

Special issue Energy



TPM QUARTERLY

Energy Delta Gas Research (EDGaR):

“Pondering the ideal mix of gas and renewable energy”



How can the Netherlands grow towards a sustainable energy mix from its current strong natural gas position? This is the core question that will be the focus of the activities of Energy Delta Gas Research (EDGaR) in the next few years. In its quest for answers, this national consortium will be developing knowledge and technology using a strategic research programme, with which Prof. Margot Weijnen (chairholder of process and energy systems engineering) and Dr Rolf Künneke (associate professor of the economy of infrastructures) are closely involved on behalf of TU Delft. Prof. Weijnen is a member of the Executive Board, and Dr Künneke is on the Programme Board.

For more than fifty years, natural gas has been the primary source of energy in the Netherlands, for industry, the service sector and households. More than 60% of the country's domestic electricity production is based on natural gas, while almost every home and every business is connected to the gas network. Market penetration on this scale is unparalleled anywhere in the world. Moreover, the Netherlands is a major gas exporter in Europe and is keen to profile itself as north-west Europe's gas hub.

Weijnen explains, "When it comes to developing technology and markets, our country is right at the forefront - a position that offers tremendous opportunities now that Europe is on the verge of making the transition from conventional to sustainable energy. In the next few decades, gas will play an important role in this. After all, it is a relatively clean conventional fuel and is a flexible addition to renewable energy sources that are not available on a continuous basis."

Smart link

The aim of EDGaR is to safeguard the country's leading knowledge position in relation to gas and, looking at the future, to make a smart link between gas and the transition to sustainable energy provision. This involves three main themes: 'from monogas to multigas', 'long-term energy systems' and 'changing gas markets'. Künneke says, "To start with the first theme: in the next few years, the Netherlands will see an increasing stream of 'new' gases, such as 'green' gases, hydrogen and syngas. Also, gas from other countries will be imported to an ever-greater degree via the extensive natural gas network, or in tanker ships in the form of liquid gas (LNG). The composition of this 'new gas' is different from the natural gas from Groningen that has been traditionally distributed in the Netherlands, which has a very unique quality. The current natural gas network is not set up for this, and neither is the equipment used by end-users. These different gases cannot simply be mixed. It could also lead to very dangerous situations for end-users if gas with divergent qualities is burned in heating boilers or gas ovens. There therefore has to be a transition from the traditional mono-gas world to a multi-gas world. The EDGaR programme is examining the relevant and important technical, policy, economic and legal aspects of this. At present, twelve research projects are underway."

A total of 40 project proposals had been submitted by 1 June 2011, of which 27 have been approved.

For the 'future-proof energy systems' theme, the key question is the role of gas in future energy provision. Gas and electricity systems have traditionally developed and been made more sustainable separately. EDGaR is now looking at ways of bringing the two together in order to make the energy system as a whole more efficient. This is also intended to lead to better use of

Organisation EDGaR

The Energy Delta Gas Research (EDGaR) national consortium is conducting the largest-scale research programme in Europe in field of gas and sustainability. Under the leadership of the Energy Delta Research Centre of the University of Groningen, EDGaR is pooling Dutch gas-related knowledge and skills with the aim of creating a sustainable energy future.

The partners are Gasunie, Kiwa Gastec, network companies Enexis, Liander and Stedin, GasTerra, the University of Groningen, TU Delft, the Energy research Centre of the Netherlands (ECN) and the Hanze University of Applied Sciences in Groningen. The Executive Board is chaired by Roelf Venhuizen, the former director of the NAM.

sustainable forms of energy that provide power at unpredictable intervals, such as the sun and wind. Weijnen continues, "For end-users, gas and electricity are competing energy sources, but at the same time the networks are linked and dependent upon each other. One of the eight approved research projects concerns 'innovative smart grid solutions', and is focused on the interaction between gas and electricity networks. Modelling the integrated gas and electricity system is a real challenge, but it is something you need to do to be able to coordinate supply and demand in the energy system in an intelligent manner and, for example, to use decentralised production units for heat and power more smartly."

The area of focus of the third main theme, 'changing gas markets', is internationalisation. The need for this is highlighted by the fact

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Ivory towers

Last month, I attended a conference in America. At the conference, a scientist from the IPCC, the UN's climate panel, was defending the work of his organisation, which has been subject to severe criticism. He was a prominent researcher who has been a victim of personal and vicious attacks in America. He has been accused of fraud and his personal safety has been jeopardised. He was taken to court by the public prosecutor and sued for large sums of money. His most disputed conclusions concerned the question of whether or not climate changes are the result of human actions: are the hockey stick statistics (the graph in the shape of a hockey stick representing temperatures in the northern hemisphere in the last millennium) accurate? At the conference, this scientist's defence of his claims consisted purely of facts. The truth, the whole truth and nothing but the truth. He presented a convincing argument demonstrating the scientific evidence on which his conclusions were based.

I am not a climate sceptic and at worst a climate pragmatist. Living as we do below sea level, we cannot afford to ignore too many developments in the climate, whether or not they are man-made. Despite this, I felt a sudden involuntary rage rise within me halfway through the presentation. It was caused by the way in which he presented his account: he was totally focused on justifying his methodology, the facts and the truth, without ever considering the social context and implications of his analyses or evaluating these facts. Human actions were indeed the most important cause of climate change. Everything was correct and yet his account was the height of amateurism. It resulted not in resentment, but definitely in resistance. There was no reflection whatsoever, no suggestion of how to respond. What mattered was the truth and that he was right. No suggestions were given as to what we should do with these truths. A few pictures of polar bears were shown. Some parched earth. There were warnings of uncontrollable instability in the global climate system.

