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In this issue

Meeting 'Paris' is not only about closing the emissions gap

Editor's note by Eise Spijker

Article 4, paragraph 2, of the Paris Agreement provides the legal background for each Party to develop and implement Nationally Determined Contributions (NDCs). Even though 167 out of 197 Parties have already submitted their NDCs, the pledged efforts are still considered insufficient to limit global warming by 1.5 to max. 2 °C.

There are several reasons for this 'emissions gap' to exist. A contributing factor is the complexity of embedding climate measures in countries' social and economic contexts. Not only does this imply that measures are assessed based on cost optimisation, market readiness, availability of (renewable) energy resources, etc., but also on priorities of communities and responsiveness of institutions. This implies that negative impacts of climate measures (risks) are weighted against benefits for robust national climate policies. Under the UNFCCC, much experience has been built up with embedding climate actions in national contexts, such as with the Technology Needs Assessments (TNA), Nationally Appropriate Mitigation Actions (NAMAs), and National Adaptation Plans (NAPs).

The fact that both developed and developing societies operate in multi-objective environments can complicate the implementation of a low-emission transition. In fact, it is common to agree upon less ambitious climate/environmental policy targets if there is uncertainty about potential adverse side-effects, such as job loss. Promoting mitigation efforts with expected long-term benefits that can result in potential job loss today will be a tough message to convey in any society. Politicians will be keen to emphasise potential co-benefits, but the very existence of potential adverse side-effects is likely to complicate the implementation of any climate action agenda. It is not only difficult to understand and quantify such trade-off risks, but also to prioritise a risk or development goal over others, considering needs, ambitions, and strengths of the various actors. Maximising co-benefits and minimising adverse side-effects is the mantra here, but this is easier said than done as most risks do not materialise in the same way and at the same point in time. Moreover, risk perceptions are highly region- and community-specific.

This requires a tailored approach when mainstreaming climate action with existing and ongoing social, economic and environmental actions. A failure to properly align NDCs with socio-economic (development) goals is a recipe for a sluggish and long transition period. Properly embedding of climate actions in national contexts accelerates the transition, as it stimulate societies to set higher ambition levels in their NDCs.

Reaching the 2020 Target? The Potential Role of Solar Energy in the Netherlands

By Krisztina Szendrei*

The Netherlands is lagging behind on the implementation of renewable energy technologies. According to an assessment by ECN[1] and a recent European Commission report[2] on Member States' compliance with Renewable Energy Directive (RED) targets, the country is expected to fall short of the 14% renewable energy target by 2020. This article presents how the larger-scale implementation of solar PV panels could intensify renewable energy production and close the gap to the national 2020 renewable energy target.

In 2016, a policy package[3] was prepared with additional measures for reaching the 14%-target by 2020 (Intensivering Energieakkoord; in English: Intensifying Energy Agreement). Reaching this target would require the generation of 289 PJ energy from renewable energy sources such as wind, biomass and solar. The assessment report of ECN contains a range estimate with a low, medium and high value for the expected share of renewable energy by 2020, depending on the efficiency of policy measures and the speed of implementing renewable technologies.

Even with the high end estimate – which requires that all the relevant extra measures in the Energy Agreement are fully adopted and all planned projects and projects in the pipeline will be realised in time ECN indicates that the 2020 target is unlikely to be met. On top of that, while technically, the options in the policy package are feasible, there are several technology implementation barriers, such as costs, spatial planning issues and public acceptance that could all potentially delay or block the implementation of renewable technologies.

	low	medium	high
Total renewable energy 2020 (in PJ)	233	264	278
Total renewable energy 2020 (in %)	11.3	12.8	13.5

Table 1. Potential scenarios for the share of renewable energy in 2020.

For example, public acceptance for onshore wind installations has shown a declining trend which resulted in delays or cancellation of wind projects. The national onshore wind monitor already predicted in 2016 that the 2020 onshore wind energy goal of 6 GW is likely to be missed by 1GW.[4] Assuming that the goals for offshore wind, biomass and biofuels will be reached, we can estimate how much solar energy we would need to reach the 14% goal in 2020.

Realising almost 50 PJ solar energy generation by 2020 is far from realistic. According to the predictions of a group of experts,[5] having about 9 GW (≈ 25.9 PJ) installed capacity in 2020 is however still feasible. More interestingly, they predict that due to the continuous decline of solar panel prices and the large amount of large-scale project applications for the national SDE+ subsidy scheme, installed capacity might reach 22 GW peak in 2023.

With the realisation of the 25.9 PJ of solar energy in 2020, the country would still only reach the estimated share of renewable energy of the medium estimate (12.8 %). This could be further increased up to 13.5% if the energy saving measures of the 2016

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1 ECN, 2016. Beoordeling intensiveringspakket Energieakkoord. Amsterdam: ECN Policy studies.

2 European Commission, 2017. Renewable Energy Progress Report. Brussels: European Commission.

3 Ministry of Economic Affairs, 2016. Intensiveringpakket Energieakkoord. The Hague: Dutch government..

4 Netherlands Enterprise Agency, 2017. Monitor Wind op Land 2016. Utrecht: Netherlands Enterprise Agency.

5 Stichting ZON and Holland Solar, 2017. Doel van 22 gigawattpiek PV in 2023. Uden: Solar Magazine.

policy package are fully effective because this could reduce the final energy use by up to 100 PJ.

Evidently, solar energy could provide a large amount of flexibility in reaching the 2020 and goals beyond, however, we need to be realistic and consider that there are still multiple factors that might prevent the adoption of such an amount of renewable technologies. For example, a negative attitude or public perception about large-scale solar projects could significantly slow down or stop the implementation of this option, similar to onshore wind projects. There appears to be still a large societal gap between the desire/ambition to become more sustainable and actually accepting the associated major changes that will bring (e.g. in the landscape).

Project developers of large-scale solar energy projects can learn from the experiences of wind park developers. Since these projects have a significant impact on the landscape, careful spatial planning and active participation of local inhabitants is needed to minimize implementation barriers and risks, such as a poor public perception.

