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IMPROVING DECENTRALIZED ECONOMIC GROWTH AND REDUCING ENERGY CONSUMPTION IN THE EUROPEAN UNION WITH THE APPLICATION OF ECOLOGICALLY ORIENTED INNOVATIONS

IZBOLJŠANJE DECENTRALIZIRANE GOSPODARSKE RASTI V EVROPSKI UNIJI IN ZMANJŠEVANJE RABE ENERGIJE Z UPORABO EKOLOŠKO NARAVNANIH INOVACIJ

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Abstract

This article presents applicable approaches for supporting the transition towards sustainable decentralized economic development within the European Union, based on the concept of supporting the development and market uptake of eco-innovations. The main topic addressed is achieving a more effective market uptake of ecologically oriented innovations facilitated through matchmaking, as well as knowledge and technology transfer between key actors of the innovation process.

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Povzetek

Članek predstavlja izvedljive pristope za podporo tranzicije v smeri trajnostnega in decentraliziranega razvoja gospodarstev Evropske unije na podlagi uporabe koncepta podpore razvoja in tržne implementacije eko-inovacij. Glavna obravnavana tema je možnost doseganja bolj efektivnega tržnega preboja ekološko usmerjenih inovacij spodbujenega z aplikacijo povezovanja ter prenosa znanja in tehnologije med ključnimi igralci inovacijskega procesa.

1 INTRODUCTION

National economies within the European Union are vastly divergent in terms of current development, specific problematic areas, and future priorities. In particular, economies from the south-eastern part of Europe are significantly limited in terms of access to resources (human resources as well as critical raw materials and capital) required to fuel future growth, which is a prerequisite to maintaining stability in the context of future economic cohesion that is strongly dependent on maintaining a high growth rate of GDP. Promoting decentralized growth across the EU has been one of the main principles of European integration but has not been adequately implemented so as to achieve an equilibrium of development in key areas such as education, business and employment (preferably in knowledge-intensive industries) in each of these countries. A clear indicator of this mismatch is illustrated in the extensive outflux of human capital from poorer countries to highly developed economies offering better opportunities for gainful employment and career development. The donor countries providing human capital through domestic investment into formal education are left without skilled labour that could raise the development level of their national economies, further exacerbating the prosperity gap within the EU. Nonetheless, the shift from conventional industries towards sustainable economies offers opportunities for less privileged countries to begin anew with ample opportunities to redesign national economies by comprehensively addressing development from a bottom-up approach, drawing from basic and applied research.

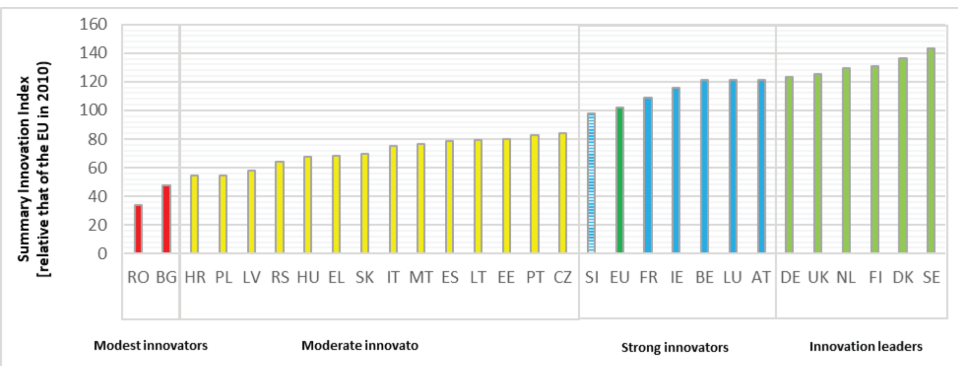

Figure 1: *Performance in innovation by country, [1]*

The future development and large-scale implementation of novel energy technologies open a plethora of market niches where less developed markets have somewhat of an advantage over highly developed ones. In terms of future ambitions of the region to build its energy sector on the basis of efficient use of energy, a high share of (intermittent) renewable energy sources with hydrogen accompanying electricity as the key vector for transport and storage of energy, it is essential to focus on activities that will enable the research and production of required equipment and infrastructure domestically to the highest possible extent.

