JiQ Magazine

Magazine on climate and sustainability

vol. 24, no. 2 • October 2018 ISSN: 1877-606X

In this issue

Update on the Dutch National Carbon Market Pilot

Editor's note by Wytze van der Gaast

About a year ago, the JIQ Magazine reported on the signing ceremony of the Green Deal Pilot National Carbon Market in the Netherlands. With the Green Deal, private sector parties collaborate with the government to create a market institution for carbon certificates in sectors not covered by the EU ETS. Since then, parties have prepared methodologies for calculating emission reductions for different project types, and identified project opportunities to apply these.

Recently, two such methodologies were considered by the Green Deal's Advisory Board: emission reduction by restoring peat land and use of residual heat for public buildings, such as a swimming pool. These methodologies have now been published at www.nationaleCO2markt.nl for a public consultation. Other methodologies are currently in the pipeline, including use of olivine for permanently storing CO_2.

Next to the methodologies, parties have prepared decisions on a set of rulebook items for trading carbon certificates. On three of these, the Advisory Board has provided advice and these items are prepared for public consultation. The first item is about additionality. Parties have agreed that additionality of emission reductions is determined by checking whether these are not yet covered by policies (policy additionality), in combination with a common practice test (whether the project technology does not have a market share of at least 20% yet). Second, a note has been prepared on preventing a 'waterbed effect', i.e. interactions between Green Deal projects and ETS emissions trading.

A relatively innovative rule put forward by the Green Deal is that of ex ante certification of emission reductions through nature-based projects. With this rule, emissions reductions of, e.g., peatland recovery projects will be certified before the project starts based on a validated project plan. Part of these certificates, 85%, are then eligible for selling in the market; the remainder is kept in a buffer. After pre-determined intervals, such as five years, project performance is verified, and the buffered certificates can be sold too.

Next steps in the Green Deal trajectory are, next to extending the rulebook with methodologies and the portfolio of projects, the development of a market institution, including a registry for certificates and market place for trading. This will enable a wider group of potential investors to invest in national or regional projects, thereby reducing their own carbon footprint and supporting Dutch progress towards complying with the Paris Agreement.

After the Kyoto Protocol: Tackling Global Emissions Through a Consumer Responsibility Approach

By Matteo Tesei*

Notwithstanding the global reach of environmental change, in the past decades the responsibility to contain climate change has been disproportionally on rich countries. Indeed, while developed nations have spent the past twenty years struggling to limit their emissions of greenhouse gases (GHGs), recently-industrialised economies have adopted a more permissive approach towards pollution to the benefit of economic growth. As a matter of fact, when looking at domestic emissions production figures, developing countries largely appear to have increased their contribution to global warming during the past decades. Since at least 2006, the Global South has started to pollute more than the developed world. However, in a world in which supply chains are increasingly globalised, this begs the question whether developing countries are the main responsible for growth in GHG emissions, or rather whether developed countries affect those emissions via international trade.

Policy instruments that are blind to this interconnectedness of global production are unable to manage the incentives behind emission production, and therefore to successfully tackle climate change. This article argues that the unique layout of the Kyoto Protocol, a prominent example of international effort to control GHG emissions, has relied on insufficient understanding of global production processes and therefore failed to account for emissions transfers among signatories. In fact, the Protocol has imposed limits on the production of CO_2 for developed countries, but not for developing countries, creating the opportunity for "carbon leakage". As developed countries, which must uphold stricter emission policies as a consequence of their participation in the Annex I group, struggle to meet their targets, they seem to have – at least partially – exploited the cheaper costs and less stringent regulations that characterise production in developing countries, to the detriment of global emission production overall. As a result, this casts a shadow on the efficacy of the Kyoto Protocol framework in reducing global CO_2 emissions.

Results

To understand global CO_2 emissions, we compare the "producer responsibility" method, employed in the Kyoto Protocol to define targets as well as to measure and account for countries' emissions, against the alternative "consumer responsibility" approach. With the first method, every country is held responsible for the emissions produced in their national territory. With the second method, every country is held responsible for the emissions necessary for the production of the final products consumed in the national territory, even if such emissions were produced in a third country.

An input-output approach inspired by Leontief (1970)[1] is employed, which allows to consider the exact intermediate deliveries between the sectors of an economy. This in turn allows us to calculate the carbon footprint of each industry and country.

As shown in Figure 1, emission production in developed countries did not vary significantly over the years. However, their consumption steadily increased up to 2007, and only decreased in 2008 and 2009. On the other hand, emission production in the developing world has been consistently increasing, with a much faster growth after 2002. The emission consumption of the Global South, however, shows a slower growth over time. By looking at trade in emissions, it is evident that Annex I countries consume more CO_2 than they directly produce, and increasingly so over the years. On the contrary, developing countries have been producing more CO_2 than they actually consume. This double divergence between North and South trends, as well as between consumption and production trends, supports the argument that the Annex I group has met the Kyoto Protocol targets by means of international trade.

* Matteo Tesei (matteo.tesei@gmail.com) is a graduate in International Economics & Business from the University of Groningen, the Netherlands. You may contact the author for a copy of his thesis report.

[1] Leontief, W. (1970), "Environmental Repercussions and the Economic Structure: An Input-Output Approach," The Review of Economics and Statistics, vol. 52, no. 3.

