

**UN-WATER EXPERT GROUP ON WATER AND CLIMATE CHANGE**  
**STUDY ON WATER REQUIREMENTS OF CLIMATE MITIGATION MEASURES**

**TERMS OF REFERENCE**

**Background**

At the 38<sup>th</sup> UN-Water Meeting on 19 August 2023, Members decided to ask the Expert Group on Water and Climate Change, coordinated by WMO, UNESCO and UNECE, to continue supporting Member States to integrate water in UNFCCC processes on mitigation and adaptation and in the IPCC 7th cycle work program, among others by undertaking a study on the potential water required to implement different mitigation measures, at the scale required to achieve the Paris Agreement targets, including guidance on how to calculate this at the national level, present results at a future COP and UN-Water Meeting, and assess the possibility of publishing such a study in the form of a UN-Water Analytical Brief.

This followed the UN-Water Expert Group on Water and Climate Change convening the “Technical Workshop on Water and Climate Change Mitigation Inter-Dependencies” on 13 June 2023 at the time of the Bonn Climate Change Conference. The objective of this workshop was to identify what is known and not known about the dependency of Paris Agreement targets on the sustainable management of water resources. This information is expected to provide feedback to Parties to the United Nations Framework Convention on Climate Change (UNFCCC) and the Paris agreement to incorporate water issues in their Nationally Determined Contributions (NDCs) and in UNFCCC processes, and to explore possibilities of any further assessment of these issues by the Intergovernmental Panel on Climate Change (IPCC).

The workshop was sponsored by the United Kingdom, Egypt and United Arab Emirates as the immediate past, current and next Presidencies of the UNFCCC Conference of the Parties (COP) respectively, and by Japan as the co-chair (with Egypt) of the Interactive Dialogue on Water for Climate, Resilience and Environment of the UN 2023 Water Conference. The workshop was hosted by the German International Cooperation Agency (GIZ) and attended by over 40 experts from organisations with water, energy and environment responsibilities globally. The workshop is reported [here](#).

To have this works further considered by governments and inter-government processes, understanding is needed of the aggregate water requirements of each kind of climate mitigation measure that has been assessed by the IPCC, if implemented at the scale estimated by the IPCC required to achieve the Paris Agreement global warming targets. Where the data allows, understanding is also needed of the regional and national requirements and the intra-annual variability of the water requirements. Governments also require technical guidance for calculating estimated water requirements of each kind of climate mitigation measure at the national level.

**Objectives**

- (1) To improve understanding of the aggregate water requirements (in gigalitres per year) of each kind of climate mitigation measure that has been assessed by the IPCC, if implemented at the scale estimated by the IPCC required to achieve the Paris Agreement global warming targets. Where the data allows, provide regional and national estimates and assess the intra-annual variability of the water requirements.
- (2) To improve understanding of the water efficiency of greenhouse gas reduction of each kind of climate mitigation measure that has been assessed by the IPCC, if implemented at the scale estimated by the IPCC required to achieve the Paris Agreement global warming targets.
- (3) To assist national water managers to calculate estimated water requirements of each kind of climate mitigation measure at the national level.

## **Tasking**

Deliverable 1: A completed table at Annex 1 observing the following requirements:

- Metrics and measures in the table must be used unless agreed otherwise.
- Column 1: Descriptions of the listed measures, and whether any further measures should be listed, to be critically reviewed and any text changes agreed.
- Column 2: Descriptions of the listed water dependencies, and whether any further dependencies should be listed, to be critically reviewed and any text changes agreed. If any further.
- Columns 3, 4, 5, 6 and 7: All cells to be filled with single best estimate numbers. Numbers currently in these columns are to be replaced with numbers from this project.
- All assumptions to be stated in footnotes, which may be extensive.
- All figures to be sourced to references.
- All defined terms to be interpreted as defined unless agreed otherwise agreed.

Deliverable 2: A report of these outcomes in writing and ppt including one worked out example for each measure using the respective methodology.

Deliverable 3: A 'plain-English' explanation of how the methods adopted at step 1 may be applied at the national level for each measure, taking account of the different national water situations.

## **Timeframe**

The report will be completed within 9 months with the following milestones:

- (1) A progress report (written report and set of PPT slides) by 30 November 2023 for presenting at COP 28.
- (2) The draft report (written report and set of PPT slides) by March 2024 for presentation to the 39<sup>th</sup> UN Water meeting.
- (3) The final report (written report and set of PPT slides) as the basis for UN-Water analytical brief by May 2024 for release at the 2024 Bonn UNFCCC Conference in May/June 2024, if possible.

## **Governance**

The study will be managed by a steering committee comprising representatives of the UN-Water Expert Group on Water and Climate Change co-convenors (UNESCO, UNECE and WMO) with WMO providing day to day supervision.

An advisory group will be established made up of representatives of organisations attending the Bonn workshop with water, energy, environment and climate responsibilities and other experts by invitation. This group will review successive drafts of the study and assist with methodology and quality control, with members meeting their own costs.

The [International Universities Climate Alliance](#) (IUCA) is responsible for deliverable 1 under a partnership with UN Water agreed by exchange of letters between the UN Water Vice Chair and the Vice Chancellor of the University of New South Wales as Chair of the IUCA.