Again I realised what mattered: however good and however scientific the research you present is, it will achieve nothing if you exclude people from the solution to the problem you present. The best you will achieve is aggression. It is like a doctor saying to a patient: there is clear evidence that you have cancer. Good day. Or a government minister saying: this will do no harm and anyway, there is no such thing as absolute safety.

In the world of policy, different values prevail from those in the ivory towers of science. Being able to deal with that is part of our professional role as engineers. If these values are taken into account in your research, it becomes possible to make a tipping point (a critical moment when doomsday scenarios become a reality) into something positive. What minor, simple interventions are possible in order to achieve a major, positive turnaround in policy? At TPM, this is what we do. We may believe that we have torn down the ivory towers, but we have not. We also need to learn how to raise our game and focus on such factors as 'power' and 'powerlessness'. Without power, implementation is impossible. Powerlessness leads to resentment. This is something I experienced for myself in America. According to this truthful account, mankind had to be the guilty party. The solution? Atonement? Through his own performance, an eminent scientist single-handedly made the search for truth into an item of faith.

Prof. Theo Toonen, Dean

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“EDGaR: Pondering the ideal mix of gas and renewable energy”

that the character of the international gas market has changed rapidly in the last ten years, due to internationalisation, deregulation, the introduction of liquefied natural gas (LNG) and the related need for different transport systems, and the quickly increasing role of shale gas. Other factors are the greater international dependence on the supply of traditional natural gas from a limited number of countries and greening as a result of the introduction of new gases and other quality specifications. Moreover, EDGaR would like to put the development of innovation in the Netherlands in an international context, with a view to new export opportunities, among other things. One of the six research projects is entitled, 'Up stream - down stream: securing gas supply and the governance of the gas value chain'. The project further highlights the various policy aspects of certainty of supply (see page 4).

for example, you will not get very far working on your own. You really need each other in order to fully understand the nature of the problems. You can no longer regard the technical aspects of energy infrastructure as separate from the economic organisation, legislation or policy - and vice versa, of course. It is also good to see that EDGaR has attracted interest in other TU Delft faculties - 3ME (Mechanical, Maritime and Materials Engineering), Applied Sciences and EEMCS (Electrical Engineering, Mathematics and Computer Science), for example, have started

To find out more about EDGaR, go to www.edgar-program.com

to consider gas technology from their own perspectives. There is also greater collaboration between PhD students from various research organisations and industrial partners, and the new knowledge is finding its way into scientific journals and is being taught to students. We very much cherish all these forms of collaboration, whether in or outside the faculty.”

“There is a huge number of themes to consider,” says Künneke. “The world is not the same now as it was when the gas infrastructure was developed. The end of Dutch supplies of natural gas is in sight, but we cannot manage without gas. All kinds of new types of gas exist, or are in the pipeline, as it were. How can we manage these developments so that they fit in the gas infrastructure? What investments are we going to make in the next 50 years? Are we going to move from gas and strengthen our electricity infrastructure? Or are we going to stay with gas, in all its forms, and with the possibilities our outstanding and intricate natural gas infrastructure offers? And are we going to use our existing gas infrastructure as a vehicle for renewable energy?”

Smart organisation will be another requirement, Künneke continues. “How will we organise the complicated array of new gases? Will it be on a smaller scale? As an economist, I wonder how in that case you can safeguard such aspects as reliability and affordability. And in a general sense, how do you regulate innovation? Because if you have a decentralised system, how do you organise it? The PhD thesis by Daniël Scholten is a case in point. He talks about the development of a hydrogen economy in 2050, but as well as the technical side, he looks at the organisational requirements. You can no longer consider these aspects separately.”

Self-governance

Much can be learned from the past. Weijnen says, “Infrastructure-based services in Europe all came about through local private initiatives. Even now, you see many private parties and local authorities involved in initiatives for developing green gas and smart grids, for example. In Germany, there are already many self-sufficient communities. What does this mean for regulatory structures of the future? Are we going to organise energy provision via energy communities? Will there be big differences in the quality of energy supplies to the better and less well off? We think self-governance and self-regulation can work very well, but not in every circumstance. We have to look for appropriate technical and institutional solutions, based on public values. These questions are very much in keeping with the research tradition at TPM. What is clear is that a great deal of research is needed, in which technology, economics and policy are looked at together. EDGaR provides the room to do that.”

As far as Weijnen and Künneke are concerned, the collaboration in EDGaR is unique: “We work with many different parties, from network companies and industrial partners to scientists, and consider the problems together. As a result, we complement each other very well. The perspective of one party may not always be clear to another, but EDGaR is useful in bridging that kind of gap. What we are all actually doing is working on one huge puzzle, and everyone understands that their contribution is just part of the bigger picture. Everything comes together, all our resources are pooled, and that is absolutely the great thing about EDGaR.”

Finance

There can be no research without finance, and EDGaR has a total budget of 44 million euros at its disposal. Half of this comes from grants from the Northern Netherlands Provinces (10 million euros), the Ministry of Economic Affairs, Agriculture and Innovation (2 x 5 million euros) and the Province of Groningen (2 million euros). The remaining 22 million euros comes from the EDGaR partners. Of the 44 million, 42 million euros is intended for research and technology development, and 2 million for management and disseminating knowledge. In addition, the University of Groningen has provided 0.4 million euros for manpower. At present, the programme is set to run until 2015.

