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EnTranCe to the Second life of Gas

EnTranCe as Source of Innovation and Human Resources

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Background

Europe has set itself the target of becoming the leading continent when it comes to innovation. At the same time, targets for CO2-emission and the contribution of renewable energy systems present a challenging environment for the energy sector.

In Europe the policies that are or shortly will be in place create a challenging environment for the energy industry. First, there is the aim to reduce emissions of CO2 by 40% in 2030 as compared to the 1990 level. The primary tool for this is the European Emission Trading System (ETS). The current price of CO2-allowances is however insufficient to initiate the innovations that are required for structural and market-driven changes in the energy system towards a low-carbon future.

Secondly, the subsequent Energy Packages have had a drastic impact on the shape of Europe's energy markets. While at first opening the markets up for new entrants, in the end it has also led to a consolidation in the industry to the level of energy companies. To ensure a level playing field for the newcomers, infrastructure and supply have been unbundled. This has fragmented the knowledge of and commitment to innovation in gas technology. The increased competition due to the open markets has furthermore put margins under pressure, in term putting stress on innovation budgets.

Thirdly, the basic structure of the energy markets is beginning to change. The philosophy of the past, based on energy as a utility, required a top-down structure. This clashes hard with the notion of the prosumer, a customer that at one time may be old-fashioned consumer yet at other times acts as a producer. To redefine their position towards such customers, energy companies will have to come up with innovative new business concepts.

Finally, the impact of global and local developments puts the role of natural gas as transition fuel under pressure. Amongst these the conflict in Ukraine, shale gas in the United States and its perceived environmental impact as well as the local effects of conventional gas production (earthquakes) are currently the most prominent. To respond to these and similar challenges, non-technical innovations have to be developed in a predominantly technical sector.

The effect of the above is an increasing complexity of the energy landscape. To respond, innovation is key. With the wide-spread notion that renewable energy systems are inextricably electrical in nature, this holds even stronger for the gas sector. With this in mind GasTerra has allied together with Hanze University of Applied Science (HUAS) and a number of other companies to set up an environment where we illustrate that the Energy Transition and the pivotal role of gas therein may become a driver for Innovation in Europe. This is the Energy Transition Centre, or EnTranCe for short.

Aim

To face the challenges of tomorrows energy market innovative gas applications have to be developed that reconfirm the role of natural gas as the transition fuel to a low-carbon society. The speed at which these are developed has to increase, and in the current market co-creation is a pre-requisite. Therefore, open innovation is key. For such innovations professionals are needed that are capable of working together in multi-disciplinary teams. These professionals are trained at EnTranCe, learning and working together on these innovations in a Living Lab, at the same time shaping the innovations. The open innovation leads to new business, creating new opportunities for Small and Medium Enterprises.

Methods

EnTranCe plays a key role with approach to energy innovation that is unique in Europe - based on the philosophy of combining research, education and innovation in a business context in a dynamic, work-based learning environment. An essential element is the notion of open innovation. Here, companies work together in the belief that by each sharing their specific knowledge with the other project partners, they will be able to create more successful innovations. So, each brings specific pieces of knowledge to a project. These pieces may be viewed as modules, and important innovations are those that link such modules together to new applications.

This concept of open innovation as bringing together modules in varying constellations is reflected in the set-up of EnTranCe as a facility, as can be seen in figure 1. On the back-bone of a multi-fuel infrastructure boxes are added that may contain specific technologies, combinations of technologies, or possibly non-technological elements such as new market structures. The interesting part of the set-up is that it does enables partners to limit the

access to their technology. Although somewhat at odds with the notion of open innovation, in practice it will lower the hurdle for some to become a partner to EnTranCe.

Figure 1. EnTranCe at a conceptual level

The research at EnTranCe focusses strongly on the system function of natural gas as expression of the interplay between the various future elements in the energy landscape. Where other industrial and scientific research focusses on other key technological developments, EnTranCe builds on the strength of the region, where gas research has taken a important position over the last decades. From this, it is logical to focus on the pivotal role that natural gas can (and should) play in an increasingly low-carbon system. With increasing de-central electricity production, the entire lay-out of the energy system is changing. At EnTranCe we that this provides a huge opportunity for natural gas, in several ways. In any of these, it is the flexibility of the natural gas system that enables balancing from the bottom up, rather than the current prevailing top-down approach.

While this provides a clear change for the gas industry, at first it does pose serious challenges. Substantial innovations are required, whereas the transition of the industry from large all-round integrated companies to unbundles and specialized firms has forced them to scale down their own research efforts. This is precisely why the industry should, and in Groningen has, embraced the concept of open innovation. What is even more important though, is that the innovations that are needed for tomorrow's market no longer are for the benefit of a single company.

Take for example the case of a micro-CHP in an area with high penetration of de-central electricity production, be it from sun, wind or a combination of the two. In such an environment, a consumer will become a prosumer that positively interacts with the renewable energy systems surrounding him. For this to materialize, a lot will have to change from the current status quo. How this takes shape, and what it involves, is the topic of one of the flag ship projects at EnTranCe called iBalance (see figure below, or www.i-Balance.org). In this project, the data from de-central real-life production from the village of Hooghalen is confronted at the EnTranCe site with the actual consumption data from the same village. The difference between the two patterns is fed to a solid oxide fuel cell (SOFC), and defines its operation. We are currently testing to what extend the varying patterns can be met by the SOFC, or whether additional elements such as micro-turbine CHP's are needed.

