Brussels, 29 October 2019

Further input to the TEG Draft report

1. Hydropower in Europe

The proposed Life Cycle Evaluation should be uniformly applied in form of technology specific standard values for the upstream LCE instead of project-specific individual measurements to avoid unnecessary administrative burden. On the basis of those technology-specific LCE standard values, **technologies that have sufficient evidence of being far below the threshold of the Emission Performance Standard of 100g CO_2eq/kWh should be exempted from the LCE assessment**. On this basis, investments into **<u>new</u> as well as into <u>existing</u> hydropower projects should be exempted** from the LCE assessment.

Based on most recent UN's Intergovernmental Panel on Climate Change (IPCC) data[1] (see table below), **hydropower** – with **worldwide median lifecycle emissions of 24 gCO_2eq/kWh** – fulfils this prerequisite clearly and should be exempted from an obligatory LCE analysis.

Table A.III.2 | Emissions of selected electricity supply technologies (gCO_2eq/kWh)[i]

Options	Direct emissions	Infrastructure & supply chain emissions	Biogenic CO_2 emissions and albedo effect	Methane emissions	Lifecycle emissions (incl. albedo effect)
	Min/Median/Max	Typical values			Min/Median/Max
Currently Commercially Available Technologies					
Coal—PC	670/760/870	*9.6*	*0*	*47*	**740/820/910**
Gas—Combined Cycle	350/370/490	*1.6*	*0*	*91*	**410/490/650**
Biomass—cofiring	n.a.[ii]	–	–	–	**620/740/890**[iii]
Biomass—dedicated	n.a.[ii]	*210*	*27*	*0*	**130/230/420**[iv]
Geothermal	0	*45*	*0*	*0*	**6.0/38/79**
Hydropower	0	*19*	*0*	*88*	**1.0/24/2200**
Nuclear	0	*18*	*0*	*0*	**3.7/12/110**
Concentrated Solar Power	0	*29*	*0*	*0*	**8.8/27/63**
Solar PV—rooftop	0	*42*	*0*	*0*	**26/41/60**
Solar PV—utility	0	*66*	*0*	*0*	**18/48/180**
Wind onshore	0	*15*	*0*	*0*	**7.0/11/56**
Wind offshore	0	*17*	*0*	*0*	**8.0/12/35**
Pre-commercial Technologies					
CCS—Coal—Oxyfuel	14/76/110	*17*	*0*	*67*	**100/160/200**
CCS—Coal—PC	95/120/140	*28*	*0*	*68*	**190/220/250**
CCS—Coal—IGCC	100/120/150	*9.9*	*0*	*62*	**170/200/230**
CCS—Gas—Combined Cycle	30/57/98	*8.9*	*0*	*110*	**94/170/340**
Ocean	0	*17*	*0*	*0*	**5.6/17/28**

Notes:

i For a comprehensive discussion of methodological issues and underlying literature sources see Annex II, Section A.II.9.3. Note that input data are included in normal font type, output data resulting from data conversions are bolded, and intermediate outputs are italicized.

ii Direct emissions from biomass combustion at the power plant are positive and significant, but should be seen in connection with the CO_2 absorbed by growing plants. They can be derived from the chemical carbon content of biomass and the power plant efficiency. For a comprehensive discussion see Chapter 11, Section 11.13. For co-firing, carbon content of coal and relative fuel shares need to be considered.

iii Indirect emissions for co-firing are based on relative fuel shares of biomass from dedicated energy crops and residues (5-20%) and coal (80-95%).

iv Lifecycle emissions from biomass are for dedicated energy crops and crop residues. Lifecycle emissions of electricity based on other types of biomass are given in Chapter 7, Figure 7.6. For a comprehensive discussion see Chapter 11, Section 11.13.4. For a description of methodological issues see Annex II of this report.