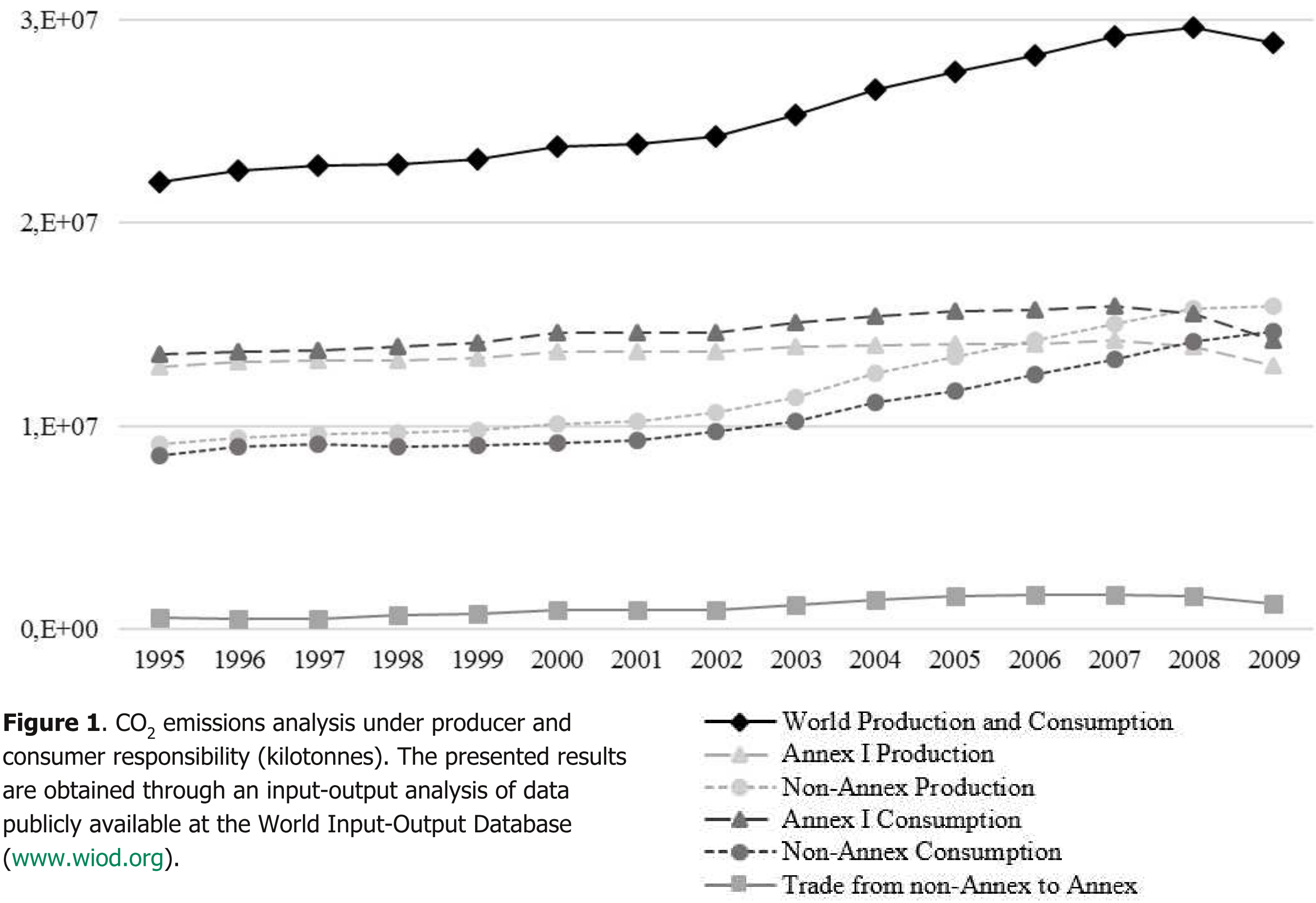

Figure 1. CO_2 emissions analysis under producer and consumer responsibility (kilotonnes). The presented results are obtained through an input-output analysis of data publicly available at the World Input-Output Database (www.wiod.org).

Conclusions and recommendations

As demonstrated, the Protocol's policy design allowed developed countries to increase carbon consumption, while there was no statistically significant change in their carbon production in the 1995-2009 period.

Using production responsibility, it is clear that most of the increase in global emissions can be attributed to developing countries. Developed countries have increased their emission production at a much slower pace. Using consumption responsibility, we still see a more rapidly increasing trend of emissions in developing countries. Yet, Annex I nations consumed more than 50% of world emissions in all years except 2009. This suggests that developed countries have indirectly imported emissions, and increasingly so until 2007. Only in 2008 and 2009, developed countries showed a substantial reduction in net emission imports from the non-Annex I group.

Hence, the production approach seems to be biased in favour of Annex I countries when compared to the consumption approach: as trade in emissions from developing to developed countries has increased, rich countries are not necessarily succeeding in cutting global emissions. On the contrary, they appear to (at least partially) substitute domestic emissions by exporting them to the developing world. This suggests both a carbon leakage and a pollution haven effect.

Although the Kyoto Protocol has been successful in promoting an international effort to tackle global warming, the distinction of targets between Annex I and non-Annex I countries, along with the choice of a production responsibility approach, created the opportunity for carbon leakage and pollution haven effects. We consider that the adoption of a producer-based approach has weakened the Protocol's ability to tackle climate change, to the profit of signatories and to the detriment of the environment.

Surely, eliminating such opportunity is the intent of the Paris Agreement, in which the distinction between developed and developing countries is absent. A different layout will assist to eliminate or reduce the practice to substitute domestically produced emissions via international trade. However, the Paris Agreement still does not tackle the faults of a production responsibility approach, leaving measurement and reporting to the individual signatories. One can only hope that the Parties will understand the importance of collecting more recent input-output data and of employing a consumer responsibility approach as an insightful tool in the fight against global emissions.

Enhancing Ambition Levels in NDCs: Learning from Technology Needs Assessments

By Erwin Hofman and Wytze van der Gaast*

Under the Paris Agreement of 2015, all Parties, both developed and developing countries, are to undertake and communicate ambitious climate actions as nationally determined contributions (NDCs). With the NDCs, a clear break with the past was made. While the Kyoto Protocol of 1997 contained quantitative emission reduction commitments for developed countries, NDCs do not contain such commitments; only their preparation and communication are required. Countries are free in how they formulate their NDCs, depending on their domestic contexts.

For developing countries, formulating NDCs may both be an opportunity and a challenge. NDCs enable countries to embed their climate contribution in their national development agendas, which could soften the social implications of climate investments and enhance public acceptance. To formulate ambitious climate plans through the NDC requires knowledge and data about the economy-wide costs and benefits of scaling up a certain technology or measure within a given sector. Ideally, countries have models and databases for impact assessments. However, such resources and capacities are underdeveloped in many countries. Familiarity with options for mitigation and adaptation is often lacking, and databases for preparing scenarios absent or incomplete. Especially in lower-income developing countries, formulating sector or nationwide plans for NDCs could benefit from additional capacity building efforts in this area. Another challenge is to get from the NDC targets and ambitions to actual projects and results, to avoid that the NDC is merely a 'wish list' that is not adequately embedded in the national context and therefore has a slight chance of implementation.

Despite these challenges, developing countries can and do tap into earlier experiences with provisions under the Climate Convention (UNFCCC) such as NAMAs, NAPs and the TNA process (Technology Needs Assessment). Of these, the TNA provision, which supports developing countries in prioritising climate technology options in light of their development agendas and strategies, has the longest history and has followed a steep learning curve since its initiation in 2001. In the article titled 'Enhancing ambition levels in nationally determined contributions – Learning from Technology Needs Assessments',[1] we have discussed the lessons from TNAs, and translated these into clear recommendations for use in NDCs.

The TNA process

The TNA programme has been set up based on a decision of COP7 in Marrakesh in 2001. It states that "developing country Parties, are encouraged to undertake assessments of country-specific technology needs". Since 2001, more than 125 TNAs have been undertaken in 90 countries.[2] A new phase of TNAs has been approved and started in 2018, covering 23 countries, of which 13 have not carried out a TNA process before. This Phase III will focus mostly on Least Developed Countries (LDCs) and Small Island Developing States (SIDS). Figure 2 shows the countries that have carried out a TNA, or are in the process of developing one. Overall, the key question that a TNA process intends to answer is: how can a country realise its sustainable development goals with low emissions and strong climate resilience? The steps of the TNA process have been clearly defined in the TNA handbook,[3] and the process is supported by among others UN Environment and UNDP.

Key TNA lessons

Based on the TNAs that have been implemented since 2001 in 90 developing countries, a range of important lessons can be drawn.

---

* Erwin Hofman (erwin@jin.ngo) and Wytze van der Gaast are researchers at JIN Climate and Sustainability, Groningen, the Netherlands.

1 Hofman, E. and Van der Gaast, W. (2018). Enhancing ambition levels in nationally determined contributions — Learning from Technology Needs Assessments. WIREs Energy Environ. doi: 10.1002/wene.311.