Renewable energy source	In PJ
Wind onshore [a]	36.3
Wind offshore [b]	37.7
Biomass co-firing [c]	25.0
Other biomass [d]	80.0
Biofuels [d]	35.5
Other RES [d]	23.7
Solar in 2016 [e]	5.9
Total	**244.1**
Additional solar needed	**44.9**
Total renewable energy needed for achieving 14%	**289**

Table 2. Renewable energy production forecast for the Netherlands for 2020.

a Corresponding to 5 GW installed capacity.

b Estimated from growth projection modelling work based on NWEA Visie 2030 (pdf).

c Maximum allowed co-firing capacity according to the Energy Agreement.

d ECN assessment of Energy Agreement, 2015; median values.

e Corresponding to 2,040 MW installed capacity. Source: Renewable energy production statistics by CBS.

Survey

Due to the potential importance of public perception in relation to the adoption of solar energy projects, JIN have performed a survey on perception and acceptance of solar PV in the Netherlands. This online survey was conducted within the framework of the EU-funded TRANSrisk project. The online survey, with over 300 respondents from the Netherlands, was closed at the end of 2017. In the coming period JIN will process the results and develop a report/article. If you are interested in the survey results please subscribe to the JIQ Magazine via ww.jin.ngo/jiq-subscribe or follow the TRANSrisk project via its website: www.transrisk-project.eu.

Re-designing the Value Chain for Water and Minerals

A circular economy project on industrial wastewater and resource recovery

By Dimitris Xevgenos*

In May 2017, the Grant Agreement for ZERO BRINE project was signed by the European Commission and TU Delft, the project coordinator. Throughout this €10M project, four large scale demonstrations will be implemented at industrial sites in the Netherlands, Spain, Poland and Turkey. The consortium involves 22 partners from 10 countries aiming at “Re-designing the value and supply chain for water and minerals” by recovering these resources from wastewater streams generated by process industries.

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ZERO BRINE concept

The process industry is the major source of chloride releases in Europe, with the Chemical Industry representing the vast majority (accounting for 11.5 million tonnes/year). These releases are very complex effluents and represent today a big challenge for the companies both in terms of management and costs. The concept of the ZERO BRINE project is to close the loop of these particularly problematic effluents by developing the necessary concepts, technological solutions and business models, while eliminating wastewater discharge and minimising environmental impact of industrial operations through brines (ZERO BRINE). The materials to be recovered include minerals (e.g. sodium chloride, magnesium hydroxide), regenerated acids, caustics and water. These materials will be recycled in the same process industries that produce the brines (internal valorisation) or/and other process industries that do not produce these streams (external valorisation).

Box 1. ZERO BRINE demonstration plant.

Ion exchange regenerate: a circular economy approach in Rotterdam Port

Evides Industriewater (EIW) is supplying with ultrapure demineralized water (average conductivity < 0.2 μS/cm) a large number of (petro) chemical industries located in the port-industrial complex of Rotterdam; 20 industries are connected to the demin water pipeline, up to date. With its capacity of 1,400 m^3/hour, DWP Botlek is one of the biggest demineralized water plants in the Benelux area.

To regenerate the ion exchange units, EIW is consuming approx. 2,000 tonnes of solid salt per year; this salt is produced and transported from a salt mining site 300 km away. Energy is required for production of this salt quantity (~300 MWh) through solution mining (evaporation of brine) and for transportation of the salt at the site of EIW at the Botlek. The salt is then diluted to produce a salt solution of 9% w/w, to regenerate the ion exchange resins.

In this value and supply chain, large amounts of energy are consumed to evaporate a brine (at the production stage) which is again diluted (at the consumption/end-user stage), releasing also greenhouse gas emissions. This can be avoided.

Bringing the industry water producer closer to the design and production phase (for salt production), will result in sustainable sourcing of raw materials and in avoiding over-production, waste and other environmental impacts, enabling also the optimization of production processes through internal valorisation of minerals recovered.

A large-scale demonstration plant will be developed in the Energy Port & Petrochemical cluster of Rotterdam Port, involving local large industries. The plant will be able to treat part of the brine effluents generated by a demineralised water supplier (Evides Industriewater), while waste heat will be sourced by neighbouring factories. For demineralised water production, softening of raw water is required; this is often performed by ion exchange units. During this process, the hardness ions, namely calcium and magnesium, are exchanged with sodium ions. The ion exchange unit needs to be regenerated before being used again, using a solution of sodium chloride (NaCl). In the demonstration plant, the chemicals needed to regenerate the softening units will be recovered from the brine effluent (internal valorisation) (see also Box 1). At the same time, other valuable minerals are produced with cross-fertilisation opportunities for other supply chains. Industrial symbiosis will play a key role in cutting down costs but also environmental impacts through waste heat recovery.

Three large-scale pilot plants will also be developed in Poland (coal mining sector), Turkey (textile sector) and Spain (chemical sector), providing the potential for immediate replication and uptake of the project results after its successful completion.

Stakeholder consultation events

The involvement of end-users and other key stakeholders in designing the circular economy model is of high value for ZERO BRINE project, the aim being to develop value-added solutions that better respond to their needs. In this respect, at least three stakeholder consultation events will be organised. The first consultation event will take place 12 March 2018 at Delft University (IDE faculty), the Netherlands. Please follow the ZERO BRINE events page for more information, or contact the author of this article.

EU-MERCI: Fostering the Growth of Energy Efficiency in the European Industry

By Erwin Hofman and Vlasis Oikonomou*

Over the past two years, a group of European energy agencies and research institutes has carried out the EU-MERCI project on energy efficiency in the industry. The project aimed to promote the exchange of good practices for energy efficiency interventions across EU Member States, based on a bottom-up analysis of practices and technologies implemented in industrial sectors. In addition, the related government policies and measures, that are used to foster implementation of energy efficiency in EU industry, have been analysed. A final conference was organised in London, 23 January 2018, to present the outcomes of the project and discuss its practical use with industry and policy stakeholders.