Logical step

For TPM and TU Delft, participation in EDGaR was a logical step. Weijnen says, “Through Next Generation Infrastructures, TPM and other faculties and universities have already put interdisciplinary infrastructure system research firmly on the map. It is now a matter of extending that further, and EDGaR is the ideal vehicle for that purpose. In addition, gas is high on the agenda of the Topsector Energie (the energy sector is one of nine designated by Dutch government as a ‘leading’ sector, based on the country’s leading position in the sectors worldwide). We are happy to play our part -

“In a general sense, how do you regulate innovation? Because if you have a decentralised system, how do you organise it?”

in fact, we are now right in the thick of it. The Netherlands is small on the world map, but our knowledge of gas is considerable. The challenge now is to be intellectually innovative, for which EDGaR is an ideal platform. What I am also very pleased about is that EDGaR was launched at an almost astronomical speed! It had to be, of course, because the Ministry of Economic Affairs wanted to carry out an evaluation after just one year. The speed has not been at the expense of quality and we came through the evaluation with flying colours.”

Another aspect linking TPM and EDGaR is that of the multidisciplinary approach, as Künneke explains. “As at TPM, resources are pooled very effectively in EDGaR. As an engineer or economist,



Flexible asset management for the transition to multigas networks



By: Prof. Paulien Herder,
Energy and Industry section

In the future the gas distribution network and services will be nothing like they are today.

For example, it is expected that the network will carry different gases. These may include biogas or hydrogen, gases with physical and chemical properties which differ from those of the present natural gas.

TPM will be taking part in the study 'Flexible asset management for the transition to multigas networks' with one postdoc from 1 January 2012. In this study we are looking at how we can make the gas distribution system more flexible from the perspective of the asset manager. Asset managers are responsible for the planning and construction, management and maintenance of the network, and now that they are becoming increasingly confronted with the uncertainties described, they are looking for methods and technologies to deal with these in a pro-active manner. We are developing intrinsic improvements for the present risk-driven asset management process by also mapping opportunities quantitatively and by calculating using real-option theory. We are also establishing this new approach to asset management in the working methods of the network companies and in the institutional context (ownership issues, regulation etc.).

Using a number of case studies from the three network companies, we hope to demonstrate the usefulness and suitability of this new approach. In this way asset management can become an important tool for the transition to a sustainable gas supply.

The network will need to be more flexible in order to accommodate the variations in gas quality and quantity. And this is not only true for the network itself, but also for the related organisations and institutions.

EDGaR at other faculties

By: Prof. B. Dam of the faculty of Mechanical, Maritime and Materials Engineering and Dr. R.F. Wolffenbuttel of the faculty of Electrical Engineering, Mathematics and Computer Sciences

In order to implement the new gas network it is essential to develop sensors, as gas of varying quality needs to be mixed in order to produce a composition with a well-defined heat of combustion.

To achieve this, hydrogen and nitrogen need to be added to the gas. The aim of our project in Delft is to develop the sensors needed for this. The sensors need to have a long lifespan, must not have any cross sensitivity with respect to methane (CH₄) and must be able to resist contamination by, for example, hydrogen sulphide (H₂S)*.

We are developing two types of sensors. The first type is used to determine the CO₂ and CH₄ concentrations in the gas mixture. The second sensor can measure the hydrogen concentration over a range of 1 to 300 mbar.

**) Note from the editors: H₂S is a poisonous gas with a strong odour best known for its smell of rotting eggs. It is found in natural gas among other things.*

Inaugural speech Theo Toonen: Biobased Governance

'Hobbes and Rousseau are not fighting about the instrument, the state, but the engineer who will be steering it.'
(Johannes Theodorus Buijs, 1864)



On 18 November 2011, Professor of Public Administration and dean of the faculty of Technology, Policy and Management, Theo Toonen, gave his inaugural speech. He took his audience on a journey through

time using a number of artefacts: an antique chair, a State Almanac from 1933, a pile of policy reports from the Rutte cabinet and a cube belonging to a Crown Prince.

Along the way he encountered his intellectual heroes Thorbecke, Van Poelje and Buijs, as well as the Nieuwe Waterweg, the North Sea Canal, the Harlemmermeer Polder, the Ried Glacier, WiFi, Skype and the Dutch electronic Patient Record System. Taking inspiration from all these people and objects, Toonen unfolded a model for the domain of his faculty, TPM: the study of public service and the relationship between society, technology administration and management.

He formulated the lessons he learned from his journey through time as a scientist and faculty administrator and released TU Delft's mascot, Prometheus, from his cube. Watch the speech at www.tbm.tudelft.nl/intreeredetheotoonen



In short

Dissertations

MENNO HUIJS
Building Castles in the (Dutch) Air - Understanding the Policy Deadlock of Amsterdam Airport Schiphol 1989 -2009,
13 October 2011



JAN WILLEM VAN DER PAS
Clearing the Road for ISA Implementation? Applying Adaptive Policymaking for the Implementation of Intelligent Speed Adaption,
13 October 2011



JASPER DAAMS
Managing Deadlocks in the Netherlands Aviation Sector,
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NIKI FRANTZESKAKI
Dynamics of societal transitions: Driving forces & feedback loops,
14 November 2011



CHANTAL CANTARELLI
Cost Overruns in Large-Scale Transport Infrastructure Projects: A theoretical and empirical exploration for the Netherlands and worldwide,
28 November 2011



REZA HAYDARLOU
Towards Use-Case Driven Self-Management of Distributed Systems,
29 November 2011



More information:
www.dissertaties.tbm.tudelft.nl

Frances Brazier takes part in 'Kenniskamer Intelligente Robots'

In November the Ministry of Security and Justice organised the 'Kenniskamer Intelligente Robots' to inform the ministry top about the opportunities afforded by new-generation robotics for policy areas covered by this ministry. Four of the nine scientists invited came from TU Delft, and one of these was TPM's Frances Brazier.

