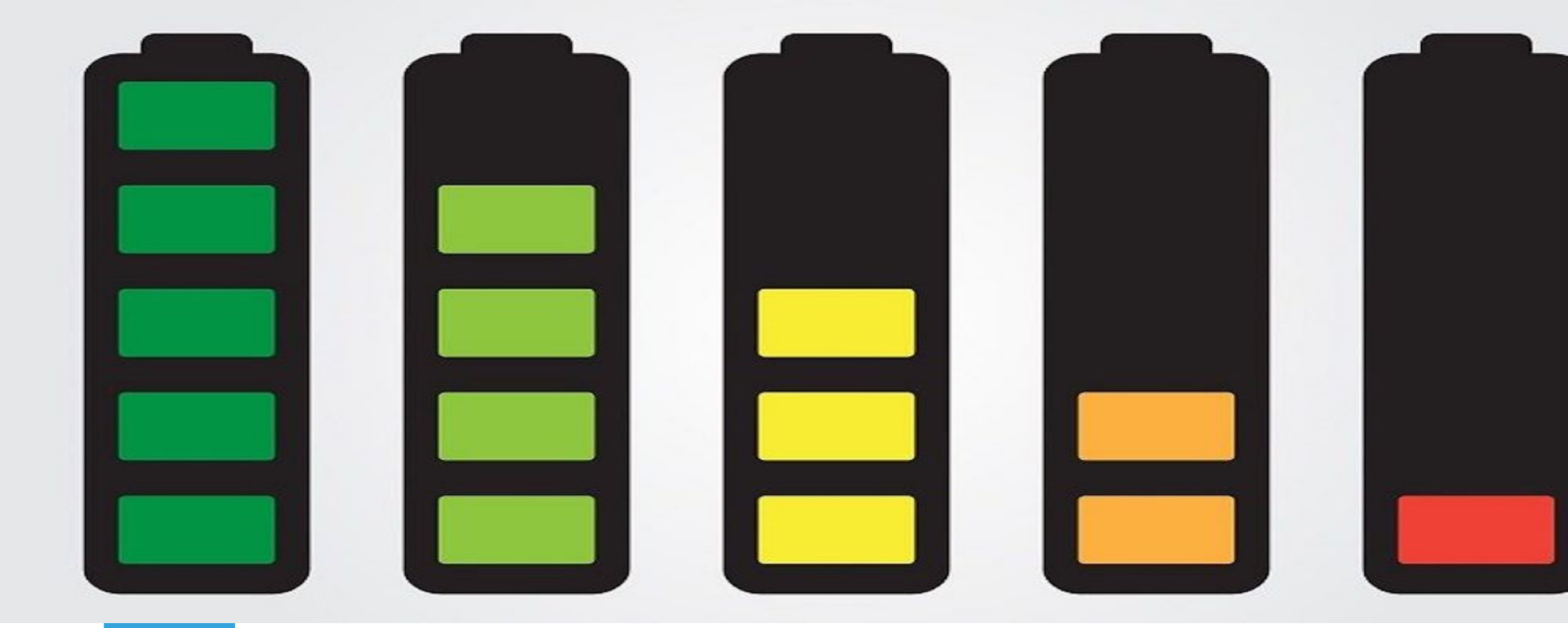

ECODESIGN BATTERIES – TASK 7.1 POLICY MEASURES ON PERFORMANCE

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Intro

Objectives:

- the potential requirements and their parameters to consider for policy measures to improve the battery in the use phase, especially those related to the battery life time

There are proposals for:

- Minimum battery pack/system life time requirements
- Maximum auxiliary power consumption of the battery system

Minimum battery pack/system life time requirements

Rationale:

- To gain this trust, demonstrate that
  - the batteries have a long service life and
  - that energy waste is minimised.
- High upfront cost and lack of confidence can be important barriers.
- The main objective of the proposal is to reduce the carbon footprint (per FU) by warranting its projected useful life time.
  - They are in line but already little more ambitious as warranty claims currently offered.
  - The calendar life warranty depends on the application.

Minimum battery pack/system life time requirements

Rationale:

Preference to shorter life test with increased thresholds, e.g. 90 % instead of 80 %, because this can shorten laboratory and market surveillance testing.

