Comments

on the proposed Energy Efficiency Index for smartphones and tablets

Brussels, 10 November 2021

Following the meeting of 16 September 2021 on the energy performance of smartphones and tablets and the subsequent distribution of the document "Energy Efficiency Index for smartphones and tablets: Measurement and calculation methods" (version 1.4), the environmental NGOs hereby submit their views on the proposed approach.

We welcome the attention being paid to this important aspect of measurement, and strongly support the development of a tool designed specifically for the purpose of testing smartphones and tablets that is cost effective and easy to use, allowing for accurate and repeatable measurement and representing as closely as possible typical consumer usage of these devices.

However, in order to ensure that the energy efficiency index (EEI) is representative of real-life use, we believe that further improvements are necessary in relation to the following aspects, as detailed in the remainder of this paper:

- Test environment should be more clearly specified (Sections 2.4 & 6)
- Configuration of unit under test should be more detailed (Sections 6.1 & 6.2)
- Usage simulation and test scenario should be based on more representative assumptions, taking into account limitations of the consultation results (Sections 3 & 4)
- Testing and calculation approach should be revisited (Section 7)

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Test environment (Sections 2.4 & 6)

We suggest that the testing environment is more clearly specified in line with CENELEC standards for other electronic products. Given that ventilation will have an impact on heat and battery performance, we believe that more detail - including on the corresponding tolerances - should be provided in relation to temperature and humidity of the laboratory, as well as on the surface on which the smartphone or tablet is placed for testing purposes.

Configuration of unit under test (Sections 6.1 & 6.2)

Section 6.2 of the proposed approach to energy index calculation provides some insights as to how the smartphone should be configured for the test. However, greater detail is necessary to ensure that the results are accurate, comparable and reflecting the real-life usage of these devices. This includes the following suggested requirements to be prescribed:

- if the device it to be tested with or without the latest software upgrades;
- if power-saving and battery optimisation functionalities should be enabled or disabled;
- how aspects such as screen brightness would be measured;
- how audio volume and refresh rate would be configured;
- how storage can be configured to be representative of typical phone use.

Usage simulation and test scenario (Sections 3 & 4)

Issues with the non-representative data set (Section 3.1)

Alternative data needs to be taken into account in the design of the usage simulation. The data on which the EEI usage profile is based is derived from a public consultation that was carried out in July 2021. While the survey received answers from some 450 respondents, there are notable issues with this usage data:

- Sampling: The questionnaire was not implemented as a survey which would sample a representative cross-section of the European population, but rather as a wider consultation open to the general public. Major variations in smartphone usage exist depending on age which cannot be corrected for, given that age was not considered a relevant variable. For example, people aged 25 or less use their phones more on weekends and in the evening, spend more time using social networking, and make more app switches per day [1]. Furthermore, respondents were able to answer as organisations, final users, or with a perspective on the whole market, meaning that the data set is not coherent and includes averages and single user data points that are not handled separately in the analysis.

[1] Deng,T. et al (2018), Measuring smartphone usage and task switching with log tracking and self-reports, *Mobile Media & Communication*, 7(1), pp. 3-23.

- **Missing key usage options**: In the meeting of 16 September 2021, it was explained that the list of activities chosen for the purpose of designing the usage profile were based on the questionnaire responses. However, a number of key usage options were not included in the said questionnaire[2], which impacts on the representativeness of the final results. The activities missing from the questionnaire include the following:
    - Social media use
    - Video calls and video conferencing
    - Reading and sending emails
    - Listening to music
    - Reading e-books

- **Low quality of self-reported data:** There are three main data collection techniques for usage data for products like smartphones and tablets, with differing levels of data quality:
    - **Self-reporting based on retrospective recall**: lowest quality data, influenced by representativity and size of population sample, inaccurate memory recall of respondents, social desirability (the tendency of an individual to represent themselves in a favourable way), and cognitive bias (limited objectivity caused by information being perceived through a filter of personal experience and preferences);
    - **Logging of actual use via field study, diary study or server data:** medium quality data, influenced by representativity and size of population sample, and inaccuracy in user logging in diaries (server studies are more reliable);
    - **Analysis of large data sets from commercially available apps:** highest quality data, resulting in relatively accurate representations of average usage across a representative sample of the population, although with some possible impairment of data due to the inability of apps to record background app usage (e.g. listening to music while doing other tasks).

  Although potentially more recent, self-reported data should not take precedence over other, more reliable sources. Taking this into account, we believe that a refinement to usage assumptions is necessary, in line with the recommendations proposed below.

Usage assumptions (Sections 3.1.1 & 3.1.2)

In order to ensure a duty cycle that is representative of real-life usage, the assumptions of the EEI report should be reworked taking into account the detailed usage study of Deng et al (2018). The study covers such important usage options as gaming, which have a major impact on battery life and stimulate smartphone functionalities not included in the current proposal. Over 90% of

[2] Options included in the questionnaire were: phone calls, using applications for chat, streaming media (i.e. video or music content), taking pictures, playing offline games, playing online games, browsing the web, other (with no option to specify)

respondents claimed to use their smartphone for gaming for at least "30 minutes/less" per day, which represents some 13% of total usage time. Taking the above-mentioned study into account, we propose to revise the usage simulation assumptions as detailed in Table 1 beloe. For further details on the rationale behind the revised usage assumptions, please see the Annex.

