GoNEXUS
Integrated solutions for water, energy, food and ecosystems

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Promising EU policy solutions to address the Water-Energy-Food-Ecosystems nexus

In the context of climate change and increasing pressure on natural resources, ensuring water, energy, and food security, alongside conserving ecosystems, are some of the most pressing challenges facing Europe. Addressing Water-Energy-Food-Ecosystem (WEFE) **nexus governance should be a top priority** for the new European Parliament, the European Commission 2024-2029, and Member States. WEFE nexus governance refers to the **coordinated management of water, energy, food, and ecosystems** to address interlinked challenges.

The GoNEXUS team has developed a framework to co-design and assess innovative nexus solutions, helping to bridge the gap between theory and practice, and ultimately enhancing nexus governance. This **policy brief aims** to highlight the importance of **WEFE nexus governance** and bring up a set of **promising policy solutions** to **policymakers** and **Commission Services** on environment, water resilience, circular economy, agriculture and food, energy, climate and clean growth.

Key messages:

- The WEFE nexus represents a complex system of interrelated interactions. Water scarcity and pollution are often driven by economic activities and, in turn, have significant impact on key sectors such as irrigation (which affects food security), energy (due to increased costs and reduced hydroelectric power generation), and biodiversity (conservation and habitat loss).
- To further increase the share of renewable energy, innovative solutions such as floating photovoltaic installations, agri-photovoltaic systems that integrate solar energy with agricultural activities, and pumped hydropower that uses reservoirs to expand energy storage offer promising pathways.
- In an EU facing growing water scarcity, the onground implementation of measures targeted at improving water use efficiency should be reinforced. Alternative water sources (desalination, reclaimed water reuse) can contribute to tackle water scarcity, provided that a supportive institutional framework is put in place.
- Policy measures to boost circular economy facilitate the transition towards a sustainable and resilient WEFE sector. These include measures to facilitate the uptake of nature-based solutions and the recovery of nutrients from organic waste and wastewater.
- Governance is a crucial cross-cutting factor for achieving effective management of the WEFE nexus. Integrating the nexus approach into decision-making processes is essential to achieving effective transformative governance.

Water-Energy-Food-Ecosystems nexus challenges in the EU

The **Water-Energy-Food-Ecosystems (WEFE) nexus** represents a **complex system of interrelated interactions**, where challenges in one sector often have significant impacts on the others (Hoff, 2011). The GoNEXUS project has identified some of the most significant WEFE **nexus challenges at the EU**. The overarching challenge is that water scarcity and pollution are often driven by economic activities and, in turn, have significant impacts on key sectors such as irrigation (which affects food security), energy (due to increased costs and reduced hydroelectric power generation), and biodiversity (conservation and habitat loss).

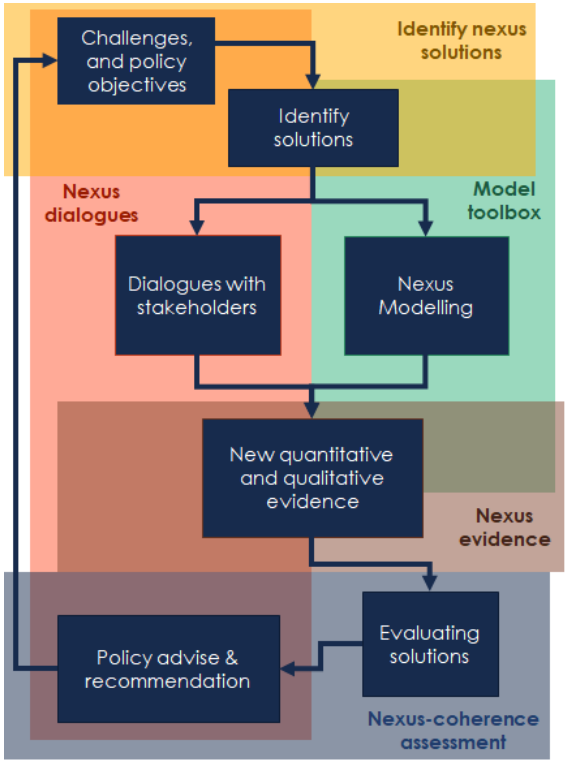
With this in mind, the following challenges have been identified:

- **Weak governance** of the WEFE nexus
- **Growing water scarcity** due to increasing water demand related to macroeconomic trends (e.g. demographic pressure) and climate change (a warmer and drier climate).
- **Green energy transition** and the reduction of GHG emissions.
- **Reconciling water, energy and food security with ecosystems conservation** (and other environmental effects).

These nexus challenges have been identified and refined through a **participatory approach** to enhance social learning and knowledge exchange. Given these, holistic and **comprehensive nexus policy solutions** are required to address cross-sectoral challenges at continental, regional and local levels.