The EU-MERCI project has received funding from the the European Union's Horizon 2020 research and innovation programme.

The overarching objective of the EU-MERCI project was to support energy efficiency in the European industry sector. It developed methods and tools for assisting industry in implementing effective energy efficiency improvements and monitoring of energy savings, and assisted policy makers in the assessment of the effectiveness and transparency of energy efficiency mechanisms.

The EU-MERCI project consisted of three strategic steps. First, an assessment and survey were undertaken on the specificities of energy efficiency policies. Second, energy efficiency interventions (practices and technologies) across industrial sectors were analysed, and 'Good Practices' identified based on technical, economical, and social key performance indicators (KPIs). Third, the project aimed at capacity building through knowledge exchange, publications, events, and validation of the Good Practices (assess and discuss whether these interventions can also be applied in other EU Member States or other sectors). This article discusses the policies, the Good Practices, and input from speakers at the final conference.

EU energy efficiency policies

The industrial sector is one of the dominant sectors when it comes to energy consumption. In the European Union, 25.3% of the 1.08 billion tonnes of oil equivalent of final energy is used by the industrial sector. Industry is therefore an important strategic sector within the EU's and its Member States' energy efficiency regulations, including the EU Energy Efficiency Directive (EED).

From the EU-28 countries plus Norway, 16 have implemented an EEO scheme that is applicable to the industrial sector (see Figure 1). Most of these countries have combined this EEO scheme with alternative measures, but for five countries the EEO scheme is the sole relevant energy efficiency measure for industry: Denmark, Hungary, Lithuania, Luxembourg, and Poland.

Apart from the five countries mentioned above that have only implemented an EEO scheme, all countries

Vlasis Oikonomou presented on industrial energy efficiency policies at the EU-MERCI conference in London.

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have introduced alternative measures. Alternative mechanisms and measures may include taxation schemes, subsidies, regulations and standards, or information campaigns. When using alternative measures, similar strict rules need to be followed for determining the resulting energy savings as used in EEO schemes.

The most common alternative measure type is financial support. Out of the 24 countries that have implemented alternative measures, 19 have introduced at least one financial support policy, such as incentives for energy efficiency equipment. Also the policy type of information and training is rather popular, with 12 countries having introduced such policies, followed by fiscal measures (9 countries).

The key energy efficiency policies in the 28 EU Member States and Norway, that are relevant to the industrial sector, show large variety in types, calculation methodologies, as well as monitoring and verification processes. While in most Member States a wide range of policy measures has been implemented, given the differences in country contexts, it remains to be seen which strategies and measures are the most effective in reaching the 1.5% reduction target.

The reports 'Comparative report of industry-relevant energy efficiency policies in Europe' and 'Barriers and costs from EEOs and alternative measures from a market perspective' can be downloaded from the EU-MERCI project website.

Identification of Good Practices

EU-MERCI has compiled a database of about 3,000 records of energy efficiency interventions in the European industry, specifically in the framework of the Italian and Polish white certificates mechanisms, energy efficiency advice by Carbon Trust in the UK, and the klimaaktiv and KPC programmes in Austria.

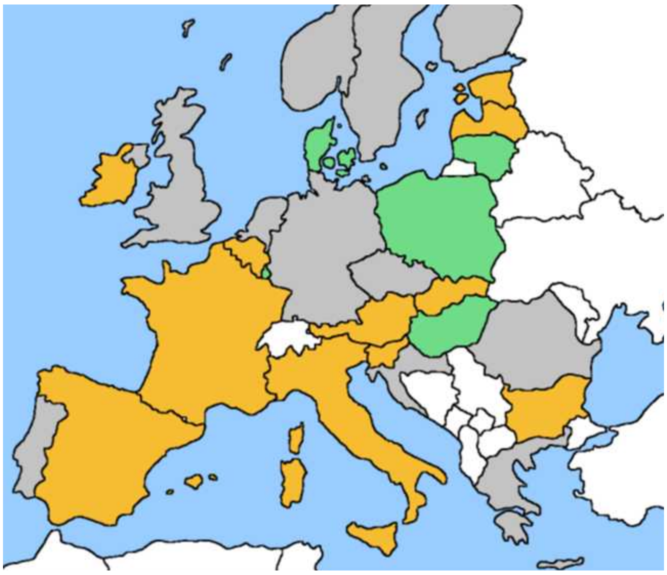


Figure 1. Map representing how EU Member States and Norway have met (for industry) requirements under Article 7 EED. Green = EEO only; yellow = EEO combined with alternative measures; grey = alternative measures only.

After clustering of identical measures, energy efficiency measures were analysed using a quantitative analysis based on 9 KPIs, a comparison to the 'Best Available Techniques' as identified in the EU Industrial Emissions Directive, and a qualitative expert assessment (engineering evaluation). This has led to the identification of 157 'Good Practices' in 11 industrial sectors (the same sectors as in Figure 2; in the figure the aluminium and copper sectors are combined as 'non-ferrous metal').

The KPIs used for the quantitative analysis of energy efficiency interventions included three technical indicators (primary energy savings, energy consumption improvement, and energy intensity reduction), three economic indicators (payback time, cumulative cashflow, and share of project costs