Complete journal *Vervoerswetenschap* now available online free of charge

Since mid-November 2011 the magazine *Vervoerswetenschap* has been available online via www.vervoerswetenschap.nl free of charge. This is the only academic and reviewed journal in the field of transport and logistics in the Netherlands and Belgium. TPM's Wijnand Veeneman, Lori Tavasszy and Caspar Chorus made an important contribution to creating the digital version of this journal.



EDGaR project

Smart organisation of a dumb network



Gerard Dijkema

The structure of the gas sector is changing. Up until now the gas supply was arranged bilaterally. One-on-one connections were the dominant feature. However, in recent years the Netherlands also imports gas from other European countries. And new forms of sustainable energy are also emerging, such as solar and wind energy, biogases and synthetic gases. So we can be certain that the gas transport network will have to change. This involves all kinds of parties with diverse and sometimes conflicting interests. These interests have to be brought into balance and this requires smart organisation on the part of the gas sector.

The problem is not technical

"The problem is not the technology," says Gerard Dijkema, member of the Energy and Industry section and leader of the 'Operating the gas transmission system: institutional design challenges and solutions (TransGasID)' project that started in September. In this subsidiary project of EDGaR he is researching how the divergent interests can be brought into balance. He is doing this together with Dr Martijn Groenleer and Dr Mark de Bruijne from the Policy, Organisation, Law and Gaming section and Dr Aad Correljé from the Economics of Infrastructures section.

"The gas transport network in the Netherlands is an uncomplicated network with pipelines covering the whole country", Dijkema explains. "So it is a relatively simple task to expand it and adapt it to other gas properties."

According to the researchers, the main problems are of a geopolitical nature: who gets what and when, and at what price? Correljé: "For example, are we willing in the Netherlands to pay to transport gas abroad? What is the gas transport network worth? Is that only the value of the pipelines? Or also the value of potential revenue, profits from gas imports and exports? What is the value of knowledge acquired in the Netherlands? Can we do anything with that? These are questions involving divergent values and which different parties need to answer."

Parties and interests

To give an example, there are two major parties and their interests: firstly the Transmission System Operators (TSOs), who played a central role for the researchers in this study and are responsible for the gas transport via the existing network, and secondly Gas Transport Services (GTS), who manage the gas transport network in the Netherlands and are responsible for gas transport and the development of the national gas transport network and the associated plants. They have a monopoly in the Netherlands and also own and manage a part of the German gas transport network. They want the Netherlands to grow further as the gas roundabout of Europe and also want the gas market to develop further. GTS have a long term vision.

The national supervisor, the Dutch Competition Authority (NMa) is more focused on the short term. It is keen to show Dutch users that the cost for gas transport can be reduced. This means no new infrastructure or expensive changes to the existing pipeline network. These are conflicting aims. Dijkema: "Transport costs form only a small part of the gas price. The real issue is the dynamic and volatile nature of the market. Will it remain stable and manageable?" Correljé: "How can you hope to achieve a European gas market if everyone is only prepared to pay for the transport of their own gas? Put your own gas first? But we are happy to drive on French motorways to get to the sun."

Typical TPM

And these are just the parties operating at national level. "By now we have a European network of TSOs as well as a European watchdog. The question is what role these should, and in particular can, play given the strongly divergent national interests. Taken together this makes it a typical TPM issue", says Groenleer. "Bringing all the different perspectives into balance in a structured manner. How to organise things in such a way that that the various interests are equally balanced." De Bruijne adds: "And of course we need to get hold of a great deal of data which is often of a sensitive nature for companies, which can be quite a task." Dijkema: "Using the results of our research the parties in the gas sector will be able to think about future challenges concerning gas transport from an integral perspective."



Mark de Bruijne



Martijn Groenleer

Up stream - down stream



off the gas tap and major customers like Germany and Italy, and also Greece, Turkey, Austria, Romania, Serbia, Slovakia and the Czech Republic stopped receiving Russian gas.

"This example illustrates the importance of an understanding of the political relationships between countries that export (up stream) and import (down stream) gas", says Correljé. "Are gas exporting countries reliable and dependable or are they guilty of opportunism?" Correljé is in charge of the project launched in 2010 entitled Up stream - down stream: securing gas supply and the governance of the gas value chain. This project is investigating all aspects of the security of energy supplies,

In the second half of the last century, 50% of European gas imports came from Russia. It was a safe source because Russia needed the money and was bound to deliver. The gas was transported through the Ukraine. But then there were disagreements between Russia and the Ukraine about prices, unpaid bills and accusations that the Ukraine was illegally siphoning off gas. Whatever was actually going on, Russia turned

and in particular gas. This immediately brings to mind the security of gas supplies. However, ensuring that the demand for gas remains stable is equally important. The research ultimately aims to develop a model to chart the geopolitical relationships, the role of sustainable forms of energy and unconventional gas and the reliability of the various players in the gas market. The partners in the project are ECN (Energy Research Centre of the Netherlands), an established energy research institute, and Clingendael, the Netherlands Institute of International Relations.

Down stream

The European countries that depend on imported gas want secure gas supplies. "Security should primarily be seen in terms of availability. The certainty that gas will be supplied when it is needed and at reasonable prices", says Correljé. In this process, the purchasers and producers are interdependent. As soon as there are several producers and purchasers, choices can be made and this dependency decreases. The development of a gas market is extremely important because it can replace this contractual dependency. The question is whether this will happen in Europe.