[1] Schlömer S., T. Bruckner, L. Fulton, E. Hertwich, A. McKinnon, D. Perczyk, J. Roy, R. Schaeffer, R. Sims, P. Smith, and R. Wiser, 2014: Annex III: Technology-specific cost and performance parameters. In: Climate Change 2014: Mitigation of Climate Change. Contribution of Working Group III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Edenhofer, O., R. Pichs-Madruga, Y. Sokona, E. Farahani, S. Kadner, K. Seyboth, A. Adler, I. Baum, S. Brunner, P. Eickemeier, B. Kriemann, J. Savolainen, S. Schlömer, C. von Stechow, T. Zwickel and J.C. Minx (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA., https://www.ipcc.ch/site/assets/uploads/2018/02/ipcc_wg3_ar5_annex-iii.pdf

This is also supported by a WNA report[2] (a secondary research compilation of literature), further pointing out that hydropower facilities apparently have lower LCE (mean value of **26 gCO_2eq/kWh**) than the average solar PV facility (mean value of 85 gCO_2eq/kWh), being similar to the average wind farm.
In May 2018, the International Hydropower Association (IHA) published a study[3] - completed in cooperation with UNESCO and several international researchers - on the GHG footprint of 500 reservoirs worldwide. This study was based on the G-RES tool (an instrument developed by UNESCO and the World Bank with the cooperation of leading industry partners), aiming to assess net emissions from reservoirs. The research concludes that the global median GHG emission intensity (i.e. LCE) of hydropower reservoirs is equal to **18.5 gCO_2eq/kWh**.

In this context, it is important to mention that the figures provided by the IPCC, the WNA and the IHA reports refer to hydropower plants worldwide. It should be noted that the **life cycle emissions of European hydropower plants are well below of these indicated maximum values**. This is also confirmed by scientific research[4], outlining that higher values were mainly found when the reservoirs were located in tropical areas. This is due to the fact that tropical reservoirs in Asia and South America[6] have higher methane (CH_4) and higher nitrous oxide (N_2O) emissions than reservoirs in other parts of the world:

> The source for the CH_4 emissions stems from the anaerobic (without oxygen) decomposition of organic matter, i.e. biomass flooded when the reservoir is filled. The discussion in this respect is an international one but from minor relevance in the European context, as most hydropower reservoirs in Europe are built in mountainous or alpine-like areas with a negligible amount of biomass being flooded (and influxes into reservoirs contain very low organic matter).
>
> The higher N_2O emissions from tropical reservoirs than from boreal or temporal waters are due to a higher nitrogen availability in this region and a higher temperature favouring certain chemical processes (nitrification and denitrification).[6]

Even though, higher GHG emissions have been registered mainly from tropical hydropower reservoirs, recent research[5] even suggests that this data can be misleading as in the past, LCA did not report “net” but “gross” emissions from reservoirs. This means that even emissions were included that would have been registered even without a specific hydropower project, instead of comparing the values for pre- and post-impoundment conditions. Today, there is scientific consensus that freshwater sources are – also in the absence of human influence – major sources of GHGs, whereas gross CH_4 emissions from tropical freshwater are by many factors higher than those from boreal and temperate waters[6, 7]. This fact has not been taken into account into older LCA studies. **Choosing the “right baseline”, i.e. to consider net land emissions, respectively net reservoir emissions, might even lead to lower LCE values for hydropower.**

In the **European context, various sources show limited life cycle emissions from hydropower:**

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[2] WNA (2011): Comparison of Lifecycle Greenhouse Gas Emissions of Various Electricity Generation Sources, http://www.world-nuclear.org/uploadedFiles/org/WNA/Publications/Working_Group_Reports/comparison_of_lifecycle.pdf
[3] IHA (2018): Study shows hydropower’s greenhouse gas footprint, https://www.hydropower.org/news/study-shows-hydropower%E2%80%99s-carbon-footprint
[4] Turconi, R. et al. (2013): Life cycle assessment (LCA) of electricity generation technologies: Overview, comparability and limitations. *Renewable and sustainable energy reviews*, 28, 555-565, https://doi.org/10.1016/j.rser.2013.08.013
[5] Raadal, H. L. et al. (2011): Life cycle greenhouse gas (GHG) emissions from the generation of wind and hydro power. *Renewable and Sustainable Energy Reviews*, 15(7), 3417-3422. https://doi.org/10.1016/j.rser.2011.05.001
[6] UNESCO/IHA: *GHG Measurement Guidelines for Freshwater Reservoirs*, table 2.1, https://www.hydropower.org/ghg-measurement-guidelines-for-freshwater-reservoirs
[7] Li, S., & Zhang, Q. (2014): Partial pressure of CO2 and CO2 emission in a monsoon-driven hydroelectric reservoir (Danjiangkou Reservoir), China. *Ecological engineering*, 71, 401-414. https://doi.org/10.1016/j.ecoleng.2014.07.014

