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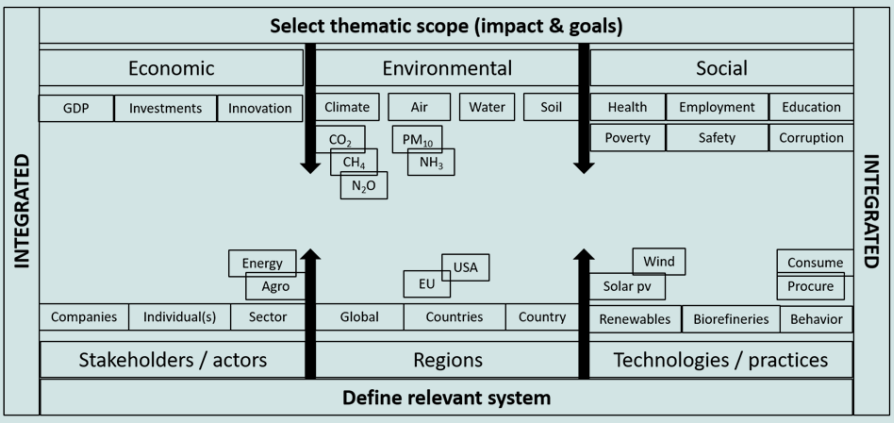
In this issue

An Integrated What? Editor's note by Eise Spijker

Throughout the years, JIN has been involved in policy discussions on energy, climate and the bioeconomy, either via a presentation at an event, or policy workshop attendance. The language used in such sessions is filled with abbreviations and jargon. One word in particular, has great appeal to many but has proven to be hard to define. Stakeholders use it frequently in different contexts for different purposes. Technology developers promote an integrated solution for their customer. The holy grail for policy makers is to develop an integrated policy framework. In research, integrated impact assessment models are quite popular. While in most settings the general sense of an integrated approach is clear; there rarely is consensus on what integrated exactly means.

While the dynamics of stakeholder sessions are such that, there is little time for a debate on the meaning of concepts; while summarising, drafting minutes or taking personal notes during such events I personally found it useful to define the concept integrated by exploring its relevant 'system' and thematic 'scope'. Both terms are borrowed from research and can be useful in exploring limitations and boundaries of the debate.

A 'system' can be many things, but often systems can be captured with the help of flow-diagrams, stakeholder mappings, or within a certain geographical area. What are the exact boundaries of this system?



Determining the 'scope' of a system, tends to focus more on which themes or topics are considered relevant. Are we talking about climate change mitigation alone? Or also on issues such as employment, air quality, safety, poverty, etc.? Asking such questions, helps to determine the scope. The graphic is an attempt to capture the essence of an integrated approach. If you have another (better) visual, please share it with us. We will feature some of them in one of our next communications.

The Role of the Education System in the Transition to a Circular Economy

To meet the objectives of the Paris Agreement, emissions of greenhouse gases will need to be reduced significantly in the coming decades. A key means of reaching this target is the transition to a circular economy. In a circular society, production and consumption cycles are closed, with 'zero waste': all products and materials are re-used or recycled for the same or another application. Energy sources are renewable.

In order to enable the transition to a circular economy, society will need to take great steps, not just technically, but also economically and socially (for example changes to new ways of consuming, travelling, recreating, etc.). The private sector plays a major role in this required transition. However, considering the wide spectrum of new knowledge and skills needed, also the education system needs to be adequately suited to prepare the citizens, employers, and employees of the future for the society and economy of the future.

Northern Netherlands research project

A consortium of six organisations (see the box) has inventoried the status of and readiness for circular economy in the education system in the northern part of the Netherlands. It was explored how circular economy and elements thereof are included in the curricula of all education levels, from elementary school to vocational and academic education. In other words: to what extent is someone who graduates prepared to get started with circular economy in the labour market? An additional question was how educational institutions and businesses can join forces to contribute to a circular economy and society. To answer these questions, the project team have conducted more than 60 interviews and surveys with representatives from all education levels, small and medium-sized enterprises (SMEs), business associations, NGOs, and the local and regional government.

Circular economy in education

The extent to which circular economy has been embedded into the education system differs per level of education.

The potential role of **elementary schools** is mainly to introduce children to the subject, creating awareness of the environment, and encouraging sustainable behaviour. As elementary schools are usually a central part of the community, awareness-building can have a wider reach than the pupils alone, also influencing parents and the village or neighbourhood. However, the inventory shows that attention for the theme of circular economy (or sustainability in a wider sense) at elementary schools remains very limited. Among teachers there is certainly support for the idea, but there is a lack of time, resources, and concrete plans.

Following on a basis of awareness-building in primary education, **secondary schools** could provide more fundamental knowledge on circular aspects. However, the inventory shows that there is only little activity related to sustainability or circularity, and it is not part of the standard curriculum. Occasionally projects on sustainability topics are organised, but these very much depend on one or a few motivated teachers or external organisations for environmental education.

DUURZAAM DOOR

provinsje fryslân
provincie fryslân

JIN Climate and Sustainability has coordinated a research project, taking stock of the current status of and potential for circular economy in education (including both the curricula and the school management), and potential collaboration with businesses. The project was cofunded by the province of Fryslân under the DuurzaamDoor programme, with the area of study being this province (for primary and secondary education) and the wider Northern Netherlands region (for tertiary education).

In addition to JIN, project partners included five organisations with much experience in the field of education: GOED (for elementary schools), IKcircuLEER and IVN (for secondary schools), NL projecten (for vocational schools), and Stichting SRF (for higher education).

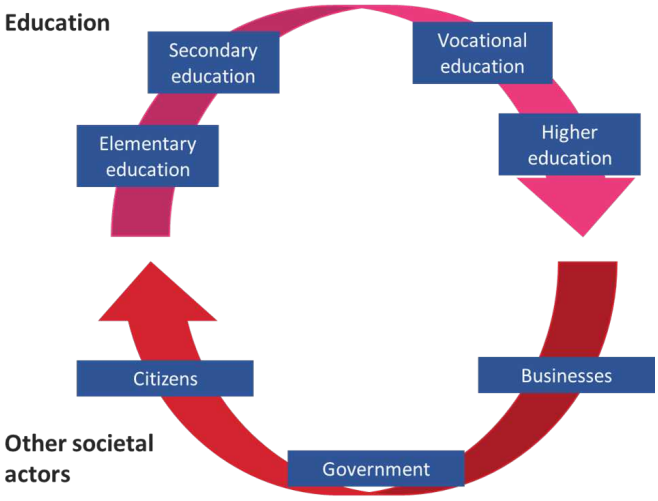


Figure 1. Schematic illustration of the 'circle' of education and society.