2 A repository of TNA reports is available via www.tech-action.org.

3 The TNA Handbook can be downloaded as a PDF.

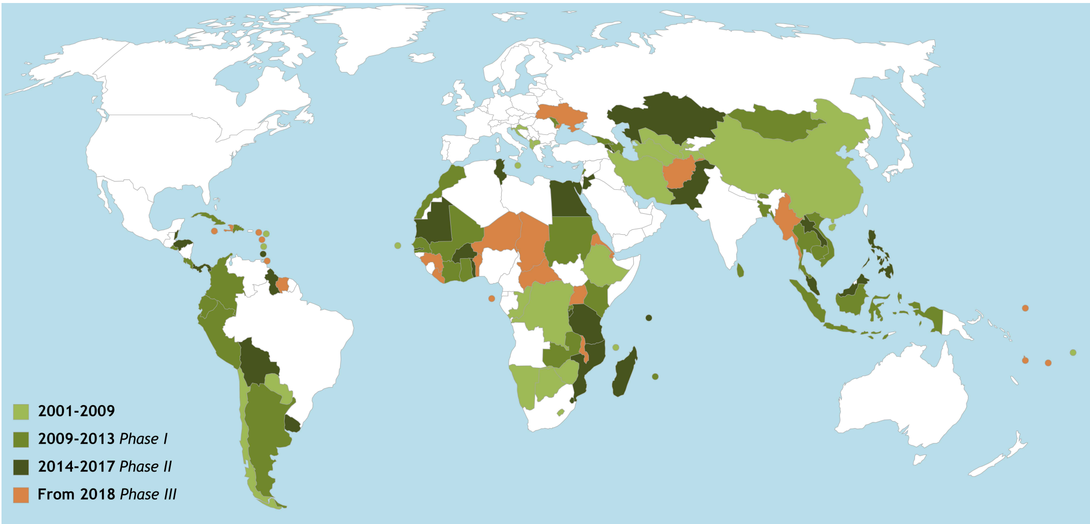

Figure 2. World map showing countries that have carried out or plan to carry out a TNA. If countries have implemented multiple TNAs, only the most recent one is indicated.

For a successful TNA process, stakeholder engagement is of vital importance. A TNA should be a participatory process, to ensure that the needs and preferences of all stakeholders are taken into account, and that the TNA is carried out based on the best available knowledge. Participation of a wide range of actors also ensures awareness and a sense of ownership of the process. This helps to avoid a situation where the TNA results are unacceptable to some of the stakeholders. To illustrate, by involving high-level policy makers from the beginning, it is ensured that there will be political backing for the results of the TNA. Financial experts should be involved throughout the TNA process in order to inform the TNA team about criteria for funding and reality checks on the feasibility of identified technologies and proposed projects.

With the TNA Handbook and related guidance documents, a strong common process and reporting framework is already used in all large group of countries. This facilitates sharing of knowledge and experiences among TNA countries, as well as the aggregation of TNA outputs across countries into regional or thematic overviews. By using a common methodology, TNA outputs and action plans are also substantiated in a similar manner, which eases consideration for implementation by for example potential funders.

While an advantage of the TNA programme is that generally a similar process and reporting format has been used across countries an aspect that had generally been overlooked is tracking the progress of implementation of TNA results. While countries were supported in prioritising technologies and developing action plans and project ideas, no system had been developed for monitoring and evaluating the progress of the implementation of TNA results. In 2017, therefore, a methodology for monitoring evaluation and a guidance for tracking the implementation status of technology action plans were proposed.

TNA vs. NDC

The similarity between the TNA and NDC processes was recognised by the Technology Executive Committee (TEC) in 2016: "Both processes use national development priorities as a starting point, and aim for integration of climate change into other national planning processes, with the overall objective of ensuring a low carbon, climate resilient sustainable development path." It could be argued, however, that the final goal of TNA is sustainable development, while the final goal of NDCs is to achieve "the purpose of this Agreement as set out in Article 2", which is holding the global temperature increase to well below 2°C and adapting to the adverse impacts of climate change. Based on this, while TNAs follow a 'development-first' approach, the approach of NDCs is 'climate-first', which could lead to different process outcomes. Nevertheless, both processes can enable countries to link climate change with other national (development) priorities.

While, unlike TNAs, NDCs do not have a clear common methodology and reporting framework the processes for NDC preparation vary widely in terms of scope and content. Some countries have requested more guidance, but others have argued that a common template would be contrary to the 'discretionary, optional and voluntary' nature of NDCs. In general, the NDC process could benefit from a guidance that includes both common and differentiated information elements, that serves both

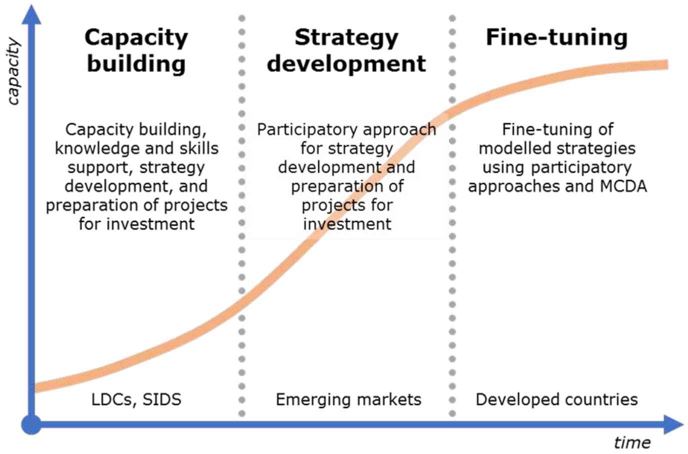

Figure 3. Use of the TNA process by countries in their NDC development, based on the countries' position on the 'learning curve' of capacity development. (elaboration by authors based on their assessment of TNA practice).

the need for clarity and comparability and the principle that NDCs are country-driven pledges.

Another difference is that the role of stakeholder engagement has not been defined in the case of NDCs. While several countries have developed their NDC based on a national stakeholder consultation process, this was not universal, and the methods and scope for stakeholder engagement have varied. For the TNA process, the stakeholder engagement process has been more clearly defined, although also in this case there has been variation among countries.

Recommendations

Some of the key challenges as experienced in NDC development and implementation have already been overcome through carrying out TNAs in the past and building up experience and insights on good practice. We argue that the TNA process can be used to strengthen the NDCs. However, as countries around the world are in different stages of their development, and have different capacities with regard to climate and development planning, the way the TNA can be used for NDC development differs. Figure 3 shows how countries' planning capacity may evolve over time, from lower to middle income developing countries with a strong need for capacity building to support their NDC work, to, for instance, rapidly growing and/or industrialised economies, and to developed countries with already strong capacities, including detailed models and databases.

For developing countries, a TNA could be a good starting point for the conception of a national climate and development strategy in which stakeholders from government, business, and research institutes work together. For many countries the TNA was the first time such cooperation was done. As such, the TNA process does not only contribute to the development of a vision and priorities to be used in the NDC, but also to national institutional capacity for climate and development planning.

Emerging markets and newly-industrialised countries generally have different capacity building needs than LDCs and SIDS have, and with regard to climate and development strategy development these countries are usually already more advanced. However, the TNA process can help to develop or elaborate on a participatory climate and development strategy based on participatory approaches. In addition, the TNA process helps to develop action plans and bankable project ideas for international support.

Most developed countries have the availability of advanced models for scenario development, high-quality data, and human capacity for strategy and policy development. For these countries, running a full-scale TNA process is therefore less useful. However, the aspects of the methodology and participatory approach of the TNA could be used to fine-tune the outcomes of modelling exercises.