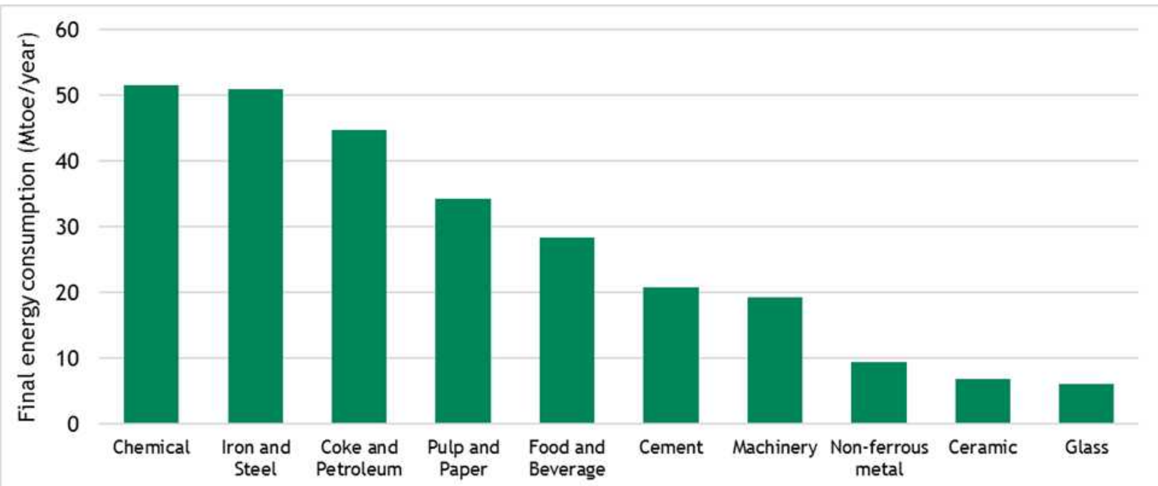


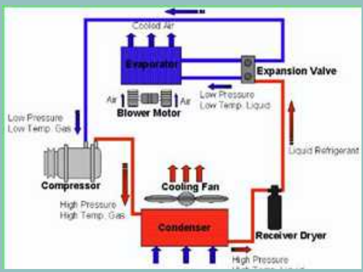
Figure 2. Final energy consumption per industrial sector (source: Eurostat).

Box 2. EU-MERCI Good Practice in the food sector.

Refrigeration systems

The EU-MERCI database contains 93 records of applications related to refrigeration systems. Various of these applications have been identified as 'good practices', including a refrigerant under-cooling system, inverter installation, and heat recovery.

The average energy use improvement is 16%, and payback time is in most cases less than a year. Energy efficiency in refrigeration systems is easily replicable.



Box 3. EU-MERCI Good Practice in the chemical sector.

Nitrogen generation and recovery

In plants for nitrogen production, as well as other chemical installations in which nitrogen is produced as a by-product, significant energy savings are possible. In situations where nitrogen is needed as a feedstock, traditionally liquid nitrogen is transported to the location. By construction a gaseous nitrogen production plant 'on site', transport is avoided and nitrogen phase changes do not take place.

In installations where nitrogen is produced as a by-product and dispersed into the atmosphere, nitrogen recovery can be applied. The recovered nitrogen (in gaseous state) is subsequently compared to a pressure of 16 bar and delivered through the distribution network designed in order to reduce the consumption of liquid nitrogen.

In the nitrogen generation and recovery examples as reported in the EU-MERCI database, it is shown that these practices can lead to substantial energy consumption improvements of more than 50%, and in some cases even up to 80%.

subsidised), and three advanced indicators (cost per unit of energy saved, cost per unit of emissions reduction, and renewable energy use).

The project has launched the European Industrial Energy Efficiency Good Practices platform (www.eumerci-portal.eu) with a database of all records, as well as a library of the Good Practice documents (including descriptions, KPIs, and illustrations). For the five sectors with the highest energy consumption, fact sheets were published with key information on the Good Practices as well as statistics, policies, and recommendations. The factsheets are available on the portal as well.

Boxes 2 and 3 show two examples of EU-MERCI Good Practices, in the food & beverage and chemical sectors respectively. In some sectors, notably the food and beverage industry, significant energy savings are still possible based on a range of relatively simple standard interventions such as heat recovery and refrigeration sectors. These interventions are easily replicable across subsectors, and the costs per unit of energy saved are generally low. In other sectors, much more effect is sorted by a small number of process-related interventions. In more energy-intensive sectors such as the chemical industry, standard measures may provide some quick-wins, but for large-scale savings far-reaching process interventions with relatively high costs will be needed.

EU-MERCI final conference

The final conference of the EU-MERCI project, titled 'Good Practices of Energy Efficiency in the European Industry', was held in London, 23 January 2018. The EU-MERCI partners presented the findings on energy efficiency policies and Good Practices, and various stakeholders commented and shared their experiences.

In his presentation, Clemens Rohde of Fraunhofer ISI indicated that for many industrial companies, there are two key challenges: there is often a lack of evidence on the performance of energy efficiency investments, which makes the benefits and (financial) risks hard to assess, and there is a lack of commonly agreed procedures and standards for energy efficiency investment underwriting, which increases the transaction costs. For this reason, the EEFIG De-risking Energy Efficiency Platform (DEEP) was launched, an open source database for energy efficiency investments performance monitoring and benchmarking with interpretation of gathered data and investments risk/performance modelling. The database includes data of over 10,000 energy efficiency projects in both buildings and industry. EU-MERCI contributed its Good Practices database to the DEEP as well.

Related to the above challenges, Quitterie de Rivoyre (Investor Confidence Project, ICP) elaborated on the 'energy efficiency capital gap'. There is no shortage of potential projects, and no shortage of capital, but projects and investors are not sufficiently connected. The main reason for this gap is the lack of standardisation, resulting in greater risks, uncertainty, and higher transaction costs. For this reason, ICP has developed protocols for projects, that come with IREE certification ('Investor Ready Energy Efficiency'). This certification reduces due diligence costs, opens access to quality projects, and because of standardisation it allows for aggregation of projects (also across borders). The IREE certificate is now available for energy efficiency projects in buildings in the EU and the US. It is currently under development for industry, district energy systems, and street lighting in the EU.

Hans De Keulenaer (European Copper Alliance) described the challenges for industry. A key issue is that there are many potential decarbonisation pathways, and choices have not yet been made. For heat demand in industry, for example, the current fossil energy sources can be replaced by either electrical options (induction, resistance, infrared, heat pumps) or options that are still based on combustion (such as bioenergy or 'green' hydrogen). A stable investment climate is needed for industry to be able to map which strategy is to be chosen.

