Energy@WUR

From Molecules to Landscapes

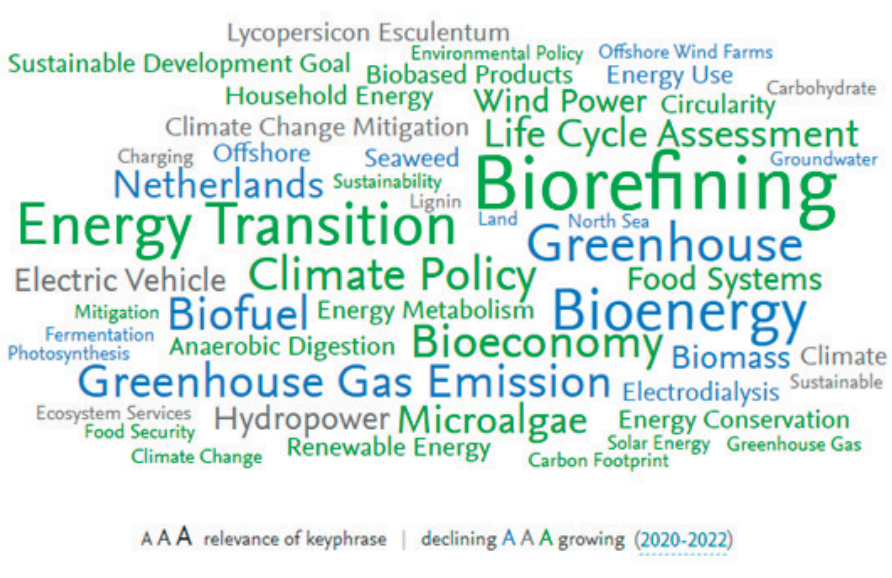

Figure 1: Keyphrase analysis energy-related research @WUR between 2020 and 2023.

WAGENINGEN
UNIVERSITY & RESEARCH

The impacts of the global climate crisis are becoming increasingly tangible and will have an even greater effect in the future. That's why researchers in the Netherlands and worldwide are gathering knowledge to accelerate the energy transition. At Wageningen University & Research (WUR), this knowledge originates from various fields and a growing number of people are involved in this endeavour. This document contains the rationale and describes the unique approach, expertise, collaboration and impact of energy-related research & education at WUR.

To bundle all insights as effectively as possible and to reinforce each other, researchers established the Wageningen Energy Alliance in 2017. Since 2023, WUR is a full member of the Netherlands Energy Research Alliance (NERA) and also involved in European and international energy platforms.
It has always been part of the DNA of WUR to contribute to large-scale challenges, such as the energy transition. Researchers are aware that countless facets of the world around us are directly or indirectly linked to the energy transition. In addition to energy saving, we need to switch to alternative energy sources instead of the fossil energy we were accustomed to. WUR researchers contribute to this with multi-, inter- and transdisciplinary research and innovation.

Societal challenge

WUR recognizes that the energy transition is a broad societal challenge. The world around us moves, reacts, accelerates and sometimes slows down the transition. That's why researchers of WUR map out the interactions between land, air, and water, and – to ensure a just transition – the interactions between people and institutions.
Researchers for example delve into the changes in the food system triggered by the energy transition. Can agriculture best generate sustainable energy with biomass or biogas, or by installing multifunctional solar parks, and how to integrate local production, storage and use despite net-congestion? What implications do these changes have for farmers and policymakers? And how do farmers, transporters, food processors, retailers, and consumers transition to a more circular, sustainable food system? With these and more questions WUR scientists investigate the energy transition in the context of food and climate (see figure 1).
The energy transition presents different challenges in urban areas too. What policy innovations in cities are required to accelerate the insulation and greening of existing building stock, and to generate urban energy? Such questions are also about smart adaptation of energy infrastructures to fluctuations in supply and demand. And what is the role of citizens and collectives in such initiatives? A glance at the sea makes it clear that wind turbines are dramatically altering the scenery. A question here is what large-scale wind farms do to biodiversity and other - human - activities at sea.

Worldwide impact

Until a decade ago, WUR's research on the link between energy and the larger environment was seen as a growing scientific niche. Today, this way of acquiring knowledge and contextualizing has become mainstream, and WUR contributes to this worldwide through the involvement of its students, researchers, and alumni. Think of research into the design of multifunctional solar power plants or energy-efficient horticulture in Africa, Asia and North-America. WUR research also concerns the role of governments and governance, which may help accelerating a just energy transition in synergy with other SDGs and topics such as poverty eradication and inequality. Thinking big leads to significant impact on the world around us (e.g. scientific advice to the Dutch government and the European Parliament).

Expertise from molecules to landscapes

WUR scientists are working at all scales of the energy transition. To develop new and sustainable energy conversion technologies, such as the production of green hydrogen, fundamental chemical and physical research is needed: at the molecular level. Meanwhile, researchers are also exploring the technical and financial possibilities of hydrogen energy generation and use in agriculture, in industry, or at sea: at the level of people, institutions and landscapes (see figure 2).

Taking into account different scales and sectors requires bringing together knowledge and (big) data from multiple disciplines. In many WUR projects, this knowledge converges by adopting a nexus approach, wherein the interconnection between the food system, the water system, and the energy system is central (see figure 3). The nexus approach ensures that the impacts of new knowledge and applications are considered in the broadest possible context. This is necessary to prevent progress in one area from leading to deterioration in another. The nexus approach thus aids in seeking a new balance both between and within these indispensable systems.

