Brussels, 13 September 2019

Solar photovoltaic modules, inverters and systems:
Comments on review preparatory study for PV modules, inverters, components and systems
Draft Report Task 6 / 7 and Transitional Methods

Comment #	Chapter No. / Section No.	Page #	Selected information subject to the comment	Major/Minor Comment	Comment description	Proposal for modification	Rationale / supporting data
		Specific page or a range of pages	Very brief reference to the title or the object of the comment	Major if it can block our support to the outcome Minor if it is a comment adding information, or will not block our support	What is the problem? What needs to be changed?	What is our proposal for change or further work	It is also possible to upload documents / graphs as supporting evidence for the rationale
TASK 6							
	6.0.2	p. 7, 8	Table 2	Major	Commercial and utility Option 10 and Option 13 respectively (Wide band gap converter) were not selected for further analysis.	These options should clearly include SiC based converters, as the GaN are not suitable for these power levels.	The use of SiC has already proven to enable increased efficiency in inverters but is not yet widely used. SiC semiconductors present lower losses in higher power conditions than the typical Si ones and should be considered for commercial and utility scale.
	6.0.2	p.9	Table 3	Minor	Within the system options for the commercial scale, the single axis tracker is not considered.	Consider the single axis tracker in the system options for commercial PVs as well.	In many commercial scale infrastructures, the single axis is rather common (especially in 150 kWp – 200 kWp).
	6.1.2.1	p.15	Table 6	Minor	The choice of 2,5kVA for residential rated power is not justified.	Justify the choice of 2,5kVA for residential rated power.	Many residential systems are using different rated power, and in many cases the rated power goes up to 10kWp/3ph.
	6.1.2.5	p.20	Table 10	Major	1500kVA is chosen as the typical inverter power for utility scale when typical values installed in reality are 500kVA or 400kVA central.	Change to 500kVA or 400kVA central.	Typical configurations of utility scale installations are 1MW with 2 Inverters/per transformer of 1MW. Most installations at utility scale are using a specific typology for availability and maintainability reasons, as well as reduced downtime

							in case of a failure. This modification (chosen by the biggest operators and installers in the EU) is the following: every 1-1,2MWp in PV installation is connected to the system through 1MW transformer with double feed, and each feed has a 400-500kWp inverter connected to it. Market data indicates that the majority of inverters sold are 500kWp and not 1500kWp.
	6.2.1	p.29	Table 14	Major	The environmental impact of CdTe PV modules seems underestimated, especially on the "heavy metals" indicator.	Justify the low values for life cycle impacts for CdTe, especially regarding heavy metals.	The current assessment seems counterintuitive considering the toxicity of Cd especially.
	6.2.1	p.32	Figure 1	Minor	It seems that figure 1 might be duplicated	Delete the first figure if it is a duplicate or clarify the difference between the two figures.	
	6.2.1, 6.2.2., 6.2.3, 6.2.4	p.30, 33, 34, 35	Table 15, Table 17, Table 19, Table 21	Major	The secondary impact categories (photochemical ozone formation, PAH, heavy metals) in these tables are not filled in.	The values should be added to the table for these categories.	The environmental indicators listed as secondary are important too, and values should be available.
	6.2.1.1	p.31, 32	Figures 2 and 3	Major	Instead of the global electricity mix, the energy mix of the countries that are producing the modules (e.g. China, India, USA) should be considered.	Consider replacing the global electricity mix by the electricity mix of each country (or a weighted average) producing PVs. Should any requirement be envisaged regarding the impact of the production phase (e.g. carbon footprint), the assessment should be made at the level of the site, not the electricity mix of the country.	The global energy mix is not representative of the countries that are the main producers of PV modules.
	6.2.4	p.34	PV inverters utility scale	Major	It is not clear why the repair scenario has not been selected for this category (PV inverters – Utility scale).	Consider the repair scenario for PV inverters – utility scale or justify further why it has not been selected.	All operators are repairing and monitoring their inverters to an extent. In this scale and for central inverters the case of repair is typical.
	6.3.1.	p.42	Lead environmental impact	Major	The selection of secondary indicators is poorly justified, and the fact that only three	Further justify the selection of the secondary impact indicators.	