2 ECO-INNOVATION

Eco-innovation is defined as the innovative creation and commercialization of new environmental technologies, products, and services that reduce the overall negative environmental impact and enable the co-creation of viable and sustainable solutions targeting specific environmental issues. As such, the concept addresses all the key challenges that societies within the European Union and beyond will have to overcome in the coming decades and shows a clear way forward for companies, decision-makers, educational institutions and academia, research and development organizations as well as the general public in the role of final consumers and beneficiaries. Implementing support measures for eco-innovation on a systemic level, be it policy adaptation, entrepreneurial development, educational reform, energy transition and so forth, will be essential in achieving inclusive, robust, and sustainable growth over the long term. This process will have to be all-encompassing to engage and facilitate requirements of literally all types of institutions and individuals, from legislative to judiciary and executive branches of government, research and educational institutions to companies, from producers to consumers.

Figure 2: *EcoInn Danube project logo, [1]*

Creating a better environment for enterprise, innovation and the citizens in general, while prioritizing sustainable development will, among other things, require increasing the level of awareness among final consumers, improving the quality of obtained skills amongst the regions human resource pool as well as creating market opportunities in areas crucial to the future wellbeing of the societies in the wider region (ecology-environmental protection, waste/resource management, energy supply, transport, etc.). A swifter move towards the new economic model of a circular economy enables the decoupling of economic growth from negative environmental effects, decreasing energy and resource dependency of the region, reducing labour intensity by increasing labour productivity and prioritizing industries that demonstrate high value-added and long-term sustainability, not only from an economic point of view but based on the complete life cycle impact, taking into account the wider benefits that it implies for the society as a whole.

Achieving a practical implementation of such an economic model will require substantial effort and engagement of various stakeholders across all levels, focusing in particular on the interconnectivity amongst relevant actors as well as to increase the flow of information and knowledge across transnational channels within the European Union.

3 VIRTUAL LAB STAKEHOLDER PLATFORM

The EcoInn Danube project (Eco-innovatively connected Danube Region) was structured on the primary premise that achieving wider market uptake of innovations with notable positive ecological impact can be achieved through the facilitation of cooperation between key innovation actors from various types of institutions by applying the quadruple helix approach. The development of new interactions and the strengthening of existing interactions amongst representatives of the eco-innovation environment was recognized as the most effective approach to increase the supply and demand of eco-innovative products by means of improving transnational cooperation on the markets of the countries within the Danube region, the EU, and in a global context.

The project addressed the challenges in a comprehensive approach that was derived from preliminary results of extensive analytical and research activities inclusive of current country-specific status with regard to obstacles and opportunities, existing support structures, analysis of political, economic, social, technological, environmental, legal considerations and so forth. The core activities of the project were however focused on direct matchmaking of key stakeholder groups, implemented through various types of events (green summer schools, green innovation forums, local/national and international stakeholder meetings, local workshops and information events, etc.) as well as through the provision of novel IT tools.