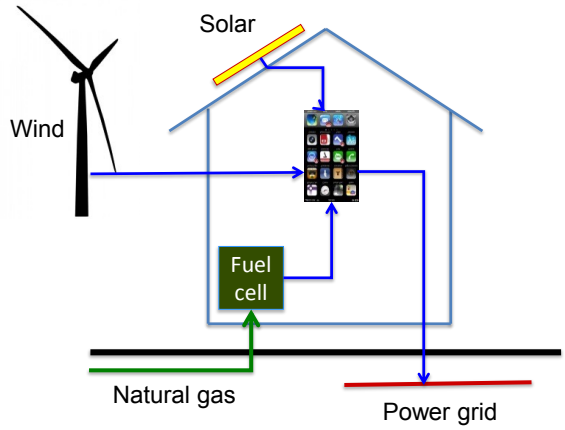

Figure 2. Schematic representation of the iBalance project

Interestingly, an important element in all this is the realisation that local balancing is much more than just a question of technological ingenuity as sketched above. Rather, the consumer in the on-going energy transition more and more transforms into an active agent in the energy system, and consequently technologies and systems are required that help putting people in power. This is not merely a question of introducing new technologies, or ICT-systems that enable the communication between these technologies, but also of social innovation. Developing and integrating these technological and social innovations through the intelligent use of the existing gas infrastructure in Europe is at the heart of EnTranCe.

Another major element that poses a challenge for the energy industry not seen before is the sheer speed at which the energy landscape is changing. Although we have seen quick changes in the past, such as the shift from town gas to natural gas in the 1960's in Europe, athis does not compare to what is currently happening. A second aspect of open innovation is a welcome element here: the decreased time to market. In traditional innovations any new development has to be a complete in-house affair. Real-life testing comes only at the very

end, substantially prolonging the overall research, development and deployment phase. In open innovation, the research, development and deployment phases partially overlap. The result is graphically illustrated below as a speeds-up of the innovation process through protracting of the innovation cycle.

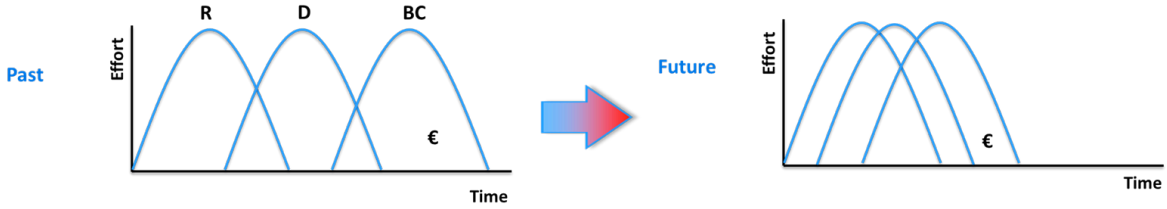

Figure 3. Open innovation speeds up the Research, Development and Deployment.

Aside from providing a platform for open technological innovation, EnTranCe facilitates the education of young professionals, graduate and post-graduate students, working closely together in multi-disciplinary teams. Precisely because the innovations that are to be successful in furthering the position of natural gas as a system fuel are a combination of technological as well as social elements, this approach is essential. For this reason, Hanze University of Applied Science has joined the consortium of leading European universities that together form the Association of European Energy Research Centres (EUREC) and developed an European Master of Science program in Renewable Energy. The post-graduate students, following courses at HUAS and participating in the multi-disciplinary projects at EnTranCe, work at two partner institutes that can bring knowledge on specific technologies, e.g. solar, wind, or bio-based. Thus, the students are trained to fill the gap between the growing industry demand for specialised renewable energy expertise and the skills currently available on the job market, with a strong focus on engineering.

As mentioned when discussing the content of the projects at EnTranCe, it should be clear for anyone working in the energy industry that the advancement of new technologies is only one of many hurdles that we face when shifting to a more sustainable energy system. This is why at EnTranCe there is a strong focus on how such future technologies interact. It is an element of the aforementioned MSc, but in itself sufficiently interesting to warrant more specialized attention. This is why in additional to the existing one, two other master studies are under construction, a Master of Science for Sustainable Energy System Management and a Master Energy and Society with a focus on Sustainable Energy Communities. Whereas the existing MSc attracts mostly engineering and physics students that want to broaden their view to the world beyond science, the second one is a business master directed to students with business, economic or engineering management background. The aim is to unlock human resource potential hitherto unavailable to the energy industry, but also to give those that may one day be the decision makers relevant for the industry to the

level where they can sufficiently appreciate the complex environment that the energy landscape entails.

Thus a new Master program should firmly be based on the current and particularly future needs of the industry and society. At the same time, students should be able to deal with the political dimensions of the energy system. With this in mind a Charrette was organised for the definition of a program for Master of Sustainable Energy System Management with a focus on System Integration and Optimization that would prove relevant and robust, a Charrette being a meeting within which stakeholders and partners can discuss experiences, opinions and ideas that are relevant for a new Master program. Although it is clear, also from the discussions that followed, that the interests of education, commerce or government do not always coincide, this format did prove to be helpful in aligning the interests as much as possible. Based on the outcome of the Charrette, HUAS was able to define a Master's program that provokes the interest of the stakeholders yet of the high quality required when aspiring to the EUREC level.

Conclusions

The living lab EnTranCe provides a platform for open innovations. Stakeholders from large industry, SME's, government and the research community team up to work on the future of the European energy system, with gas in a pivotal role. An important element of the innovation strength of EnTranCe is that it also serves a number of MSc programmes. This brings you students in contact with relevant research and gives hands-on experience in solving the intricate problems that come with stronger interconnected and changing energy markets. is explained. Thus, the innovative projects taking shape at EnTranCe have a dual role in forming the students while at the same time leading to innovative applications of natural gas. In all, the developments at EnTranCe strongly support the case of natural gas as the bridging fuel in the European Energy Transition.