- In **Germany**, emission factors for hydropower vary in the range from **2.7 gCO_2eq/kWh** (run-of-river) to **25.65 gCO_2eq/kWh** (storage and pumped storage with natural inflows).[8]

- In **Switzerland**, the average lifecycle emissions of hydropower plants amount to **12 gCO_2eq/kWh** and to about **16 gCO_2eq/kWh** when also considering the electricity demand of pumped storage plants.[9]

- In **Swedish** hydro river systems, LCE have been estimated to be about **4 to 5.1 gCO_2eq/kWh**[10]

- In **Finland**, emission factors from hydropower can reach **up to 30 gCO_2eq/kWh**[4]

Even **outside of Europe, LCA for specific hydropower projects in boreal and temperate zones show low emissions**:

- **Japan**, **11.3 gCO_2eq/kWh**[11]
- **Canada, 4.4 gCO_2eq/kWh**[12]
- **China, 7.6 gCO_2eq/kWh** and **9.12 gCO_2eq/kWh**[13]

Higher LCE values are mainly found when reservoirs are located **in tropical**[4, 14] **and subtropical (monsoon) areas**[7], where emissions can also show a high spatial and temporal variability:

- **Brazil**, up to **340 gCO_2eq/kWh**[4]

In the current draft of the TEG report, existing hydropower is exempted from performing a LCA, in case reservoirs are not enlarged. Since plant retrofitting and renovation can increase the generation output with no or very low additional adverse effects on the environment and as science[14] clearly shows that emissions decline with reservoir age, adaptations and modifications of existing reservoirs should be exempted from a LCA. In this context, we do believe that **a distinction between existing and new hydropower does not make sense**.

To sum up, **all the scientific data provided clearly shows that LCE of hydropower projects in Europe and comparable climate regions are well below the threshold of 100 gCO_2eq/kWh**. Therefore, we **call to exempt existing as well as new hydropower from the LCE analysis**.

[8] UBA Deutschland (2018): Emissionsbilanz erneuerbarer Energieträger, table 23, p.54, https://www.umweltbundesamt.de/publikationen/emissionsbilanz-erneuerbarer-energietraeger
[9] Karin Flury et al. (2012): Erkenntnisse aktueller Ökobilanzen zu Strom aus Wasserkraft, http://esu-services.ch/fileadmin/download/flury-2012-Bulletin-SEV.pdf
[10] World Energy Council, WEC (2004): Comparison of Energy Systems using Life Cycle Assessment, A Special Report of the World Energy Council, London.
[11] Hondo, H. (2005): Life cycle GHG emission analysis of power generation systems: Japanese case. *Energy, 30(11-12)*, 2042-2056, https://doi.org/10.1016/j.energy.2004.07.020
[12] Spadaro, J. V., Langlois, L., & Hamilton, B. (2000). Greenhouse gas emissions of electricity generation chains: Assessing the difference. *IAEA bulletin*, 42(2), 19-28.
[13] Li, Z. et al. (2017): Carbon footprints of two large hydro-projects in China: Life-cycle assessment according to ISO/TS 14067. *Renewable Energy*, 114, 534-546. https://doi.org/10.1016/j.renene.2017.07.073
[14] Barros, N. et al. (2011): Carbon emission from hydroelectric reservoirs linked to reservoir age and latitude. *Nature Geoscience*, 4(9), 593.

2. LCE approach and ISO 14044

With regard to the standards relevant for life-cycle assessment, it is indeed ISO 14040 and 14044 which are the references (the two standards complement each other: the first defines the LCA framework, the second its application). **Eurelectric does not see any other standards that could be more relevant**, and indeed they allow some **flexibility** to adapt the methodology to the objectives of the study.

However, as already mentioned in our response paper to the TEG report, Eurelectric would welcome further guidance: the proposed ISO 14044 criteria do not give sufficiently detailed advice on how/what exactly would be required in a LCE analysis. In concrete, the ISO 140044 does not give any guidance neither on how to set system borders nor on the use of possible valuation methods – **hence, no effective and reasonable comparison between specific technologies, projects, activities can be made.**

There is therefore a need to specify the specific hypotheses for the sectors concerned by the taxonomy on certain methodological choices. In particular, the proposed ISO do not define the boundaries of the systems evaluated (e.g. consideration or exclusion of certain infrastructures).

