The Internet of Things as a Key Enabler for Quantifying the Water, Energy and Food Nexus

Photo: An IoT deployment in Taygetos Mountain for aromatic plants. Credit: Future Intelligence Ltd (http://futureearth.org/sites/default/files/styles/full_blog_image/public/field/image/dsc07921.jpg?itok=9cdizXO7)

DEC 2018 18

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The Water-Energy-Food Nexus Blog Series

Delivering water, energy and food for all in a sustainable and equitable way is a major challenge faced by society. The water-energy-food nexus concept aims to address this by better understanding how interactions between water, energy and food are shaped by environmental, economic, social and political changes and how the synergies and trade-offs among them can be better planned and managed. The Water-Energy-Food Nexus Knowledge-Action Network is a network of people and organisations which fosters transdisciplinary research and communicates the importance of holistic system approaches across water, energy and food systems. Acknowledging that the nexus concept is often described as overly academic and not practical on the ground, the Water-Energy-Food Nexus Knowledge-Action Network is organising this blog series to illustrate the role of the nexus concept in addressing local and national challenges of sustainable and equitable access to resources. Understanding the perceptions and entry points with which local and national stakeholders can engage with the nexus concept is key to further implementing nexus approaches, especially in the Global South.

Learn more about the Future Earth Water-Energy-Food Nexus (http://futureearth.org/future-earth-water-energy-food-nexus) Knowledge-Action Network.

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Water, energy and food systems are highly complex systems which are heavily interdependent. In other words, as the systems are linked to each other, using water for energy, for example, is likely to impact agriculture and human settlements. A change in one of the systems will have ramifications across and beyond the others. Yet despite this interdependency, the water, energy and food sectors are often developed in isolation from each other (UNECE 2016 (http://www.unece.org/fileadmin/DAM/env/water/publications/GUIDELINES/2017/nexus_in_Sava_River_Basin/Nexus-SavaRiverBasin_ECE-MP.WAT-NONE-3_WEB_final_corrected_for_gDoc.pdf)).

The Internet of Things is the process of giving an online identity and virtual personality to all the physical objects that surround us. Giving a digital identity to an electrovalve, a LED feature or a pump may not be viewed as revolutionary but upon reflection, it does raise serious challenges to security, privacy and transparency in decision making. Following an Internet of Things approach, such objects would independently and autonomously make decisions based on certain conditions, without human intervention. The INCOVER project (https://incover-project.eu/), a H2020 collaboration that demonstrates "Innovative eco-technologies for Resource Recovery from Waste-water," explores how the Internet of Things concept could be used to rationalise irrigation while, at the same time, facilitating the implementation of the water, energy and food nexus.


(/sites/default/files/images/INCOVER%20figure%201.png)Figure 1. INCOVER Demo Case Study in Almeria, ©AUTARCON

One of the core partners of INCOVER, Future Intelligence, deployed two drip irrigation systems in Spain, one in an agricultural field in Barcelona and one in an industrial landscape facility in Almeria. The drip irrigation system in Barcelona enabled the company to optimise irrigation by considering data generated from both users and machines, including crop, microclimate and weather data. Future Intelligence stored the irrigation data in the Internet of Things platform, which enables farmers, agronomists and irrigation auditors to easily extract and re-use the information. By doing so, the monthly intersection of food, water and energy could be estimated while providing additional information to consumers such as food per crop per kiloWatt-hour. As a result, an Internet of Things application that initially aimed to help farmers to use irrigation water more efficiently has now been re-marketed to deliver farm traceability, food safety and sustainability-relevant information to consumers.

(/sites/default/files/images/INCOVER%20figure%202.png)Figure 2. Internet of Things enabled smart drip irrigation system in Barcelona, ©UPC

Meanwhile, the drip irrigation system in Almeria was deployed to demonstrate water reuse in public spaces in hot desert landscapes. In order to decrease the amount of water lost to the atmosphere from soil and plants, known as evapotranspiration, the drip system was built below ground using what is known as a subsurface drip irrigation method. The aim of the system is to minimise the amount of water needed to sufficiently maintain a recreational green field, while automating monthly estimations of the amount of water and energy used. Moving beyond the objectives of the project, the Internet of Things could also be used to count the number of people nearby, which would allow the municipality to adjust the water and energy use in real-time in response to the crowd density.

(/sites/default/files/images/INCOVER%20figure%203.png)Figure 3. Internet of Things enabled smart subsurface drip irrigation system in Almeria, ©AQUALIA

The big advantage of using an Internet of Things system is that it takes into account the environment within which it operates by collecting data from multiple sources, such as sensors, external systems (like open weather data) and users, in simpler and more cost-effective ways than traditional automation or monitoring systems such as Supervisory Control And Data Acquisition or Programmable Logic Controllers did in the past. In addition, Internet of Things systems can exploit data more effectively since they can be trained to identify issues based on pattern recognition and proactively notify operators when critical thresholds are about to be reached.

Water scarcity is a big issue in Mediterranean area, especially in the summer, during the peak tourist season for many southern European countries. Regional schemes like Smart Specialisation Strategies help countries to work together to identify and develop their own competitive advantages and strategically address drawbacks (Uyarra et al. 2014

(http://s3platform.jrc.ec.europa.eu/-/inter-regional-collaboration-in-research-and-innovation-strategies-for-smart-specialisation-ris3-?inheritRedirect=true)). Such inter-regional strategies encourage applied research and the collective mobilisation of resources to address the challenges (Uyarra et al. 2014 (http://s3platform.jrc.ec.europa.eu/-/inter-regional-collaboration-in-research-and-innovation-strategies-for-smart-specialisation-ris3-?inheritRedirect=true)). The Digital Single Market could provide an umbrella for the collaboration of the Internet of Things and the water, energy and food nexus and in doing so promote common sustainability, resource security, equality and digital transformation objectives (European Commission 2018 (https://ec.europa.eu/digital-single-market/en/policies/shaping-digital-single-market)). All these are strongly related to the core strategy of the Single Market, which seeks to make the most of data. The platforms and technologies offered by the Internet of Things could have a profound role in quantifying, visualising and sharing important data that would help state and non-state actors to plan, develop and maintain sustainable economic activities. The Internet of Things can offer innovative and valuable insights like predictive analytics for irrigation, water and food waste patterns and even sharing their data with cross-sectorial domains to deliver novel services to multiple stakeholders.

References

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COMMENTS