Governance is key to tackle nexus challenges

Governance is a critical factor that has a **cross-cutting impact** on the management of the WEFE nexus. The GoNEXUS **Solution Evaluation Framework** (GoNEXUS SEF) is a framework designed to co-design and evaluate innovative nexus policy solutions (González-Rosell et al., 2023). This framework can be applied at regional, national or EU levels and presents vital steps towards implementing comprehensive policy solutions. For a solution to be successful, it is also essential that it meets a set of criteria and quality standards. Nexus solutions should be **feasible** for implementation, **sustainable** over their time and scope, and socially **desirable** and acceptable. This approach helps to **bridge the gap between theory and practice**, provides evidence on trade-offs and synergies between policy objectives, and ultimately offers guidance to policymakers on how to strengthen nexus governance.



GoNEXUS SEF scheme

Promising Policy Solutions

Following the proposed framework, we have identified a list of promising policy solutions that address the nexus challenges in the EU. While the proposed solutions primarily address sectoral issues, their implementation has repercussions on other sectors within the nexus. Understanding how these solutions interact within the WEFE nexus is crucial to reinforce the robustness of decision-making processes. This step is essential for moving from theory to practice and achieving effective governance of the WEFE nexus.

Invest in water use efficiency

Improving water use efficiency and enhancing agricultural water productivity are essential responses to growing water scarcity. Efficiency gains facilitate maintaining the ecological flow of rivers and lakes, sustaining ecosystem services, and meeting growing domestic and industrial water demand(Water Framework Directive, Fitness Check of the EU Water Legislation).

While current measures, such as river basin management plans, are aligned with this objective, their implementation has been insufficient. Water use efficiency can be improved by implementing targeted measures, such as setting an appropriate price for water (e.g. cost recovery pricing), allocating water and water-related funds more efficiently, fostering water-efficient technologies and practices, encouraging the emergence of a water-saving culture in Europe and improving water-related knowledge and data collection.

Develop non-conventional water sources

As droughts and water scarcity are becoming more prevalent in Europe, desalinated and reclaimed water (with special focus in coastal areas) can contribute to ensure a reliable and sustainable water supply. These alternative water sources can play a fundamental role in meeting agricultural irrigation demands and other water needs, while reducing pressure on natural water bodies (Hristov et al., 2021). By replacing part of groundwater abstraction, the use of alternative water resources can contribute to a more sustainable management of groundwater resources (De Roo et al., 2023). Furthermore, they can also mitigate the impact of wastewater discharges into sensitive areas.

Specific measures such as support to investment in reuse of treated water in irrigation (through the Common Agricultural Policy), support for innovation in circular water use (through the European Innovation Partnership-AGRI), or the regulation of substances released in water bodies (the revised Urban Wastewater Treatment Directive, Water Reuse Regulation) are some examples of how the use of non-conventional water sources can be developed. However, significant challenges remain, including their high costs and a lack of acceptance for irrigation use among farmers. While subsidies can provide short-term support, supporting innovation should also focus on developing cost-effective and scalable processes to ensure the sustainable integration of these water sources. Additionally, it is essential to raise awareness on the safety of using alternative water resources. These are key points to be considered in the development of the new Initiative for water resilience.

Promising Policy Solutions

Increase the share of renewable energy

Since the energy sector accounts for 75% of total EU greenhouse gas (GHG) emissions, increasing the share of renewable energy sources is essential to achieve climate targets (Renewable energy targets). Furthermore, the transition to renewable energy sources will decrease the dependence on imported non-renewable energy, enhancing overall energy security.

The EU's green energy transition, aims to reduce net GHG emissions by at least 55% by 2030, and achieve the ultimate goal of climate neutrality by 2050 (Fit for 55). Current measures, such as increasing the binding target for renewable energy in the EU energy mix from 32% to 38-40% by 2030 (updated Renewable Energy Directive), setting a 14% target for renewable fuels in transport, and introducing new provisions for renewable energy communities and self-consumption are key to encourage the use of renewable energy. To further increase the share of renewables, innovative solutions such as floating photovoltaic (PV) installations, agri-PV systems that integrate solar energy with agricultural activities, and pumped hydropower using reservoirs for expanded energy storage offer promising pathways. Additionally, subsidies for photovoltaic self-supply infrastructures in agriculture can support the integration of renewable energy into farming, contributing to a more sustainable energy system.

Improve energy efficiency

Energy efficiency is a key approach for reducing energy consumption while supporting our lifestyles. Improved efficiency not only boosts economic productivity but also reduces the dependence on imported energy. Furthermore, it also contributes to reducing our emissions and achieving the goal of climate neutrality by 2050(Nepal et al., 2021).