A key focus of the EU-MERCI project has been on the food and beverage industry, with the European Economic Interest Grouping 'SPES' validating the outcomes and conclusions of the project in this particular sector. Maurizio Notarfonso of the Italian food industry association indicated that there are significant obstacles for companies to implement energy efficiency interventions, especially in the food and beverage industry where many small and medium-sized enterprises (SMEs) are active. There is generally a lack of knowledge of the existing opportunities and tools and a resistance to make investments, if there is no immediate perception of concrete (financial) returns. Sharing of knowledge and experiences (including Good Practices and success stories) is therefore very important, and energy audits could be promoted as a useful tool to realise a clear diagnosis of opportunities.

All presentations of speakers at the EU-MERCI final conference are available at the EU-MERCI project website as PowerPoint presentations and as videos. Both the project website and the European Industrial Energy Efficiency Good Practices platform provide a wide range of reports and background documents.

TRANSrisk survey: sustainable development in the livestock sector

With the Paris Agreement, and the commitments made in the Nationally Determined Contributions (NDCs), robust and balanced low-emission strategies for all economic sectors are needed. Climate action, however, is 'just' one of an ensemble of Sustainable Development Goals (SDGs), with relevance for the livestock sector. Relevant SDGs include; SDGs #2 zero hunger, #3 good health and well-being, #6 clean water and sanitation, #12 responsible production and consumption, and #15 life on land.

If you have an interest in the livestock or agricultural sector, please take part in this survey!
surveymonkey.com/r/sustainable-livestock

Implementing a low-emission strategy in a multi-objective environment will likely trigger a political and societal debate in societies on which development goals have to be prioritized over others as co-benefits (opportunities) and trade-offs (risks) are likely to manifest. For example, does a society prefer a reduction in greenhouse gas emissions over an increase in unemployment? Or improving the quality of ground- and surface water more import than reducing greenhouse gases? Aside from the likely occurrence of trade-offs, co-benefits can also manifest. Such co-benefits, ideally have to be maximized so as to enhance the societal value of a given mitigation technology or practice. Such technologies and practices that serve multiple development objectives (and have low to no trade-off impacts) are likely to face less implementation barriers.

This survey not only aims to shed some more light on which development goals are perceived as more important, but also explores what potential risks and opportunities can occur when pursuing an ambitious low greenhouse gas emission strategy in the livestock sector.

The survey (developed within the framework of the EU-funded TRANSrisk project) aims to explore which social, economic and environmental development priorities are considered most relevant for shaping the low-emission development strategies for the livestock sector.

Thank you for your cooperation!

Eise Spijker, researcher at
JIN Climate and Sustainability

TRANSrisk

Realising the Potential for Climate Change Mitigation Options

The goal of the Paris Agreement of 2015 is to limit the global mean temperature increase to well below 2°C above pre-industrial levels and aim for 1.5°C. Realising such goals requires substantial emission reductions, leading to low- or even zero-emission economies and societies over the course of this century, supported by options to extract greenhouse gases from the atmosphere. This would require a great variety of decision-makers to simultaneously overcome economic feasibility, technology availability and social acceptance issues of identified climate solutions, asking for significant coordination across governance levels.

The efforts through which countries address their mitigation challenges are communicated via national climate plans, the so-called nationally determined contributions to the global response to climate change (NDCs). Responding to its Paris commitments, the European Union requires Member States to submit Integrated National Energy and Climate Plans (INECPs), in accordance with the EU's Energy Union Strategy for 2030, and national longterm low emission strategies for 2050, by January 2019.

The CARISMA project, funded by the EU's Horizon 2020 Programme, addresses a range of aspects related to successful implementation of technologies and policy for climate change mitigation. Earlier research and practice have already established a strong knowledge base on feasibility of mitigation options and pathways. Hence, CARISMA's efforts focus on issues related to scaling up options within different country contexts. While decision-makers, both in the private and public sector, often have a good understanding of costs and potentials of options for mitigation, especially when implemented as a stand-alone project or small-scale programme, the consequences of large-scale implementation of options, in longer timeframes, in different social contexts, are often less clear.

For example, costs of a technology when implemented as a technology project may be mainly related to investment and operational costs. When scaling up the technology application within the sector or country, additional costs become relevant such as those related to grid system modifications (system level costs) and economy-wide costs. Moreover,

CARISMA

The CARISMA project has received funding from the the European Union's Horizon 2020 research and innovation programme.

people may not mind a single wind turbine or solar photovoltaic project, but may resist large-scale implementation of these technologies. It is in these areas where implementation problems often arise, and it is important that early in the policy cycle, at the stages of agenda setting, policy formulation and adoption of a policy package, the potential impacts of scaling up mitigation options are clearly understood and addressed.

Therefore, CARISMA has worked on improving the understanding of these aspects, related to: (1) the EU's innovation policy; (2) deployment of mitigation options on a larger scale; (3) mitigation policy interactions and evaluations; (4) contextual factors and context-sensitive policymaking; and (5) international cooperation on research and innovation for mitigation.

During the CARISMA final conference in Brussels, 6 February 2018, a booklet was launched with a summary of the project results, structured around the aspects mentioned above. This article includes a few highlights from this booklet.

The EU's innovation policy

Figure 3 provides an overview of EU funding of R&D on climate change mitigation-related technologies between 2008 and 2015. Several of these technologies are not fully 2050-proof, as they will be unable to achieve emissions reductions of over 90%. We could therefore conclude that R&D funding is partly wasted.