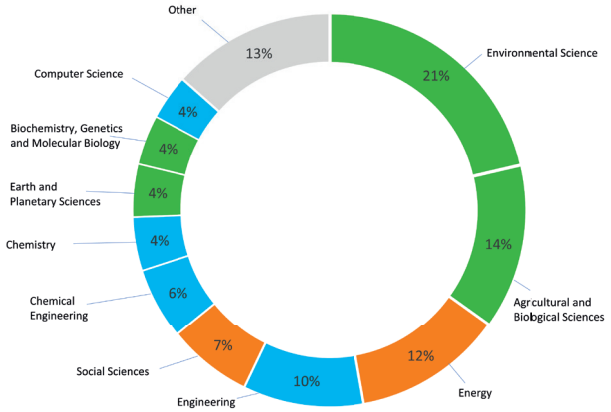

Figure 2: Overview of subject areas of publications on energy-related research at WUR between 2020 and 2023. Subject areas are derived from the Scopus classification system.

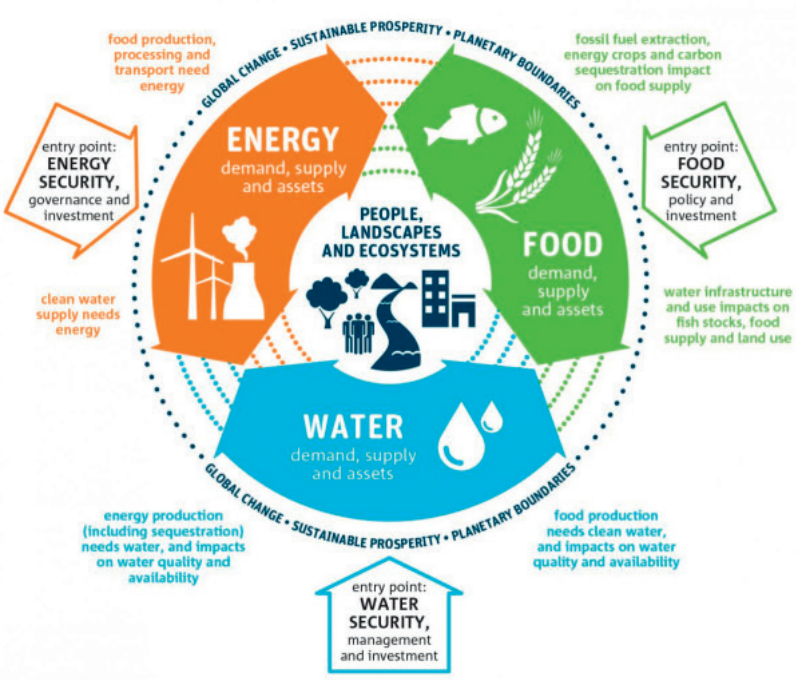

Figure 3: The food-energy-water nexus, with some of the links between each feature identified and explained. Source: IWA, 2018. Sustainable Development: The Water-Energy-Food Nexus

Finding energy together

To generate knowledge on such complex topics related to the energy transition, collaboration is more critical than ever. Researchers of WUR collaborate with a diverse range of organisations with complementary expertise on innovation, in the Netherlands and the rest of the world (see e.g. figure 4). These could be other universities, as well as ministries, provinces, municipalities, NGOs, and businesses. About 84% of all scientific publications from WUR are co-authored by experts from other institutions. WUR is part

Figure 4: Visit with partners to the WUR agrivoltaics test installation in Randwijk/Gelderland (image by Sven Stremke).

Figure 5: Master students and PhD researcher conducting biodiversity research at the Solar Power Plant Hardenberg (image by Timea Kocsis).

of national and international consortia, such as EERA Bioenergy, National Consortium Zon in Landschap, the Wageningen Solar Research Programme, and co-creates shared research facilities, such as 'Switch' to test in practice how to integrate renewable energy in the electricity grid. Scientific integrity and responsibility are central in WUR's research and partnerships.

Education for energy transition

Energy scholars at WUR introduce students to their research area through teaching (see e.g. figure 5). The nexus approach thus also underpins much of WUR's education, equipping students within their respective disciplines to tackle the challenges of the energy transition. In the next decades, there will be a growing demand for professionals adept at navigating the interconnected realms of the food, water, and energy transition. WUR's emphasis on this integrated approach ensures that Bachelor, Master and PhD students are well-prepared to innovate and lead in addressing these complex and interrelated issues.

Practice what we preach

WUR sets high standards in energy research and education, and it also maintains them for advancing the energy transition on its own campus and at 23 locations across the Netherlands. The Application Centre for Renewable Resources (ACRRES) in Lelystad, for example, is entirely focused on the application of green resources (such as solar, wind, and biomass) to generate sustainable energy. The aim is to close circles and use residual streams as profitably as possible for and by farmers.

For the energy supply on the campus itself, WUR naturally takes significant steps towards a more sustainable future. In 2021, an ATES-loop (Aquifer Thermal Energy Storage) for seasonal storage of warm and cold water was installed on the campus to provide sustainable heat and cold to the buildings. With these and many other measures, WUR is well on track to be CO_2-neutral by 2050 and achieve a total energy reduction of 72% compared to 2005. According to the UI GreenMetric World University Ranking, in which 1,183 universities participated in 2023, WUR has been ranked the most sustainable university on the planet for the seventh consecutive time.

Colophon:
Ideas developed with input from the Energy Alliance.
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