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The water-land-food-energy-climate Nexus for a resource-efficient Europe

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According to the 2015 European Environment-State and Outlook (SOER, 2015), the EU's total resource use has declined by 19% since 2007, less waste is being generated and recycling rates have improved in nearly every country; however, despite this progress and the relative decoupling of economic growth from environmental harm that is observed, a majority of environmental systems are not used or managed sustainably. Among others, targets of the Water Framework Directive (EC/WFD, 2000) are often not met, ecological integrity of river basins is compromised, and land use changes and poor water management together with climate change will increase the risks of both floods and droughts. Moreover, there are several problems that slow the EU's rate of transition to greater resource efficiency. Some of the barriers to resource efficiency, according to the Roadmap to a resource efficient Europe, are as follows: Policy inconsistencies and incoherence reduce predictability and response/reaction adequacy: policy made for a good reason in one field can have unintended consequences that hold back efficient resource use in another. Knowledge gaps about future risks constrain policy-makers from planning for the future; there are significant uncertainties on how environmental systems will change and the impacts these changes will have, which leave policy-makers unaware of risks in complex, global supply chains.

We present a novel methodology for addressing policy inconsistencies and knowledge gaps that hinder the transition to a resource efficient Europe. We focus on the integration of all different sectors that interact and influence each other, namely the "water-energy-food-land use-climate nexus" and we develop tools for identifying and quantifying their complex interlinkages under the influence of climate change. We also mitigate trade-offs in the Nexus and exploit synergies. In order to achieve this, we employ a series of sophisticated thematic models, each of which addresses a different nexus dimension, or a combination of a few, while none of them addresses them all in an integrative manner. We use dynamic systems modelling and other complexity science techniques in order to "merge" different thematic model outputs in a single coherent result, which is presented to the user in an easy-to-comprehend Serious Game environment. This way, the effect of policies that are designed to affect one field (nexus dimension) on others can be quantified and simulated, thus informing policy-makers for the unintended consequences of policies, reducing uncertainties, covering knowledge gaps and leading to a resource efficient Europe faster.

The methodology is to be validated in a series of case studies developed at a regional, national, cross-boundary, continental and global level through the use of data from various sources. This effort is part of a four-year EC Horizon 2020 project entitled "Sustainable Integrated Management FOR the NEXUS of water-land-food-energy-climate for a resource-efficient Europe (SIM4NEXUS)" that started in June 2016 and involves 25 partners from 15 European countries.

References

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