A consultant expert may be engaged by WMO on behalf of UN-Water to undertake analysis and drafting of the overall study report.

**Language:** The study will be written in English.

**ENDS**

## **STUDY ON WATER AND CLIMATE MITIGATION INTER-DEPENDENCIES – INFORMATION REQUIRED**

The table below set out the information to explain the quantity of freshwater required to achieve each of the listed climate mitigation outcomes at the global scale, and the efficiency of this use of the water in terms of the amount of water for each unit of carbon mitigation.

The table is set up follows:

- Column 1 = mitigation measure from IPCC figure SPM.7
- Column 2 = water dependency: how water is needed to achieve the measure, as advised by Workshop.
- Column 3 = conversion factor: energy measures = clean energy produced each year by 2050 to limit warming to 2 degrees<sup>2</sup> (GJ/y). Environment measures = square kilometres of sequestration sites.
- Column 4 = climate benefit: emission reduction resulting from the measure<sup>2</sup> in gigatonnes of CO2 equivalent emissions abated per year (GtCe/y)
- Column 5 = water required: water to be consumed<sup>1</sup> by the measure by 2050 in billions of litres per year (Gl/y)
- Column 6 = water efficiency of the measure in terms of water required for each unit of climate benefit, in litres per tonne of carbon equivalent emissions (l/t).

### Defined terms:

‘Consumed’ means the water is lost to other uses by being converted into other substances or being committed to an exclusive ongoing use, or is lost in the short term by evaporation or transpiration.

‘Dependency’ means the measure cannot be implemented without the consumption of freshwater.

‘Freshwater’ means any water that is not seawater or saline groundwater that has no other use without desalination.

### WATER DEPENDENCIES TABLE

<b>PART 1: WATER DEPENDENCIES OF CLEAN ENERGY MEASURES</b>					
<b>(1) Measure</b>	<b>(2) Water required for...</b>	<b>(3) Clean energy produced GJ/y (a)</b>	<b>(4) Climate benefit GtCe/y (b)</b>	<b>(5) Water required GL/y (c)</b>	<b>(6) Water efficiency of GHG reduction l/tCe (d) = (c)/(b)</b>
Bioenergy	Growth of biomass		~1.7 GtCe/yr incl BECCS + ~0.8 GtCe/yr) for biofuels)		
Hydrogen	Chemical conversion. Thermal cooling				
Hydropower	Storage		~1 GtCe/yr incl. from geothermal)		
Solar and wind	Pumped hydro for dispatchable energy supply		Solar (= ~4.5 GtCe/yr)  Wind (= ~3.94 GtCe/yr)		
Batteries	Rare earth mining and processing		~0.8 GtCe/yr for electric vehicles		
Clean thermo- electric power (such as nuclear, biomass, geothermal)	Cooling		= ~0.9 GtCe/y for nuclear		
Totals for clean energy:					
<b>PART 2: WATER DEPENDENCIES OF SEQUESTRATION MEASURES</b>					
<b>(1) Measure</b>	<b>(2) Water required for...</b>	<b>(3) Area Km2 (a)</b>	<b>(4) Climate benefit GtCe/y (b)</b>	<b>(5) Water required GL/y (c)</b>	<b>(6) Water efficiency of GHG reduction l/tCe (d) = (c)/(b)</b>
Maintenance of the hydrology of wetlands, peatlands permafrost and	Maintaining natural functions		= ~4 GtCe/yr)  = 0.5-2.1 GtCe/y (peatlands and coastal wetlands restoration only (IPCCMR TS 7r		

other natural systems					
Tree planting ('afforestation')	Maintaining natural functions		= ~2.9 GtCe/yr = 0.5-10 GtCe/yr (IPCC MR TS.7) 1.7 and -2.4 GtCe/yr (SRCCL 2.6.2)		
Carbon sequestration via carbon capture and storage (BECCS):	Maximising sequestration potential		= 0.5-11 GtCe/ yr (IPCC MR TS.7) = 6.5, -11 and -14.9 GtCe/yr (SRCCL 2.6.2)= 1.7 GtCe/yr incl BECCS		
Totals for sequestration					
<b>PART 3: WATER DEPENDENCIES OF OTHER MEASURES (IRRIGATION, WATER SERVICES ETC)</b>					
<b>(1) Measure</b>	<b>(2) Water required for...</b>	<b>(3) Area km<sup>2</sup></b>	<b>(4) Climate benefit GtCe/y (b)</b>	<b>(5) Water required GL/y (c)</b>	<b>(6) Water efficiency of GHG reduction l/tCe (d) = (c)/(b)</b>
Irrigation water management	No additional water required. This a water saving opportunity.	N/A	=0.3GtCe/ year	N/A	N/A
Wastewater management	No additional water required. Requires improved water treatment.	N/A	3% global CO <sub>2</sub> E	N/A	N/A
Managed waterways and other wetlands	Restore natural functioning (eg natural rise and fall of rivers and lakes)				
Water storages	Filling reservoirs in a low emission manner				
Direct Air Carbon Capture and Storage	Solvent regeneration		100-300 GtCe/ yr		
Totals for other measures					