Table 7-1 Life time related performance parameters for a fist Tier to support with policy

	BC1 PC BEV HIGH	BC2 PC BEV LOW	BC3 PC PHEV	BC4 Truck BEV	BC5 Truck PHEV	BC6 Resid. ESS	BC7 Comm. ESS
Max. calendar lifetime installed battery (no cycling ageing) [yr]	20	20	20	20	20	25	25
Max. number of cycles for battery system until EOL (no calendar ageing) [-]	1,500	1,500	2,000	2,000	3,000	8,000	10,000
Service life of battery (Tbat) [y]	14.40	13.43	10.67	8.04	5.33	17.02	17.02
Number of battery application systems per Tapp (Ass) [-]	1	2	2	2	3	2	2
Average efficiency of battery system [%]	96	96	96	96	96	96	96
Self-discharge (@STC) [%]	2	2	2	2	2	2	2

Minimum battery pack/system life time requirements

Proposal:

- Proposal for
  - maximum capacity fade,
  - internal resistance increase and
  - round trip efficiency
  - for
    - battery systems/module/packs brought on the market
    - the intended application
  - Based on standards

Minimum battery pack/system life time requirements

Proposal:

- Standards

Table 7-43: Battery requirements covered in current standards for the discerned base cases.

Base case		Level	Reference	Capacity	Energy	Power	Energy efficiency	Resistance	Cycle life test	Calendar life test	Auxiliary power need	Cooling & heating need
BC1	*PC BEV high &*	Cell	IEC 62660-1: 2010	x	x	x	x	x	x			
			DOE-INL/EXT-15-34184(2015)	x	x	x		x	x	x		
& BC2	*PC BEV low*	Module	DOE-INL/EXT-15-34184(2015)	x	x	x		x	x	x		
			SAE J1798:2008	x	x	x		x				
		Pack	ISO 12405-4: 2018	x	x	x	x	x				
			DOE-INL/EXT-15-34184(2015)	x	x	x		x	x	x		
		Battery system	ISO 12405-4: 2018	x	x	x	x	x	x			
			DOE-INL/EXT-15-34184(2015)	x	x	x		x	x	x		
		Batt.appl.system										
BC3	*PC PHEV*	Cell	DOE-INL/EXT-07-12536 (2008)			x	x	x	x	x		
		Module	DOE-INL/EXT-07-12536 (2008)			x	x	x	x	x		
		Pack	ISO 12405-4: 2018	x	x	x	x	x				
			DOE-INL/EXT-07-12536 (2008)			x	x	x	x	x		
		Battery system	ISO 12405-4: 2018	x	x	x	x	x	x			
			DOE-INL/EXT-07-12536 (2008)			x	x	x	x	x		
		Batt.appl.system										

Other base cases: almost nothing to nothing covered, see report

Minimum battery pack/system life time requirements

Proposal:

- Cycle-life
- The proposed values are based on ensuring that at 50 % of the cycle-life performance can be proven under applicable laboratory test conditions

Table 7-2 Proposal for cycle-life performance requirements

Application	Maximum capacity fade (relative to the declared value)	Maximum internal resistance increase (relative to the declare value)	Minimum round trip energy efficiency	Standards
PC BEV	90 % @ 750 cycles	30 % @ 750 cycles	92 % @ 750 cycles	ISO 12405-4:2018 Cycle-life test according to Dynamic discharge application
PC PHEV	90 % @ 1000 cycles	30 % @ 1000 cycles	92 % @ 1000 cycles	ISO 12405-4:2018 Cycle-life test according to Dynamic discharge application
Trucks BEV	90 % @ 1000 cycles	30 % @ 1000 cycles	92 % @ 1000 cycles	*standard to be developed*
Trucks PHEV	90 % @ 1500 cycles	30 % @ 1500 cycles	92 % @ 1500 cycles	*standard to be developed*
ESS	90 % @ 2000 cycles	30 % @ 2000 cycles	94 % @ 2000 cycles	IEC 61427-2 Cycle-life test according to declared application(s)

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Minimum battery pack/system life time requirements

Proposal:

- Calendar life
  - half of the economic application lifetime for the calendar life warranty.

Table 7-3 Proposal for minimum battery pack/system warranty

Application	Calendar life[1] warranty (whatever reached first)	Total Functional Unit[2] kWh warranty (whatever reached first)
PC BEV	10 years	Declared capacity[kW]x750h
PC PHEV	10 years	Declared capacity[kW]x1000h
Trucks BEV	10 years	Declared capacity[kW]x1000h
Trucks PHEV	10 years	Declared capacity[kW]x1500h
ESS	12 years	Declared capacity[kW]x2000h

[1] Measured from the manufacturing time (see information proposal)
[2] Total energy stored measured at the output over its life time (see also BMS proposal)

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Minimum battery pack/system life time requirements

Timing:

- Should take effect as soon as possible, e.g. 2021.
- A second Tier with more ambitious requirements could be considered later in time, e.g. from 2025 onwards.

Challenges:

- Only two standards appear to cover a substantial part of the test requirements but for a limited amount of base cases (BC1, 2 and 3): IEC 62660-1 and ISO 12405-4
- For all other battery levels and applications new standards and test methods must be defined before thresholds can be determined. Also, the mentioned two standards do not cover all test requirements.