Schools for **vocational education** are closer to the labour market, and activities related to sustainability are increasing, which is also reflected in more familiarity with the topic of circular economy. However, there are significant differences between schools and between fields of study, with courses related to construction, engineering, and energy more focused on innovation and technical aspects of the circular economy. However, also here the progress depends on the motivation of individual teachers.

Finally, at **university**, sustainability and circular economy are key themes in several (mostly technical) courses and research centres. Still, circular economy is no integral part of academic education, and especially economics and business studies are still lagging (e.g. limited attention to the value of circular economy processes and benefits).

Collaboration between schools and businesses

For small businesses and local business associations interviewed, circular economy is hardly an issue of interest. Some local and regional business clubs have discussed topics such as renewable energy and waste separation, but for none of them sustainability is a key focus point. For individual SMEs, it is seen that a few leading entrepreneurs are very active and enthusiastic, but the majority is merely 'follower' out of necessity for regulatory or financial reasons.

Based on the inventory in Fryslân, businesses and business clubs agree that the skills and knowledge on circular economy and sustainability are insufficient. In addition, many agree that there is insufficient interest and attention for the topic. Related to this, many businesses feel that the education system insufficiently prepares the 'employees of the future' for issues related to circular economy and sustainability. As one entrepreneur puts it: "It is very important that these issues are taught to children from a young age, so circularity and sustainability will be automatic behaviour. Currently, sustainable behaviour is no automatism, and also often there is no incentive for it."

Both businesses and schools see opportunities for collaboration with regard to circular economy topics, but currently this is no common practice. Vocational schools have the closest cooperation with the private sector, for internships and work placement. However, sustainability or inclusion of circular economy topics is no criterion for selection of businesses, as due to a scarcity of available placements, schools must settle for any company that offers to be involved and they are not in the position to set additional demands.

One good current example of useful collaboration focused on sustainability is that students of a vocational school carry out a sustainability scan in their internship companies. The students are supported by students from a regional university. This programme leads to concrete suggestions for the businesses to 'green' their operations and at the same time the students get practical insights in the topics related to circular economy and sustainability.

Key issues

The inventory of circular economy in the Northern Netherlands' education field has led to the following key issues:

- **'Circular economy' is a difficult term**: many teachers and other stakeholders don't know the precise meaning, and they lack knowledge on how to develop education on this topic. Suitable teaching materials are often either not available, or difficult to find.
- **Growing attention for sustainability, but very much dependent on individual teachers**: 'sustainability' is a more common term and easier to understand, and attention for it is growing. However, initiatives related to sustainability depend on the enthusiasm and motivation of individual teachers, and widespread support (for example from the school board) often lacks.
- **No circular economy in economics education**: circularity and sustainability start to

become a topic of interest in technical education, but economics and business studies stay behind, both in vocational and in academic education.

- **Vocational education institutions collaborate closely with businesses, but hardly on circular economy and sustainability topics**: both schools and business associations are positive about the possibilities to collaborate on circular economy issues, for example through internships and work placement, but in practice this is currently no priority.
- **Progress on circularity in school management is slow**: large educational institutions usually have a strategy for sustainable building, renovation, and maintenance. However, in the daily practice of schools there is often only little attention for circularity and sustainability: at many schools there is no separate collection of waste. Involving pupils/students in sustainable school management is seen as useful at all education levels, but in practice this is not implemented.
- **Many good initiatives, but no integrated approach**: the final report of the study is titled in Dutch 'Parels zonder ketting' ("Pearls without a chain"). This signifies that there are various good practices, but an integrated approach towards a circular society is lacking. This means that good practices often remain one-off initiatives, and that many organisations need to "reinvent the wheel" because they are not aware of existing good practices.

Conclusions and recommendations

There is a gap between the increasing interest in circular economy in European and national policies on the one hand, and the embedding of the issue in education and wider society on the other hand. In the inventory, the research team has identified three challenges that are at the basis of this gap.

Firstly, the concept of circular economy is insufficiently known among teacher and pupils/students, which hinders active implementation. Teachers or other stakeholders that are motivated to work on circular economy issues therefore also feel a lack of support, as there is insufficient awareness of the topic and its importance among their colleagues and supervisors as well as the students. The first recommendation therefore focuses on awareness: a large-scale societal campaign is needed to stress the importance of circular economy for the society at large.

Secondly, it is found that there is insufficient collaboration and mutual learning. Good practices therefore remain one-time solutions that are often not copied to other schools. Although collaboration and discussion structures do exist, these are barely used for activities on sustainability and circular economy. The second recommendation does specifically not intend to set up new structures or organisations, but to establish a 'focal point' (a person or small organisation) with knowledge of ongoing circular economy-related activities, to redirect teachers and other stakeholders to the relevant colleagues or organisations that have experiences to share. This would enable mutual learning. Especially in vocational education it was also found that existing collaborative structures can be strengthened, and widened to focus more specifically on sustainability and circular economy. The boards of directors of the seven institutes for vocational education in the Northern Netherlands already meet regularly, so a focus on circular economy can be integrated. The same applies to the four universities of applied sciences.

Thirdly, related to the second point, it was found that there is the need for easily accessible information for teachers. Currently, it is difficult to find information on "who does what" and which persons or organisations can provide support services. It is also difficult to find teaching materials, guest lecturers, businesses for internships, etc. It is recommended that a central database is developed for such information, for teachers and other stakeholders to find, but also offer, information.

Report

In September 2017, the project consortium published the final report 'Parels zonder ketting' (in Dutch). The report can be downloaded from the JIN website. For more information about the project and its results, please contact Wytze van der Gaast (wytze@jin.ngo).

The project partners intend to continue the work on the programme, based on the three key recommendations focusing on awareness, networking, and information sharing, in collaboration with the local and regional governments, educational institutions, businesses, and other relevant stakeholders.