In particular, it should be clarified that the proposed EPS applies to power generation only and not to the entire value chain of the power plant (for instance the construction or decommissioning phases). Indeed, if we link this TEG proposal with the fact that the TEG requires that the carbon impact of almost all power generation technologies is to be assessed on LCE basis, we do not see as feasible to reach a threshold of 0g CO2/kWh by 2050, even for carbon neutral technologies such as RES, if construction and decommissioning phases are taken into account.

In addition, there is a need to further clarify the following elements: allocation of impacts in the event of co-production, choice of impact characterisation methods (e.g. for climate change: IPCC method or Product Environmental Footprint (currently under development by DG Environment), consideration of avoided emissions, consideration of biogenic carbon effects, etc.

Another important question concerns the verification mode: are the data from the LCE validated by an external critical review? Is there an expert panel associated with the TEG whose task it is to verify the data?

On way of further specifying the ISO 14044 would be to complement it with other relevant ISO standards depending on the technology in question. For example, it should be complemented by:

- ISO 14040 which complements ISO 14044 by defining the LCA framework, while ISO 14044 defines its application.
- ISO 13065:2015 is the relevant standard for sustainable biomass for example. Please find also some more scientific background on the relevant ISO standard for sustainable biomass.
- ISO 14025 is suitable for environmental claims, with specific Product Categories Rules for Electricity, Steam and hot/cold water generation and distribution

Eurelectric therefore insists that ISO 14044 in its current form and without complements does not provide a science-based, uniform LCE methodology / application to ensure comparability and reliability.

As mentioned in our response paper to the TEG, Eurelectric believe that L**CE should be uniformly applied in form of technology-specific standard values for the upstream LCE instead of project-specific individual measurements.** The European Commission in cooperation with the Platform for Sustainable Finance (Article 15) should develop the technology-specific LCE standard values up to the time the technical evaluation criteria in form of non-binding guidelines are transposed into delegated acts. The guidance on the LCE approach from the TEG could be a first step for the creation of the technology-specific LCE standard values.

Until the LCEA methodology is developed based on a scientific, uniform LCEA methodology only the direct gCO2eq / kWh emissions should be used as threshold values.

3. Electricity Grid

The draft TEG report proposes to evaluate the eligibility of transmission and distribution lines on the basis of the CO2- equivalent emitted by new generation plants. The metric says that infrastructure in “systems which are on a trajectory to full decarbonisation” is considered as eligible, referring to the carbon intensity of incremental new generation in this system “on a five-year rolling average basis”.

From Eurelectric’s point of view, there are problems that arise from this idea:

- The Rationale describes under which condition a “system” is deemed to be “on a trajectory to full decarbonisation”, making use of the 100g CO2/kWh threshold. But the term “system” as such is not defined. It remains unclear how large the considered “system” is and what it would encompass in practice.

- The lifespan of these investments (and their need to integrate renewables in the future) goes well beyond a 5-year time horizon (up to more than 40 years). The long lead times faced by TSOs for commissioning such projects may incentivise to defer required grid investments in time to be eligible as sustainable at a later stage.

We propose to simplify the wording because due to the meshed nature of the European electricity grid and its physical and market reality it is difficult to clearly define the “systems” referred to in the TEG report. **The EU power sector has a proven track record of continuous emissions reductions and has pledged to become carbon neutral well-before mid-century. As electrification is broadly recognized as a key tool to decarbonise the economy, strengthening electricity networks does support the transition and should therefore be reflected in the TEG proposals.**

Eurelectric amendment:
Taking into account the meshed nature of the European electricity grid, its physical and market reality, as well as the power sector’s track record of reducing emissions, all *electricity* transmission and distribution infrastructure *or equipment* ~~in systems which are on a trajectory to full decarbonisation~~ are eligible, except for infrastructure or equipment that:

• Is ***exclusively*** dedicated to directly connecting or expanding existing direct connection to production plants that are more CO2 intensive than 100 gCO2e/kWh measured on a LCE basis.

Eurelectric therefore proposes that the threshold applies only to infrastructure and equipment exclusively used for direct connection of power plants above the threshold to the nearest substation.

