Brussels, 8 November 2019

Further Information on Hydropower in Europe
Input to the TEG Draft report

Supplementing the Eurelectric position paper on the TEG report as well as the additional Eurelectric input submitted on 29 October, we would like to refer to further sources and data. All our provided information and scientific data clearly show that LCE of hydropower projects in Europe and regions are well below the threshold of 100 gCO2eq/kWh. Therefore, **we call to exempt existing as well as new European hydropower projects from a LCA.**

Europe has a unique opportunity to establish its global leadership in clean technologies and sustainability in the fight against climate change in line with the Paris agreement. Even though, the revised Renewable Energy Directive 2018/2001/EU (RED II) only foresees an overall EU target for renewable energy sources consumption by 2030 of 32%, the majority of electricity will be provided by renewables in the future. By 2045, renewables will represent more than 80% of energy supply driven by rapid cost decline, increasing capacity factors, and large untapped resource potentials.[1] In this context, **hydropower has been contributing significantly to achieving EU's decarbonisation and renewable energy targets**: With a total generation of more than 330 TWh per year equalling to about 30% of the electricity generated from renewable energy sources and about 10% of the gross electricity generation of EU28 in 2017.

Hydropower has been providing significant amounts of balancing power, facilitating the efficient integration of the constantly increasing shares of variable renewables such as wind and solar power. Due to the projected increase in variable renewables, the importance of hydropower will rise in the future. Hydropower will provide the future power system with storage and flexibility services, thus allowing for higher shares of wind and solar power without compromising security of supply and system stability.

Moreover, hydropower shows the **highest energy payback of all generation technologies**. This means that hydropower has the lowest ratio between the total electricity output over its lifetime and the energy needed to build, operate, maintain and decommission a specific plant. During its long lifetime (up to 80 years and even longer), a **hydropower plant can generate far more than 200 times the energy needed to build, maintain and operate it**.

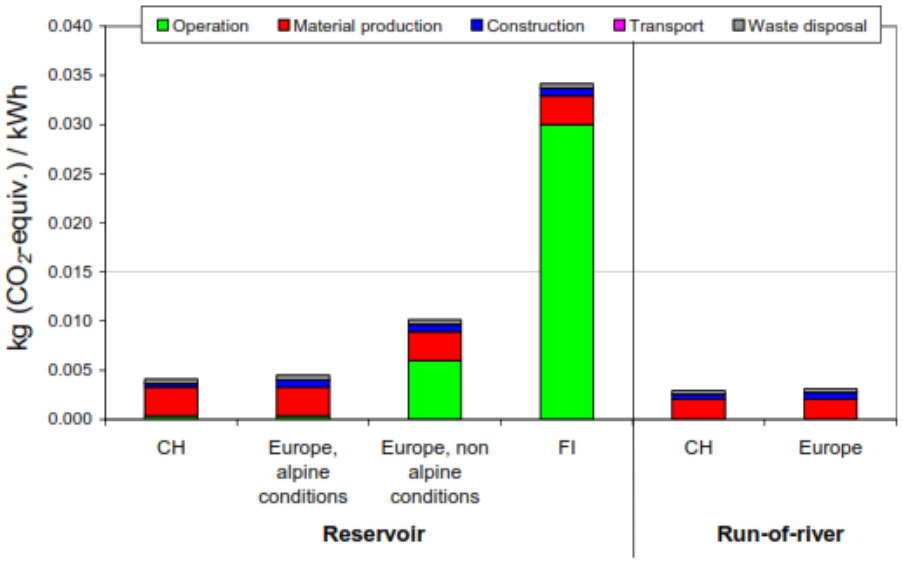
The hydropower sector plays a key role in supporting Europe's clean energy transition to reach its international climate objectives. Hydropower is not only **highly resource-efficient (with 85% to 95%)** but is also crucial in fighting climate change. With its low-carbon footprint, hydropower can provide significant volumes of renewable low-carbon electricity, both for base and peak load. **Once built, hydropower infrastructure can generate electricity for many decades, even for more than 100 years**. For this reason, life-cycle assessments of hydropower provide a very good carbon footprint (defined as the total quantity of GHG emitted over the lifecycle) and energy efficiency profile. Lifecycle GHG emissions for different electricity generation technologies clearly show that hydropower plants have the lowest carbon footprint among all generation technologies. Furthermore, **hydropower even contributes to avoiding CO_2 emissions**. Assuming that hydropower would be replaced by the current generation mix, hydropower avoids about 180

[1] Eurelectric 2018: Decarbonisation Pathways

Mt of CO_2 emissions in the EU28, equalling to 15% of total power sector emissions. Research even shows that each MWh of additional hydropower generation leads to savings between 0.3 to 0.7 t of CO2.[2]
In this context, we would like to refer to the **additional sources that prove that LCE of hydropower projects in Europe and regions are well below the threshold of 100 gCO2eq/kWh**:

DISCLAIMER: Quantitative elements and figures below are provided by individual Eurelectric members

1) A study from Ecoinvent (2007)[3] shows LCA results for various generation technologies (p. 103), whereas all LCE of hydropower plants are by far below the threshold of 100 gCO2eq/kWh:



2) A recent (revised 2018) LCA- study[4] of 14 evenly spread large scale hydropower plants in Sweden states 10.6 g CO_2eq/kWh distributed:

3.4. Pollutant Emissions

Table 13 Pollutant emissions

Ecoprofile		Output						
Pollutant emissions	Unit/kWh	Upstream	Core	Core - infrastructure	Total - generated	Downstream[1]	Downstream - infrastructure	Total - distributed
Greenhouse gases[2]	g CO_2-eq. (100 years)	$2{,}03 \cdot 10^{0}$	$5{,}05 \cdot 10^{0}$	8,52	8,58	$4{,}17 \cdot 10^{-1}$	1,49	10,6
Acidification potential	g SO_2-eq.	$1{,}83 \cdot 10^{-4}$	$1{,}36 \cdot 10^{-4}$	$5{,}28 \cdot 10^{-3}$	$5{,}68 \cdot 10^{-3}$	$9{,}20 \cdot 10^{-4}$	$1{,}04 \cdot 10^{-2}$	$1{,}88 \cdot 10^{-2}$
Photochemical Ozone Creation Potential	g Ethene-eq.	$1{,}96 \cdot 10^{-5}$	$1{,}31 \cdot 10^{-5}$	$5{,}11 \cdot 10^{-4}$	$5{,}43 \cdot 10^{-4}$	$9{,}77 \cdot 10^{-5}$	$1{,}41 \cdot 10^{-3}$	$2{,}06 \cdot 10^{-3}$
Eutrophication Potential[3]	g Phosphate-eq.	$5{,}32 \cdot 10^{-5}$	$2{,}87 \cdot 10^{-5}$	$1{,}14 \cdot 10^{-1}$	$1{,}14 \cdot 10^{-1}$	$3{,}62 \cdot 10^{-3}$	$5{,}38 \cdot 10^{-3}$	$1{,}23 \cdot 10^{-1}$

1 Distribution losses of 3 % of generated electricity are included in the downstream column.
2 Approximately 84 % (7,1 g/kWh of 8,5 g/kWh) of the CO_2 emissions from core-infrastructure emanate from inundation of land, as calculated in accordance with the methodology described in the PCR.
3 Over 96 % emanates from COD and inundation of land; this is calculated in accordance with the methodology described in the PCR

[2] DNVGL 2015: The Hydropower Sector's Contribution to a Sustainable and Prosperous Europe – Main Report
[3] Life Cycle Inventories of Energy Systems: Results for Current Systems in Switzerland and other UCTE Countries (2007), https://db.ecoinvent.org/reports/05_EnergySystemsSummary.pdf?area=463ee7e58cbf8&area=463ee7e58cbf8
[4] Vattenfall 2018, https://gryphon4.environdec.com/system/data/files/6/7470/epd88en%20EPD%202018.pdf

3) In May 2018, the International Hydropower Association (IHA) published a study[5] in cooperation with UNESCO, the World Bank and several international researchers on the **GHG footprint of 500 reservoirs worldwide**. The study was based on the G-RES tool to assess net emissions from reservoirs. The research concludes that ***the global median GHG emission intensity*** **[i.e. Life Cycle Emissions – LCE]** ***of the hydropower reservoirs included in the study was 18.5 gCO_2-eq/kW*****",** which represent significantly lower values than PV facilities (median values of LCE between 41-48 according IPPC).

   As the IHA recalls, *the process of taking measurements to determine the greenhouse gas (GHG) footprint of a hydropower facility or reservoir can be cumbersome or prohibitively expensive. Calculating the net change in emissions caused by a reservoir is highly challenging*. **The empirical evidence suggests that especially for minimum power densities (W/m^2>1 – 1.5), the emission intensity is very low (in line or below other 0-emission technologies), i.e. for existing as well as for new hydropower assets, the requirement of a full LCE analysis is not technically justified**. In addition, **for low power density facilities (W/m^2<1 – 1.5**), if the primary goal of the asset is not the power generation, additional hydropower facilities could bring even more efficiency to the installation.

In view of the EU's ambitious climate and renewable energy targets, we believe **that LCAs for new as well as for existing hydropower projects in Europe are not scientifically justified** and can constitute an additional financial challenge on our way to a carbon-neutral power sector.

[5] IHA 2018, https://www.hydropower.org/news/study-shows-hydropower%E2%80%99s-carbon-footprint