GHG and Energy Consumption: The Overlooked Challenges in Wastewater Treatment

By Evina Katsou and Vasileia Vasilaki*

Sustainable water management systems are in the heart of low-carbon and energy resilient economies. However, wastewater treatment plants (WWTPs) are vigorous energy consumers. For many European municipalities, they are the largest energy consumers with a share of 20% of the municipality's electrical load. On top of that, wastewater treatment facilities also emit greenhouse gases (GHGs). The direct GHG emissions, mainly connected to the treatment process, include methane (CH_4) and nitrous oxide (N_2O). Indirect emissions occur due to the use of energy. With a global warming potential (GWP_{100}) of 265 times higher than that of carbon dioxide (CO_2), N_2O is a potent GHG and the most significant contributor to ozone depletion.[1] WWTPs are responsible for 6% of the global anthropogenic N_2O emissions.[2] In the sewer system conveying wastewater to the treatment plants anaerobic conditions prevail, resulting in the emission of CH_4 (GWP_{100} CH_4 = 28).

Organic matter contained in wastewater has the potential to produce up to five times the energy required to treat the same wastewater. Through wastewater treatment and nutrient recycling up to 20% of the global phosphorous consumption can be extracted from wastewater; the nitrogen loads in wastewater are equal to 10-30% of the nitrogen required in agriculture. Considering that phosphorus was recently identified as a critical raw material for the European Union the need to pursue more energy and resource efficient waste water treatment practices becomes more important. We can recover and recycle these valuable nutrients from sewage and make use of them, thus reducing our needs for new (non-renewable / fossil) resources. A report by the United Nations Environment Programme and Stockholm Environment Institute[3] confirms this picture as it indicates that advances in wastewater management can facilitate European countries to accomplish up to 32 Sustainable Development Goals (SDGs) targets.

Scale-up of low-carbon footprint MAterial Recovery Techniques in existing wastewater treatment PLANTs: SMART-Plant is an EU-funded project (Horizon 2020 programme, running from 2016 to 2020) that will prove the feasibility of circular management of urban wastewater and environmental sustainability of the systems and co-benefits of scaling-up water solutions.

The opportunity

Luckily, the water sector is already shifting towards a philosophy of considering waste as a resource and recovering valuable materials and energy from wastewater streams. Zero-carbon, energy efficiency improvement and resource recovery are the dominant approaches that are currently implemented to improve the sustainability of WWTPs and boost the circular economy.

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1 Ravishankara, A.R., Daniel, J.S., and Portmann, R.W. (2009). Nitrous oxide (N_2O): the dominant ozone-depleting substance emitted in the 21st century. Science 326, 123–125.

2 Palut, M.P.J. and Canziani, O.F. (2007). Contribution of working group II to the fourth assessment report of the intergovernmental panel on climate change. Cambridge University Press.

3 Andersson, K., et al (2016). Sanitation, Wastewater Management and Sustainability: from Waste Disposal to Resource Recovery. Nairobi and Stockholm. United Nations Environment Programme and Stockholm Environment Institute.

The urgency to implement and upscale these approaches in the water sector throughout the EU will be massive in the coming years. This transition will on the one hand be powered by water utilities, which are seeking to increase their revenues by recovering compounds and materials from sewage, which are currently lost. On the other hand water utilities are struggling to comply with the Urban Waste Water Treatment Directive (91/271/ECC) and seeking to increase efficiency and reduce operating costs. In the EU alone, the investment required for compliance with the directive and for upgrading existing infrastructure is projected to be equal to ~$25 billion in 2018 alone.[4]

A great transition is ahead of us. We can choose to replace aging infrastructure with new generation wastewater recovery facilities, equipped with state-of-the-art technologies that would not only provide clean water, but also recover resources nutrients and energy. These facilities recover valuable materials, reduce the cost, lower the environmental impact and provide energy to the local community.

SMART-Plant: wastewater as a resource

The SMART-Plant project involves 25 water utilities, companies and universities, to transform the water services from norm followers to leading biorefineries of the 21st century. The project showcases a challenging endeavor: to design, construct, operate and optimise technologies that recover energy and valuable materials from wastewater. Materials (e.g. biopolymers, cellulose, nutrients including struvite, and phosphorus rich compost) will not only be recovered, but also transformed into commercial products, namely fertilisers and biocomposites, or used to recover energy.

For example, in the Netherlands, the municipal WWTP of Geestmerambacht is working together with Cirtec and Brunel University to recover dry toilet-paper pellets from raw wastewater and transform it to an energy source and to a new type of sludge plastic composite with applications in the automotive and construction industry. Other demo/pilot projects include: the Short-cut Enhanced Phosphorus and Polyhydroxyalkanoates Recovery (SCEPPHAR) scheme at Manresa-site in Spain; the sidestream short-cut nitritation-denitritation demo called SCENA (Short-cut Enhanced Nutrient Abatement) at the Carbonera-site in Italy; the sidestream SCENA enhanced by thermal hydrolysis pre-treatment at the Psyttalia-site in

Greece; the secondary mainstream anaerobic treatment by polyfoam biofilter and biogas recovery at the Karmiel-site in Israel; and the tertiary nutrient recovery by ion exchange at Cranfield (UK).

In order to overcome the sustainability challenges of the water industry, SMART-Plant aims to dynamically integrate crucial environmental performance variables, such as GHG emissions and energy consumption into the monitoring and control system of the wastewater treatment technologies demonstrated in this project. Energy consumption and GHG emissions will be continuously monitored and introduced into a cost-effective, dynamic and robust carbon-footprint assessment platform. The SMART-Plant project will use the methodologies developed earlier under two other EU-funded projects. The C-FOOT-CTRL project has developed a software tool that enables sewage treatment plant operators to track and limit GHG emissions at their plant and pinpoint the most environmentally harmful activities. The ENERWATER project develops and validates an innovative standard methodology for assessing, labelling and improving the overall energy performance of WWTPs.

We will investigate dependencies and patterns between direct GHG emissions, energy consumption, and operating variables monitored online in WWTPs in order to identify combinations of operating variables that optimize the environmental performance of the systems. The SMART-Plant energy and carbon footprint platform will improve the effectiveness of the water governance by delivering sustainable water treatment processes that improve wastewater treatment in terms of sustainability and energy consumption. The developed methodological framework is transferrable to any new/existing plant and will provide a guide towards applying operating conditions that lead to energy and carbon efficiency. SMART-Plant 'smart-metering' solutions will benefit the water sector by reducing energy consumption.

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* European Commission (2016). Facts and Figures about Urban Waste Water Treatment (link).

Is the EU Gas Sector 'Greening'?