					impacts and not more are selected is not clear either.		
	6.3.2, 6.3.3, 6.3.4, 6.3.5	p.45, 47, 48, 50	Recyclability and End-of-life treatment	Major	The cost of treatment of PVs at end-of-life is missing.	In the life cycle cost the end-of-life treatment is absent for PVs and inverters. It is of paramount importance to include the cost of recycling as the volumes expected to be produced are extremely high.	In order to achieve the goals for minimisation of waste, circular economy and environmental protection, it is crucial to act towards maximum recyclability of PV systems.
	6.4.2.	p.54	BNAT analysis for inverters	Major	SiC semiconductors are missing from the list of BNAT for inverters.	Include SiC semiconductors in the list of candidates for BNAT.	SiC semiconductors are already used in high power applications but are not yet available for PV inverters. The industry has already started testing the SiC for solid state transformers and will then test it for inverters. Lab tests have shown a potential of 10-15% less losses in the semiconductors compared to Si and MOSFET in high power area. The results are currently being presented to the scientific community.
	Task 6		Assessment of BAT, design options and improvement potential	Major	This task report lacks an in-depth assessment of the end of life treatment of modules and inverters, and of the design options to ease repairability and recyclability.	Improve the evaluation of different design options regarding the ease of treatment at end-of-life and the recyclability, all of which is currently missing from the task report.	
TASK 7							
	7.1.3.3	p.19	Proposed Ecodesign module and inverter requirements under policy option 2.	Major	The proposed ecodesign requirements on quality and durability should include provisions related to design for increased repairability and recyclability, for both PV modules and inverters, especially at residential scale given the market increase expected in the coming years.	Include design requirements to facilitate repairability and recyclability of the modules. Moreover, information requirements for inverter and module performance under specific conditions, especially at different ambient and operating temperatures should be added. This information can enable a proper design of the PV system and a harmonisation of the yield calculations taking account of local conditions.	PV module and inverter recycling will be a challenge in the coming years as many PV installations were installed over 20 years ago and are already reaching their end of life. See: IEA-PVPS-Task12 End-of-Life Management of Photovoltaic Panels: Trends in PV Module Recycling Technologies https://www.sciencedirect.com/science/article/pii/S0301421500000914?via%3Dihub

	7.1.3.3	pp. 20-21	Proposed Ecodesign module requirements under policy option 2.1	Major	In the last paragraph of page 20 and in Table 7-9, a tier ranging 14%-16% is proposed in option 1 related to module efficiency, but the minimum efficiency should be 16 or 17%, especially if the requirement enters into force after 2 years.	In option 1, change the lower value of the range to 16 or 17% instead of 14%.	The proposed efficiency of 14% as a starting tier is too low especially for PV modules over 150Wp. The typical efficiencies in the market are nowadays around 15% -17% and the prices of more efficient modules is dropping fast. Low efficiencies (around 14%) are usual in OPVs (organic PVs) and small PV modules supporting appliances and applications (e.g. solar lamps).
	7.1.3.3	p. 21	Proposed Ecodesign module requirements under policy option 2.2	Major	In Table 7-9, option 2 tier 1 the minimum module energy yield is expressed in kWh/kWp according to IEC 61853-3 and for a reference climate zone. This will not be transparent and difficult to implement and verify. All climate zones should be presented.	In Table 7-9, option 2 tier 1 the minimum module energy yield is expressed in kWh/kWp according to IEC 61853-3 and for a reference climate zone. This will not be transparent and difficult to implement and verify. All climate zones should be presented.	The production in kWh/kWp depends on a number of parameters: installation, BOS, position, temperatures, weather, etc, and cannot lead to transparent results. It is very difficult to establish a transparent specific minimum ratio and develop the transparent mechanism required to verify it, also in terms of market surveillance.
	7.1.3.3	p.21	Proposed Ecodesign module requirements under policy option 2.2	Major	In Table 7-9, tier 2, option 2 the module energy yield is expressed in kWh/kWp for an average over 30 years. This will not be transparent and difficult to implement and verify. All climate zones should be presented.	For the sake of transparency and implementability, for Tier 2 all climate zones should be presented and not only a reference climate zone. Option 2 should be favoured as the energy yield allows to take several aspects into account that the module efficiency alone does not.	
	7.1.3.3	p. 26	Proposed Ecodesign inverter requirements under policy option 2.3 in Table 7-11	Major	Smart readiness is proposed as an option (2.3.2). This is already possible, but it requires consumers to purchase an additional module. This should become a mandatory requirement and not be an added cost for the consumers.	"Smart readiness" should be included as a requirement in such a way as to allow for flexible, manufacturer independent, free of charge monitoring solutions.	The inverters currently available on the market (also at residential scale) already support this, provided that the customers purchase an additional module and software. Manufacturers are not currently obliged to deliver this functionality and it is proposed as an extra option for which the customer is charged.
	7.1.3.3.	p.28	Policy option 3: Energy labelling requirements for residential PV systems		The Energy Label should steer consumers towards the best choice of system packages based on comparability of expected yield.	Further assess an alternative policy approach building on the setting of performance information requirements under ecodesign, enabling the calculation by installers and	