If the current distinction between systems is nonetheless kept, Eurelectric recommends several changes. The methodology to calculate the level of emissions of a system should be clarified as various elements relating to this concept are unclear:

- 5 years reference: forward or backward looking;

- Incremental generation: measured as installed capacity (MW) or annual energy provided (MWh);

- Scope of the notion of "system": In any case, all assets connected to the transmission and distribution grid should be considered. If not deleted, a system on a trajectory towards full decarbonisation should be defined as:

Eurelectric amendment:
"A system is deemed to be on a trajectory to full decarbonisation if the weighted emissions factor of energy produced by incremental expected new generation connected within the system is below the a to be defined threshold , on a forward looking five-year rolling average basis."

Moreover, the list of infrastructure and equipment that are eligible irrespective of whether the system is on a trajectory to full decarbonisation should be broader. Furthermore, the metric and related threshold should not be applied to investments covering multiple systems (incl. interconnections). As proposed in the Report, investments in interconnectors (possibly Projects of Common Interest) between countries where the weighted average emissions are above the 100gCO2e/kWh threshold would not be eligible. This could negatively impact European integration (for which specific targets are put forward) and the integration of renewables in the EU energy market. Therefore, **the threshold should not apply to investments covering multiple systems (incl. interconnections) and such investments should always be regarded as eligible.**

In addition, applying a generation-weighted average emission across all concerned systems in the case of investments covering multiple systems is not desirable. This would discard investments between a country that is in line with the targets and a country that is not, whereas such investments can accelerate the transition in the latter by allowing increased imports of renewable electricity. The discrimination between 45 Member States is also not in the spirit of the Clean Energy Package to provide all Member States with sufficient flexibility in the achievement of their sustainability targets.

It is not desirable neither to exclude connection or connection expansion for new load unless it allows for demand side management. Electrification of new end-use sectors (transport, industry, building) can still deliver environmental benefits even if the new loads have no demand-side response capability.

Last but not least, we would also like to highlight the following section of our response paper with regard to the **connection of specific gas plants to the gas network**:

*"To ensure a cost-efficient energy transition while keeping the lights on, a transitional flexible set-up for highly efficient natural gas fired units may be required, especially while large scale deployment of demand response, storage and power-to-gas technologies is yet to happen. In this context, a specific approach should be envisaged for specific gas infrastructures which directly connect highly efficient natural gas fired units needed for security of power supply."*Two last issues on which we would welcome clarifications from the TEG:

- **Proposals relating to the Ecodesign for Transformers Regulations**

The draft TEG report proposes that T& D Transformers are required to comply with the **Tier 2 requirements** from Ecodesign Regulation 548/2014. **We would welcome clarifications from the TEG whether such criteria would prevent a DSO securing investment in existing assets which may not comply** for the reasons stated below, as our understanding is that TEG criteria apply to both the construction and operation of existing T and D networks.

If this is the case, we would like to highlight that:

- The Tier 2 requirements do not come into effect until July 2021 (even though the Regulation dates back to 2014). So investments in transformers that do not comply with Tier 2 requirements can legally take place now and until July 2021.
- In addition, Tier 2 provisions were reviewed earlier on 15 January 2019[15] and a derogation is now to be allowed so that network operators don't have to comply if the cost of purchasing a compliant transformer will be disproportionate. So it is important that the TEG report recognises this point.

- **Proposals relating to Overground high voltage lines**

Our understanding is that the draft TEG report proposes not to use PCBs for overground high voltage lines.

The new Persistent Organic Pollutants Regulation 1021/2019 now mandates the removal of contaminated equipment down to very low levels (but not elimination), and the deadline for doing this is not until December 2025. (cf. Annex1, Part A). We support this approach for investments in new assets.

Our understanding is that the TEG criteria is intended to apply to both the construction and operation of existing T and D networks. **We would therefore welcome clarifications from the TEG whether such criteria would prevent a DSO securing investment in existing assets which may have some low level of contamination** (dating back to manufacturer errors in the 1980s).

[15] Additional explanatory notes to COMMISSION REGULATION (EU) …/… of XXX amending Regulation (EU) No 548/2014 of 21 May 2014 on implementing Directive 2009/125/EC of the European Parliament and of the Council with regard to small, medium and large power transformer