Up stream

As the main supplier of gas to Europe, Russia was reliable until conflicts emerged with the transit country Ukraine. This is why

plans emerged for the Nabucco pipeline, to transport natural gas to Europe from the countries around the Caspian Sea (Azerbaijan, Turkmenistan). Russia does not support this project as it wishes to preserve its position of strength in the energy market. As an alternative to this pipeline, it has begun the construction of two pipelines through Germany (the recently-commissioned North Stream pipeline) and through Bulgaria (the South Stream pipeline). But this is just the technical context of the game.

The rules of the game

Ultimately, the researchers need to develop a model that shows how the behaviour of the different players in the market can be controlled by agreements and policy enshrined in regulations. Rules that determine who can take what from the ground and who can buy what and at what price. It is also possible to reduce the effects by ensuring that there are sufficient alternatives.

These alternatives will involve making adjustments on the supply side, for example in the future role played by sustainable energy and unconventional gas. This is research in which economics, the politics of energy supply and international relations play a major role.



The future of energy supplies



The Groningen gas field was discovered more than fifty years ago. The Netherlands rapidly grew to become one of Europe's major gas exporters and developed an efficient, reliable, safe and profitable infrastructure.

However, the gas field in Slochteren will become depleted in the coming decades, new technological developments are on the rise and there is increasing pressure in society for more sustainable energy supplies. Kas Hemmes leads a team working on a research project focusing on what might happen in the next fifty years and the potential strategies that could maintain the Netherlands' leading position during the process of transition towards an international and, ideally, sustainable energy market.

Hemmes and his team are investigating the options offered by these new technological developments, how likely they are to be accepted or opposed by wider society and how we should handle the uncertainties involved in policy development. He is attempting to explore future scenarios for the gas sector as widely as possible and examining potential ways of combining what are essentially separate developments.

One example of this is offshore gas exploration and the construction of offshore wind farms. Until now, these kinds of projects have been considered separately, but what if both developments were combined in order to leverage the effects of synergy? "Why shouldn't we construct offshore wind farms in the same locations as the gas fields and convert the gas into electricity at sea in order to enable us to use the infrastructure we build to transport electricity to the mainland for the gas as well?" Hemmes wonders.

In his research, he is assessing the likelihood of a range of radical visions of the future and how the government and the gas sector can best capitalise on them. For example, imagine a future scenario in which everything runs on electricity and gas is no longer used. How stable and sustainable would our energy supplies be? Hemmes and his team are examining a large number of future scenarios and discussing these with a wide range of stakeholders. "Much research is conducted with a specific aim in mind (an approach known as backcasting, Ed.), but it is our job to investigate potential changes in the energy sector and to advise how policy can best respond to these now and in the future", says Hemmes.

Regulatory changes increase uncertainty in the energy sector



Alfredas Chmieliauskas (l.) and Catalin Bucura (r.)

This is the thrust of the argument put forward by Alfredas Chmieliauskas and Catalin Bucura, who are working on the PhD project 'Understanding gas sector intra- and inter-market interactions', one of the EDGaR subsidiary projects.

Deregulation has resulted in significant changes in the gas sector. Until 1998, a single vertically-integrated company - Gasunie - was responsible for the nationwide transport of natural gas and for regulating the long-term contracts for the sale of the Netherlands' natural gas. Since then, a complex market has emerged in which one company - Gasunie Transport Services - takes care of nationwide transport while providers and purchasers of natural gas are free to enter into contracts with each other. In the meantime, policy in the Netherlands and across Europe has focused on guaranteeing a stable gas supply - in part by realising pipeline connections and contracts with Russia and land connections for LNG - alongside a reduction in CO₂ emissions. Chmieliauskas and Bucura are conducting research into the impact that changes to policy and regulations have on these objectives.

Bucura's research focuses on interaction within the gas sector (intra), whereas Chmieliauskas is looking at the interaction between the gas sector and the energy market as a whole. They have identified three different layers within the gas sector: the infrastructure used for gas transport, the regulation applied to the sector and finally the energy market. "Research into these different layers is usually conducted individually, but the impact of regulation on all three layers as a whole actually reveals some interesting data. This is what makes our research really unique", says Chmieliauskas. The three layers within the sector are being simulated by means of agent-based models. The researchers are using these simulations to explore the effects of specific regulations on the three layers and ultimately on the stability of gas supplies and CO₂ emissions.

Catalin Bucura is primarily focused on the behaviour of the various players in the gas sector. "As a result of deregulation, the coordination of supply and demand in the sector has become extremely complicated and this can have an influence on whether the existing gas infrastructure is used appropriately", says Bucura. He hopes to use his models of the gas sector to develop recommendations for policymakers. For example, will investments in infrastructure be required in the future, such as additional storage capacity or additional or thicker pipelines? Or can regulation actually provide incentives to market players to modify their behaviour in such a way that potential bottlenecks in the infrastructure are prevented?

Chmieliauskas and Bucura began their research in 2009 and are already coming up with their first results. For example, it has emerged that the increased interaction between different players in the gas sector and the energy sector as a whole is increasing market uncertainty. Regulatory changes also play an important role in this. Chmieliauskas: "Although the aim of policy is to achieve a stable and environmentally-friendly energy supply, rapidly changing regulations are increasing uncertainty in the sector to such an extent that investors are beginning to view the energy market as a risky investment. In the future, this could drive up energy prices."

