Industrial Innovation: Pathways to deep decarbonisation of Industry

Part 3: Policy implications

02 March 2020

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Executive summary

The focus of the analysis for DG CLIMA carried out by DIW Berlin under this task, includes four parts, which had been identified by CLIMA colleagues as relevant for their work and were completed by DIW, accordingly. The four parts (results presented in sections 1-4 of this report) were defined as follows

1. **Green Public Procurement (GPP)**. This section presents the findings from the review and assessment of existing experiences on GPP implementation in different countries, in light of existing economic literature, and what can be learnt for the design of public procurement practices and schemes in Member States to draw synergies with the Innovation Fund.
2. **Carbon Contracts for Difference (CCfD) – an overview**. This section provides an overview on CCfD, including policy papers, case study on Contracts for Difference (CfDs) for renewables, and a numeric example for CCfD.
3. **Non-financial data and ESG reporting**. This section provides a short qualitative exploration of the reporting and use of non-financial data in the context of the fitness check of the EU framework for public reporting by companies.
4. **Product carbon requirements**. This section explores the role of product carbon requirements (PCRs) as one of the instruments that could help phasing out the production of carbon-intensive processes.

The four parts are summarised below:

Green Public Procurement (GPP)

Public procurement accounts for around 15% of GDP in the EU. In sectors like infrastructure, transport systems and buildings, governments and other public authorities command substantial shares of the market. These sectors are also responsible for large shares of GHG emissions. The large impact of public sector's purchases implies, on one hand, that public buyers are responsible for a relevant share of emissions but, on the other hand, have the opportunity to leverage their purchasing power not only to reduce their carbon footprint but also to create demand and lead markets for low-carbon products, services and practices.

Climate-friendly Green Public Procurement practices that takes into account the carbon footprint of products and services in the award of public contracts, can help realize the mitigation potential of public purchases.

This report reviews and assesses existing experiences on climate-friendly GPP implementation (mostly related to infrastructure procurement) in different countries (Netherlands, Sweden, UK, California), and summarize what can be learnt for the design of public procurement practices and schemes in Member States so to allow synergies with the Innovation Fund.

The main messages of the report can be summarized as follows:

First, climate-friendly GPP practices that include significant functional carbon requirements (e.g., as in the model of the Swedish Transport Administration) or shadow carbon prices that increase the economic viability of low-carbon options relative to standard ones (e.g., as used by the Dutch Infrastructure Authority), or practices that require climate-friendly elements as part of specific technical requirements (e.g. on carbon caps in materials as envisaged by the Buy Clean California Act) can achieve substantial emission reduction e.g., by triggering material-efficient product design, climate-friendly material choices and optimization in construction, manufacturing and logistics.

Second, the emissions reduction potential lies at different stages of the (construction) supply chain and with different actors. Yet project time constraints often limit flexibility and innovation in design as well as the opportunity for coordination across the supply chain. Enhancing integration of the supply chain, for example through collaborative contracting and alliances (e.g., as implemented in Anglian Water's business model) can allow detecting and realizing measures with larger mitigation potential (e.g., re-design a building to serve functions at lowest carbon cost).

Third, to achieve full potential of carbon emission reduction and speed transformation for a given pre-defined design choice, functional reduction requirements (or award criteria), to stimulate innovative technical solutions, should be combined with specific requirements to influence directly materials producers and spread technologies and practices already tested. In addition, a possibility to reduce risks, overcome the time and resource constraints imposed by the project, and speed up innovation is to use smaller pilot projects for quicker testing of new materials, tools and technologies and, once, proven, use procurement requirements in large projects to spread their adoption in the market.

Fourth, setting carbon requirements (or criteria) at the right level and inducing carbon reduction from suppliers requires a very clear incentive framework combined with transparent and comprehensive systems for calculation of baselines, verification of performance and penalties for non-compliance. High competence of contracting authority is required as well as awareness of both the supplier's competence and of the opportunities for carbon reduction in the specific project.