By Catrinus J. Jepma, Charlotte van Leeuwen and Daan Hulshof*

One of the concerns of the European Union is to not only turn the power sector into green, but to also make sure that the world of energy molecules is getting green as well. The gas sector is a typical part of the energy system where greening is developing, but is developing slowly. In a recent study carried out in the framework of the Horizon 2020 STORE&GO project, it was investigated how the greening of the gas sector, responsible for about a quarter of the overall EU energy system, proceeds. The STORE&GO project is a large project in the group of low-carbon economy (LCE) projects in which, with the help of three dedicated pilots in Germany, Italy, and Switzerland, it is investigated what the potential is of methanation, i.e. combining (green) hydrogen with (green) CO_2 in order to create a green syngas consisting of methane.

The current 'green gas' market

In order to analyse the greening of gas uptake, it is important to note that currently the European Union consumes annually about 400 to 450 bcm natural gas, if completely burned corresponding with an annual CO_2 emission ranging between some 710 and 800 $MtCO_2e$. With regard to the future, the EU reference scenario assumes that by 2030 the overall gas consumption will not be much different, albeit that by then the current (2016) import share of natural gas of 72% will have increased to about 79%. The target of the EU is to reduce its greenhouse gas (GHG) emissions by 80 – 95% below 1990 levels by 2050. This means that natural gas can no longer be used by that date, unless the CO_2 linked with the burning of natural gas can be stored underground or otherwise compensated by additional mitigation.

So far, the greening of the gas system, based on biogas and biomethane, has proceeded to a share of about 4%. This greening has typically focused on the introduction of biogas and biomethane, almost exclusively produced with the help of anaerobic digestion technology. Subsidy schemes have promoted the production of biogas, although with varying success across the EU Member States. Most of the biogas throughout Europe is produced in the North-western part of it, with Germany being a clear champion (about half of the EU production volume). Due to technical and cost issues, only a limited share of the biogas is upgraded such that it can enter the grid as biomethane: so far some 11% only. The rest of the biogas is directly used for the production of heat and power, but is included in the 4% mentioned.

Future 'green gas' scenarios

How much can this share of green gas grow in the next phase of the energy transition? Estimates as to how this share may increase towards 2030 differ, because this progress will obviously depend on incentives, public acceptance, and technology learning curves. The study concluded that scenarios that can be considered optimistic in this regard suggest that

STORE&GO

In the EU-funded STORE&GO project, 27 partner organisations and companies from all over Europe collaborate to integrate power-to-gas technology into the future European energy system. The project, coordinated by the German gas association DVGW, demonstrates three innovative power-to-gas storage concepts at locations in Germany, Switzerland, and Italy in order to overcome technical, economic, social, and legal barriers.

The University of Groningen works on several research topics within the STORE&GO project, including relevant licensing and regulatory regimes, environmental impact assessments, and an analysis of the business and economic aspects of the market uptake of power-to-gas energy storage.

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the current 4% share could grow towards 12%, at least if biomass gasification technologies – currently still in their infancy – would also add somewhat to the volume.

Although methane is currently the most important gaseous energy carrier in our economy, hydrogen could fulfil a similar role. A gradual shift from our current natural gas-based world to a hydrogen economy could take place in the foreseeable future. Hydrogen from renewable sources is therefore also considered in this report.

Power-to-gas

So, a relatively new development in 'greening' gas is the power-to-gas technology in which renewable power from wind and solar energy is turned into green hydrogen. The green hydrogen can be used directly but also be further converted in either green methane via methanation, or into green liquids through various conversion technologies. Although power-to-gas technologies are just only in their pilot stage - with across Europe currently some 40 pilots on this technology running - this technology is considered a promising new way to turn renewable energy surpluses into an energy form that is easy and cheap to store, to transport, and to apply. The technology, however, still has to go through a considerable part of the learning curve, which explains why most scenarios assume that by 2030 it is unlikely that considerable volumes of green gases (hydrogen or methane) will be put on the market based on power-to-gas technologies.

Still, it seems not unlikely, obviously depending on the incentives towards this technology, that by 2030 green gases based on power-to-gas will represent a few percent of the EU-wide gas volume. After that year, it is well conceivable that power-to-gas technology and the green gases based on it will exponentially grow in use throughout Europe, especially if mobility would turn massively towards green hydrogen/green gas cars, and if the chemical industry would (need to) replace hydrogen feedstock from natural gas by green hydrogen from renewables.

'Green' certificates

How much of the gas will be green by 2030 also strongly depends on the acceptance of certificates, as is illustrated by Figure 2. The figure illustrates that fossil gas can be put on the market as 'grey' gas, 'green' gas, or compensated gas:

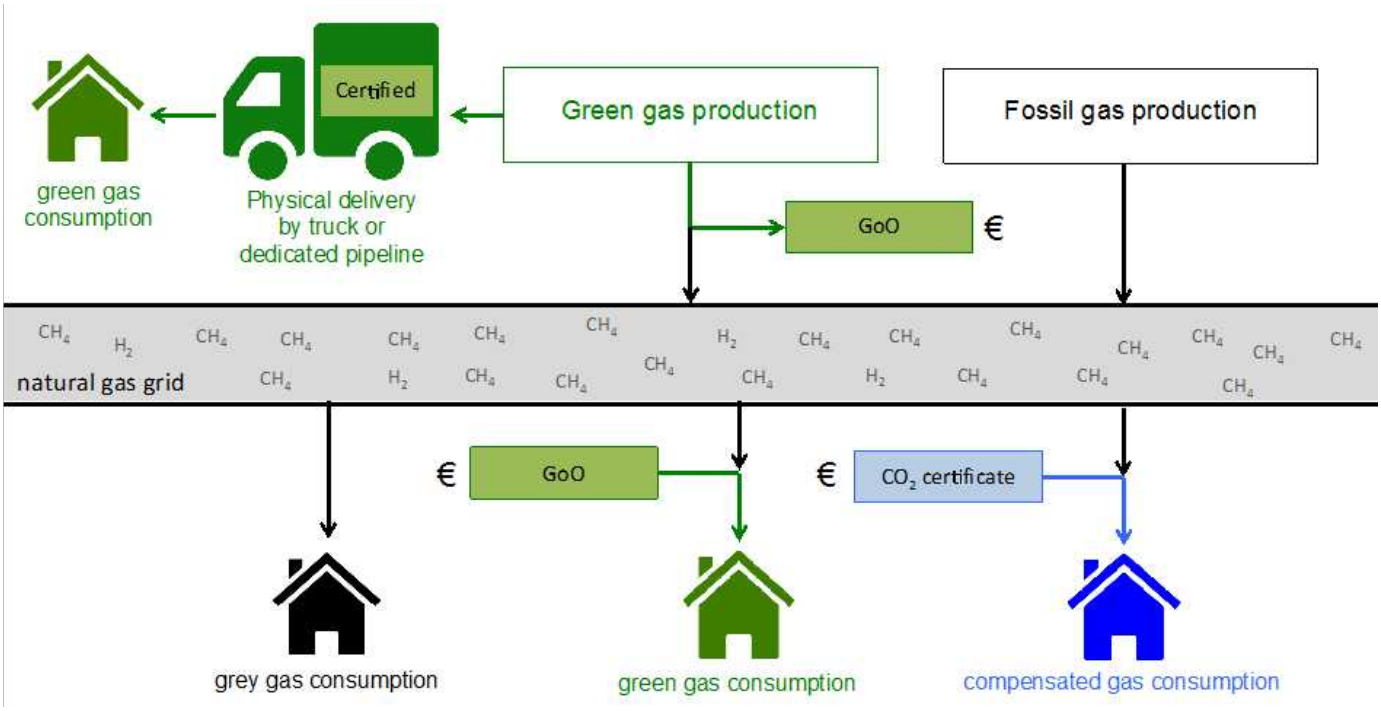

Figure 2. Illustration of the use of certificates with the production, delivery and consumption of green and grey gases, valid for both methane and hydrogen. Green gases can be transported by trucks or through dedicated pipelines to be delivered physically. Alternatively, they can be transported through the natural gas grid, but here, no physical dis-tinction can be made anymore between green and fossil gases. Certificates therefore have to determine which consumers consume green gas. Besides GoOs generated with the production of actual green gas, alternative CO2 certificates from e.g. afforestation projects can be used to compensate the CO2 emissions that arise from natural gas consumption.

- **'Grey' gas**: fossil gas, recognising its CO_2 footprint;
- **Compensated gas**: gas that is combined with a CO_2 certificate, compensating for the CO_2 footprint of the (fossil) gas;
- **'Green' gas**: gas combined with a guarantee of origin (GoO) derived from physical green gas production, whereby the GoO is transferred from the original 'green' gas to the fossil gas.

Obviously, in the latter case, the physical 'green' gas from which the GoO has been transferred, can no longer be considered 'green'.

So, on the one hand, guarantees of origin (GoOs) are certificates based on the physical production of green gases. On the other hand, CO_2 certificates are based on other ways of reducing GHG emissions of all kinds globally, such as forestry projects. The certificate market,a' buoyant under the Kyoto Protocol regime, has currently been less prominent in volume worldwide, but could easily grow again in volume if the demand or certificates in order to 'green' e.g. natural gas would grow. It is difficult to make any projections for 2030 on the degree to which certificates could grow in importance to 'green' the about 400 bcm of gas to be consumed across the EU in 2030 (according to the EU reference scenario), but this share could become substantial indeed. Scattered information suggests the increase in popularity of this way of 'greening' gas.

STORE&GO report

In the STORE&GO report, the various factors determining the greening of gas across the EU by 2030 have been inventoried, and summarised in four scenarios, that differ in the degree to which markets on the one hand and policies and measures on the other hand create incentives to get to green gases. In the two extreme scenarios, either (in the optimistic scenario) the share of green gas would grow towards 13 to 14% even if the 'greening' through CO2 certificates would not be included, or (in the pessimistic scenario) the current share of about 4% would hardly grow (some 4.5%), again excluding the greening through CO2 certificates. Obviously, if the 'greening' through CO2 certificates is included in the scenarios, the differences mentioned could grow towards much wider proportions.

For more information, see the report "Exploring the future for green gases" on the STORE&GO website.

The Heat Is On!

The Local Heat Energy Transition in Midden-Drenthe, Netherlands

In the framework of the EU-funded PUBLENEF project, JIN Climate and Sustainability supports the Dutch municipality of Midden-Drenthe in its ambition to become energy neutral. The municipality aims to reduce local energy demand, while ensuring that the remaining energy consumption will be fully locally (or regionally) generated without a carbon footprint. In the process, there is a specific focus on heat energy, which makes up more than half of the municipality's energy use.

The heat energy transition

Looking at the ambition to become energy neutral, a distinction can be made between three energy carriers: electricity, heat, and transport fuels. With wind and solar energy capacities expanding year-on-year, the transition in the electricity system has already reached a certain level of maturity. Influencing the transition in transport fuels is

PUBLEnEf

JIN Climate and Sustainability coordinates the EU-funded PUBLENEF project. The project aims to assist EU Member States in implementing effective and efficient sustainable energy policies, with a focus on energy efficiency, and empower them to make use of the best practices and policy processes implemented in other Member States at the national, regional, and/or local level.

The PUBLENEF partners support specific regions and municipalitiesin 12 EU Member States on energy efficiency-related policy challenges. In the Netherlands, JIN supports the municipality of Midden-Drenthe on issues related to its energy strategy and citizen engagement.

considerably more challenging, particularly since municipalities have a lower degree of (policy) influence on the mobility sector.

The heat transition is becoming more and more important in the Netherlands. On 10 October 2017, four political parties (VVD, D66, CU, CDA) published their political agreement to form the government for the 2017-2021 period.[1] One important paragraph of that agreement includes that by 2021, all new buildings will no longer automatically be connected to the gas grid, and there is the ambition to disconnect around 50,000 existing buildings per year from the gas grid. The final goal is to convert the entire Dutch building stock to alternative forms of heating by 2050. Since the heat transition has a strong local focus, with local solutions and local actors, municipalities can anticipate a role as facilitator and mediator in the heat transition (including space heating for houses and other buildings, and for industrial processes).

Out of the total energy consumption in Midden-Drenthe (5,590 TJ in 2015), more than half (3,139 TJ) is heat, compared to 670 TJ for electricity and 1,781 TJ for transport fuels.[2] Midden-Drenthe is not exceptional in this, also in the country as a whole, heat makes up more than half (about 55%) of the energy consumption.

About 22.7% of all energy consumed in Midden-Drenthe is coming from renewable resources. This shows that Midden-Drenthe still has a long way to go to become energy-neutral (in heat, transport and electricity combined). This 22.7% is higher than for most other regions in the Netherlands because of the renewable electricity generated by a large waste incineration plant located in Midden-Drenthe, which is processing the waste of a large part of the Northern Netherlands.

