Energizing The Life Sciences at WUR

WUR Energy Alliance working paper

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Energizing the Life Sciences at WUR

This document presents the state of the art of energy research and education at Wageningen University & Research and outlines our ambitions to contribute to the energy transition. The working paper was written by the **WUR Energy Alliance** – a recently established network of researchers from all Science Groups at Wageningen University & Research. The WUR Energy Alliance currently consists of 50+ researchers with proven track record and genuine interest in excellent research and education on energy-related issues within the broader WUR domain. The material is derived from the study of WUR energy research projects and a series of meetings with Wageningen University & Research staff.

The COP21 Paris Agreement is clear on the need for sustainable low-carbon energy solutions to mitigate climate change. Energy is also core to the Sustainable Development Agenda, Goal 7: Ensure access to affordable, reliable, sustainable and modern energy for all. The transition to renewable energy sources will provide new jobs and opportunities in the green economy of the EU. This is reflected, among others, in several sustainable energy programmes of Horizon 2020 and other international research programmes.

In the Netherlands, as in other parts of Europe, many initiatives are being set up to stimulate and accelerate the transition to a low carbon future. The energy transition encompasses the switch from fossil fuel-based systems towards systems based on renewable and bio-based sources. First implications of this transition for research and development appear in the research agendas of NWO, NERA (Netherlands Energy Research Alliance) and the Energy Top sector. Several 'routes' in the Portfolio for research and innovation of the Dutch National Research Agenda (Nationale Wetenschapsagenda) are related to energy, climate and sustainability. Wageningen researchers are currently advising several working groups both for the 2018 National Climate Agreement as well as for the Gelderse Energy Agreement (province of Gelderland).

Although Wageningen University & Research participates in national and international research and development related to the energy transition, the Wageningen-profile with relation to energy is not yet clearly defined. Energy-related research is conducted in various science groups, both within the University and within research institutes. The required and emerging shifts in energy generation and consumption present additional opportunities for the life sciences that WUR excels in. Examples include the transition from fossil to renewable energy sources, from central to distributed energy provision, and from large energy utilities to complex networks of energy co-providers and prosumers.

In this document, the WUR Energy Alliance highlights opportunities to consolidate and further develop (inter)national energy research at Wageningen University and the associated research community. This is underpinned by an inventory of contemporary WUR energy research projects, educational and staff expertise. With this document, the WUR Energy Alliance aims to communicate with the larger WUR community as well as with public and private energy actors and research funding agencies, about what Wageningen energy research can offer in terms of innovation, analysis, design, planning and governance for the transition.

In the following sections we will discuss the energy research niche for WUR, introduce key research partners and explore the opportunities for future energy research and education at WUR.

Figure 1: Wind turbines of WUR in Flevoland, The Netherlands (photographer: Andrea Terbijhe).

WUR energy research niche and main themes

WUR occupies a specific niche when it comes to energy research, related to its core areas living environment, health, lifestyle and livelihood, food and food production. This focus sets WUR apart from the other Technical Universities in the Netherlands, which focus on the electrical, building and civil engineering of energy production and distribution.

Energy research at WUR can be characterised by its purposeful embedding in wider social-economic, spatial and ecological contexts. While energy extraction, production and consumption are often studied in isolation, they are deeply connected to other major environmentally relevant anthropogenic and natural systems of production and consumption, in particular those of water and food. At WUR, research on the water, energy and food nexus is blooming because of its typical multi-disciplinary research. The nexus perspective emphasises the strong material and social interdependencies between energy, food and water systems in society. Nexus-based research in Wageningen entails for instance the research on circularity of flows and services in metropolitan contexts, on innovative technological systems in which energy and nutrient content of water flows are being recovered for heat, electricity and food production, or on the relations between resilience and access to water, energy and food in urban settlements.

Notwithstanding the embeddedness of WUR energy research in wider systems and disciplines, a further categorization of WUR energy research and associated opportunities results in the following three main themes: spatial energy research, technological energy innovation, and governance for energy transition.

Spatial energy research

The environment (in the largest sense) is the source of renewable energy, host of energy technologies as well as energy infrastructure and affected by the adverse effects of energy production and consumption. It is the environment - land and water, urban and rural landscapes - where the degree of sustainability of the ongoing energy transition will be decided upon. Wageningen University & Research covers a wide range of energy research with a spatial dimension, from dedicated energy crops and biodiversity effects of renewable energy to the conscious creation of sustainable energy landscapes. The effects of wind turbines on landscape perception and local biodiversity, for example, are well-established WUR research themes. But energy also links up rural with urban areas, both economically and literally through energy infrastructure such as high-voltage power lines. It is therefore key to ensuring the quality of life in both the urban and rural living environments. The WUR-expertise on envisioning, implementing and monitoring alternative futures is of critical value to safeguard the transition to sustainable, secure and affordable energy. The focus on (long-term) change is a common denominator of spatial energy research at WUR. The spatial dimension of energy, largely disregarded in the fossil fuel energy system, is gaining much attention while we embark on a sustainable energy transition (see e.g. National Perspective Energy and Space, project commissioned by the (then) Ministry of Environment and Infrastructure, 2017).