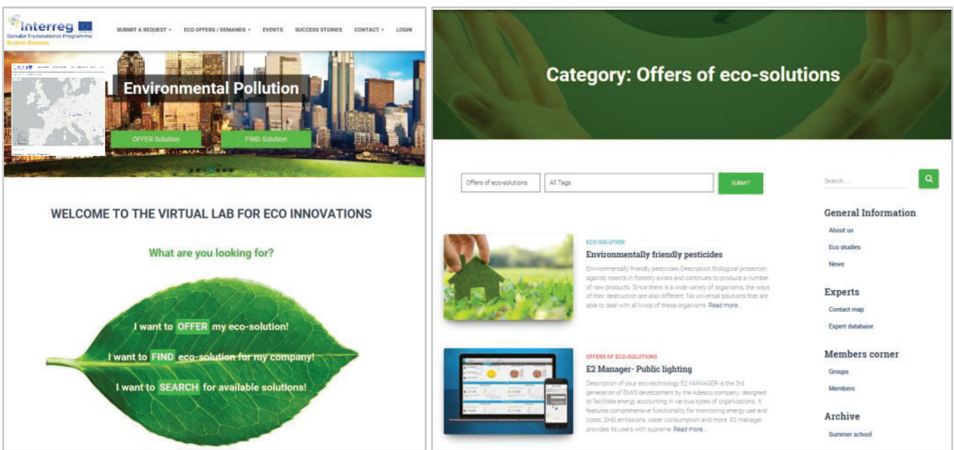

***Figure 3**: Virtual lab web platform, [1]*

One of the main tools developed in this regard was the virtual lab platform, with a key function to provide a matchmaking portal for pairing offers and demands of eco-innovations. The virtual lab achieved a notable input from individuals (independent innovators, students), research and academic institutions as well as companies regarding specific eco-innovative products and services developed by said organizations. The final development of the virtual lab was the organization of an international competition, in which the most promising eco-innovations with respect to predefined criteria were chosen, for which comprehensive feasibility studies of their developed products and/or services will be developed. One of the three best overall products chosen was an innovative design of a constructed wetland for treating municipal waste-water.

4 LOW-ENERGY CONSUMPTION WASTEWATER TREATMENT METHODS

Water as a compound is relatively abundant as it covers roughly 71% of the Earth's surface. The total water reserves represent roughly 0.02% of the planet's mass which would amount to about 1.35×1018 metric tonnes or 1.386 billion cubic kilometres (km^3) as volume, *[1].* However, the majority of water reserves are not made available in a form that is economically/technically appropriate for human consumption. The vast majority is salt-water of which 96.5% is contained within oceans and about 1% below ground. Freshwater reserves represent roughly 2.5%, of which 70% is ice. Merely 1.3% is freshwater, mostly located inside lakes. Generally, only groundwater (0.4%) and surface water (0.004%) are viable sources for human consumption, indicating that water reserves are considerably scarce in practical terms. The water cycle in itself is a cleaning mechanism, which allowed the reuse of water reserves throughout aeons. In essence, it could be concluded that all previous generations of human beings drank and used the very "same" water.

However, never before in history has the impact of human existence on water reserves been so profoundly negative and so extensive in scope, that natural cleaning mechanism cannot keep pace with ever-growing demand and pollution.

The predominant objective of waste-water treatment is the disposal (management, treatment, reuse) of human-originated and industrial effluents that does not threaten human health and subject the natural environment to undesirable damage. Waste-water treatment is defined as a series or combination of various physical (mechanical), chemical and biological processes and operations applied with the goal of removing pollutants such as solids, organic matter, and nutrients from influent waste-water.

Conventional waste-water treatment is an energy-intensive process. There are over 22,000 waste-water treatment plants in Europe; their operations account for more than 1% of overall electricity consumption within the EU. Annually, the combined final electricity consumption for all the participating plants is over 15 GWh, *[2].* Reducing the energy requirements for waste-water treatment would extensively support the efforts of the EU to reduce energy dependency and energy-related emissions. Considering that energy use within the sector could be reduced by a conservative 10%, this would imply a reduction of GHG emission by 4.47 million tonnes of CO^2 equivalent, *[3].* Waste-water treatment, therefore, can be considered one of the many areas that would be optimally addressed comprehensively through the prism of life-cycle assessment and eco-innovation.