Most heat in the Netherlands is generated using natural gas, with about 96% of all households being heated using natural gas. The Netherlands (still) is the European Union's largest natural gas producer. This mainly is because of the Groningen gas field, the largest on-shore natural gas field in Europe. However, the end of the gas production is in sight, as reserves are steadily declining. On top of that decades of onshore gas extraction has started to induce a rise in earthquakes, particularly in the Northern part of the Netherlands. Thus far the most severe induced earthquake in the North has been at 3.6 Richter scale, which is quite high in a country that is not located near any major fault line of the tectonic plates. This also makes that large-scale gas production is no longer considered socially acceptable. Apart from lowering gas consumption to reduce greenhouse gas emissions, additional (political) drivers for the heat energy transition include maintaining energy security, lowering (future) import-dependence of natural gas, and earthquake prevention.

Heat transition target for Midden-Drenthe?

Within Midden-Drenthe under a 'business-as-usual' scenario, about 1.1% of the total housing stock of about 14.000 is replaced annually, through demolition and/or new construction (see Table 1). This usually contributes positively to the energy performance of the housing sector, as demolition often involves older buildings, while newly constructed houses have to comply with the latest building standards with regard to energy performance.

Assuming that the rate of demolition and new construction remains constant, most of the heat transition would involve conversion of the existing building stock. Considering that an average house is substantially renovated once per 45-50 years, about 2.25% of houses in Midden-Drenthe are renovated

		%	Number of houses converted per year in Midden-Drenthe	Cumulative in 2018-2050 period
Demolition	Business as usual	1.1%	155	5,115
New buildings	Business as usual			
Renovation	Policy focus links to 'natural rate' of renovation	2.25%	320	10,560
Total		***3.35%***	***475***	***15,675***

Table 1. Rough calculation: number of houses that can be covered by the transition in Midden-Drenthe, 2018-2050.

1 In Dutch: Vertrouwen in de toekomst: Regeerakkoord 2017-2021.

2 Energy statistics source: Klimaatmonitor. Rijkswaterstaat, Ministry of Infrastructure and the Environment.

annually. If the municipality ensures that the heat transition is included in all new construction and all renovations, about 3.35% of the building stock can undergo the transition every year, which would mean that in some 30 years the entire local housing stock can be converted.

Alternatives for heat

Based on the abovementioned developments, the demand for heat will have to be filled in another way than using natural gas. A lot of existing buildings will need to be retrofitted. The transition will also have huge social implications, as it will affect the houses of seven million households in the Netherlands.

First and foremost, the heat transition requires major investments in both energy efficiency and energy savings measures. Roof, floor, wall insulation, double glazing, etc. will all be needed to bring down the heat consumption. After that, alternative heat generation and supply systems will need to be embedded in the energy system to enable the replacement / phase-out of gas-based equipment. There are numerous options for alternative heat supply, including heat pumps, district heating, block heating, wood/pellet stoves, solar boilers, geothermal, heat storage/buffering, biogas, renewable gases, etc. Which option eventually will prevail largely depends on local circumstances, local potentials and preferences. Although the Dutch government's 'Energy Agenda' states that in principle no new gas grids will be built in new construction areas, and gas fired heating systems will not be converted from low-calorific (domestic) to high-calorific (imported) gas, it should be no surprise that the national government leaves it up to local governments (municipalities) to decide on the most appropriate energy savings and alternative heat options. It is expected that per type of housing (e.g. terraced housing, semi-detached housing, apartments, farmhouses, etc.), per neighbourhood, per region, but also per household (financial capacities) and per individual (age, education level, etc.), the preferred heat alternative will differ. The role of the municipality will be to trigger and facilitate both individual actions as well as collective actions (e.g. in case of a district heating system).

The PUBLENEF project aims to assist Midden-Drenthe in the process to become energy neutral in the area of heating. The support will focus on helping the municipality and other relevant local stakeholders to

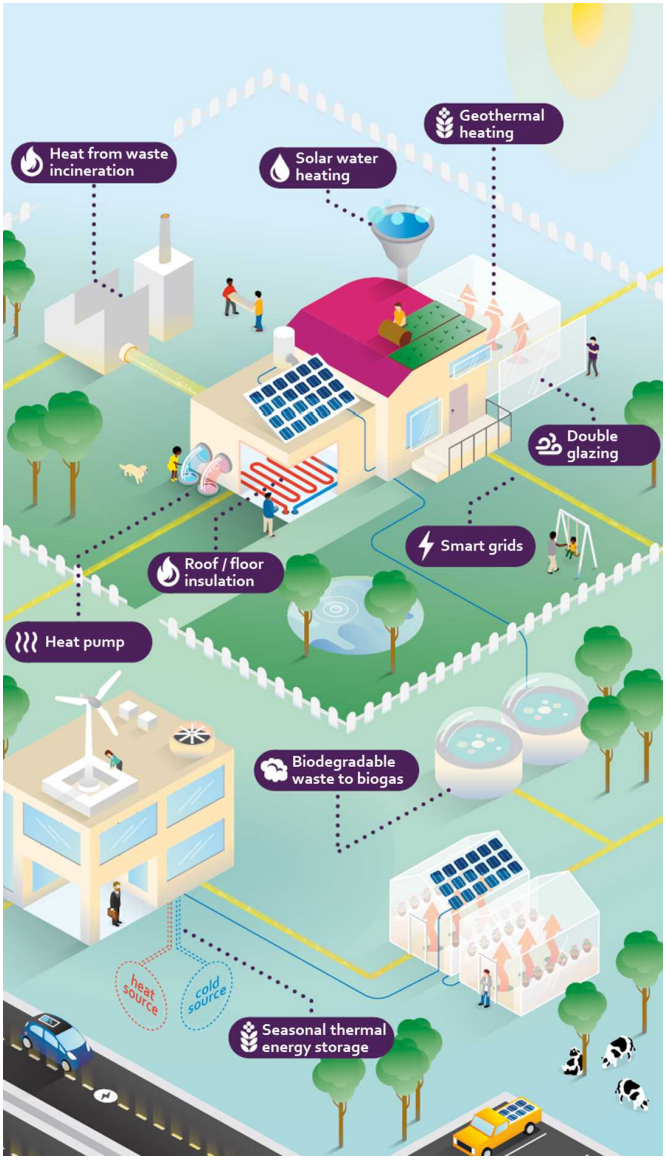

Figure 3. Infographic 'sustainable heating for buildings in 2050' from the Dutch Ministry of Economic Affairs.[3]

inventory and identify the specific local preferences with regards to efficient and alternative heating systems. Aside from helping in the local preferences, there will also be a need to assess which contextual factors (demographic, social, economic and environmental) influence the capability and willingness of individuals or organisations to invest in the heat transition from the bottom-up. A key ingredient in this process will be to seek meaningful and effective collaboration with existing social networks in the neighbourhoods, villages and country-side, such as the district council, house owner associations, sports clubs, etc.