Figure 2: Solar park Laarberg (Groenlo, The Netherlands) designed for multifunctional land use and preservation of existing trees (photographer Dirk Oudes).

Technological energy innovation

There is a large societal need for innovations beyond the fossil energy based technologies of the past. Renewable electricity is becoming the new primary energy source in our world. Technological energy innovations are needed

which process, store and utilise renewable electricity and other available renewable sources. Since these sources come in intermittent flows and often require large surface areas, they must be converted throughout our society in most effective means. Various new conversions need to be developed. Wageningen energy research, traditionally, is well-geared to contribute to innovations in biomass conversion. Use of biomass for energy applications often requires pre-treatment of the biomass. Different forms of pre-treatment, via chemical, thermal and biological reactions, are under investigation. Over the past three decades, WUR has expanded its spectrum and invented new technologies while making use of (new) natural processes. Current technological energy research at Wageningen University & research focuses, amongst others, on: the conversion of electricity into various chemical energy carriers; waste & biomass conversions into fuels, heat or electricity; electrification of separation processes; creation of artificial leaves; effectuating photosynthesis; CO_2 capture and utilisation with e.g. algae and micro-organisms. The newly developed technologies are assessed and integrated in bio-refineries and circular systems at an urban, national and global scale. It is key to assess the impact of technological innovations on our society and environment to assure effective (re)use of widely available resources and understand the possible (negative) feedback loops on our climate.