	SMARTPHONES		TABLETS	
	EC study	ECOS Recommendation	EC study	ECOS Recommendation
Chat / Social Network	27%	**54%**	9%	**9%**
Video and Streaming	26%	**13%**	47%	**37%**
Web browsing	30%	**15%**	44%	**34%**
Call	17%	**8%**	excluded without justification	**4%**
Online gaming	excluded without justification	**5%**	excluded without justification	**8%**
Offline gaming	excluded without justification	**5%**	excluded without justification	**8%**

Table 1: ECOS recommended refinements to usage simulation assumptions

Assumptions on total use time & task switching (Section 3.1.1 & 3.1.2)

The total use time per day (in hours) reported or assumed by different sources varies considerably. Deng et al. found average use of 2 hours 39 minutes, but with a variance of 2 hours 23 minutes, and an overestimation through self-reporting of 23 minutes. The GSMArena benchmark assumed 3 hours, but the preparatory study showed that almost half of users spent 5 hours or more and more than 25% users spent 7 hours. We therefore consider that the 4 hours assumed by the EEI study is appropriate.

In relation to task switching, Deng et al. found from their logging data that users switched between apps over 100 times a day. On average, 24 use sessions per day were observed, with an average duration of 7 minutes and 3.4 switches between app categories per phone session. The proposed duty cycle is very different to this type of usage, so instead of trying to reproduce a typical cycle that is, in the end, non-typical, we suggest instead a dedicated test cycle for each usage type which can then be adapted through calculation to reflect a representative distribution between tasks (see section on calculation of EEI below for further details).

Proxies for third party apps (Sections 3.2.2, 3.2.4 and others)

We believe that comparative tests should be carried out - and reported on - to ensure similarity of the social network simulation (FTP download and upload) and web browsing proxies to the use of third-party apps, so that the simulation approach can be tailored to be more representative if necessary.

Moreover, it should be considered how running of background apps can be simulated to be representative of typical phone use, and how the disabling of Bluetooth functionality will be compensated for in the design of the testing app, as most users would have this enabled as default - thereby impacting on battery usage.

Calculation of energy efficiency index (EEI) (Section 7)

The approach proposed in the EEI study diverges from the recommendations of the preparatory study. The preparatory study proposed a calculation of EEI as:

$$EEI = \frac{END_{Device}}{C_{rated}}$$

Where:

END_{Device} is the calculated battery endurance in hours

C_{rated} is the rated battery capacity in mAh

With END_{Device} calculated similarly to the GSMArena approach for smartphones as:

$$END_{device} = \frac{24}{\left(\frac{1}{END_{talk}} + \frac{1}{END_{web}} + \frac{1}{END_{video}} + \frac{21}{END_{standby}}\right)}$$

ENDtalk, ENDweb and ENDvideo are endurance ratings in hours. Each test is to be carried out individually in order to measure the time to run down of the device from full charge to 10% charge.

The approach of the circulated EEI report is different, as it combines the different usage modes into one duty cycle and extends the usage assumption from 3 to 4 hours. Therefore, END_{device} is proposed to be calculated as:

$$END_{Device} = \frac{24}{\left(\frac{4}{END_U} + \frac{20}{END_I}\right)}$$

Because only one test is to be run, the duty cycle includes assumptions on the different usage modes, and the proposal aims to correct for different proportions of battery charge depletion based on:

- 5% of battery use being on idle/standby time;
- 90% of battery use on active time;
- 5% of battery discarded as it is prior to shutdown

We believe that the approach proposed in the EEI report contains some major flaws which we call to be corrected:

- **Lack of flexibility due to a single testing cycle:** the lack of a separate testing cycle for each usage type removes the flexibility in the calculation approach, as assumptions are built into the duty cycle instead of the calculation;
- **Low data quality behind usage assumptions:** we consider that the data on which the usage assumptions were based is flawed, and recommend an alternative usage profile taking into account more robust logged data as well as the questionnaire results;
- **Invalid upscaling of usage figures:** the measured usage time is effectively corrected for the amount of battery charge that was used during the test (e.g. idle is present for 5% of the battery charge, and is scaled up to 100% for the END_I value). We do not consider such a calculation approach appropriate, as the battery will perform differently at different levels of charge. The objective of this test is to evaluate how the battery charge is impacted during a cycle for each activity. Therefore, the figures should be determined directly through testing, not calculation.

