RECENT research agenda: Water-energy-climate nexus

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Abstract

Water, energy and climate are inextricably linked. Energy and water demands are increasing worldwide, while climate change affects the availability of both. Disturbances in the supply of energy and water can cause tensions or crises and access to safe water sources and supply of energy is a health and well-being concern. There has been a lot of attention on cybersecurity of late. However, much less attention is paid to the safety and security of municipal infrastructures such as water and wastewater networks, power supply, access to heat and other critical sources of energy. Preparedness of the society has to include also safeguarding these critical infrastructures, that fell under the jurisdiction of municipalities. This means safeguarding vital functions in partnership between authorities, business, as well as environmental organizations and citizens.

Background

Growing population and increasing living standards mean that we will soon need 30% more water and 40% more energy. At the same time, we hope reduce CO_2 emissions to 50%. Water, energy and climate are limited and interlinked. The supply, cost and quality of water and energy are also dependent on each other. There is also a considerable overlap between the 1.1 billion poor people without adequate access to water, the 1.5 billion who are without access to electricity, and the 1 billion who are undernourished. To date there is no consistent quantitative assessment of water and energy security at the global scale. Reducing poverty and end world hunger are the top two goals of sustainable development, and they are impossible to achieve without addressing the issues of climate change, water security and energy safety. It is estimated that those regions where there is highest pressure on land and water resources overlap strongly with those regions where food self-sufficiency is no longer possible[1]. Synergies can be built and positive feedbacks generated across the three nexus sectors.

The circular economy concept opens a new perspective on the role of sustainable water management. Water is the most CO_2 intensive product in the EU; about 3.5 kg of CO_2 is produced per every euro of water "product". Electricity is a critical input for delivering municipal water and wastewater services and electricity costs can contribute up to 30 % of the operating costs of water and wastewater utilities. Pumping water to customers can consume up to 70 – 80 % of the overall electricity usage of water utilities. To become more efficient and smart in this area is indispensable. Water utilities will have to be more resource efficient and explore their renewable energy assets.

Cross-sectoral management can minimize trade-offs, build synergies and increase resource use efficiency. Wastes, residues and wastewater can be used for closing loops of water, nutrients and other resources. However, there is no harmonized 'nexus database' or analytical framework that could be used for monitoring or trade-off analyses. Hence the effects of climate change on access to water and energy, as well as potential synergies between land, water and energy management, are not well understood. Questions include to what extent higher availability of one resource can sustainably reduce the scarcity of another, and how this might work at different spatial scales.

[1] Stockholm Environment Institute: Understanding the nexus. Background paper to the Bonn2011 Nexus Conference.

Objective

The objective of RECENT research agenda is to ensure that efforts are made to safeguarding critical municipal infrastructures, especially that of water/wastewater and energy, in order to ensure the functioning of these key environmental services also in the case of disturbances and exceptional circumstances, such as extreme climate events. We proposed that research is done to contribute to the water-energy-climate nexus debate with the assessment of the following issues:

- What are the main weaknesses and strengths of current infrastructures?
- Assess the resilience of critical infrastructure in case of extreme climate events – e.g. hotter and dryer summers, extreme rain or snowfall events, increase of icing, aso.
- What mechanisms are needed to guarantee energy safety and security of supply and improve resilience bearing in mind that we are moving towards a low-carbon society and decentralized systems
- In addition, some key elements of the water-energy-climate nexus will be explored, such as the energy efficiency and carbon footprint of water services
- Continue promoting best practices in renewable energy generation in providing and promoting the use of renewable energy in water services
- Explore potential climate scenarios, their impact on water availability and related impacts on energy prices and achieved decarbonization targets.

The emphasis is on issues of interests to end-users in the Northern Periphery and Arctic region, since boundary conditions (e.g. environment, transportation distances, resources availability) are more challenging in the North.

Connection to European policy

Such research proposal would contribute to integrating natural resource management, to understand complex interactions across various systems, scales, pressures with coupled phenomena, in particularly the climate-land-water-energy Nexus. The research has to be linked to the assessment of policies of carbon neutrality, as well as other impacts on environment, in particular to water resources, biodiversity.

Scientific added value

The nexus approach requires a strong understanding of the interdependencies among critical services to ensure water and energy security under climate change pressures. This demands increase knowledge about the intersection of these systems and to determine trade-offs. We need integrated planning and management tools for greater coordination and better policies. With this knowledge, mutually beneficial responses and synergies can be identified that meet demand without compromising sustainability.

Expected results

The expectation is to build secure and resilient systems that provide critical services for the people of the Northern Periphery and Arctic region, with sustainable use of northern natural resources, considering the challenges of climate change. Collaboration and interaction across ecology, geography, hydrology and architecture will also be needed planned, with considerations of public health and well-being. The key issues are reducing climate change impacts, while safeguarding water resources, reduce natural resources use, ensure the security of energy provisioning and contribute to the sustainable growth of the region.