

# **Innovative energy education in the Netherlands**

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## **ABSTRACT**

This paper describes innovation in existing and future Master's degree education in renewable energy at the Hanze University of Applied Sciences Groningen (Hanze UAS). Inter-relationships between research and industry are significant within this education. Clearly illustrated by development of the Energy Transition Centre (EnTranCe), this facility at Hanze UAS uses open innovation to accelerate the application and functionality of technology. Enabling consumers to become producers (prosumers) is central to the approach to energy transition in Groningen.

The city is located next to the largest natural gas field in Europe. As the fuel most suited to balancing the intermittent character of renewable energy sources, it is central to the technical approach at Hanze UAS. With the coming of the Energy Academy Europe and inclusion of Hanze UAS within the European Renewable Energy Research Centres Agency, Groningen is an international partner in education and perfectly positioned to innovatively assist energy transition.

## **INTRODUCTION**

Education in energy at Hanze UAS is a direct response to the need for professionals able to facilitate sustainable (energy) transition in Europe. The particular need is quantitative, in terms of human capital, and qualitative. Within Europe, there is a shortfall in available labour educated with the appropriate skills and knowledge needed to successfully operate within the evolving energy market. Sustainable transition in this context aims to meet the European goals of the 20:20:20 policy whilst also stimulating socio-economic transformations that will benefit individual citizens, local communities, regions and the environment.

## **APPROACH**

The individual citizen and local community are recognized as key initiators within the process of energy transition and in the majority of situations require professional assistance and empowerment to undertake the necessary changes in the way they utilize and interact with the energy system. The term "People in Power" is used by Hanze UAS and its energy research and business partners to express the philosophy underpinning this approach. People can

become so-called “prosumers” (producing consumers) rather than merely consumers of energy. This is a consequence of decentralized energy production and the emergence of the decentralized, balancing “smart (energy) grid”.

“People in Power” is an innovative socio-economic approach to energy rooted within the development of technological functionality. Over the past seven years, this has become one of the fundamental principals within all of the energy research and educational programs developed within the Centre of Applied Research and Innovation – Energy (CARI-E) at Hanze UAS [1]. The centre is a broker in and translator of expertise in the field of energy and, whilst offering education and training, it carries out energy projects for businesses. The centre seeks to close gaps in applied knowledge in the field of energy within different arenas, e.g. technology, economics, sociology, environmental engineering and business studies. In addition, the centre aims to contribute to the innovative power of the business community in the north of the Netherlands and to stimulate smart and sustainable energy consumption.

Due to its extensive network CARI-E has contacts throughout the energy sector and in other research institutes. The CARI-E uses this access to the source of knowledge to initiate study programs and training courses in the field of energy, infrastructure and management. In addition the centre carries out research and projects for (multinational) companies, but also for small and medium-sized enterprises.

## **RESEARCH**

Increasing the flexibility within energy systems at all scales of interpretation, local (micro), regional (meso) and international (macro), is essential to enabling energy transition. The intermittent nature of the primary renewable sources of energy, wind and solar power, require balancing and integration with systems experiencing increases and massive fluctuations in demand. An important precondition for the feasibility of developments in renewable energy supply is that they can be optimally integrated into the existing infrastructure, namely a gas infrastructure, an electricity infrastructure or an infrastructure for transporting heat where the different scales (micro, meso and macro) are identified.

The “Flexi-” group of research programs at CARI-E, developed in partnership with the research and development laboratory RenQi [2], are designed to meet these specific needs in various specific ways.

They are:

*Flexines.* This project was one of the first research and development programs at EnTranCe, developed an energy management system for households. This integrates different appliances (e.g. using controllable resources, a dishwasher, a fridge), photovoltaic cells on the rooftop and a natural gas fuelled micro-CHP system. It works on the basis that energy tariff differentiation is the dominant factor of purchase in a liberalized setting with producer-consumers and several energy service providers and predictable pricing.

*Flexigas.* This project develops applications for introducing flexibility in biogas grids (i.e. a smart biogas grid) with possibilities to upgrade the biogas to so-called ‘green gas’ quality or the development of a wide range burner at the end of the gas chain.

*Flexiheat.* Flexiheat develops applications for a local heat infrastructure (an exchange of heat and use of geothermal applications).

*Flexistore.* Flexistore is a running project targeted for application development of flexible storage at the interface between micro and macro levels.

*I-balance.* Supported by the Dutch government, this project is the most recent project; it continues the research and development of the Flexines program and includes new devices for local electricity production, such as natural gas based solid oxide fuel cells (SOFC), several of which have been set up as demonstrator in EnTranCe. It also develops appliances including intelligence for local balancing of the (predictable and non-predictable) intermittent character of the renewables.