4.1. Constructed wetlands

Constructed wetlands are engineered systems that apply natural processes for waste-water treatment. Generally, they are composed by wetland vegetation (macrophyte coverage of varying degree) and filter mediums (soils, sands) placed in separated shallow basins. In most cases, the flow of waste-water is driven by gravity, while some applications include additional pumping installations if the gradient on the location is not sufficient. The underlying technology was originally developed in the 1950s in Germany (Käthe Seidel, Max Planck Institute) and has since evolved into a viable waste-water treatment technology for various types of waste-water, *[4]*. Several variations of the technology exist in which free water surface (FWS), horizontal subsurface flow (HSF) and vertical subsurface flow (VSF) wetlands are the basic types. Several studies, however, indicate that improved treatment performance can be achieved by combining different types of constructed wetlands. Most existing hybrid systems are comprised of interchangeable sections of horizontal and vertical filters; however, various types of constructed wetlands could generally be applied (combined) to achieve desired outcomes in terms of treatment efficiency of specific water pollutants. There are several hundreds of conventionally constructed wetlands in operation across Europe today, the majority of which are located in just a few countries; for example, the Czech-Republic is one of the very few countries that have implemented the technology at scale, with about 250 plants active at present. However, most conventional systems have certain shortcomings in terms of low-efficiency in colder climates and inadequate removal of nitrogenous compounds, which have a profoundly adverse impact on aquatic life due to causing oxygen depletion in receiving water biota, *[5]*.

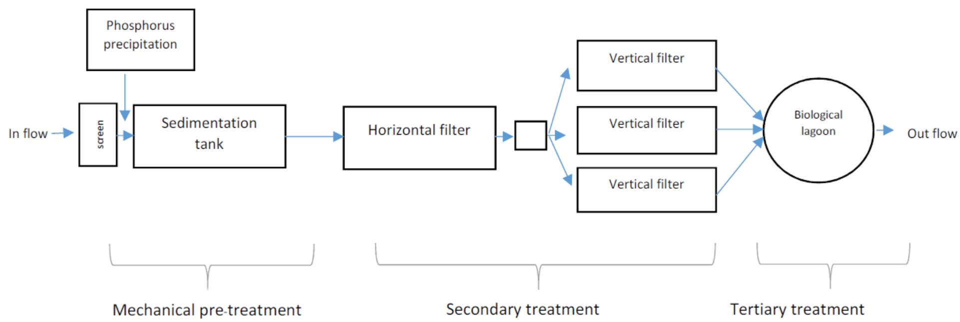

Figure 4: *Process block scheme (Source: Brno University of Technology)*

A team of researchers at the Institute of Landscape Water Management of the Faculty of Civil Engineering at the Brno University of Technology have developed a concept of constructed wetlands that displays a very high efficiency of nitrogen compounds as well as BOD, COD, and TSS removal. The concept has been verified and validated through extensive monitoring of waste-water effluent at a semi-prototype plant located in the village of Dražovice in the Czech Republic. The constructed wetland has undergone a comprehensive reconstruction on one of two horizontal filters with and an improved version of a vertical filter featuring an innovative waste-water dispensing system. The design of the plant allows for comparatively lower capital expenditures within the construction phase against conventional waste-water treatment plants for municipal waste-water; however, the main benefit is its astoundingly low operational costs. The proper design of the plant whereby a sufficient gradient of the landscape on which it is located is available indicates that such a facility does not have any need for energy (or very low requirements in the case that elevation pumps are required) in the secondary stage of waste-water treatment.

5 CONCLUSION

Future economic development must take into consideration environmental limitations as primary concerns, especially in the areas of freshwater reserves, sustainable energy supply and critical raw materials. Eco-innovations can offer a competitive edge over industries that still rely on inefficient methods of production, supply and waste management.

Countries of the EU-28 had an energy dependence of 54% (meaning that over one half of its energy needs had to be met by imports) in 2016. Furthermore, a high proportion of said imports, of which about two thirds were represented by petroleum products, gas (24%) and solid fuels (9%), are still concentrated amongst very few exporting partners [6]. The majority of energy imports were provided by Russia, with which the EU has been engaged in an unproductive diplomatic showdown in recent year, exacerbating the associated risks even further.

Eco-innovations that demonstrate very low requirements for critical raw materials, notably reduce the need for energy supply and use of chemicals and even demonstrate a clear economic benefit to the final beneficiary are clearly the way forward. The innovative waste-water system developed by dedicated experts at the Brno University of Technology is just one excellent example of how to address the challenges ahead pragmatically.

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