FACT SHEET: *Po River and Connected Riverine Areas*

This document presents further information in regard to the **PowerUp NetZero OPEN CALL FOR INNOVATION PROJECTS**, specifically the activities expected for Consortia presenting innovation projects to the **Strand B: City of Turin Challenges.**

Innovative solutions for CO_2 capture and storage through the recovery and valorization of aquatic plants and algae from the Po River

Type of Area	Po River and connected riverine areas
Duration	Up to 10 months from the date of signature of the Grant Agreement, with all activities to be completed by 30 November 2027, including baseline monitoring, solution implementation, pilot testing, maintenance, final evaluation, and reporting.
Technological Focus Areas	Solutions focused on the valorization of aquatic plants and algae from the Po River, covering the entire value chain from selective biomass harvesting to long-term carbon storage

Context

The Po River and its hydrologically connected riverine areas may be affected by the seasonal growth and accumulation of algae, aquatic macrophytes, and floating, submerged, or riparian vegetation.

These phenomena - driven by nutrient availability, high temperatures, reduced flow velocity, and specific environmental conditions - may pose challenges to the ecological and landscape quality of the river, navigation, the functioning of hydraulic infrastructure, and the use of riverine areas.

At the same time, algae and aquatic plants absorb CO_2 and nutrients during their growth and can represent a biological resource for recovery and valorization. However, the actual climate benefit depends on preventing the rapid decomposition of biomass and converting the absorbed carbon into products or materials that ensure its long-term storage or durable use.

The test area will support the validation of innovative solutions for the selective harvesting, characterization, and valorization of riverine biomass, as well as methodologies for measuring the amount of carbon absorbed, recovered, and permanently stored.

Objective of the Pilot Testing

Testing solutions designed to:

- Selectively harvest excess algae, macrophytes, and aquatic vegetation
- Improve the ecological, landscape, and functional quality of the river section
- Quantify biomass production and CO_2 uptake during growth

- Prevent the rapid release of carbon through uncontrolled biomass decomposition
- Recover carbon, nutrients, and organic matter
- Convert biomass into materials, products, or energy carriers
- Promote medium- to long-term carbon storage
- Reduce the costs and environmental impacts associated with biomass harvesting and disposal
- Assess the technical, environmental, and economic sustainability of the proposed solutions
- Identify the conditions required for future large-scale deployment

Test area

A section of the Po River or a hydrologically connected riverine area, preferably characterized by:

- Recurring or seasonal presence of algae and aquatic macrophytes
- Accumulation of floating, submerged, or bank-side vegetation
- The presence of meanders, piers, weirs, hydraulic structures, or areas with reduced flow velocity
- Accessibility for land-based or waterborne equipment
- Availability of suitable areas for the temporary storage and pre-treatment of biomass
- Availability of data on water quality and hydrological conditions
- The possibility of identifying a comparable control area or monitoring period
- Compatibility with environmental protection requirements, hydraulic safety, navigation, and the recreational use of the river.

Solutions Sought

1. Selective Harvesting of Algae and Aquatic Plants

- Electric or low-emission vessels for biomass harvesting
- Floating systems, nets, barriers, and interception devices
- Amphibious vehicles or lightweight equipment for harvesting along riverbanks
- Selective cutting and harvesting systems for aquatic macrophytes
- Technologies designed to minimize biomass fragmentation and dispersal
- Modular solutions adaptable to different flow and water-depth conditions
- Systems capable of reducing the accidental capture of aquatic fauna

2. Monitoring and Forecasting of Biomass Proliferation

- Sensors for monitoring temperature, dissolved oxygen, turbidity, pH, chlorophyll, and nutrient levels
- Satellite imagery, drones, and computer vision systems
- Predictive models for biomass growth, accumulation, and transport
- Early warning systems for abnormal proliferation events and algal blooms
- Platforms supporting the planning and scheduling of harvesting operations

- Integration with meteorological, hydrological, and water quality data

3. Quantification of CO_2 Captured and Recovered

- Methodologies for estimating the amount of biomass produced
- Analysis of the carbon content of biomass
- Calculation of CO_2 captured during biomass growth
- Measurement of the amount of carbon recovered through harvesting activities
- Assessment of the share of carbon effectively stabilized in end products
- Analysis of emissions generated by harvesting, transport, treatment, and valorization processes
- Net accounting of captured, avoided, and generated emissions
- Monitoring, reporting, and verification systems for environmental performance and outcomes.