Although we suggest that all countries use the TNA or a similar (participatory) process in their NDC development and updating, we recommend not to integrate the TNA as an integral and compulsory part of it. The TNA owes part of its success to the fact that it is not directly linked to targets or commitments for emission reductions. While NDCs do not contain commitments either, their communication and implementation is directly linked to the goal of the Paris Agreement to limit global average temperature increase to 2°C (or well below that) compared to pre-industrial levels. TNAs are therefore generally less political than an NDC. This should make it easier to carry out the process with the involvement of a wide range of stakeholders. At the same time, this has also been a weakness of the TNA process, as this means that it does not automatically lead to implementation of results. Therefore, by combining or harmonising implementation of both processes, the contribution and implementation can be strengthened by including the concrete inputs from the TNA process in an NDC. On the other hand, in such a harmonised co-existence of TNA and NDC processes, TNA results have a higher chance of being implemented, as financial support allocated to NDC implementation could also, indirectly, support implementation of TNA results.

Earth Observations for Evidence-Based Decisions

By Maddie West*

Individuals, organisations and governments make decisions every day that impact lives, livelihoods and the environment we live in. Many of the most pressing global challenges require the use of Earth observations for effective action; including climate change, disaster risk reduction, food security, forest and water management and many others.

Earth observations refer to all atmospheric, oceanic or terrestrial data and information collected about our planet. This includes both space-based or remotely-sensed data, as well as ground-based or in situ data. Coordinated and open Earth observations enable decision makers around the world to better understand the issues we face, in order to shape more effective policies, make decisions and take actions.

Earth observations allow farmers, governments and businesses to lessen food insecurity and food price volatility by making better decisions for crops and food markets. They help communities identify disaster risks, and forecast and monitor droughts, floods, earthquakes, and other potentially devastating events. They enable first responders to quickly identify disaster-impacted areas and contribute to effective response. They provide insight into species and ecosystem health, climate change, water quality, and much more. They enable countries and institutions to measure progress against global policy, including the Sendai Framework, the Paris Agreement and the United Nations 2030 Agenda for Sustainable Development.

"Without Earth observations, internationally-defined goals and targets would not be within reach"

Countries and organisations that fail to incorporate Earth observations into relevant policy processes inevitably make less informed decisions that decrease effectiveness. In order to make it easier for these bodies to find and use Earth observations appropriately, partnerships such as the Group on Earth Observations (GEO) are working to coordinate and improve open data resources and tools, support knowledge production and sharing, and build awareness.

GEO GROUP ON EARTH OBSERVATIONS

A central part of GEO's mission is to build the Global Earth Observation System of Systems (GEOSS). GEOSS is a set of coordinated, independent Earth observation, information and processing systems that interact and provide access to diverse information for a broad range of users in both public and private sectors. GEOSS increases our understanding of earth processes and enhances predictive capabilities that underpin sound decision-making: it provides access to data, information and knowledge to a wide variety of users. The 'GEOSS Portal' offers a single Internet access point for users seeking data, imagery and analytical software packages relevant to all parts of the globe.

The GEO community, a partnership of over 100 UN Member States and over 120 participating organisations, promotes open, coordinated and sustained data sharing and infrastructure for better research, policy making, decisions and action across many disciplines. This community is filling data gaps and ensuring coordination among existing systems, and is developing end-user oriented resources, tools and platforms that are creating real impact on a wide range of global challenges.

Use cases of Earth observations for practical, impact-driven applications such as those outlined throughout this note showcase just a few of the ways that more open and better coordinated data and information can contribute to a more sustainable management of our planet.

* Maddie West (mwest@geosec.org) is communications manager at the Group on Earth Observations (GEO).

The Energy Transition in the Built Environment: Future Roles of Local Government and Market Parties

By Eise Spijker and Erwin Hofman*

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.

Netherlands steps away from natural gas

Many Dutch municipalities have formulated the ambition to become 'energy neutral' over the coming decades. In order to provide the country with renewable electricity, there are already numerous existing and planned projects for wind and solar power generation. For provision of heating in the built environment, the 'heat transition' gets plenty of attention, since the Dutch government has decided to start phasing out the use of low-calorific gas from the large Groningen gas field.[1] With well over 90% of all Dutch households relying on low-calorific gas for space heating this planned phase-out will have a substantial impact on the building sector.

As part of the EU-funded PUBLENEF project, JIN Climate and Sustainability collaborates with the municipality of Midden-Drenthe to identify and analyse possibilities for accelerating the energy transition in the built environment, with a focus on the residential sector. In the project, we look at the role that various public and private stakeholders including local government can play in speeding up this transition process.

With new buildings already having to comply with high energy performance standards, the key challenge in this transition lies within the existing building stock. The Dutch government stated the ambition to fully phase-out low-calorific gas in the built environment by 2030, and the 2050 ambition is to have a completely energy neutral building stock. Considering that by 2050 the overwhelming majority of today's housing stock will still be in use, this transition poses a formidable challenge. A government taskforce for the building sector[2] estimated that in order to be energy neutral by 2050, from now on each year about 350,000 buildings will need to be upgraded/renovated. This is equivalent to around 1,000 houses per day, while currently at best only a few dozen houses per day are refurbished in the country. An additional challenging factor is that already today the Dutch construction sector has difficulties in finding and hiring adequately-trained staff to perform all current work in this sector.

Scale-up and accelerate, but how?

Scaling up and accelerating the transition will foremost require additional efforts from all private and public stakeholders within the sector; particularly at the local level. To speed up the process the various sector in the sector can benefit from combining their knowledge and resources to develop and implement 'integrated energy solutions' for buildings. We found

---

* Eise Spijker (eise@jin.ngo) and Erwin Hofman (erwin@jin.ngo) are researchers at JIN Climate and Sustainability, Groningen, the Netherlands.

1 This process is driven by the government decision to terminate gas extraction from the Groningen gas field – one of the largest onshore natural gas fields in Europe – due to the increased frequency and intensity of induced earthquakes in the Groningen region.

2 Information on the Taskforce Bouwagenda is available, in Dutch, via www.debouwagenda.com.

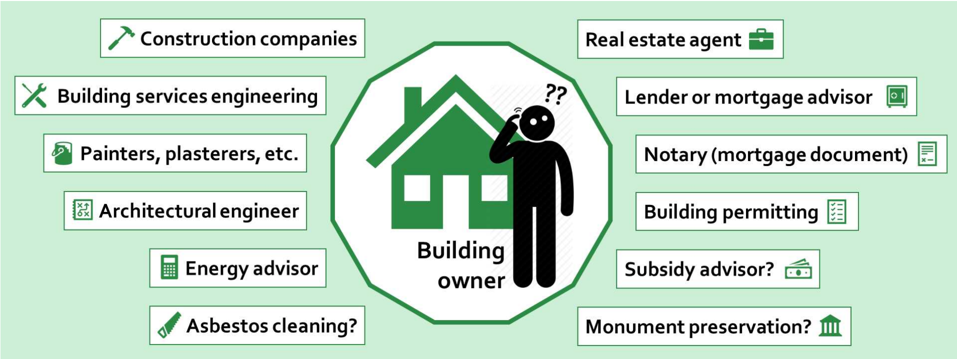

Figure 4. Building refurbishment for energy efficiency can be a complex proces for building owners, with many stakeholders involved.

that accumulating single energy saving measures over time without a clear end-goal in mind can frustrate the transition in the mid- to longer term (e.g. it can generate technology lock-in). Smart and integrated refurbishment strategies start with implementing 'no-regret' actions first, and ensure the implementation of the next measure that fits with the 2050 target (and meets financial capacities of the building owner). To ensure that integrated solutions are implemented, the building sector needs to intensify and streamline its collaboration (e.g. construction company with plumbers, electricians, plasterers, etc.), especially in the project acquisition and planning stages.