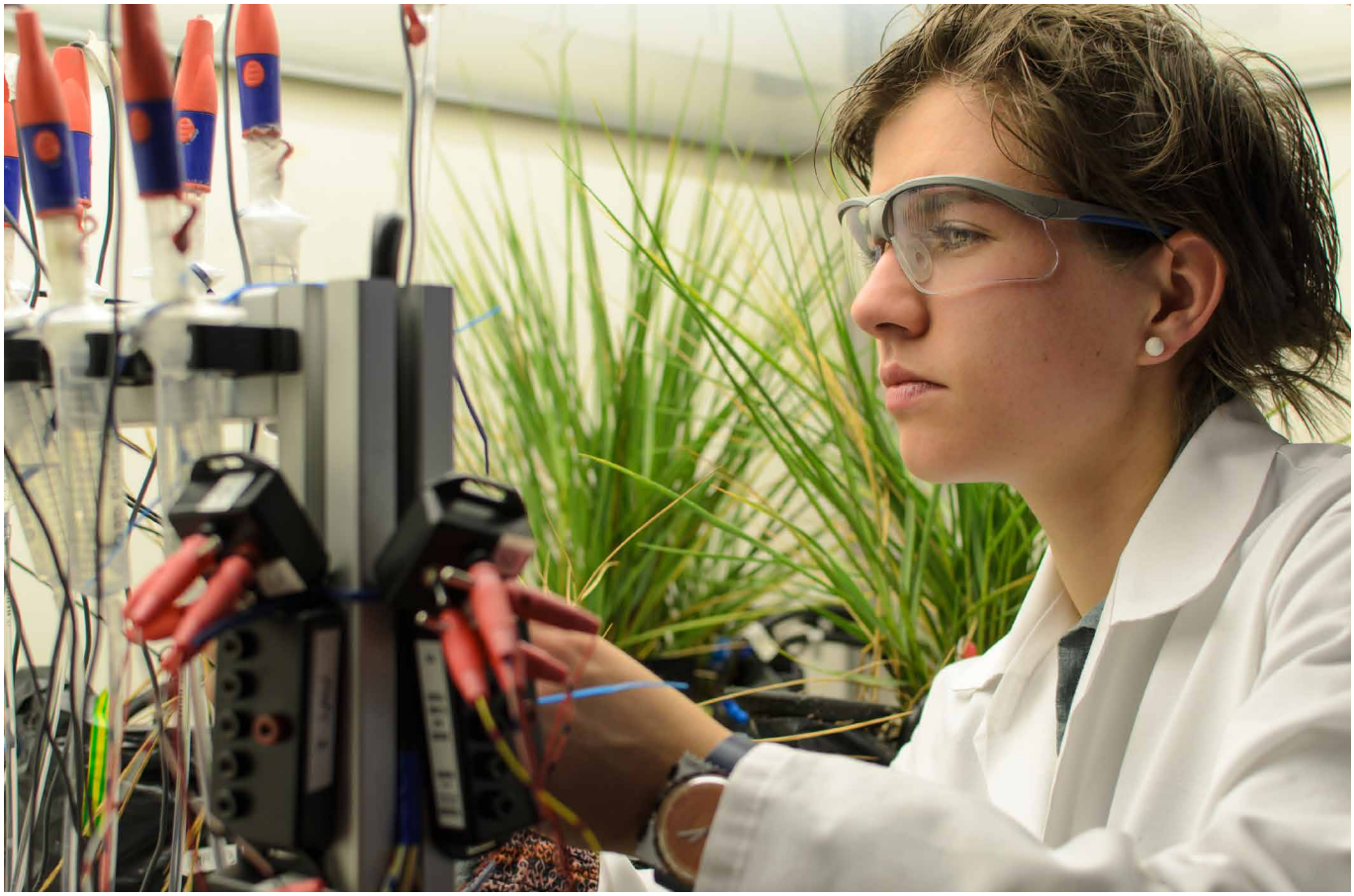

Figure 3: Researcher working on the recovery of electricity from living plants (photographer: Joris Schaap).

Governance for the energy transition

Energy systems are at the heart of modern societies. Therefore, the required energy transition involves major changes and disruptions in technologies, spatial planning, systems of production and consumption, roles of stakeholders, and everyday life. The questions, of how these aspects interrelate and what can be done to steer or govern them, present enormous challenges. There is also a multitude of different actors involved in the governance of energy transition. Apart from the 'usual suspects' such as governments, utilities and energy companies, increasingly other actors such as energy cooperatives, new intermediaries, NGOs and individual citizens take part in governing the energy transition through home-based or collective local and regional based energy production.

Governance for energy transition is therefore a topic in its own right as well as a cross-cutting issue, involving disciplines in the social sciences such as sociology, political sciences, and (urban and environmental) economics as well as systems analysis, technology and landscape architecture. Our research fields cover the multi-level governance of the energy transition, its democratic dilemmas, transport and production, communities of practice, the role of energy cooperatives, household energy practices and consumer behaviour. Objects of study are governance dilemmas around emissions trading, pilot projects of smart electricity grids and energy storage, the planning and participative design of on-shore and off-shore wind farms, and consumers and users of smart energy systems and buildings (i.e. European CO_2 emission Trading, CityZen projects, Energy Retrofit in Amsterdam).

Figure 4: Participants of the excursion to the renewable energy island Samsø in Denmark speaking with the director of the local energy academy Søeren Hermansen (Sven Stremke).

Collaborative and Transdisciplinary Energy Research

Apart from the multi-disciplinarity of energy research within Wageningen University & Research, most energy-related research is executed in close collaboration with national and international research agencies, energy companies, grid operators, ministries, local governments and civil society groups. The application of new knowledge via pilots, living labs and start-ups is common practice at WUR. Our partners involved in energy research are (selection only):

- AMS-institute, KWR, PBL, RIVM
- Alliander, Enexis, TenneT
- ECN-TNO, Deltares, Rijkswaterstaat
- Energy Cooperatives

- Waternet, Water Boards, Vitens
- Municipalities of Wageningen, Amsterdam and many others
- Metropolitan Region of Amsterdam, Parkstad Limburg region and others
- Ministries of I&W, EZK, Binnenlandse Zaken, LNV, OCW

Energy in Education

The Wageningen education ecosystem consists of a variety of on-campus BSc and MSc programmes, online diploma courses, professional education courses and a growing number of MOOCs. Although the number of courses with "energy" in their name is (presently) limited, energy is a major topic in many courses and programmes at Wageningen University, such as Environmental Sciences, Bio Systems Engineering, Urban Environmental Management, Climate Studies and Landscape Architecture and Planning, to name a few. The courses in which energy already plays a key role are e.g. related to urban planning and design, technology development, climate governance or sustainability transitions. Often, these courses feature input from experts across various science groups, providing interdisciplinary experiences for students who are increasingly keen to engage in energy-related topics for their studies and theses.

Notably, WUR is contributing to the Metropolitan Analysis Design and Engineering programme at the AMS-institute in Amsterdam, in which energy features prominently as one of the challenges to provide metropolitan solutions for sustainability. WUR energy research is represented in several recently developed MOOCs and Micro Masters: Sustainable Urban Development, Co-creating Sustainable Cities, Advanced Biorefinery and Circular Economy. Typical for the Wageningen education ecosystem is that many courses and programmes bring staff and disciplines from different science groups together. No matter what their own specific programmes and courses, our students encounter energy issues in all its social, economic, spatial and ecological aspects.

