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Towards a sustainable bioeconomy

Professor Dr Toine Smits and Swinda Pfau are investigating the socioeconomic processes of sustainable resource use on the border between Germany and The Netherlands. Here, they discuss their research into the possibility of transitioning from a fossil fuel-based economy to a sustainable bioeconomy



Could you provide a brief introduction of the Decentralised Energy Landscapes Niederlande-Deutschland (DELaND) project, focusing on its core objectives and the reason for its inception?

The DELaND project addresses the potential of biogas production from residual biomass. Recently, there has been increasing interest in the use of residual biomass streams and other alternative resources to replace cultivated biomass, such as corn, in the production of biogas. In our project, we have analysed the technical and organisational feasibility of these applications in both urban and rural landscapes. We paid special attention to the sustainability of current and future biogas solutions and the possibilities of contributing to a sustainable bioeconomy. Furthermore, DELaND will also have strong practical implications, providing specific guidelines to integrate residual biomass use in both Dutch and German spatial planning and institutional arenas.

What environmental, technical and economic issues have been made apparent during your research? How have you sought to overcome them?

The bioeconomy is often assumed to provide a great contribution to sustainability. However, our research has shown that many conditions

have to be met to ensure the sustainable use of biomass. In our research, we provide an overview of these conditions – which have been discussed in scientific literature – based on the experience of practitioners. We identified several barriers, especially regarding the transition towards a sustainable bioeconomy. For instance, on a policy level there is a strong focus on the production of renewable energy while alternative applications are sparsely promoted.

Furthermore, in both policy and research we discovered a great focus on possible outputs and products. However, if biomass is to address global challenges to its full potential, the focus has to shift from specific products, such as electrical energy, to evaluating the most efficient and sustainable applications for the different types of biomass. At the moment, subsidy regulations promote inefficient use of biomass instead of stimulating innovation and synergies between multiple applications.

Could you highlight some of the institutional and procedural issues that you are taking into consideration?

Both public and private organisations are interested in putting their residual biomass to better use, while trade, logistics and processing are mostly executed by private organisations. Therefore, a fruitful collaboration between public and private stakeholders is essential – and this has been a central element of our research within DELaND. Furthermore, we are evaluating possibilities of improving market structures for biomass and bio-based products. For example, we are weighing the advantages and disadvantages of long-term contracts

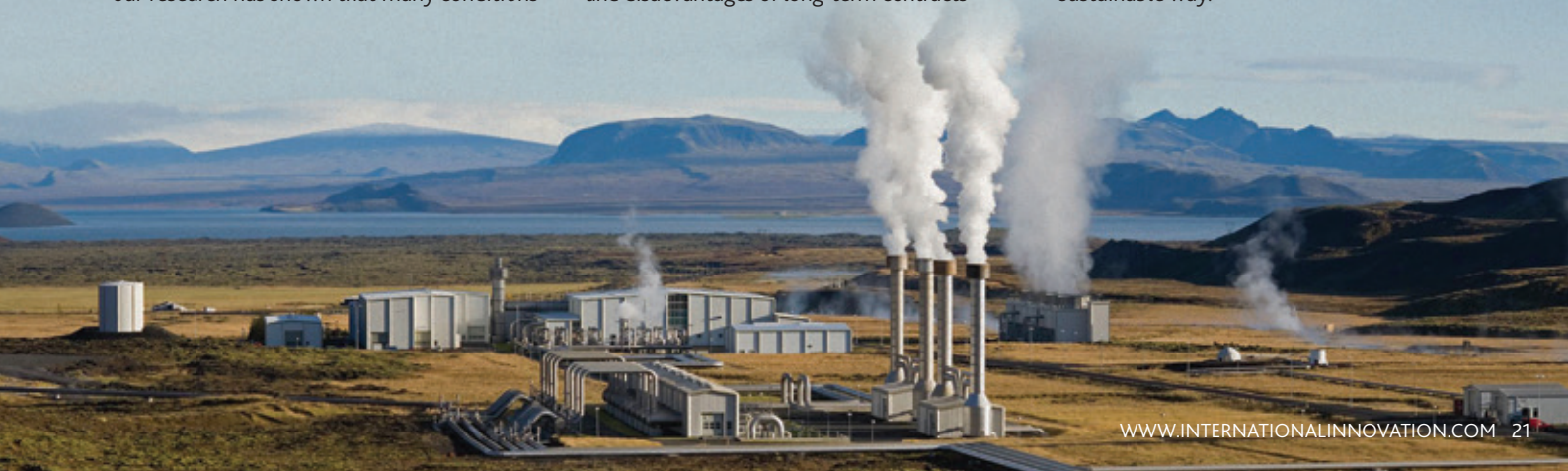
versus an auctioning system for biomass supplies. Finally, one of the central issues regarding biomass use and the bioeconomy is the level of decentralisation. Decentralised solutions can offer many advantages, and we are examining the possibility of collecting and processing biomass on a regional scale. Important issues in this context include logistics, regulations and questions of ownership.