The spending on R&D in different sectors is roughly proportional to their emissions. However, R&D funding for emissions reductions in the industry sector is relatively low. It is therefore recommended that R&D is prioritised for technologies that could help

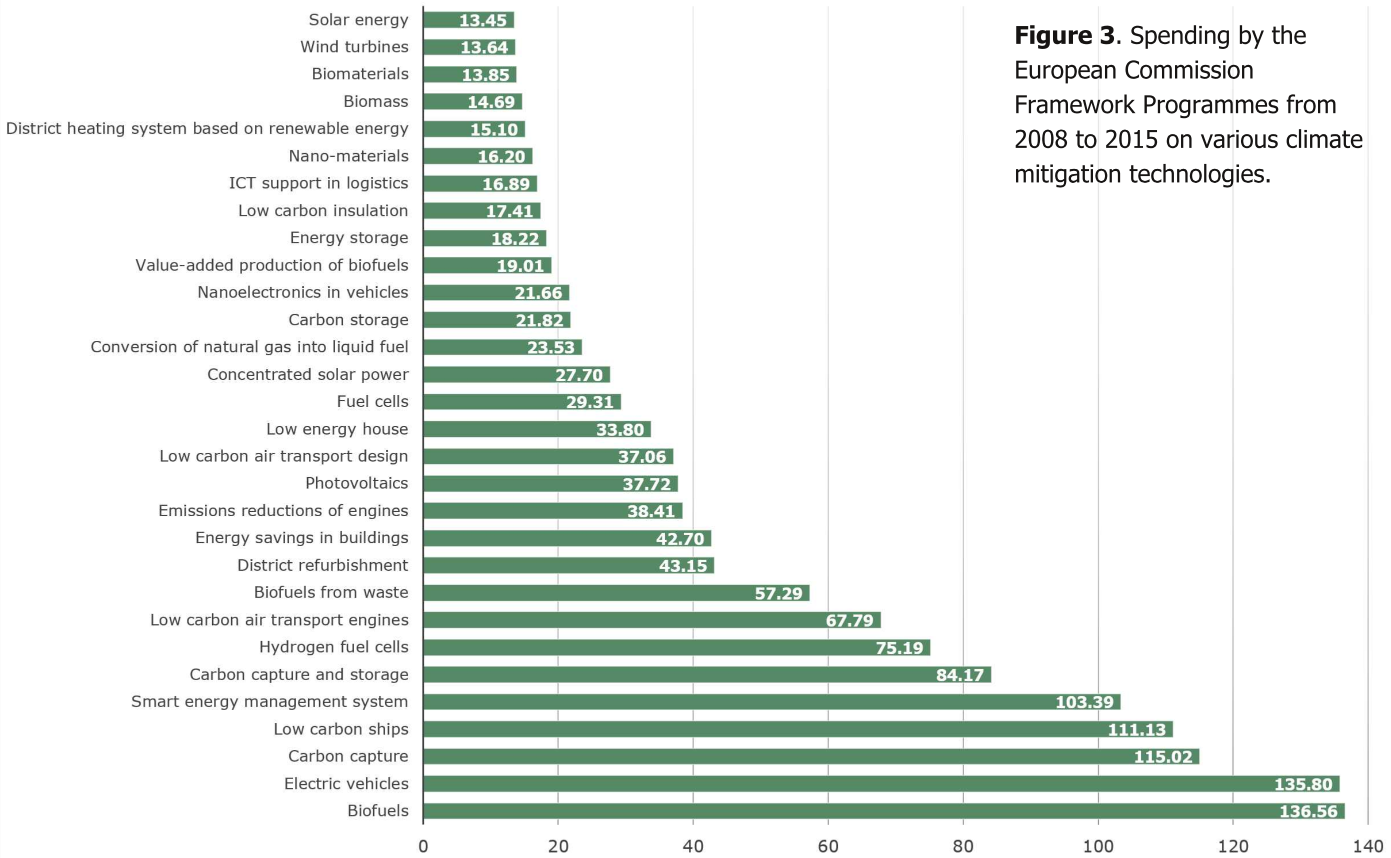


Figure 3. Spending by the European Commission Framework Programmes from 2008 to 2015 on various climate mitigation technologies.

industry to decarbonise quickly. These options, including renewable electricity, hydrogen, and carbon capture and storage (CCS), have the advantage that they may be applicable to multiple sectors.

Scaling up mitigation option deployment

When selecting and scaling up mitigation options, several aspects need to be considered, such as where to locate a technology for effective contributions to mitigation, what are system and macro level costs of scaling up, what are social implications of scaled up mitigation options and what does that mean for public acceptance of these?

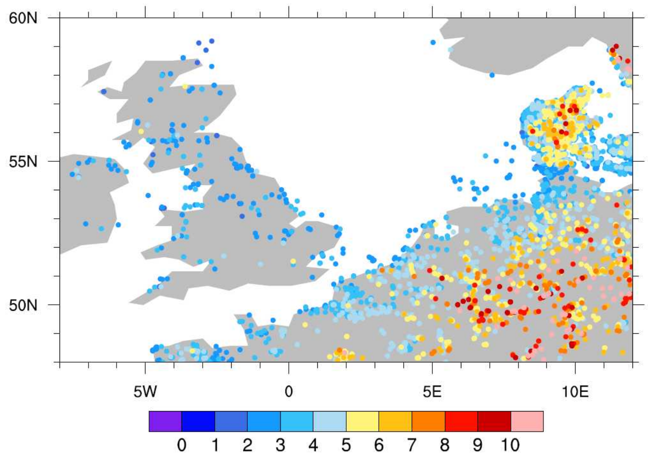


Figure 4. Example of location-specific CPTs for wind power in North-West Europe as determined by CARISMA.

For selecting effective locations for mitigation options, carbon payback time (CPT) is a helpful indicator. With CPT it is measured how much time it takes before a technology's contribution to emission reduction outweighs its own life-cycle emissions. CPT is very technology-specific, and its value is influenced by geographical, climatic and spatial factors, resource availability, and the local energy mix in the grid. For example, a wind turbine will have a relatively short CPT in a region with large wind rsources and a relatively carbon-intensive energy mix. Figure 4 shows that wind power in the UK and along the North Sea has a relatively low CPT (blue dots).