4. Biomass Pre-treatment and Stabilization

- Water separation and moisture content reduction
- Dewatering, centrifugation, and natural or low-energy drying processes
- Washing and removal of sediments, sand, plastics, and other foreign materials
- Biological, chemical, or thermal stabilization processes
- Reduction of biomass volumes to be transported
- Mobile or modular treatment units that can be deployed close to the harvesting area

5. Valorization of Harvested Biomass

- Production of biochar through pyrolysis
- Production of biogas or biomethane through anaerobic digestion
- Production of compost or soil amendments, subject to verification of biomass quality
- Recovery of nitrogen, phosphorus, and other nutrients
- Production of absorbent or filtration materials
- Extraction of cellulose, pigments, proteins, and other valuable compounds
- Development of biocomposites, panels, packaging, and other bio-based materials
- Use of biomass in durable products capable of retaining carbon over time
- Development of local biorefinery value chains and circular valorization pathways

6. Long-Term Carbon Storage and Utilization

- Conversion of biomass into biochar
- Use of biomass in construction materials or biocomposites
- Production of soil amendments capable of retaining carbon in the soil
- Development of materials and products with an extended service life
- Systems to prevent the uncontrolled decomposition of biomass
- Methodologies for verifying the stability and durability of carbon storage
- Traceability of carbon from biomass harvesting to its final destination

7. Water Quality Improvement

- Plant or algae-based systems for the controlled uptake of nitrogen and phosphorus
- Vegetated floating islands and phytoremediation systems

- Controlled cultivation of algae or aquatic macrophytes in confined areas
- Systems for intercepting nutrients before they enter the river
- Solutions integrated with wastewater discharges, canals, wetlands, and stormwater runoff
- Technologies capable of reducing eutrophication and uncontrolled algal blooms.

Environmental and Safety Requirements

Proposed solutions shall:

- Avoid the introduction or spread of invasive species
- Minimize disturbance to aquatic and riparian fauna and habitats
- Ensure the selectivity of harvesting operations
- Avoid deterioration of water turbidity and water quality
- Include the biological and chemical characterization of the biomass
- Assess the potential presence of metals, hydrocarbons, microplastics, pathogens, and other contaminants
- Ensure the proper management of biomass that cannot be valorized
- Comply with requirements related to hydraulic safety, navigation, and access to riverbanks
- Define operational procedures adapted to seasonal and hydrological conditions
- Identify in advance all permits and authorizations required for the harvesting, transport, treatment, and use of biomass

Pilot Testing Methodology

The proposal shall include:

1. Initial characterization of the test area
2. Identification of the plant and algal species present
3. Analysis of water quality and, where necessary, sediment quality
4. Initial estimation of the available biomass
5. Preliminary assessment of the carbon and nutrient content of the biomass
6. Installation and deployment of the harvesting solution
7. Pilot testing under real operating conditions
8. Weighing, sampling, and characterization of the harvested biomass
9. Biomass pre-treatment and subsequent valorization
10. Monitoring before, during, and after implementation
11. Comparison with an untreated situation or with conventional management approaches
12. Environmental, energy, operational, and economic assessment
13. Evaluation of the net CO_2 balance
14. Definition of the conditions for replicability and larger-scale deployment

Expected Results

- Effective harvesting of excess plant and algal biomass
- Improved visual quality and functional performance of the river section
- Reduction in vegetation accumulation in critical areas
- Quantification of the biomass and carbon recovered
- Reduction of emissions associated with uncontrolled biomass decomposition
- Recovery of nutrients and organic matter
- Production of bio-based materials, energy, or products
- Carbon storage in durable products or materials
- Reduction in biomass management and disposal costs
- Availability of reliable data on the sustainability of the value chain
- Definition of a replicable model for the circular management of riverine biomass

Indicative KPIs

#	KPIs
01	Quantity of biomass harvested
02	Quantity of biomass harvested per day or per kilometre of river
03	Area or volume of vegetation removed
04	Dry matter content of the biomass
05	Carbon content of the biomass
06	Tonnes of CO_2 equivalent absorbed
07	Tonnes of CO_2 equivalent recovered and stabilized
08	Quantity of nitrogen and phosphorus recovered
09	Water quality before and after the intervention
10	Energy consumption of harvesting and treatment activities
11	Emissions generated by transport and valorization
12	Percentage of biomass effectively recovered
13	Quantity and quality of the final product
14	Expected duration of carbon storage
15	Costs of harvesting, treatment, and valorization
16	Potential revenues or cost savings generated
17	Impacts on biodiversity, navigation, and the use of the river

Duration

Up to 10 months from the signing of the Agreement with Fondazione Piemonte Innova, as explained in the Open Call Guidelines, with completion by 30 November 2027.

The pilot testing shall be organised to include, within the available timeframe:

- Initial characterization, baseline definition, and subsequent monitoring.
- Biomass harvesting and characterization.
- Pre-treatment and valorization.
- Monitoring of results.
- Final environmental, technical, and economic assessment.

Final Outputs

- Technical and environmental report of the pilot testing
- Mapping of the plant and algal species present
- Dataset on water quality, biomass, carbon, and nutrients
- Net carbon balance
- Life cycle assessment of the solution
- Assessment of the quality and potential end uses of the biomass
- Operational plan for harvesting, treatment, and valorisation
- Economic model of the value chain
- Management and maintenance plan
- Scale-up and replicability model
- Technical and environmental requirements for future procurement procedures
- Guidance on permits, safety, and biomass management.

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