Are you encouraging members of the public to assist in the project?

In DELaND, the input of stakeholders is highly appreciated. Through implementing regional discussion groups and stakeholder interviews, we not only gathered valuable information about current practice but also provided input and feedback to various activities in the border region between Germany and The Netherlands. Furthermore, in the context of DELaND, various informative workshops, presentations and excursions have been organised.

Looking forward, what will be the trajectory of your research?

The focus of our upcoming projects will centre on the application of insights and the practical feasibility of residual biomass applications. We will seek to implement our findings in European projects that make use of pilots and evaluate the success of applying new concepts in practice. We will therefore concentrate on organisational structures and sustainability issues. It is our goal to contribute to a transition that moves away from a fossil-based economy and towards a circular economy where biomass is used in a sustainable way.





Visions of sustainability

A research project coordinated by scientists based at the Institute of Science, Innovation and Society at **Radboud University**, The Netherlands, is investigating the advantages and challenges associated with using biomass as a clean energy source

IN A WORLD with a rapidly expanding population, the demand for energy is constantly increasing. At present, humanity largely relies on diminishing supplies of fossil fuels to fulfil these demands; however, fossil fuels majorly contribute to the emission of carbon dioxide into the atmosphere and, as non-renewable supplies, they will one day run out. In an effort to limit the use of polluting fossil fuels, a large body of research has started to form that concentrates on exploring alternative sources of energy. This includes a renewed focus on energy derived from biomass.

As biological material mainly derived from plant and animal waste, biomass is carbon-based and humans have used it as an energy source for many thousands of years; for instance, ancient humans would have cooked on and warmed themselves around wood fires – a practice that is still in place today, especially in rural areas of developing countries. Of course, since the Industrial Revolution began in the 18th Century, many of these biomass applications have gradually been replaced with fossil fuel resources, which have proved much faster and more efficient. Yet the urgent need for clean, reliable and diverse energy sources has led scientists to rediscover and re-evaluate the use of energy

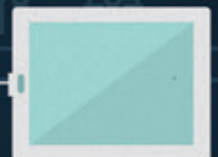
derived from biomass. Indeed, the potential of biomass to solve various global challenges has opened up a rigorous and lively debate within the scientific community.

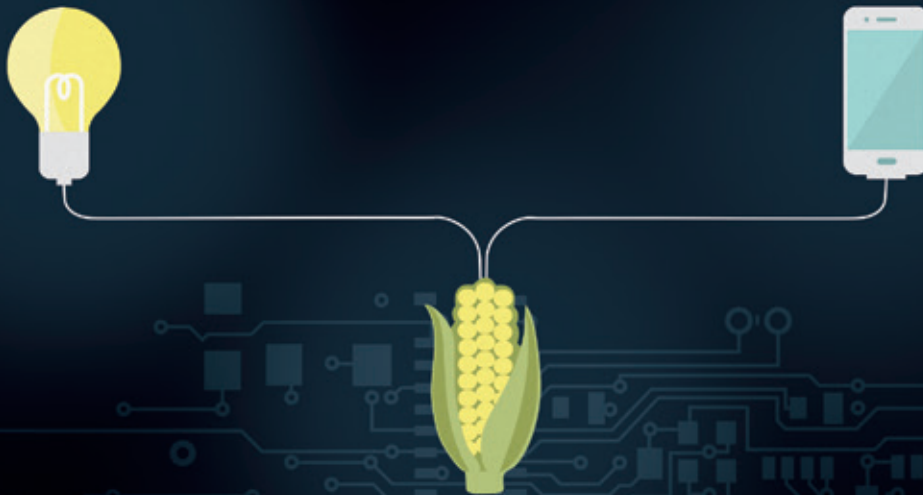
Interestingly, scientific opinion regarding the implementation of a bioeconomy – that is, an economy in which biomass resources replace most fossil fuels – is mixed, with some researchers extolling its intrinsic benefits and others warning against its negative impact on the environment. For example, a 2014 paper authored by Swinda Pfau from the Institute of Science, Innovation and Society at Radboud University flagged up a number of different attitudes towards the sustainability of a bioeconomy, ranging from the perception of sustainability as an inherent characteristic to the perception that a bioeconomy is essentially unsustainable. The paper found that most of the literature corroborated that a bioeconomy would bring a certain degree of sustainability, provided that certain conditions were met. Indeed, Pfau and her collaborators identified several motivating factors for the development of a robust bioeconomy, including the need to reduce dependence on fossil fuels and greenhouse gas emissions, the need for a secure supply of energy and commodities, and the prospect of rural economic development.