Fifth, it is crucial that the contracting authority has a long-term perspective, and that requirements and shadow prices are raised over time to reflect climate targets and are communicated clearly and timely so that industry can adjust. It is also important to increase collaboration between different departments of the contracting authority (e.g., purchasing department and sustainability department).

Sixth, an important barrier to broader implementation of GPP is the perception that it increases the cost of the purchase for the contracting authority. However, best experiences so far have demonstrated that (in the case of infrastructure), substantial emission reduction (up to 50%) can be achieved without an increase in cost by reducing material use and optimization in logistics and construction. In addition, according to current research, the incremental cost from using low-carbon material production processes or alternative materials is likely to be very contained. Furthermore, by moving from a concept of "best value for money" based on purchasing cost to one based on life cycle cost, public purchasers would be able to purchase items not only with lower life cycle emissions but possibly also lower overall costs.

Seventh, climate-effective GPP can be very complex to implement. Especially at the local level (i.e., regions and cities) procurement teams are often small and officials lack both technical and legal expertise as well as resources (e.g., software and databases) for the implementation of GPP. Moreover, GPP is perceived a time-consuming and effort-intensive activity that is not compatible with the tight timeline of the procurement process and resource constraints of the team. Therefore, authorities should be supported for GPP implementation. Helpful measures in this sense can include for example i) training programs for public officials to get professionalization of and commitment to GPP; ii) a professional consultancy service on the technical and legal implementation of GPP; iii) guidelines for the implementation of GPP and platforms for sharing of best-practices; iv) standardization of methods and tools for the quantification of LCC, as well as for monitoring, evaluating ex-post compliance and reporting; v) cooperation and coordination between authorities and countries, and joint public procurement initiatives for smaller contracting authorities.

Eight, public procurement schemes in Member States (MS) and the Innovation Fund can be mutually supportive. On the one hand, green public procurement schemes in MS can support low carbon production processes and alternative materials thereby helping to overcome the so-called valley of death that is haunting technologies after initial support through R&D and demonstration funding. On the other hand, the Innovation Fund could be extended to open competition between ambitious GPP pilot projects at the local level. This would allow overcoming the concerns of incremental costs and initial risks of climate friendly options, as well as rewarding the pro-active authorities and increasing signaling and visibility of low-carbon options in cities.

Carbon Contracts for Difference (CCfD) – an overview

Climate targets can only be achieved with a shift to new technologies and practices for the production and use of basic materials, as these account for around 16% of European greenhouse gas emissions. The moderate price level of the EU Emissions Trading System (EU ETS) and the uncertain price development does however not provide sufficient incentives for significant investments in innovative climate-friendly options.

Project-based Carbon Contracts for Differences (CCfDs) offer governments the opportunity to guarantee investors in innovative climate-friendly technologies and practices a fixed price that rewards CO2 emission reductions above the current price levels in the EU ETS. CCfDs thereby lower financing costs, set efficient incentives for continuous operation and provide a clear commitment of governments to long-term climate policy goals.

How do carbon contracts work?

CCfDs pay out the difference between the price of emissions allowances (EUAs) and the contract price, thus effectively ensuring a guaranteed carbon price for the project. In exchange for this insurance, investors are liable for payment if the carbon price exceeds the contract's strike price. Companies would thus have an incentive to make climate-friendly, innovative investments and thereby reduce their CO2 emissions.

Carbon contracts lower financing costs & can be combined with traditional investment grants

One major advantage of Carbon Contracts for Difference is the reduction of financing costs, which results in lower levels of required CO_2 prices to realise the investments in clean technologies. Stabilizing the revenue streams from the normally highly volatile CO2 prices enables investors to secure loans and thus reduce financing costs. Creditors typically require high confidence that their debts are repaid, and the stabilisation of revenue streams via CCfDs enables investors to use more and cheaper debt capital. Furthermore, a combination with investment grants, for example from the EU Innovation Fund, is conceivable, which could be combined in a common procurement procedure, thus simplifying coordination for governments and companies between different instruments. This combination would lower financing costs even more.