Mitigation policies

The evaluation of climate change mitigation policy is crucial for knowing how well policies work. But how are climate policies in the EU being evaluated? To answer this question, CARISMA conducted a meta-analysis of a total of 236 ex-post climate change mitigation policy evaluations in the EU and six Member States (Austria, Czech Republic, France, Germany, Greece, and the UK). By doing so, it was aimed to provide insights into how evaluation practices might be improved and responds to information and knowledge needs about the state of European climate change mitigation policies, which are expected to become ever more important in the context of the Paris Agreement and the forthcoming

Regulation on the Governance of the Energy Union. Compared with the results of a previous meta-analysis carried out in 2008-2009, formal evaluations commissioned by government bodies have been on the rise in 2010-2016. Most evaluations focus on the effectiveness and goal achievement and usually forgo a deeper level of reflexivity and/or public participation in the evaluation process. The analysis also revealed the dominance of the energy sector in the sampled evaluations (much more evaluations focus on energy rather than on for example industry, transport, or agriculture). It was found that while the EU and the six Member States have made some progress in reducing emissions and increasing the share of renewable energy sources in the energy mix, other sectors such as transport and buildings for energy efficiency lag behind those efforts. The low number or indeed the absence of any policy evaluations in the agriculture, waste or land-use sectors is an area for further investigation.

Context-sensitive climate policy

Policymaking is complex: the institutional, economic and social policy contexts are difficult to control. Sometimes policy and policy instruments cannot deliver what was expected when they were designed. In practice, contextual factors could positively or negatively affect the implementation of policy instruments, and unforeseen changes to these contextual factors may influence the outcome of a policy instrument. The better policymakers understand these factors, and how they support or hinder the outcome of the policy instrument introduced, the better they could be prepared to deal with the unforeseen changes to the contexts that would shape the policy outcome.

Based on a literature review, and validation through a range of case studies, CARISMA has identified key contextual factors that can affect the outcome of climate change mitigation policies. Table 3 provides an overview of contextual factors as defined and validated by CARISMA. With those insights, policymakers' knowledge base can be further enhanced, making them better prepared to deal with unanticipated changes to the contexts or contextual factors that could shape the outcome of policies.

International cooperation on R&I

Research and innovation (R&I) in relation to technologies for mitigation is increasingly taking place at a global scale, across a geographically dispersed set of interlinked actors, units and activities. In particular, over the past decade a number of emerging economies, such as China, India and Brazil, have become prominent actors in global innovation activities. The global R&I landscape has therefore changed significantly from mainly being undertaken within and across the classic Triad of Europe, Japan and the United States to increasingly involving emerging economies.

With a focus on particular mitigation technology options, work conducted in the CARISMA project has focussed on gaining an improved understanding of this shift in the global R&I landscape, focusing on international R&I intiatives, R&I offshoring, and policy transfer to developing countries. The insights generated have been aimed at informing key (international) stakeholders and decision makers on how international R&I cooperation could help to accelerate the development and transfer of climate technologies.

Moving R&I activities to emerging economies involves opportunities to reduce costs, adapt technologies to local markets and conditions, and take advantage of access to talent, knowledge, and new ideas. However, the analysis has also identified a number of barriers and challenges related to R&I offshoring. These are related to cultural and organisational differences between R&I units in various countries, the difficulty of managing a globally dispersed set of interlinked R&I activities, and the required efforts to protect intellectual property rights and prevent spillover of knowledge and technology.

Read more

The CARISMA booklet, titled "Realising the Potential for Climate Change Mitigation Options - Implementing the Paris Agreement in Europe and beyond", has been published in February 2018 and launched at the CARISMA final conference. A pdf version of the booklet can be downloaded from the CARISMA project website: carisma-project.eu.

Institutions and governance	Innovation and investment	Attitudes and lifestyle
• Institutional coordination • Constellation of stakeholders	• Presence of a technological innovation system • Market and regulatory framework • Policy continuity • Macroeconomic environment	• Public perceptions • Demographic attitudes and other parameters • Behavioural disposition at the individual level • Knowledge and experience

Table 3. Overview of contextual factors as defined and validated by CARISMA.

Reports

Open access / free of charge

Bais-Moleman, A.L., Sikkema, R., Vis, M., Reumerman, P., Theurl, M.C. and Erb, K.-H., 2018. Assessing wood use efficiency and greenhouse gas emissions of wood product cascading in the European Union, Journal of Clearner Production, Vol. 172, Pp. 3942-3954.
A scenario and life cycle approach was followed to quantify the potential benefits of cascading use of woody biomass. Following a supply chain perspective, different stages of production were analysed, including forgone fossil-fuels substitution, optimization at manufacturing level and forest regrowth. This explorative study highlights the potential of cascading use of woody biomass in the wood production chains to contribute to a reduction of environmental impacts related to wood resource and energy use, but it also reveals trade-offs in terms of GHG emissions reduction, relevant especially in meeting short-term (2020–2030) renewable energy targets.

Hamrick, K. and Gallant, M., 2017. Fertile Ground: State of Forest Carbon Finance 2017, Forest Trends' Ecosystem Marketplace, Washington, United States.
This report details innovative finance mechanisms that channel finance towards enhancing the ability of forests and other natural land areas to absorb carbon from our atmosphere. In particular, it shares the latest data and trends for three forest carbon finance mechanisms: voluntary carbon markets, compliance carbon markets, and payments for Reducing Emissions from Deforestation and Forest Degradation (REDD+) programs. For each of these mechanisms, the report covers the volumes and values of offsets transacted, key market actors, and relevant trends and policy developments. It also includes information about the projects that receive these payments, how they operate, and how they are influencing the communities and ecosystems around them.

Brandi, C., Dzebo, A. and Janetschek, H., 2017. The Case for Connecting the Implementation of the Paris Climate Agreement and the 2030 Agenda for Sustainable Development, DIE German Development Institute Briefing Paper 21/2017.
The adoption of the 2030 Agenda for Sustainable Development and the conclusion of the Paris Agreement in the closing months of 2015 represented a significant moment in the global movement towards sustainability. The opportunity to connect the Paris Agreement and the 2030 Agenda should be considered in order to promote policy coherence by maximising cobenefits and systematically mediating trade-offs for a more efficient implementation.