					We acknowledge important challenges in the implementation of the label, as the efficiency of a combination of a PV panel with an inverter will also depend on specific installation conditions. For comparability, the efficiency would have to rely on standardised assumptions, which would not sufficiently take local factors into account (especially losses due to shading and inclination, but also temperature effects). Additionally, we recognise that the complexity of performance calculations for all kinds of combinations of system components would be enormous. A potential Energy Label should be carefully considered so as not to create general confusion on the benefits of PV panels and discourage the purchase of systems that might be less efficient due to suboptimal orientation or other local conditions, while nevertheless having the potential to produce significant amounts of clean electricity. Last but not least, technology development is so fast, that performance classes will soon be outdated or leave a lot of room at the top, possibly misinforming about	sellers of the expected yield of the system based on known performance of modules and inverters under specific local conditions and harmonised calculations rules. Consider policy options to require installers/sellers of such systems to communicate the yield calculations to the buyer of the system so that it can compare different solutions to optimise the energy yield.	

					the positive value of these systems.		
			Policy option 4: EU Ecolabel criteria set		We welcome the development of the EU Ecolabel for PV systems. Ecolabel should be considered as a complementary policy aiming at the highest ambition, but without hindering the ambition of ecodesign requirements. Ecolabelling the service offered to households could provide the greatest benefits in complement to ecodesign, by including aspects such as: the selection of components of superior quality and improved environmental performance, optimised system design considering local conditions, quality service and proper protocols for handling and transporting modules, installation and monitoring or maintenance and aftercare services.	Ecolabel criteria could also address balance of system components (e.g. mounting structure, cables), which may be more difficult to address through ecodesign. We recommend to the study team to consider this proposal which has not been addressed in the study. The potential of Ecolabel to also address other life cycle stages should be exploited, especially for the production phase.	
Transitional methods							
	5.2.2	p.20	PV inverter efficiency	Minor	The PV inverter efficiency is given as an average for a middle-Europe climate but consumers should be informed of the efficiency for each climate zone.	Consumers should be informed of the efficiency in different EU regions (South / North), as efficiency differs greatly across them.	
	5.4.3	p.21	Efficiency dependency on temperature	Major	Manufacturers should automatically provide the information regarding the	All manufacturers should provide the necessary information regarding efficiency dependency	This parameter is of high importance as the temperature derates the efficiency. This should also be addressed in Task 7.

					efficiency under different temperature conditions.	on temperature in their datasheets.	
	6.2.3	p.25 – line 4	"Unless specifically calculated, losses in cables will be accounted for as part of the general system losses, which is a single value for the whole system, n_{system_loss}."	Major	The sentence as it is formulated is not clear enough.	The sentence should be rephrased as follows: *Unless specifically calculated, losses in cables will be accounted for as part of the general system losses, which is a single value for the whole system* ***and are represented by the system's efficiency factor*** *n_{system_loss}."*	This proposal is important to ensure a clear identification of each parameter included in the calculation.
	6.2.4	p.26	Equation 8	Major	n_{system_loss} is the efficiency factor representing system losses and not losses.	Correct the meaning. If this indicator represents losses the equation 8 should be $n_{EUR} * (1-n_{system\_loss}) * EY_{DC}$	The current equation could easily lead to confusion and mistakes.

Contact:

ECOS – European Environmental Citizens' Organisation for Standardisation

Mélissa Zill, melissa.zill@ecostandard.org

EEB - European Environmental Bureau

Blanca Morales, blanca.morales@eeb.org