For the building owner such a refurbishment process can get quite complex. Considering that a single building owner often asks for two to three competing quotes, the planning stage can take a lot of time and resources. Aside from the technical services needed to enable the transition, there is a range of other market actors, such as mortgage providers, real estate brokers, municipalities (e.g. for permits) that also play an important role in this transition. Within this context, a building owner almost has to become a process director or manager with a broad set of technical, financial and other knowledge. A range of interviews conducted fond that several market parties consider that most building owners and building managers will not be able to efficiently and effectively manage the energy transition process of a building.

With several market parties, including construction and installation companies, mortgage advisors, real estate agents, and energy consultants, we discussed and explored how this building refurbishment process can be simplified so that the transition can be accelerated.

Three suggested modalities

The first suggested way forward is the appointment of an external energy director or '**energy transition broker/coach**'. Such a broker would support a home owner in the purchasing and installation of a range of no-regret interventions to improve the energy performance of the building. The broker should not only have sufficient recent knowledge on technologies and sustainable energy solutions, but is also versed in financing issues, government regulations, available subsidies, and permitting issues. A key question remains how this energy transition broker can be funded? We suggest that in the early stages, local governments assume a role in subsidising such brokers for pilot or experimental purposes. Eventually, the market should take over and internalise the costs for such services.

A second option is that the building sector takes a leading role and 'removes' the building owner from the transition process. This option envisages that building or installation companies purchase existing houses themselves, carry out a full renovation to make the building energy neutral, and subsequently sell the property again. One key advantage of this option is that the building and construction and installation companies can implement the required energy savings measures much faster in comparison to a process where the building owner and construction company enter in a dialogue to define and fine-tune the options and preferences, while many building owners lack knowledge and expertise to properly validate the quality and price of the agreed measures and services provided.

Using this **purchase-renovation-sale model**, much fewer stakeholders are involved, making the process simpler, faster and cheaper for the building and/or installation company. Especially in popular urban areas, this can be interesting for institutional and private investors, developers, and companies in the construction sector. A question remains whether it will also work in rural regions with a declining population. Here local governments could provide additional incentives or guarantee funds to market actors to pursue this.

A third option to speed up the transition is to better train and **equip building owners to manage** this process on their own. In addition to those building owners that have sufficient knowledge and expertise themselves to manage such a process, in general better training and equipping building owners (e.g. planning/budgeting tools, checklists) to adequately manage and monitor energy transition of their own building. Although we anticipate that this 'do-it-yourself' option will have more relevance for larger and/or rural buildings and/or a more select group of building owners, we consider it worthwhile to better equip this category of home owners.

Concrete suggestions

Building and installation companies: it is suggested to ensure a higher level or collaboration and organisation among stakeholders in the construction sector. Together, building, construction and installation companies can develop and implement standardised refurbishment approaches. Such approaches can be scaled up at the regional level or in specific neighbourhood/villages. This includes the creation of 'construction teams' for example following the model used by Asbestschakel[3] where a consortium offers collective renovation services in targeted geographic areas.

Financial advisors and real estate agents: local real estate brokers and mortgage advisors could be encouraged to be frontrunners in providing services and information that promote/enable building owners to implement (future) energy saving measures. Such services should not only focus on financing and maximum loans, but also on minimisation of monthly 'total cost of ownership' expenses through energy savings measures. It has become clear that many mortgage advisors are not yet fully aware of all financial rules, subsidy schemes, etc. for financing and planning (future) energy savings interventions. Despite that there are various initiatives at sector level to scale-up and improve such 'mortgage advisor 2.0' services,[4] additional communication and training efforts at the local level can help to speed up this process.

Local governments: for local governments, it is suggested to adjust/update the permitting system and process to make it better suitable to energy transition related refurbishment actions. Local governments (or regional energy agencies) can also play a part in supporting the uptake of role of the energy transition broker (e.g. by setting up a pilot project), or promoting the mortgage advisor 2.0 in the region (by offering training programs or launching a communication campaign targeting mortgage advisors). Also, municipalities could play a role in putting in place incentives to enable the purchase-renovation-sale option in more rural areas (e.g. by setting up a guarantee fund).

---

3 Asbestschakel is an initiative in which various companies work in a cooperative approach for cleaning asbestos roofs. For more information, in Dutch, see www.asbestschakel.nl.

4 For example through the Dutch national organisation for mortgage advisors, SEH.

The Future Role of Gas in a Decarbonising Europe

By Eise Spijker*

Developments in gas use in the EU-28

Natural gas has a relatively low carbon intensity compared to coal and oil. It is therefore often labelled as a transition fuel. According to the EU Reference scenario and Eurogas, EU-28 gas demand is estimated at 420 to 460 bcm in 2050. This is similar to the current gas demand levels, which indicates that gases will continue to play a pivotal role in the EU's energy system in the coming decades.

This article serves as supplementary material for a presentation on 15 October 2018 at the Policy Workshop 'Towards "net zero" methane emissions in the gas sector – challenges and opportunities'. The workshop is hosted by the Florence School of Regulation at the European University Institute. The agenda is available online.

With the Paris Agreement and EU climate targets, we know that the EUs greenhouse gas (GHG) emissions have to go down by some 80 to 95% by 2050 (relative to 1990).[1] With the role of coal in the EU set to reduce considerably,[2] the scope for achieving GHG savings by means of fuel switching from coal to gas also declines. This means that additional GHG savings will increasingly need to come from within the gas sector, indicating that more 'internal' measures are needed to reduce the GHG footprint of gas supply chains. As a result, (un)conventional natural gas transported over long distances will likely have a comparative disadvantage relative to indigenous gas resources in terms of climate impact. 'Internal' measures include reducing leakages from gas transmission and compression systems and managing boil-off of methane from LNG shipping; but also energy efficiency measures in the supply chain.

Currently most gases in the EU-28 are consumed for final use in space heating in the residential and services sectors, followed by centralised power and heat generation, and for final use in industry. Current uses of gas in transport and for non-energy purpose in the petrochemical sector are still relatively modest (see Figure 5).