Carbon contracts set efficient incentives for continuous operation of innovative technologies and build on the EU ETS

Innovative technologies for emission reduction in the industrial sector are often not only characterized by higher investment costs, but also by higher operating costs. In the case of funding schemes that only provide investment grants, there is a risk that, at low CO_2 prices, the operation of an already constructed plant will not be worthwhile and the plant will become an investment ruin. Even the prospect of such a possible development can be a deterrent to innovative investments. Since payments of contracts for differences are linked to the emission reductions achieved in a particular project, incentives for long-term success of the

project are already set at the investment stage and remain in operation. CCfDs are also fully integrated in the EU ETS , could built on its MRV mechanisms for verifying emission reductions and are compatible to free allocation of allowances, as companies could sell unused freely allocated CO2 certificates at the contract price.

Clear signalling of governments' commitment to long-term policy goals & potential recuperation of government expenses

CCfDs can serve as a tool to make long-term political goals and political ambition visible and represent a credible voluntary commitment of climate policy. As governments incur higher costs for CCfDs if CO2 prices remain low or even fall over the long term, these agreements are also an incentive for policymakers to contribute to a strong European emissions trading framework. On the other hand, rising CO2 prices would allow governments to recuperate costs of CCfDs over time.

If companies have invested in the development of innovative technologies through the CCfDs, there is also an interest on their part that emissions trading is strong, whichpromotes future investment in climate-friendly technologies.

Design options matter and would benefit from a EU-wide harmonization

There are several design options for realizing and awarding carbon contracts in general, which will affect the financing conditions projects can obtain and the incentives during operation. The award procedure and eligibility are also important parts of the overall policy framework, as CCfDs should be limited to innovative, carbon-neutrality compatible technologies.

A common European design with harmonization on key parameters of CCfD signed by EU member states would reduce complexity for private sector decision makers engaging in multiple countries and thus also strengthen the common European market, enhance transparency, and contribute to a level playing field where projects participate in tenders for the EU Innovation Fund. Such harmonization may be a result of natural (but potentially slow) convergence, may be supported by a common template, and may be incentivized if a common template is used as a reference in the context of EU state aid assessment. Design options are outlined in the full report.

Conclusion

Carbon Contracts for Difference are an important element in the policy mix to trigger emission reductions in industry. A major challenge for investments in climate-friendly production processes are the low and volatile prices in emissions trading. CCfDs solve this problem by guaranteeing innovative projects a fixed CO2 price, thus reducing financing costs and providing effective incentives for emission reduction. Especially in combination with other funding instruments and a climate pledge on basic materials, significant emission reductions in the industrial sector could be triggered.

Non-financial data and ESG reporting

Background

In the EU, certain companies are required to disclose (so-called) non-financial information (which is generally related to environmental, social and governance aspects) along with their traditional financial disclosure.

Amending directive 2013734/EU (the so called "accounting directive"), Directive 2014/95/EU (commonly referred to as non-financial reporting directive) specifies the corresponding reporting requirements of large public-interest entities with more than 500 employees. Public

interest entities means listed companies, banks and insurance companies, as well as any additional categories of entity specified at the level of member States.

The directive defines the reporting scope only in broad terms and in particular, in terms of mode and place of reporting the directive leaves a lot of flexibility to the reporting entities. Against this backdrop, the European Commission drafted non-binding guidelines in order to support companies in particular as regards their environmental and social disclosure.

The European Commission published a "Fitness check on the EU framework for public reporting by companies" [1] in the second quarter of 2019. The Commission also updated the Non-Binding Guidelines on Non-Financial Reporting in the second quarter of 2019, specifically with regard to the reporting of climate-related information.

In this context, DIW Berlin executed a 4-week project to contribute to this fitness check, through a targeted literature review, exploring the consistency, quality and availability of ESG data across different types of entities and member states.

This literature survey was complemented by a small survey, and a few longer interviews to get some additional qualitative information in relation to the use of and demand for ESG data by investment professionals.

Key Messages from the Literature Review

The results of the various studies discussed here are not easily comparable, as they are using different definitions, scope and levels of aggregation. However, the variety of approaches is useful to inform the design of the required systematic assessment of reporting practices across all EU member states, which should be pursued by the European Commission. Some qualitative insights, which we found particularly relevant, have been taken from the review and are summarized here.