The project 'Understanding gas sector intra- and inter-market interactions' is being supervised by Dr Gerard P.J. Dijkema from TPM's Energy and Industry section. The University of Groningen, ECN and Gasunie/Kema are partners in the research project. The research is focusing on the Dutch gas sector and the Netherlands' position within the European gas market. Ultimately, its recommendations will contribute to strengthening and safeguarding the Netherlands' position as the 'gas roundabout' of Western Europe.

For its energy-related research, TPM has established the Energy Modelling Laboratory, which is open to interested parties. The data being used in the models provides a wealth of interesting information about the worldwide gas sector and can be accessed at

<http://enipedia.tudelft.nl>





Construction of green gas

Stedin: Green light for green gas

Green gas is the fuel of the future. The people at grid operator Stedin are convinced of this. Albert van der Molen, Stedin's Senior Asset Management Specialist is one of them: "If we are to be fully prepared for a sustainable future, it is essential that we become involved in concrete projects as early as possible. EDGaR presents us with the opportunity to do that."

STEDIN

Stedin is a regional grid operator in the Randstad. The company is responsible for transporting gas and electricity to almost two million private and business customers. Working efficiently is a key aim: because regional grid operators have a natural monopoly, the prices they charge are regulated by government. Van der Molen is part of the innovation department specialising in gas, which explains his involvement in EDGaR.

"Stedin is currently working hard to make gas supplies more environmentally-friendly. We all know the concept of businesses and households generating their own electricity and selling it back to the grid. But the very latest trend involves people producing their own gas and supplying it to us, upgraded to natural gas quality, of course. They are providers having biomass at their disposal, such as farmers, waste processors, fish processing plants and sewage purification plants. In alliance with other grid operators, we are doing our best to accommodate them, but this is still relatively uncharted territory. New energy streams call for a different approach to organising and controlling the energy grids."

Customised approach

Because the supply is still limited, Stedin tends to adopt a customised approach. Currently, there are three green gas installations connected to the Stedin grid: in Beverwijk, Mijdrecht and Spakenburg. Van der Molen: "But the number of initiatives is growing at a remarkable pace, partly because of the SDE+ government subsidies. Asset management involves identifying smart ways of organising the infrastructure, such as gas pipelines and electricity cables. It is all about making the right choices at the right time, which means finding a midway between acting too early and too late. Alongside ad hoc solutions, we are also thinking about the longer term. For example, we are working hard to develop a gas infrastructure that can cope with two-way traffic. As part of this, we are co-funding a number of PhD students at TPM who are researching this under the supervision of Dr Rolf Künneke. The research project is called Towards sustainable gas distribution systems."

As part of its partnership in EDGaR, Stedin's employees attend its meetings and sit on various supervisory committees. "EDGaR brings together the world of science and practice. At Stedin, our focus is primarily on what the research can

achieve. Any research has to have a practical value. That can be difficult. In the dynamic environment in which Stedin works, we often need answers as soon as possible, but PhD research can sometimes take five years. This means that the subject of the research may already be outdated before the results are revealed. This is why we also call for interim results to be published. We also make a careful assessment of which projects we will fund and which we won't. At TPM, we frequently find an excellent match."

One of the benefits of EDGaR is that it gives students the chance to find out what Stedin has to offer. "We are happy to allow people working on EDGaR to join us in the field. Thus our lines of communication with TU Delft are also kept short. That is very valuable for us: we need a lot of science students and they are in very short supply. The closer we are to their breeding ground, the better. EDGaR is an excellent way of achieving this because it brings science and practice closer together."

Gasunie: A question of finding the right balance in a changing gas and energy market.

"Thanks to EDGaR integral research is taking place in the gas market. In this way we can see clearly how we can continue to change the market without it getting out of balance." So say Rob de Wolf and Martien Visser of Gasunie, a co-founder of EDGaR. De Wolf works in the Corporate Strategy department and coordinates Gasunie's EDGaR activities. Visser works for Gas Transport Services and heads up the department working on 'The Netherlands as a gas roundabout'.

gasunie

Gasunie is a European gas infrastructure company with one of the largest high-pressure networks in Europe. The network comprises over 15,000 km of pipelines in the Netherlands and North Germany, dozens of installations and around 1300 gas receiving stations. Every year it transports around 125 billion m³ of gas. The reliability and strategic position of the Gasunie transport network have helped to make it the heart of the Northwest Europe 'gas roundabout'. "This is why we are so occupied with innovation - for ourselves and also in relation to the entire gas value chain", says De Wolf. "The imminent energy transition has consequences and opportunities for all parties. EDGaR fits into this excellently because of the collaboration between science and industry."

Gasunie is closely involved in the EDGaR project 'Understanding gas sector intra- en inter-market interactions', of which TPM is also a partner. Visser: "Liberalisation has resulted in fragmentation of the gas market and the formation of islands: everyone is doing their own thing without seeing the whole picture. Although every party is trying to be as efficient as possible, I doubt if this is true of the market as a whole. The challenge

is to make integral efficiency improvements, and there seem to be plenty of opportunities here. For example, the gas market used to be extremely decisive, yet in recent years more and more detailed regulations have been introduced which are often hard to change. Yet at the same time the gas market needs to be flexible in order to anticipate new developments, such as the emergence of sustainable energy. This is a real challenge and there is much to be gained through research within the EDGaR framework. Another part of the project concerns the way in which the gas market is perceived. Many people see the gas market as an ideal neoclassical market. And many policy decisions are made on the basis of this. However, the actual situation is completely different, in part because of the specific technical properties of gas. There is a considerable risk that the wrong policy decisions will be made concerning the gas market. EDGaR's approach is to consider the gas market on its own merits and to see what consequences this has for policy.