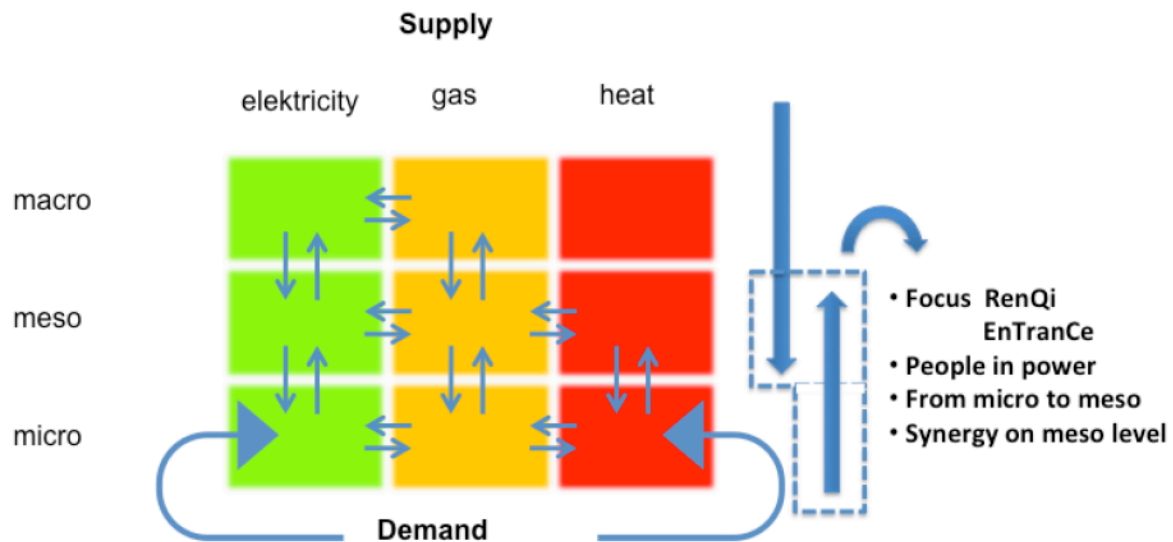


Figure 1. Flexibility at boundaries in infrastructures and the RenQi and EnTranCe research programs

## LOCATION

Groningen is the historical capital of the North of the Netherlands and remains the largest city and educational centre of the region. The city's and the region's association with energy are a combination of history, geography and potential.

## Gas hub

The exploitation of immense natural gas reserves at Slochteren, Groningen has been of importance both for the Netherlands and internationally for more than 50 years. Considerable local expertise has developed during this time, particularly in the production, distribution and management of natural gas and more recently biogas technology. The north of the Netherlands is also the location of exploitable geothermal heat sources, proposed coastal and offshore wind farms and leading in the research and development of organic photovoltaic technology. Apart from potential developments in the widespread application of Hydrogen for the storage of electricity, natural gas is likely to be the most flexible, low emission, balancer of renewable energy power supplies in Northern Europe for the coming decades. This creates a significant role for the north of the Netherlands in steering national and international energy transition towards renewable sources.

## **Cluster**

The Energy Valley foundation [3], located in Groningen, is an important partner organisation with the mission to enable collaboration between companies, research institutes and government bodies. The objective behind this is development of joint projects that will make real progress towards clean, reliable and innovative energy. The foundation's geographical threshold is recognized as an energy region valued at 25 billion (Euros) in energy investments. Establishment of the Energy Academy Europe (EAE) in Groningen in 2012 as an active collaboration between all of the local higher educational establishments, research institutes and industry ensures a significant, combined, international role in facilitating energy transition. The EAE[4] is the logical development of a process that began with the exploitation of the Slochteren gas field and has since then seen unique combinations of research and educational establishments (the EAE's Energy College for vocational education, the Hanze UAS, the University of Groningen - RuG and the Energy Delta Institute – EDI, international energy business school), with local development and investment in technology, innovation and hardware. A steady influx of energy expertise into the region has arisen as a clear and tangible result of these circumstances.

## **Applied science**

The deliberate and progressive application of scientific innovation at CARI-E and partnership with RenQi has resulted in the establishment of EnTranCe (the Energy Transition Centre). Based on the philosophy of combining research, education and innovation in a business context within dynamic, work-based learning environments, EnTranCe [5] is a key facility with an approach to open (energy) innovation that is unique in Europe. It integrates research and development in sustainable energy technology with the education of students and professionals from diverse disciplines to enable them to become key facilitators in the new energy world. EnTranCe provides the possibility for employees of companies to collaborate, educate, learn and work in an inspiring environment. EnTranCe facilitates the generation and exchange of creative, innovative and entrepreneurial knowledge and activities and, although this is perhaps its least tangible quality, it is its most important contribution to regional and perhaps wider sustainable development. The companies involved at EnTranCe include (Koningklijke) BAM Groep BV, GasTerra, GasUnie, ImTech, KEMA and TNO among others.