One of the key questions for 2050 will be how the gas demand profile will look like, and what climate targets will be in place in the individual sectors. With the energy transition starting to have an impact on all sectors, and given the versatility of gases, it is likely that all sectors will remain using natural gas. However, the use of gas in the power sector and the built environment are set to decline, as suitable renewable 'electric' alternatives are upscaled, while gas use in transport and petrochemical applications is likely to increase at the expense of oil. Where gases initially were deployed for switching from coal to gas in power generation, the next step in the transition is to reduce the role of oil in transport and petrochemical applications. It is also in relation to these fuels that gases still have a strong climate performance. However, in the run up to 2050 also gases need to become even more climate-friendly than they currently are. In fact, Eurogas estimates that by 2050 up to 70% of all gases used in the EU-28 will be of renewable origin.[3]

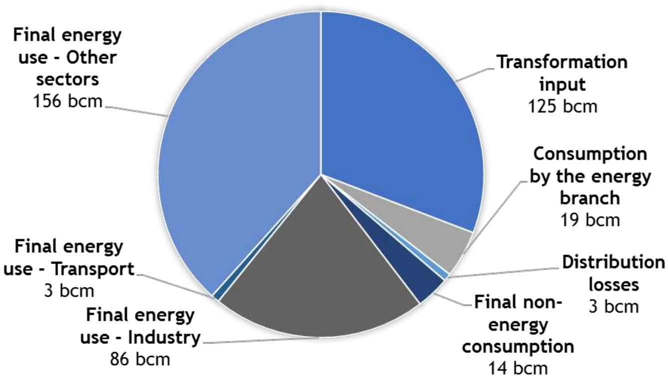

Figure 5. Use of gases in the EU-28 in 2016 (in Mtoe).

* Eise Spijker (eise@jin.ngo) is a researcher at JIN Climate and Sustainability, Groningen, the Netherlands.

1 European Commission: 2050 low-carbon economy. ec.europa.eu/clima/policies/strategies/2050_en.

2 To about 5.5% share of gross inland consumption in the EU-28 in 2050, compared to about 17% in 2016.

3 Eurogas: Scenario Study with PRIMES (pdf).

On the climate impact of (renewable) gases and fossil fuels

Considering that the anticipated EU 2050 gas demand will be 100% from fossil origin, and assuming a life cycle GHG emission for natural gas of about 66 gCO_2/MJ,[4] the GHG emission footprint of the gas sector in the EU-28 is about 1161 Mt CO_2-eq.[5] While combustion emissions (988 Mt CO2-eq.) occur within the EU-28 borders, an increasing share of the indirect GHG emissions will be emitted outside the EU, as more natural gas is imported. Higher shares of imported gas make it more challenging to minimise / mitigate upstream GHG emissions, such as associated with natural gas exploration and production. GHG performance standards or carbon emission border taxes could be implemented to provide an incentive to gas suppliers outside the EU-28 to lower their GHG emissions. However, if by 2050 most of the gas used will likely be of renewable origin, there will also be an increasing need to keep track of the emissions intensity of this category. This will be increasingly relevant as most emissions from renewable gases are not related to the combustion process, but to the up-, downstream part of the life cycle. For fossil gases the opposite is true with combustion emissions comprising 80-90% of total life cycle emissions. As a result, there will be an increasing need to apply full life cycle GHG accounting in the (renewable) gas sector.

Table 1 provides an overview of the life cycle GHG intensities of renewable gases and a set of fossil fuels for transport, heat or power application. We can calculate the net GHG savings when substituting the use of natural gas (EU-mix) for power and heat application (= 66 gCO_2-eq./MJ) by renewable gas from wet manure (= -89 gCO_2-eq./MJ). The difference between two footprints is the net saving. In our example this adds up to a net GHG saving of 155 gCO_2-eq./MJ.

From the table we can infer that renewable gases generally outperform fossil fuels, including conventional fossil gases. This is especially true for wet manure derived biogases. The main reason for this is that manure digestion results in large methane emission reduction from manure storage. This is sometimes referred to as a 'methane bonus', which shows the potential of controlling methane emissions in the gas sector.

While promoting efficiency improvements in combustion processes improves the GHG intensity per unit of output. The absolute emissions from gas will not automatically reduce, since EU level aggregate demand is not expected to change. Bringing down absolute GHG emissions related to gas use relies on implementing renewable gases, deployment of carbon capture use and geological storage (CCU, CCS), and managing up- and downstream (indirect) emissions.

Aside from wet manure, the table also lists two electrolysis-based supply chains for the production of hydrogen with a competitive (i.e. low) life cycle footprint. However, we also see that some renewable gases, derived from energy crops (maize) are less 'climate competitive' in certain supply chain configurations. While renewable gases derived from electrolysis processes seem to have a relatively low life cycle GHG footprint, such supply chains are often criticised due to their 'energy penalty'. While conversion efficiencies are an important metric for determining economic viability, many other biomass derived renewable gases as well as most CCS applications face a similar challenge. On top of that many biomass-derived renewable gases often face additional sustainability challenges. Such challenges are related to the food versus fuel debate, but are also related to indirect land use change and adverse local environmental impacts. While the current natural gas EU mix still outperforms coal and oil based energies in terms of GHG footprint, we can see that coal-based power plants with CCS can be climate competitive relative to natural gas.

On GHG emissions monitoring

Assuming that by 2050 around 70% of all gas used in the EU-28 will be of renewable origin, the key challenge is not only to bring down absolute GHG emissions from the remaining share of 30% fossil gases used, but to better manage life cycle emissions for fossil and renewable gases. This involves reducing methane emissions and energy use in the natural gas supply chain, but also to consider leakage emissions related to renewable gases, including leakages, postponed or embedded emissions of syngases, hydrogen, methane, nitrous oxide as well CO_2.

From a monitoring perspective this ideally would relate to physical measurements of fugitive gas

---

4 9.7 gCO_2-eq./MJ for gas supply, and 56.2 gCO_2-eq./MJ for gas combustion, see JRC, 2017 (pdf).

5 Note that the applied emission factor is based on the current EU-gas mix. The future gas mix is subject to change, and so will its associated emission factor.

Type	Process	Fuel placed on the market	GHG intensity
Wet manure	Biogas for biomethane(4) - closed digestate - off gas combustion	TRANSPORT FUEL (mix) or fossil gases	-100
Wet manure	Biogas for electricity - Case 3 (Electricity from grid heat from boiler) - close digestate	Electricity and/or Heat	-89
Wet manure	Biogas for biomethane(4) - open digestate - off gas combustion	TRANSPORT FUEL (mix) or fossil gases	1
Renewable energy	Sabatier reaction of hydrogen from non-biological renewable energy electrolysis	Compressed synthetic methane in a spark ignition engine	3,3
Renewable energy	Electrolysis fully powered by non-biological renewable energy	Compressed Hydrogen in a fuel cell	9,1
Wet manure	Biogas for electricity - Case 2 (Electricity from grid heat from CHP) - open digestate	Electricity and/or Heat	10
Biowaste	Biogas for biomethane(4) - closed digestate - off gas combustion	TRANSPORT FUEL (mix) or fossil gases	14
Biowaste	Biogas for electricity - Case 2 (Electricity from grid heat from CHP) - close digestate	Electricity and/or Heat	21
Maize whole plant	Biogas for electricity - Case 1 (Electricity and heat from CHP) - close digestate	Electricity and/or Heat	28
Maize whole plant	Biogas for biomethane(4) - closed digestate - off gas combustion	TRANSPORT FUEL (mix) or fossil gases	30
Biowaste	Biogas for electricity - Case 1 (Electricity and heat from CHP) - open digestate	Electricity and/or Heat	44
Biowaste	Biogas for biomethane(4) - open digestate - off gas combustion	TRANSPORT FUEL (mix) or fossil gases	50
Biowaste	Biogas for electricity - Case 2 (Electricity from grid heat from CHP) - open digestate	Electricity and/or Heat	52
Coal	Coal with Carbon Capture and Storage of process emissions	Compressed Hydrogen in a fuel cell	52,7
Maize whole plant	Biogas for electricity - Case 2 (Electricity from grid heat from CHP) - open digestate	Electricity and/or Heat	54
Natural gas	EU Mix	Electricity and/or Heat	66
Natural gas	EU Mix	Compressed Natural Gas in a spark ignition engine	69,3
Biowaste	Biogas for biomethane(4) - open digestate - no-off gas combustion	TRANSPORT FUEL (mix) or fossil gases	71
Maize whole plant	Biogas for biomethane(4) - open digestate - no-off gas combustion	TRANSPORT FUEL (mix) or fossil gases	73
Natural gas	EU Mix	Liquefied Natural Gas in a spark ignition engine	74,5
Conventional crude	-	Diesel or gasoil	95
Natural gas	Natural gas using steam reforming	Compressed Hydrogen in a fuel cell	104,3
Oil shale	-	Diesel or gasoil	133,7
Coal	Coal-to-Liquid	Petrol	172
Coal	Coal	Compressed Hydrogen in a fuel cell	234,4