Great importance

"If you look at the pure facts of the aims of the project with TU Delft, you may think it is only applicable to us in part.

But if you place us in context, you can see that it is of great importance, even though this may be indirectly", De Wolf comments. "For us as a service provider it is important that the gas market functions well. It is also in the interest of the consumer, as he pays the costs. So it is vital that we work as efficiently as possible from the entire gas chain, and in the long run the entire energy chain." We need to be clear about how the balance of the market is disturbed if we make changes. "It's all about innovation and finding new balances. We are keen to carry out the transition, but need to understand beforehand how we should arrive at new design criteria, for example."

They both feel the current scientific approach to integral research is an enormous advantage. "Academic studies show more and more often how important it is that changes are examined integrally. In a changing society we have more and more actors to deal with. To achieve the best results practical knowledge is vital, but you also need the academic world. Gasunie provides insight into the gas market as well as our position. The academic world carries out new contextual studies. We are really happy to have TU Delft on board: they have a practical mindset and are used to a results-oriented way of working. This is crucial."

The collaboration may lead to focused research and to a better positioning of the Netherlands, which is good for both parties. EDGaR, with its serious potential and image for the international European energy market, is an excellent platform for this.

Professor profile

NAME

Peter Kroes

POSITION

Professor of Philosophy of Technology

Private life

Married to Karin, with three children: Mark, Laura and Thomas; three grandchildren: Sven, Isabel and Hannah

What is your favourite hobby?

I like walking, reading, playing sport and gardening...

Career high point?

It is difficult to choose one; I have always really enjoyed my work and continue to do so. If I look back a little further in time, I do recall the relief I felt on finally completing my PhD thesis. It was not so much the PhD conferral ceremony as actually completing my research. It was a wonderful moment. More recently, there was the NWO approval of the Dual Nature project and the time I spent working on it with my colleagues. I should also mention my sabbatical at the NIAS.

Your greatest challenge at the moment?

Establishing a research programme on the conceptualisation and modelling of socio-technical systems.

Most enjoyable aspect of work?

Discussing philosophical and other issues with my colleagues and working with PhD candidates and students. Administrative work is what I enjoy least.

Why Delft?

The question implies that the choice of Delft was something completely under my control. Like many things in life, chance also played a role in this. I came second in the application process, but more than six months later I received a telephone call out of the blue asking if I was still interested in the job because the candidate originally appointed had already left the position. I have ended up staying here a long time and that is not purely coincidental. I really feel at home here for many reasons. As a philosopher at a University of Technology, one is continually being challenged, explicitly and implicitly, to clarify how your discipline can contribute both to the education of future engineers and to the issues faced by engineers. This keeps you on your toes and ensures that you keep at least one foot on the ground in your philosophical work.

Best character trait?

I would rather leave others to make a judgement on that.

So if I asked someone who knows you well, what would they say?

In that case, I think they would say that you can rely on me, but that may be wishful thinking.

And what would they say was your worst character trait?

I would expect them to say something along the lines of impatient and a control freak.

Key issues on the political agenda?

One issue that I find increasingly intriguing and about which I would like to read more (although that will probably have to wait until I retire) is the difference between the public and private sphere and the government's relationship to both of these. Traditionally, the government has operated in the public sphere alone (the 'res publica'), but it seems that it is becoming increasingly difficult to draw the distinction or to construct it, because of all kinds of developments in which technology often plays a role. If this issue is ever on the agenda, it is usually based on concrete issues or proposals. What I think is missing is a more general debate about this difference and the basic principles on which it can be based. I would prefer to see such a debate on the social agenda rather than the political one, because it concerns us all.

"As a philosopher at a University of Technology, one is continually being challenged to clarify how your discipline can contribute both to the education of future engineers and to the issues faced by engineers."

Source of inspiration?

I do not have any specific philosophical or academic heroes. That does not mean that I do not learn a lot from other people; quite the contrary, but I tend to adopt a rather eclectic approach. In terms of philosophy in particular, I have issues with the formation of schools around 'major' philosophers, because I find this to be at odds with what philosophy should be about, which is a radical ('right down to the roots') questioning of the concepts and assumptions that we use to attempt to understand life. This kind of questioning does not sit well with the formation of philosophical schools because the latter assumes that certain points of departure cannot be questioned. I also hate philosophical fads; one moment everyone is inspired by one philosopher and then suddenly by another.

Personal philosophy?

This is a difficult one. Perhaps the best answer I can give is probably also the shortest: none. But an explanation of this answer would call for a long conversation with a good glass of wine under the Christmas tree...



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“I have become more versatile and a richer person”



One of the partners in EDGaR is ECN, the Energy Research Centre of the Netherlands, the country's largest research institute, which has a strong international reputation. Jeroen de Joode works at ECN. He started out as an economist, but now he is much more than that. He has already been called a gas expert. On 19 March 2012 De Joode will obtain his PhD under the supervision of TPM professor and member of the EDGaR board Margot Weijnen. For his research into the regulation of the gas infrastructure, Jeroen spent over five years working part-time for TU Delft and ECN.

Both the press and politicians regularly consult Jeroen de Joode for his expert opinion regarding developments in the gas market. “Of course that's great, but I was quite surprised to start with. Ten years ago I knew no more about gas than the average Dutchman. By now I know just what an important subject gas is. It is often in the news, and that's hardly surprising as the Netherlands has a unique position on the gas market. And I am also now aware of just how few researchers there are who look

at the usefulness and necessity of developments in the gas sector through the eyes of an economist, coupled with knowledge of the characteristics of this specific sector. So it doesn't take much to be an expert...”