3 Image translated from Ministerie van Economische Zaken (2016). Energierapport Transitie naar duurzaam.

Lost in Transition?

By Eise Spijker*

A fundamental energy system transformation, the food system transition, or any other transition process puts societies to the test. How do we keep world regions committed to such transitions? How to avoid freeriding? How to combat climate change without frustrating economic growth and social development? Transitions typically introduce a shock to systems, such as ecosystems, social systems, infrastructure, and institutions. Big societal transitions rarely can be orchestrated solely from the top-down. While we need international framework agreements and strategies, bottom-up actions are crucial for success. Decision-making in a complex interface of individuals, groups of individuals, and systems is not easy, as objectives, scope, scale, contexts, norms, (cultural) values and preferences differ. International agreements rarely have the same meaning and impact on all regions; let alone on individuals. Yet, we need to speed up the transition towards a more sustainable society. How do we avoid getting lost in the complexity of transitions?

Literature on transition management is helpful to understand the governance process and complexities of sustainable development. Understanding this is one thing, but organising collective action at the desired scale and time is another. First, collective action requires engagement of all relevant stakeholders. Second, a shared sense of urgency to take action is needed. Third, all relevant positive and negative co-effects of the transition need to be identified and quantified. Fourth, the selection of technologies and practices should be driven by a proper appreciation of development priorities (weighting). The research community has a proven track-record in quantifying and mapping co-effects and impacts with the help of integrated assessment models (e.g. TRANSrisk project), life cycle impact assessments (e.g. BIOTEAM project), or social cost-benefits analysis. Also methods like multi-criteria decision analysis can help to explore preferences, set development priorities, and make choices. There are, however, very few staunch approaches to ensure engagement of all relevant stakeholders, and even less robust methods to generate a commonly shared sense of urgency.
JIN Climate and Sustainability, as partner in the EU project PUBLENEF, supports the Dutch municipality of Midden-Drenthe in its efforts to become energy neutral. Triggering active involvement of home-owners in the transition process (to disconnect from the natural gas grid and switch to alternative heating systems) will be one of the key challenges. See also the article on pages 9-11. We anticipate to have to break the transition process down at the level of individuals, and better understand both personal drivers and the various stages people go through when confronted with change. It is at this point where bottom-up actions meet with top-down transition strategies. Theories on personal and organisational change can teach us which stages we (as individual) go through when facing a transition. As an example, I found myself hovering between stages 3 and 4 of the the ADKAR model in the personal energy transition for my own house (see the table below). Which transition stage are you in?

Awareness of the need for change
Yes, awareness was already since 2013 when my wife and I moved in our 'new' house; an early 20th century single wall country house with wood stove and propane heating system. Our previous apartment was a highly insulated new build with a renewable heating/cooling system.
Desire to support the change
Desire to support this change has been there, but it has not been easy to get this on top of the household priority list, with two young daughters growing up.
Knowledge of how to change
A fair share of information gathering on floor, roof, wall insulation and efficient heating systems has been done. Also funding options have been explored, including a good chat with my current mortgage provider.
Ability to demonstrate new skills and behaviours
The first action (2015) was to install double-glazed windows. The 'bigger' measures (roof, walls, floor) had to wait, but a window of opportunity is about to open up as our youngest daughter will go to primary school in a few months. A considerably lower monthly day-care bill will free up some funds that could finance this transition.
Reinforcement to make the change stick
Since it involves physical changes, the change is likely to stick. Other reinforcement mechanisms are the anticipated lower energy bill, and the expected increase in in-house comfort. Incorporating smart metering and monitoring systems in the process also seems like a good idea.

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Reports

Open access / free of charge

Bickersteth, S., Dupar, M., Espinosa, C., Huhtala, A., Maxwell, S., Pacha, M.J., Sheikh, A.T. and Wesselink, C., 2017. Mainstreaming climate compatible development, Climate and Development Knowledge Netwerk, London, UK.
CDKN's flagship book draws from the alliance's seven year experience of supporting climate compatible development in Asia, Africa, Latin America and the Caribbean. The book provides recommendations on how to achieve low-carbon, climate-resilient development in low income and emerging economies. Pragmatic lessons are shared on making the political case for climate action; planning; mobilising financial, human, and institutional systems and resources; scaling up ambition; and leveraging the momentum.

German Emissions Trading Authority (DEHSt), 2017. Robust Accounting of International Transfers under Article 6 of the Paris Agreement, German Emissions Trading Authority at the German Environment Agency, Berlin, Germany.
This discussion paper explores key issues and options to ensure robust accounting of international transfers from market mechanisms under Article 6 of the Paris Agreement. The paper first provides an overview of key issues that must be addressed to ensure robust account and highlights approaches to address them. The further analysis focuses on: the nature and scope of „internationally transferred mitigation outcomes" under Article 6.2 of the Paris Agreement, discussing possible definitions and scopes; how double counting of emission reductions could be avoided through „corresponding adjustments", taking into account the diversity of nationally determined contributions under the Paris Agreement; how the vintage of mitigation outcomes and the timing frames of mitigation targets, including single-year targets, can be accounted for; and how the transfer of mitigation outcomes can be tracked.

IRENA, 2017. Synergies between renewable energy and energy efficiency, a working paper based on REmap, International Renewable Energy Agency, Abu Dhabi, UAE.
Renewable energy and energy efficiency work in synergy. When pursued together, they result in higher shares of renewable energy, a faster reduction in energy intensity, and a lower cost for the energy system. This also has important environmental and societal benefits, such as lower levels of air pollution. IRENA has explored this synergy, and shows that the combined deployment of renewables and energy efficiency contributes significantly to a realistic, timely and affordable reduction pathway to meet global climate objectives.