Table 1. Life cycle GHG emissions of a number of renewable gases and a set of fossil fuels for different applications. Sources: JRC, 2017 (link); EC, 2015a (link); EC, 2015b (link).

emissions from transmission and distribution infrastructure, flaring and venting emissions and well-related leakages. Downstream, monitoring of CO_2 leakages from underground storage formations (CCS Directive),[6] as well as estimated non-permanence[7] of carbon fixation related to CCU activities (e.g. plastics, ceramics, steel) would be needed. In general, physical monitoring is preferred over model-based estimates. While physical monitoring generally implies higher costs of monitoring, recent advancements in Earth Observation (EO) technologies and practices (merged with conventional in-situ / ground-based monitoring) could bring down such costs.[8] Since EO has the potential for global coverage it seems rational and efficient to pursue a harmonised and collective approach on of GHG emission monitoring for the (EU) gas sector.

6 EU Directive 2009/31/EC on the geological storage of CO_2 (link).

7 See the IPCC Fourth Assessment Report (2007), section 9.6.6.2: potential non-permanence of carbon storage (link), and Global CCS Institute: provisions for non-permanence (link).

8 Grantham Institute Briefing Paper No. 16 (2016): Satellite observations to support monitoring of greenhouse gas emissions (pdf).

On GHG emissions compliance

Aside from the monitoring challenges, the gas sector up-, mid- and downstream actors will increasingly face more stringent GHG emission reduction targets. However, the way in which 'climate compliance' is organised and enforced differs per sector. Heavy industries, the power sector and aviation fall under the European Emissions Trading Scheme (ETS Directive),[9] that is concerned with GHG emissions accounting and compliance at the installation level. Of the non-ETS sectors, transport has to comply with the life cycle based GHG accounting rules stipulated in the Fuel Quality Directive (FQD)[10] for all fuels (both fossil and renewable) supplied to the market. Life cycle based GHG accounting is also included in the (revised) Renewable Energy Directive (RED)[11] which applies to biofuels and bioliquids. The revised RED and the FQD both include relevant provisions on GHG emissions associated with land use change.[12] GHG accounting in the residential and agricultural sector is still often done as part of national GHG emission inventory assessment reporting to the UNFCCC,[13] while no stringent compliance regimes are in place. While in several EU countries specific GHG reduction targets have already agreed upon for individual sectors; the responsibilities for GHG monitoring and compliance actions are rarely transposed to individual companies or specific supply chains within the residential and agricultural sector.

While GHG accounting increasingly focus on full life cycle GHG accounting, one of the key EU GHG emission compliance system to date (i.e. the ETS) still only includes GHG emissions that occur at the installation level. There are good arguments to also expand the scope of the ETS not only in terms of GHG accounting, but also in terms of compliance. For (renewable) gases, used by an ETS installation, full life cycle GHG accounting would be needed. However, for GHG compliance – inclusion of additional emission sources/categories would require a significant amendment of the ETS Directive. While the ETS does seek to expand its scope to also include other economic sectors, a life cycle based GHG accounting and compliance approach for ETS installations has not yet been extensively debated. At the heart of the matter, lies the question whether or not the ETS installations should also cover indirect emissions related to its activities. While indirect emissions (e.g. upstream methane, CO_2 emissions) occur outside their installations boundaries there undoubtedly is some level of responsibility that ETS installations (operators) have in mitigating them. Aside from the issue of allocating compliance responsibility for indirect emissions, in terms of GHG accounting a life cycle based approach for (renewable) gases requires close cooperation across the entire gas value chain.

While the ETS does recognise the difference between fossil and renewable gases in terms of combustion emissions, the current GHG compliance practices under the ETS, ensure that an ETS installation operator is indifferent in which type of renewable gas (or fossil gas)[14] it consumes. Both renewable gases with a high and low level of indirect (footprint) GHG emissions will result in a similar compliance performance under the ETS. Thus essentially, an ETS installation would not have an incentive to buy a cleaner form of either renewable or fossil gas. While the inclusion of indirect emissions related to ETS activities seems challenging both from an operational and political perspective, the current CCS Directive, for example already includes closure and post-closure provisions for surrendering ETS emission allowances in case CO_2 leakages from underground geological reservoirs occur. Also with reference to the provisions on land use change associated with the use of biofuels and bioliquids are another subcategory of energy sources that cover indirect GHG emissions in combination with the ETS. While for life cycle based GHG monitoring throughout the (renewable) gas value chain collective action and collaboration seems practical, the compliance responsibilities (and thus liabilities) are not always clearly divided. This is relevant not only for downstream GHG emissions, but also for upstream GHG mitigation actions and related investments.

---

9 EU Directive 2003/87/EC on establishing a system for greenhouse gas emission allowance trading (pdf).

10 EU Council Directive 2015/652 on calculation methods, reporting requirements pursuant to the FQD (link).

11 Proposal for a recast of the Renewable Energy Directive, 2017 (pdf).

12 European Commission: Land use change (link).

13 UNFCCC: National Inventory Submissions 2018 (link).

14 The ETS would treat either imported LNG or indigenous pipeline gas equally for ETS GHG accounting and compliance, while full life cycle GHG emissions differ.

Reports

Open access / free of charge

De Coninck, H., Bößner, S., Lindner, S., Van Asselt, H., Fujiwara, N. and Alberola, E., 2018, Tricky tensions: Being a climate policymaker in the Paris Agreement era, CARISMA project synthesis report D8.1.
Whether the Paris Agreement objectives are met depends on domestic policymaking, but the diversity of local contexts, the fast pace of social and political change and the greater importance of markets limit the span of control for the climate policymaker. Climate policymakers face many tricky tensions, including: (1) using policy evaluation while the world is changing, (2) taking a firm lead while remaining on speaking terms with society's diverse stakeholders, on whom they depend for implementation, and (3) the need for cooperation while countries and companies are also in tough global competition for the world's clean technology market share. This report discusses how these tensions can be managed by policymakers.