In order to ensure the most robust benchmark, we propose the following changes:

1) Individual testing cycles should be run for each usage type, measuring time from 100% charge to 5% charge for each of the following:
    - Idle (END_{IDLE})
    - Call (END_{CALL}) (for tablets this is for video calls)
    - Web (END_{WEB})
    - Video Streaming & video playback (END_{VIDEO})
    - Social networking & messaging (END_{SOCIAL})
    - Online gaming & offline gaming (END_{GAME})
2) Overall battery endurance, END_{DEVICE} for smartphones should be calculated as:

$$\mathbf{END_{DEVICE}} = \frac{\mathbf{24}}{\left(\frac{\mathbf{20}}{\mathbf{END_{IDLE}}} + \frac{\mathbf{0.32}}{\mathbf{END_{CALL}}} + \frac{\mathbf{0.6}}{\mathbf{END_{WEB}}} + \frac{\mathbf{0.52}}{\mathbf{END_{VIDEO}}} + \frac{\mathbf{2.16}}{\mathbf{END_{SOCIAL}}} + \frac{\mathbf{0.4}}{\mathbf{END_{GAME}}}\right)}$$

3) Overall battery endurance, END_{DEVICE} for tablets should be calculated as:

$$END_{DEVICE} = \frac{24}{\left(\frac{20}{END_{IDLE}} + \frac{0.08}{END_{VIDEOCALL}} + \frac{0.68}{END_{WEB}} + \frac{0.74}{END_{VIDEO}} + \frac{0.18}{END_{SOCIAL}} + \frac{0.32}{END_{GAME}}\right)}$$

The values proposed above are in line with ECOS recommendations for an alternative usage profile taking into account other data sources. For more information on the usage assumptions, please see the annex.

Circumvention (Section 8.2)

We strongly support the text included in the section dedicated to circumvention, and believe that it should be retained in the forthcoming legislative proposal.

Other

Ranking of results in reference to OS version

There is no indication of how results would be ranked in reference to the OS version used to derive the EEI, as was indicated would be the case in the meeting of 16 September. It will be important to consider what the implications would be of a change in the OS resulting in a different performance. This proposal will need to be consulted on with stakeholders.

Reporting

No insight is provided on how EEI details would be reported. We believe that the output (in hours) of each usage test should be reported, alongside the details of the EEI calculation itself.

Bias towards smartphones

We recommend the whole document is revised to ensure that appropriate attention is paid to the testing of tablets as well as smartphones.

Annex: rationale behind recommended user profiles

ECOS recommendations compared against other sources:

SMARTPHONES	EC study	Deng et al., 2018		ECOS Recommendation	Corrections in recommendation
		Self reported case study	Logging study		
Chat / Social Network	27%	31%	59%	54.0%	Questionnaire figure doubled as under self-reported in both studies by around half
Video and Streaming	26%	38%	14%	13.0%	Questionnaire figure halved as over self-reported in both studies by almost double.
Web browsing	30%	7%	13%	15.0%	Questionnaire figure halved as over self-reported only in EC study by almost double.
Tools	N/A	6%	8%	N/A	No information was provided in Deng et al on what the tools group comprised, so it cannot be included in the usage profile.
Call	17%	8%	3%	8.0%	Questionnaire figure reduced by half as double self reporting in academic study-
Online gaming	excluded without justification	N/A	N/A	5.0%	Although over 90% of respondents claimed to use their smartphone for gaming for at least "30 minutes/less" (13% of total usage time) per day, this option was dropped from the usage simulation. Proportions were very similar for online and offline gaming, so time is split equally between each.
Offline gaming	excluded without justification	N/A	N/A	5.0%	
Camera	N/A	2%	1%	0%	Low usage proportion so disregarded
Leisure	N/A	8%	1%	0%	
Finance	N/A	0%	0%	0%	
Health	N/A	1%	0%	0%	

TABLETS	EC questionnaire	ECOS Recommendation	Corrections in recommendation
Chat / Social Network	9%	9%	Questionnaire figure
Video and Streaming	47%	37%	Questionnaire figure reduced by 10 percentage points to allow for gaming and video call time
Web browsing	44%	34%	Questionnaire figure reduced by 10 percentage points to allow for gaming and video call time
Gaming	0%	16%	not included in EC questionnaire but a notable usage category
video calls	0%	4%	Not included in EC questionnaire. Half phone call use on smartphone

Summary of usage profiles in hours:

SMARTPHONES			4 hours total use	
	EC study		ECOS Recommendation	
	% active time	hours	% active time	hours
Chat / Social Network	27%	1.08	54%	2.16
Video and Streaming	26%	1.04	13%	0.52
Web browsing	30%	1.20	15%	0.60
Call	17%	0.68	8%	0.32
Online gaming			5%	0.20
Offline gaming			5%	0.20
	TOTAL	4.00	TOTAL	4.00

TABLETS			2 hours total use	
	EC study		ECOS Recommendation	
	% active time	hours	% active time	hours
Chat / Social Network	9%	**0.18**	**9%**	**0.18**
Video and Streaming	47%	**0.94**	**37%**	**0.74**
Web browsing	44%	**0.88**	**34%**	**0.68**
Call			**4%**	**0.08**
Online gaming			**8%**	**0.16**
Offline gaming			**8%**	**0.16**
	TOTAL	**2.00**	TOTAL	**2.00**

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