## **EDUCATION**

The education at Hanze UAS is orientated towards the formation of a new type of professional to meet the needs of the European energy market and society. Facilitating transition to a sustainable and effective energy system is an essential response to the current concerns over climate change and security of (energy) supply. Providing enough manpower with the appropriate expertise to implement and facilitate energy transition remains the fundamental, underlying principal and philosophy behind the education already being provided and currently in development. Whilst there remains a need for technologically focused engineers able to plan, design and implement new installations, the need for energy professionals at management level is also a critical and relatively new development within the evolving scenario of energy transition.

Europe requires a new generation of energy professionals who are innovative, entrepreneurial and creative; able to deal with localized, regional and global challenges arising from the process of energy transition. Capable in communication, analysis and business development and planning, the new energy professional referred to here is therefore someone familiar with

the capacity, application and limitations of all sources of renewable energy. He or she is able to integrate them at organizational and local. From recent research of the student target group (for a European MSc in Renewable Energy Systems and Management) it quickly becomes apparent that the energy professional will be a strongly motivated, investigative and enthusiastic specialist with a strong grasp of the need for energy transition.

The field of work is growing and evolving, making the opportunity to discover new potential, markets and applications a significant part of the future professional's motivation. Consideration for societal and environmental issues and the importance of communication within the professional's role requires development of a multi-disciplinary approach to problem solving. The "triple helix" approach of research, business and (innovative) education is also a fundamental underlying principal and embodied, at Hanze UAS, by the integration of EnTranCe as a key facility within all programs.

### **Roadmap to Education**

In July (2013) Hanze UAS released its "Roadmap to Energy Education" to formally declare its commitment to the development of four programs at Master's level. The programs are all European in nature and structure, requiring students to spend at least 6 months in a foreign country to increase their awareness, openness and ability as leaders and team workers. The European Master of Science in Renewable Energy (in partnership with EUREC) is in its second year and provides a technological grounding in renewable energy [6]. The aim of the program is to train post-graduate students to fill the gap between the growing industry demand for specialized renewable energy expertise and the skills available in the job market. The core semester is organised to provide the students with sufficient technical background to follow any of the specialisation courses on offer, while also providing them with a good grounding in renewable energy technology. During the second semester the students move to Kassel University (Germany), or Northumbria University (UK), or Zaragoza University (Spain), or Université de Perpignan (France), or IST Lisbon (Portugal) or to the National Technical University of Athens (Greece), according to their choice of specialisation. In the third semester, they undertake a six-month project in a company or a research centre.

The European MSc in Renewable Energy Systems Management is in development with a number of European partner universities. The MSc in Energy and Society is just beginning similar development whilst development of the MSc in Energy Markets, Policies and Trading will shortly follow.

The Master's programs are all special because they provide the education, training and formation of professionals at the standard of a Master of Science course. The objectives are to educate innovative, creative entrepreneurs aware of issues and their inter-related nature. The new energy professionals will be trained to use systematic, scientific approaches (including modelling) to problem solving and also to communicate with the different kinds of stakeholders involved in energy transition.

The education is necessarily broad and uses targeted specialisation to ensure sufficient depth of knowledge in key areas. Real-life projects (in collaboration with businesses and governmental organisations) further enhances specialist skills and knowledge. Specifically focused tasks in multi-disciplinary, experimental environments (such as EnTranCe) grounds the students in their functional roles as problem solvers and facilitators. The collaborative public-private sector business environment within which they are trained is an essential innovation within all 4 Master's programs.

The current issues and problems facing energy transition are transnational and this remains a significant motivating factor in the development of the 4 Master's programs. Other kinds of transnational obstacles to collaboration must be overcome in the development of courses. For instance, the inconsistencies such as variations in the structuring of credit systems that exist between the universities of European nations. Despite the difficulties caused by this and other issues Hanze UAS remains committed to its approach because of the dynamism inherent to this kind of education.

## CONCLUSION

The Master's programs are by nature an innovative response to the need for sustainable development in Europe. They have emerged from an innovative environment peopled by expert researchers, teachers, businessmen and women who all wish to make a difference by facilitating energy transition. Whilst apparently of significant commercial risk, open innovation is known to accelerate and increase the productivity of research and development. This approach is consistent with the underlying philosophy "People in Power" and of undeniable benefit to the students wishing to study renewable energy at a Master of Science level. The development of the EnTranCe facility as a result of partnership between RenQi and Hanze UAS can be seen as a logical outcome of the circumstances particular to Groningen at this time of economic, social and environmental transition.

The establishment of the Energy Academy Europe in Groningen and the agreement of all educational, research and business partners to collaborate in the process of energy transition provide immense educational opportunities at all levels of higher education. The facilities, expertise, organisational structures, motivation and combined potential in Groningen have created opportunities for international co-operation and collaboration in the field of energy. Students coming to Groningen to study energy are therefore themselves fully involved within an innovative environment using cutting-edge technology to solve extremely relevant challenges and at the same time connected to a national industry based network and an international research and educational network. Groningen [7] is in a perfect position to innovatively assist energy transition not least by providing new energy professionals.

## REFERENCES

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