Dong-Ho Lee, Dong-hwan Kim and Seong-il Kim, 2018, Characteristics of forest carbon credit transactions in the voluntary carbon market, Climate Policy, vol. 18, no. 2, pp. 235-245.
The voluntary carbon market allows participants to go beyond regulatory carbon offsetting. Recent developments have improved the transparency and credibility of voluntary carbon trading, and forest carbon credit transactions constitute more than half of trade volume. Its workings, however, have not been sufficiently explored in literature. This study analyses the characteristics of forest carbon credit transactions in the voluntary carbon market using frequency analysis and logistic regression analysis. The results reveal that the co-benefits of forest carbon projects are an important factor influencing carbon credit transactions. Developing co-benefits is important for strengthening market competitiveness of forest carbon credits in the voluntary carbon market. Additionally, unlike the compliance carbon market, in the voluntary market stringent carbon standards do not always guarantee credit transaction performance.

Elkerbout, M. and Egenhofer, C., 2018, Tools to boost investment in low-carbon technologies: Five possible ways to create low-carbon markets in the EU, CEPS Policy Insights 2018/11.
Objectives set by the EU in line with the Paris Agreement will, over time, lead to demands for greenhouse gas emissions reductions including, increasingly, from energy-intensive industries that can only be fulfilled by rapid deployment of breakthrough low-carbon technology. Disincentive policy measures such as carbon pricing will not in themselves be sufficient to achieve these goals. There is a need for a set of tools that can help to create and grow markets in new low-carbon technology, particularly against a background of international competition and widely varying carbon constraints. This Policy Insight reviews a number of tools that could boost investment in low-carbon technology.

Flinkman, M., Sikkema, R., Spelter, H. and Jonsson, R., 2018, Exploring the Drivers of Demand for Non-industrial Wood Pellets for Heating, Baltic Forestry vol. 24, no. 1, pp. 86-98.
The targets for renewable energy in the EU have resulted in a surge in the use of wood pellets. This study analyses the drivers of the use of pellets for heating (non-industrial pellets). An enquiry directed to biomass and pellet organisations indicates that country-specific subsidies could be a driver for the purchase of pellet stoves and boilers, resulting in a base level of consumption of non-industrial pellets. Econometric analysis indicates that GDP is less important, while the price of wood pellets as well as the price of alternative energy carriers seem to be significant drivers. The results indicate the importance of considering competing fossil-based fuels when modelling wood pellet demand. This aspect is also relevant when new policy measures for a low carbon economy are applied, such as the levying of carbon taxes on fossil fuels.

Hofman, E., Alberola, E., Bößner, S., Harnych, J., Kovalovska, M. and Türk, A., 2018, Lessons from CARISMA: the role of business in climate change mitigation, CARISMA project synthesis report D8.2.
Based on the CARISMA work, literature review, interviews, and surveys, this report looks at the role of business in climate change mitigation. It is discussed which barriers are faced by the private sector in the development and deployment of innovative technologies. Also the role of international collaborative innovation activities is discussed. Focusing specifically on SMEs, drivers for taking part in the transition to a decarbonised economy are discussed, as well as challenged faced. The report

concludes with eight specific recommendations focused on the role of business in climate change mitigation, relevant policies, and overcoming specific challenges faced by SMEs.

IPCC, 2018, Global Warming of 1.5 °C: Summary for Policymakers, 48th Session of the Intergovernmental Panel on Climate Change, Incheon, Republic of Korea.

The IPCC had been invited by COP21 in Paris "to provide a Special Report in 2018 on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways." The full name of the report is 'Global Warming of 1.5°C, an IPCC special report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty'. This Summary for Policymakers presents the key findings of the Special Report, based on the assessment of the available scientific, technical and socio-economic literature relevant to global warming of 1.5°C and for the comparison between global warming of 1.5°C and 2°C above preindustrial levels.

Lindner, S., De Coninck, H., Bößner, S., Elkerbout, M., Türk, A. and Williges, K., 2018, Towards a European research and innovation agenda for the Paris Agreement goals, CARISMA project synthesis report D8.3.

This report reviews the research, development and innovation space of four low-carbon technologies with applications across different sectors: energy storage, syngas and power-to-gas, hydrogen and carbon dioxide capture and storage (CCS). It is found that for energy storage, syngas and power-to-gas, and hydrogen plenty of funding opportunities exist in Europe for all technologies, which are aimed at demonstration (syngas, storage), and scaling up. CCS is in need of social acceptance, on which it is challenged, in addition to smart policy design to push the technology out of the "technology valley of death" in which it is currently stuck.

Scarlat, N., Dallemand, J-F. and Fahl, F., 2018, Biogas: Developments and perspectives in Europe, Renewable Energy, vol. 129, part A, pp. 457-472.

This paper presents an overview of the development and perspectives of biogas in and its use for electricity, heat and in transport in the European Union (EU) and its Member States. Biogas production has increased in the EU, encouraged by the renewable energy policies and economic, environmental and climate benefits, to reach 18 billion m^3 methane (654 PJ) in 2015, representing half of global biogas production. The EU is the world leader in biogas electricity production, with more than 10 GW installed and a number of 17,400 biogas plants, in comparison to the global biogas capacity of 15 GW in 2015.

Tirado, R., Thompson, K.F., Miller, K.A. and Johnston, P., 2018, Less is more: Reducing meat and dairy for a healthier life and planet, Greenpeace Research Laboratories Technical Report (Review).

In this report, the question 'What to eat?' is answered by reviewing scientific evidence pointing at the ways in which changes to the global food system can help to achieve a healthy population and healthy planet. In particular, the focus is on how reducing meat and dairy consumption and production can contribute to preserving climate, biodiversity and water systems, while improving the wellbeing of humans, now and into the future. It provides an in-depth review of current science, looking at the meat and dairy system in a holistic way. The report discusses the climate impact, the environmental impacts, and the human health impacts of meat and dairy.

Box 4. 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. 15 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

15 October 2018, Florence, Italy
FSR Policy Workshop: Towards "Net Zero" Methane Emissions in the Gas Sector - Challenges and Opportunities
fsr.eui.eu/event

16-18 October 2018, London, United Kingdom
Carbon Forward 2018 - Survive and thrive in the global carbon markets
carbon-forward.com

31 October - 1 November 2018, Singapore
IOREC 2018: 4th International Off-grid Renewable Energy Conference
iorec.irena.org

6 November 2018, Brussels, Belgium
TRANSrisk event "Paris in Practice: understanding the risks and uncertainties"
transrisk-project.eu

6-8 November 2018, Dublin, Ireland
2018 Climate Innovation Summit
climate-kic.org/events/cis2018

7 November 2018, Brussels, Belgium
GREEN-WIN, TRANSrisk and CD-LINKS Joint Policy Day: trade-offs and synergies between climate, economic and sustainable development goals
transrisk-project.eu

3-14 December 2018, Katowice, Poland
UN Climate Change Conference, 24th session of the Conference of the Parties to the UNFCCC (COP24)
cop24.katowice.eu

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.

Chief Editor:
Prof. Catrinus J. Jepma
- Chairman of JIN Climate and Sustainability
- Professor of Energy and Sustainability at University of Groningen, the Netherlands

Editors:
Wytze van der Gaast
Erwin Hofman
Eise Spijker

JIQ contact information:
JIN Climate and Sustainability
Ubbo Emmiussingel 19
9711 BB Groningen
The Netherlands
phone: +31 50 762 0930
e-mail: jin@jin.ngo
website: www.jin.ngo