Thesis

Jeroen de Joode studied general economics in Tilburg and did his traineeship at the CPB, the Netherlands Bureau for Economic Policy Analysis. His Master's thesis was on Russian gas and the European security of gas supply, a subject that was already topical and came his way purely by chance. After graduating he continued to work at the CPB on the gas supply security question, until his contract ended and was not renewed due to cutbacks. He continued working on the gas theme at ECN, where the thought of a PhD research programme appealed to him. While at the CPB he had already written a proposal for this, 'together with people in the sector' among whom were some TPMers. Jeroen: “First there was no money for this, but this came later with the new Next Generations Infrastructures research programme. I was employed for 50% by TU Delft and 50% by ECN, an interesting combination. It is very good for the department to have some PhD students who are affiliated to other institutes, and it is also good for collaboration and contacts with the sector.”

His 50/50 contract lasted from May 2005 to December 2010.

“Since then I have worked full-time for ECN, putting the finishing touches to my PhD thesis in my free time. What I learned most at TPM was to see things in a broader perspective than a pure economist is used to doing. This has made me more versatile and a richer person. I am now more able to identify with the position of the various parties, who often have their own interests at heart.”

EDGaR-projects

At ECN Jeroen de Joode is working on two EDGaR projects. One of these examines the interaction between the gas market and other markets, particularly the energy market. Core questions include how the energy transition on the electricity market is being realised, how this affects the gas market and the consequences for the infrastructure. “In the long term, the role of gas will diminish. But how small will this role be, and is this a good idea? That is what we are looking at in the other project. To what extent should we be dependent on electricity and to what level must we, or do we want to, invest in gas infrastructure in the future? There is still a lot of calculating to be done.”



ALUMNUS MENNO NEDERVEEN:

“Right now I can use my skills in technology, later I hope to use them in management”

Menno Nederveen graduated on 18 October under Professor Margot Weijnen. In his final thesis 'What is a gas hub? Putting European gas hubs in perspective' he describes gas hubs from various perspectives. He also charted the main concepts and causal relationships in the development of European gas hubs. His thesis ties in perfectly with the EDGaR research programme which examines the development of the Dutch gas infrastructure.

Gasunie and the Dutch government argue that the Netherlands must not become too dependent on other countries for gas. The idea is to create a 'roundabout' in the Netherlands, fed by gas from various sources and countries. The Netherlands can then distribute this gas to other countries in Western Europe via all sorts of flows. The 'gas roundabout' is related to the American concept of the gas hub, a physical intersection of gas pipelines where gas is stored [gas flows meet].

During his research Nederveen assumed the situation in the Netherlands was comparable to the American situation, but it turned out to be completely different. “Here the gas does not come together at one physical point. You need to see the whole of the Netherlands as a gas hub, with liquid gas entering the country in Rotterdam and Russian gas via new connections with the Nord Stream pipeline in the east of the country. And we also have Slochteren and the cross-border connections to Germany,

England and Belgium, as well as the large-scale storage facilities being developed.”

Body of knowledge

Because the situation in the Netherlands is so different to America, Nederveen's study started off on the wrong track. It did not help that the scale of European gas hubs is so different to those in America and there was no source material available giving a clear description of European gas hubs. Nederveen: “This meant that various parties were examining gas hubs from different perspectives.” He invested a lot of time creating a body of knowledge. “I wanted to write a clear description of what European gas hubs are and to bring together the most important concepts. It cost me a lot of time and energy to complete this information source, which meant it took a long time before I could study the subject in the required depth.”

Nederveen's choice for TPM back then was surprising. Given his preference for technology one might have expected him to choose an aerospace or physics-related degree programme. “But I never saw myself tinkering with machinery or working in a lab”, he says. TPM offered the breadth he was looking for and it turned out to be an excellent choice, even though it did take some getting used to. “In the first year you take a lot of basic subjects. These are not really linked together, so I couldn't get a clear picture of where the degree programme was headed. In the second year a lot of modelling subjects were added and everything fell into place.”

Process engineer

Recently Menno Nederveen started work for E.ON as a process engineer on the Maasvlakte. “It's a fairly technical position, but the job fits perfectly with my desire to work in the energy sector.” He monitors all the processes throughout the entire organisation. How is the performance, and what can be improved? “I am involved in a lot of things, such as logistics, operations and maintenance. On the technical side I am involved right down to the valves. And the E.ON Maasvlakte plant is one of the most attractive locations there is as far as power stations go. In the long term I would like to progress within the organisation. Right now I can use my skills in technology, later I hope to use them in management.”

TPM's educational programmes

■ BSc Systems Engineering, Policy Analysis and Management ('Technische Bestuurskunde', TB) ■ MSc Systems Engineering, Policy Analysis and Management (SEPAM) ■ MSc Management of Technology (MoT) ■ MSc Engineering and Policy Analysis (EPA) ■ MSc Transport, Infrastructure and Logistics (TIL) (in cooperation with the Faculty of Civil Engineering & Geosciences and the Faculty of Mechanical, Maritime and Materials Engineering) ■ MSc Information Architecture (IA) (in cooperation with the Faculty of Electrical Engineering, Applied Mathematics and Computer Science) ■ MSc Geomatics (in cooperation with the Faculty of Civil Engineering & Geosciences and the Faculty of Aerospace Engineering)

Did you thoroughly read the available information and are you considering enrollment in a TPM-programme? Are you not sure your educational background is sufficient? Then please contact one of our study advisors: Drs. Marja Brand ✉ (m.j.c.c.brand@tudelft.nl) or Drs. Danielle Rietdijk ✉ (d.rietdijk@tudelft.nl).