Hermwille, L. and Gornik M., 2017. Steps Towards Carbon Neutrality: An Overview of Strategies and the Role of Offsetting, JIKO Policy Brief No. 02/2017.
This brief portrays the commitments towards carbon neutrality of Costa Rica, Norway, Sweden, the City of Melbourne, Australia and the corporation Microsoft. All cases have set themselves ambitious neutrality goals and have implemented measures to achieve them. However, none of the cases will be able to achieve accomplish neutrality on their own, at least not on short-term. The remaining emissions will be compensated using carbon credits either from domestic offset schemes (Costa Rica) or from international schemes. For the time being, voluntary carbon neutrality goals, as presented in this brief, are an effective way to demonstrate leadership in climate protection. For the near future, pioneering actors that set voluntary carbon or climate neutrality goals could provide a significant source of demand for international carbon credits.

Hetemäki, L., Hanewinkel, M., Muys, B., Ollikainen, M., Palahí, M. and Trasobares, A., 2017. Leading the way to a European circular bioeconomy strategy, From Science to Policy 5. European Forest Institute.
The year 2016 was a turning point: the 2030 Agenda for Sustainable Development and its Sustainable Development Goals (SDGs) were adopted, and the Paris Agreement on climate change came into effect. These sent out a global political message of the need to transform our economic system to end poverty, protect the planet, and ensure wellbeing for all. The critical question now is how to reach the ambitious targets they set. A necessary part of the answer will be the move to a circular bioeconomy to increase the use of renewable non-fossil raw materials and products in sustainable, resource-efficient way. The new From Science to Policy study from the European Forest Institute analyses what a circular bioeconomy strategy would require, particularly in a European context.

Opitz-Stapleton, S., Nadin, R., Watson, C. and Kellett, J., 2017. Climate change, migration and displacement: the need for a risk-informed and coherent approach, Overseas Development Institute, London, United Kingdom.

This report presents an overview of the current evidence base on the complex relationships between climate change and human mobility. It aims to support the development of an informed global discourse across the humanitarian, peace and sustainable development agendas and as a counter to some of the sensationalist claims often propagated by the media. In so doing, the paper illustrates that to adequately address human mobility in international and national policy responses, the links between climate change, displacement and migration need to be better understood.

Streck, C., Howard, A. and Rajão, R., 2017. Options for Enhancing REDD+ Collaboration in the Context of Article 6 of the Paris Agreement, Meridian Institute, Washington, United States.

This report evaluates options for how countries that are parties to the Paris Agreement can cooperate to accelerate the implementation of REDD+. Five options are presented, including for example the use of Article 6 to involve private and public entities in REDD+ implementation, and the negotiation and implementation of joint NDCs. Essential for the decision on how to combine various mechanisms and modalities of cooperation is a decision on the side of the tropical forest countries on whether and how much emission reductions they wish to transfer in return for financial support and how such transfers will affect their ability to achieve their NDCs.

UN Environment – DHI Centre, CTCN and UNEP DTU Partnership, 2017. Climate change adaptation technologies for water: a practitioner's guide to adaptation technologies for increased water sector resilience.

This guide aims to help address this challenge by providing the missing identification and evaluation assistance that those looking for adaptation solutions initially face. More specifically, it focuses on adaptation technologies for building resilience to climate change induced hazards in the water sector. It provides a simple and comprehensive overview of specific water technologies and techniques that address challenges resulting from climate change and help to build adaptive capacity. The cornerstone of this guide is the water climate change adaptation technology taxonomy developed, systematizing the most pressing climate change challenges in water sector, and their corresponding water adaptation technologies. A total of 102 water adaptation technologies are included in this guide. Further to introduction of the adaptation technologies, several approaches to selection and prioritization various adaptation technologies are also discussed.

World Bank, Ecofys and Vivic Economics, 2017. State and Trends of Carbon Pricing 2017, World Bank, Washington, United States.

In the 2017 edition of State and Trends of Carbon Pricing, an up-to-date overview is given of carbon pricing initiatives worldwide. The value of carbon pricing initiatives – including emissions trading schemes (ETS) and carbon taxes – has reached $52 billion, an increase of 7 percent compared to 2016. With eight new carbon pricing initiatives in place since early 2016 - three quarters of them in the Americas (Colombia, Chile, and a number of Canadian provinces) – there are now 42 national and 25 sub-national jurisdictions putting a price on carbon emissions. The report shows that momentum on carbon pricing continues to grow, but that stronger action will be needed to meet the Paris Agreement goals while 85% of global emissions remain uncovered by carbon pricing.

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. 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

5-7 March 2018, Edmonton, Canada
CitiesIPCC 2018 Cities and Climate Change Science Conference: Fostering new scientific knowledge for cities based on science, practice and policy
citiesipcc.org

16 March 2018, Amsterdam, Netherlands
Heat Roadmap Europe Workshop: Flagship Research on Modelling for Unlocking the Decarbonising Potential in Heating and Cooling
heatroadmap.eu/Events.php

20-21 April 2018, Berkeley, United States
Tenth International Conference on Climate Change: Impacts and Responses, Engaging with Policy on Climate Change
on-climate.com/2018-conference

30 April-10 May 2018, Bonn, Germany
Bonn Climate Change Conference: 48th Sessions of the UNFCCC Subsidiary Bodies
unfccc.int/meetings/meeting/10552.php

11-13 June 2018, Helsinki, Finland
3rd European Sustainable Phosphorus Conference
phosphorusplatform.eu/espc3-2018

20-22 June 2018, Naples, Italy
Environmental Impact 2018: 4th International Conference on Environmental and Economic Impact on Sustainable Development
witconferences.com/impact2018

24-27 September 2018, Helsinki, Finland
2018 Global District Energy Days
'Unite | Innovate | Experience'
2018dedays.org

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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