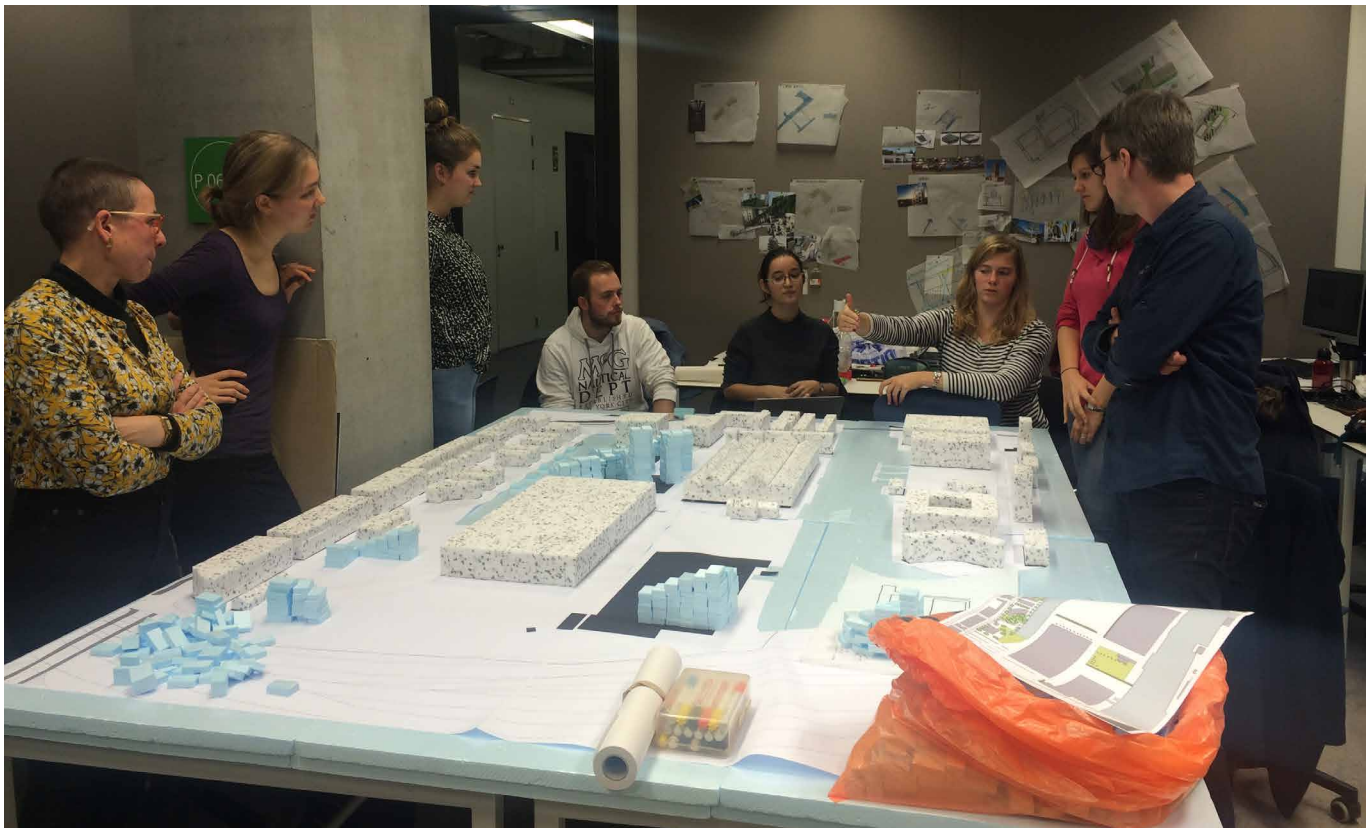

Figure 5: Students and teachers of the Climate-Responsive Planning and Design course at Wageningen University (photographer Sven Stremke).

Starting ambitions of the Energy Alliance

- Consolidate and extend the **network** within Wageningen University & Research (capitalize on 'One Wageningen' approach) by setting up a Wageningen Dialogue, Website, WUR intranet and regular meetings. Consolidate and expand linkages with other universities, research institutes, government, private sector and civil society as key network for energy research related to the life sciences, e.g. with NERA, Topsector, NVDE, etc.
- Increase **visibility** of energy research in Wageningen and to the outside world, focusing on the core strengths of WUR and the strategic programs of the involved science groups.
- Facilitate new **collaboration** and putting knowledge into practice with Wageningen Science Groups and Research Institutes as well as WU Facility Management by means of (large) grant proposals, publications and educational activities through regular general and specific meetings on relevant energy topics and around relevant projects/ calls.

Colophon

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Links
List WUR Energy Alliance members
List of energy-related projects
List of energy-related courses