A PIONEERING PROJECT

One key project that is exploring the sustainable use of biomass energy is the Decentralised Energy Landscapes Niederlande-Deutschland (DELaND). Coordinated by Dr Toine Smits, Director of the Institute of Science, Innovation and Society, this timely and ambitious project addresses the potential of biogas production from residual biomass and is focusing on the socioeconomic processes of energy transformation in a trans-boundary setting – in this case, between The Netherlands and Germany.

DELaND was born from the 'Green Gas Project', a wider initiative pioneered by researchers from Germany and The Netherlands in 2012. This project branched into 16 subprojects – comprising various social, technological and economic considerations – including DELaND. In an attempt to avoid the food versus fuel debate – that is, the tension between using biomass resources for the production of food or biofuels – the project investigated potential opportunities for using residual biomass for energy in the border zone between the two countries. Residual biomass is essentially a range of biomass materials that are produced as by-products, residue or waste from some





INTELLIGENCE

DELaND

OBJECTIVES

The DELaND project addresses the potential of biogas production from residual biomass in the border region between Germany and The Netherlands. The technical and organisational feasibility of applications of residual biomass in both urban and rural landscapes are analysed, providing specific guidelines to integrate residual biomass use in Dutch and German spatial planning and institutional arenas.

PARTNERS

Lead partner: **Institute for Science, Innovation and Society**, Radboud University Nijmegen, The Netherlands

Project partners: **Chamber of Agriculture Lower Saxony**, Germany • **COAST – Centre for Environment and Sustainability at Carl von Ossietzky University Oldenburg**, Germany • **Department of Spatial Planning & Environment at University of Groningen**, The Netherlands • **Municipality of Nijmegen**, The Netherlands • **Province of Drenthe**, The Netherlands

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PROFESSOR DR TOINE SMITS is Director of the Institute for Science, Innovation and Society at Radboud University Nijmegen, The Netherlands. He is involved in various European climate adaptation and mitigation studies and project coordinator of the Decentralised Energy Landscapes Niederlande-Deutschland (DELaND) project, which focuses on the socioeconomic processes of energy transformation in a transboundary setting.

SWINDA PFAU studied Environmental Sciences and works as a junior researcher at the Institute for Science, Innovation and Society at Radboud University Nijmegen. Her interdisciplinary research focuses on sustainable use of biomass and the transition towards a sustainable bioeconomy.

other process. Many of these by-products have energy content that can be exploited, with the added bonus that this can reduce landfill or incineration.

In the context of the DELaND project, the researchers analysed and evaluated the relative benefits and drawbacks of using residual biomass as a clean energy source. They found that the expected transition to a bioeconomy results in a competition for biomass resources for different applications – and that advanced applications of biomass tend to be underdeveloped. "Modern technology enables various improved and new applications that help us to develop a so-called bioeconomy, where fossil resources are replaced by biomass as input material," Pfau discloses. "However, biomass resources and land area to cultivate biomass are limited, which makes it essential to use resources efficiently and sustainably." The researchers identified the use of residual biomass as a positive development in the border region between Germany and The Netherlands, contributing to greener energy and greater sustainability.

STRONG SOCIETAL IMPACTS

One of the most important implications of the DELaND project is the strong impact it has on society: "Our research helps to provide a focus for practical applications of residual biomass, triggering further research into its sustainable use," Smits points out. "Indeed, if biomass is going to be a viable solution for responding to global challenges, the efficiency of each application that addresses

these solutions must be considered." This moves beyond current practice, where the added value of residual biomass is measured by examining the potential income from subsidies or calculating the avoided costs from disposing of the biomass in other ways. Indeed, although policy makers often maintain that the implementation of a bioeconomy would solve contemporary problems regarding fossil fuels, the factors that contribute to its efficiency have not been fully evaluated. The research Smits and Pfau have conducted addresses this knowledge gap by identifying the opportunities and constraints that surround the use of biomass in a decentralised setting.

DRIVING PROGRESSION

Although biomass is a promising resource for a wide variety of applications, the results of DELaND indicate that not all aspects of a bioeconomy are inherently sustainable. Indeed, in regard to residual biomass, it is crucial to evaluate the efficiency of the different applications and implement robust logistical strategies that minimise negative environmental impact. Ultimately, however, the team advocate the concept of biogas production as a stepping-stone towards the implementation of a sustainable bioeconomy: "Synergies with other renewable energies, waste processing and innovative production processes in various sectors should be at the centre of future research," Smits affirms. "In the future, biogas may be a by-product of various processes, but it should not be the only goal of biomass applications."