Michaelowa, A. and Hoch, S., 2017. Guardrails for the Paris mechanisms: Operationalizing Article 6 and generating carbon market credibility, Carbon Mechanisms Review, issue 3/2017, pp. 4-9.
With the clock ticking for operationalising market mechanisms under Article 6 of the Paris Agreement, this article highlights the critical issues to be resolved in the negotiations on the Article 6 rulebook. These issues include among others defining roles for stakeholders; ensuring additionality; limiting transaction costs; ensuring sustainable (co-)benefits; and how to ensure the functioning of carbon markets with little or no international oversight. The article includes practical recommendations for the negotiations.

Mizuno, Y., 2017. Proposal for Guidance on robust accounting under Article 6 of the Paris Agreement, Insitute for Global Environmental Strategies, Hayama, Kanagawa, Japan.
This material aims to illustrate description of the concrete proposals for guidance on robust accounting under Article 6, paragraph 2 of the Paris Agreement. It includes guidance on the avoidance of double counting, on accounting rules for various types of NDCs and for sectors not covered by NDCs, and the issues of double registration, double issuance, and double usage.

Nikas, A., Doukas, H., Lieu, J., Alvarez Tinoco, R., Charisopoulos, V. and Van der Gaast, W., 2017. Managing stakeholder knowledge for the evaluation of inovation systems in the face of climate change, Journal of Knolwedge Management, vol. 21, no. 5, pp. 1013-1034.
The aim of this paper is to frame the stakeholder-driven system mapping approach in the context of climate change, building on stakeholder knowledge of system boundaries, key elements and interactions within a system and to introduce a decision support tool for managing and visualising this knowledge into insightful system maps with policy implications. It is

the first study that clearly defines the system mapping approach in the frame of climate policy and introduces the first dedicated software option for researchers and decision makers. System mapping can contribute to evaluating systems for climate change by capturing knowledge of expert groups with regard to the dynamic interrelations between climate policy strategies and other system components, which may promote or hinder the desired transition to low carbon societies.

Peterson St-Laurent, G., Hagerman, S. and Hoberg, G., 2017. Barriers to the development of forest carbon offsetting: Insights from British Columbia, Canada, Journal of Environmental Management, vol. 203, part 1, pp. 208-217.
This paper uses the case study of British Columbia to explore the barriers associated with achieving widespread implementation of forest carbon offsets in the next several decades. Drawing on interviews with experts from government, non-governmental organizations, the private sector and First Nations, six main barriers are identified and discussed: deficiencies of carbon markets, limited economic benefits, uncertain climate effectiveness, negative public opinion, limited and uncertain property rights, and governance issues.

Wynes, S. and Nicholas, K.A., 2017. The climate mitigation gap: education and government recommendations miss the most effective individual actions, Environmental Research Letters, vol. 12, 074024.
This article recommends four widely applicable high-impact (i.e. low emissions) actions with the potential to contribute to systemic change and substantially reduce annual personal emissions: having one fewer child, living car-free, avoiding airplane travel, and eating a plant-based diet. The authors argue that these four actions have much greater potential to reduce emissions than commonly promoted strategies such as comprehensive recycling or changing lightbulbs. It is suggested that there are opportunities to improve the existing structure in education to promote these effective strategies.

Zamfir, A.-M., Mocanu, C. and Grigorescu, A., 2017. Circular Economy and Decision Models among European SMEs, Sustainability, vol. 9, no. 1507.
This paper explores entrepreneurial decision models for adopting circular economy practices, focusing on European SMEs. Using decision tree models, business strategies are uncovered for the optimal level and nature of investments in the circular economy at the company level. The article offers a better understanding of the relation between characteristics of European SMEs and their decisions in the field of circular economy.

Zhang, Z. and Zhang, Z., 2017. Intermediate input linkage and carbon leakage, Environment and Development Economics.
Climate regulations tend to target energy-intensive sectors whose products are widely used in industrial production as intermediate inputs, and carbon abatement may be partially offset by intermediate input-led leakage. This paper aims to examine the impact of intermediate input linkages on carbon leakage both theoretically and empirically. When imposing a carbon price on the electricity generation sector, the results show significant sectoral carbon leakage. Our decomposition analysis further suggests that such leakage is mainly through the production substitution effect and the multiplier effect. The results highlight the importance of sectoral linkage when discussing the carbon leakage issue of climate policies.

Box 1. Climate Change Mitigation portal.

Online portal highlighting EU-funded research on reducing emissions

The ClimateChangeMitigation.eu portal highlights information from different EU-funded research and coordination projects emission reduction. The portal covers a range of mitigation-related topics, including mitigation technologies and practices, scenarios and models, links to relevant data sources, case studies, policy information, and stakeholder engagement. 13 EU-funded projects have joined the portal, and additional projects are invited to become involved!
Linked to the online portal, updates on mitigation research are shared on Twitter using the #mitigationEU hashtag.

JIQ Meeting Planner

6-17 November 2017, Bonn, Germany
2017 UN Climate Change Conference: 23rd Conference of the Parties (COP23) under the Presidency of Fiji
cop23.com.fj

8-9 November 2017, Aarhus, Denmark
7th Annual European Biomass to Power
wplgroup.com/aci/event/european-biomass-to-power

27-29 November 2017, Eindhoven, Netherlands
3rd ManuREsource conference on manure management and valorization
manuresource2017.org

29-30 November 2017, Amsterdam, Netherlands
5th Global Geothermal Energy Summit: Maximising The Global Expansion of Geothermal Utilisation
wplgroup.com/aci/event/global-geothermal-energy-summit

12-14 December 2017, Paris, France
World Efficiency Solutions: for the low-carbon and resource-efficient economy
world-efficiency.com

Launch of GCECA

JIN Climate and Sustainability congratulates the cities of Groningen and Rotterdam, the Netherlands, on being selected as host cities for the newly founded GCECA: **Global Centre of Excellence on Climate Adaptation**. The GCECA, initiated by the Dutch Ministry of Infrastructure and the Environment, UN Environment, and the Japanese National Institute for Environmental Studies, will be introduced during a COP23 side event, 9 November 2017 in Bonn, Germany, and officially opened in January 2018.

JiQ Magazine

JIQ Magazine (Joint Implementation Quarterly) is an independent magazine with background information about the Kyoto mechanisms, emissions trading, and other climate policy and sustainability issues.

JIQ is of special interest to policy makers, representatives from business, science and non-governmental organisations, and staff of international organisations involved in climate policy negotiations and operationalisation of climate policy instruments.

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