Maximum auxiliary power consumption of the battery system

Rationale:

- When using a battery system, insight in the auxiliary power consumption might also be needed.
  - If the BMS power is drained from the battery it can lead to a problematic self-discharge: the consumption of the BMS can be too high to bridge standstill periods.
  - This applies also to heating & cooling system.

Maximum auxiliary power consumption of the battery system

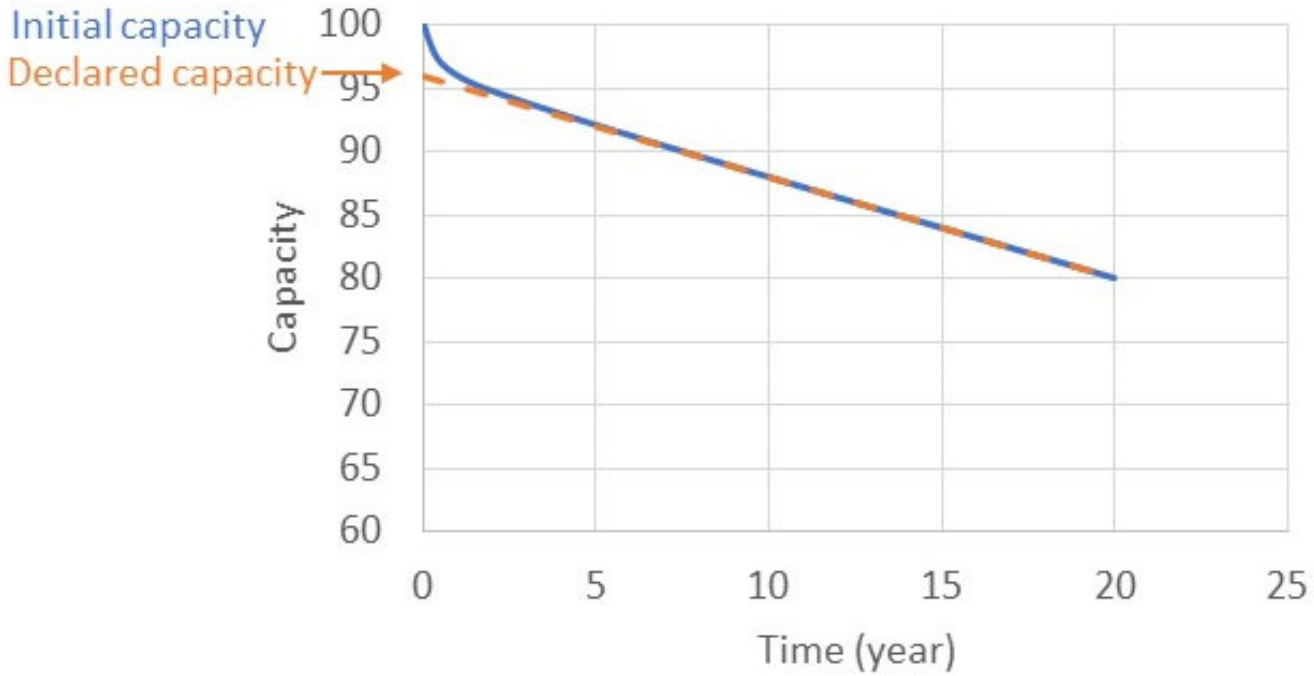
Proposal:

- For the auxiliary power need a maximum value is proposed.
  - The test method must be developed.
  - Auxiliary power, i.e. ≤ *TBD* W/ $kWh_{declared\ capacity}$.
- For the cooling & heating need a similar threshold is needed.
  - To allow comparison between energy cost and lifetime gain, a method needs to be developed to estimate the annual energy need.
  - Cooling & heating need, i.e. ≤ *TBD* $kWh_{yearly\ need}/kWh_{declared\ capacity}$.

Maximum auxiliary power consumption of the battery system

Proposal:

- Principle of **declared** capacity



Maximum auxiliary power consumption of the battery system

Timing:

- Dependent on standard development.

challenges:

- It appeared that the auxiliary power need and the heating & cooling need is not covered by standards for the batteries.

Items considered but not proposed

Minimum initial energy efficiency:

- Because redundant with criteria after .. test cycles.

Minimum gravimetric energy density for e-mobility :

- Because it is already an important design parameter for e-mobility and there is no evidence that setting a minimum requirement will be useful to influence the market.

Minimum self-discharge for cells/packs (loss at storage) [% SoC/time]:

- It is not recognized as a problem for the lithium batteries cells/packs. The no load losses in battery application systems are usually attributed to power electronics.