Current initiatives, such as the proposed new Energy Efficiency Directive seeks to introduce a higher target for the reduction of primary (39%) and final (36%) energy consumption by 2030, now binding at EU level, in line with the 2030 Climate Target Plan initiative, up from the current target of 32.5% (for both primary and final consumption). To stimulate this acceleration, the proposal focuses on sectors with a high potential for energy savings (heating and cooling, industry and energy services) and puts additional emphasis on the public sector to lead the transition. Moreover, this approach extends to other sectors within the nexus. For instance, the revised Urban Wastewater Treatment Directive introduce energy audits and mandate energy neutrality in the wastewater treatment sector, creating a built-in mechanism that pushes the industry towards greater energy efficiency. Agriculture, being a highly energy-dependent sector, will likely face market pressures to increase efficiency. Additional measures targeting specific areas within agricultural production that are known for inefficiency, such as irrigation systems, energy-intensive processes in food production, and outdated equipment, can lead to significant improvements. The implementation of technological innovations, such as precision agriculture, and management measures, such as energy audits, could facilitate the shift towards more efficient practices.

Promising Policy Solutions

Optimize the use of fertilisers

Crops require nitrogen to grow optimally, so it is commonly applied to agricultural fields as synthetic fertiliser and animal manure. However, not all this nitrogen is absorbed by plants or retained in the soil. Some of it is lost in the form of nitrous oxide gas (a GHG) or is washed away by heavy rain or excessive irrigation (leaching) and ends up polluting water bodies. The EU currently faces an excess of nutrients in its waters, which exacerbates environmental degradation. Improving fertiliser use efficiency can significantly reduce emissions while preserving fragile agricultural ecosystems. Additionally, mineral fertiliser production is energy-intensive and categorized as a “hard-to-abate”, making the transition to more sustainable fertiliser practices critical for reducing energy consumption (Paris et al., 2022).

These challenges further highlight the need to promote organic fertilising products as a viable alternative. Although technologies for nutrient recovery from wastewater present a potential solution, they are still underdeveloped, with significant requirements for scaling up and cost reduction. The same hurdles apply to manure, wastewater, and sewage sludge management. The Nitrates Directive aims to protect water quality by preventing nitrates from agricultural sources and promoting good farming practices. However, its voluntary implementation has largely failed to achieve the directive's objectives (Strategic Dialogue on the Future of EU Agriculture). Additional measures to optimize the use of fertilizers are needed (through the Common Agriculture Policy), including the use of nutrients recovered from organic waste and wastewater.

Implement Nature-based solutions

Nature-based Solutions (NBS) are approaches that draw inspiration from and are supported by natural processes. They aim to be cost-effective while simultaneously providing environmental, social, and economic benefits, thereby building resilience. They work in collaboration with nature, harnessing its inherent capacity to address societal challenges, support human well-being, and preserve biodiversity at the local level (Davies et al., 2021). These solutions are nature positive actions that integrate diverse natural features into urban, rural, and marine environments through locally adapted, resource-efficient interventions. Additionally, due to their characteristics, they can help boost a more circular economy. However, the implementation of NBS is hampered by barriers such as a lack of funding, insufficient data on their effectiveness, and resistance to change from traditional sectors.

To facilitate the adoption of NBS, policy measures should be introduced, such as provisions on no-net-land take in urban development, minimum greening requirements for new projects, tax incentives for ecosystem restoration initiatives, and the establishment of dedicated funds to promote NBS projects. Furthermore, the implementation of specific measures to protect, restore, and manage natural and semi-natural ecosystems, sustainable manage of aquatic systems and cultivated lands, and integrating nature into urban environments are essential to support NBS. Consequently, it is essential to bring up and highlight NBS in the future and renewed bioeconomy strategy.

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Recent project-related publication

González-Rosell, A., Arfa, I., & Blanco, M. (2023). Introducing GoNEXUS SEF: a solutions evaluation framework for the joint governance of water, energy, and food resources. Sustainability Science, 18(4), 1683-1703. https://doi.org/10.1007/s11625-023-01324-1

About the GoNEXUS project

Innovative tools and solutions for Governing the water-energy-food-ecosystems NEXUS under global change

GoNEXUS (Grant Agreement ID: 101003722) is a Horizon 2020 project funded by the European Union for the period 2021-2025, aimed at addressing the water-energy-food-ecosystems (WEFE) nexus challenges through the co-designing and evaluation of nexus solution.

The project adopts a mixed-method approach that integrates dialogues with stakeholders and a model toolbox to evaluate various policy changes, technical, and infrastructure measures. With all the collected nexus evidence, the researchers provide informed policy advice and recommendations. This approach aims to address nexus governance issues under global change, boost the EU's role in water diplomacy, and facilitate participatory dialogues to generate solutions for joint governance of the WEF nexus. Furthermore, GoNEXUS aims to align existing EU WEFE policies and reduce institutional fragmentation.

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