Regarding reporting quality, a survey across various European member states finds that only 20% of the 80 top-listed companies included a specific climate change policy section in their reports. 80% disclose GHG emissions, 30% report GHG targets. TCFD-aligned disclosure and climate-scenario analysis are still the exception and human-rights related disclosure turns out in various reviews of different national reporting practices to be least extensive and concrete.

Some of the reviewed reports point out that effective disclosure is not just about indicators but also about context, which should be considered when evaluating disclosure quality and effectiveness.

The evidence on changes in reporting practice after the transposition of the NFRD are very sparse as of the writing of this review. Initial findings suggest little change in Germany and significant increases of non-financial reporting in Italy and Poland.

Different countries implement the directive differently and exemptions to the directive's scope and in particular the degree of precision in the reporting requirements differ significantly between EU member states.

Key Messages from the Survey

1. Data Sources, reporting frameworks and drivers of demand for and availability of ESG data

60% of respondents consider ESG rating agencies as most important data source for ESG data, while GRI and TCFD are confirmed as most useful reporting framework by 73-80% of the participants

[1] https://ec.europa.eu/info/law/better-regulation/initiatives/ares-2018-744988_en

Key drivers for ESG data availability according to the participants are increased investor engagement, the NFRD and its non-binding guidelines and the TCFD recommendations.

Reputational risk is seen as number one driver (73%) of the demand for ESG information by investment professionals, followed by a range of other drivers which around 50% of participants considered important.

2. Use of ESG data and importance of different types of ESG/carbon data

Asset management (Fund managers) are named by far the most frequently (80%) as main users of ESG/carbon data, while on the other hand all major firm functions mentioned in the survey are confirmed by between 20 and 47% of the respondent to also use it. The use of ESG data hence seems to be spread across firms' different departments/functions.

No single class/type of data stands out as being more important than others, but it may be noteworthy that forward looking climate transition risk assessment features in the top group (57%).

The majority stated that carbon emissions are incorporated in their firm valuation models (47%),

The number one driver of the materiality of carbon emissions according to survey participants was climate regulation (9 out of 15 or 60%), followed by reputational risk (6 out of 15 or 40%).

Only 20% consider ESG information about smaller companies as important or very important

Product carbon requirements

Basic materials are, and will be, essential for the functioning of our societies and economies. However, their production is highly emission-intensive, contributing a quarter of global GHG emissions (IEA, 2017). As recognized by the Paris Agreement, there is wide scientific consensus that, in order to limit the catastrophic impacts of climate change on our societies, the world community must limit the global temperature rise to well below two degrees. This requires a reduction of GHG emissions toward climate neutrality, as, for example discussed for a 2050 horizon in Europe (COM (2018) 773 final). Therefore, a drastic reduction of GHG emissions from the production of basic materials along with enhanced recycling and material efficiency is urgently needed. This implies the replacement of carbon-intensive production processes with clean production processes and, thus, involves large capital expenditures and, often, higher operating costs.

This section explores the role of product carbon requirements (PCRs) as one of the instruments that could help phasing out the production of carbon-intensive processes.[2] PCRs would establish near-zero emission limits for the basic materials to be sold within a jurisdiction: only basic products that are near carbon neutral would be allowed for sale. This requirement would apply both to domestic and imported products. From a practical viewpoint, the implementation of such PCRs would need to ensure that low-carbon production processes or substitute materials have reached a certain technological readiness. However, the announcement of a future implementation of PCRs would impact the long-term viability of carbon intensive business models and investments as of today, potentially enhancing the efforts of firms toward aligning their business models and technologies with European and global climate objectives.

[2] Please note that we use the term "carbon" as a generic reference to all GHG emissions released during the production process of basic materials.

A labelling standard for basic materials linked to their emission-intensity could be a first possible (voluntary) step towards the implementation of PCRs.[3] Such a standard would set criteria for traditional carbon-intensive materials like steel, cement, plastics, and aluminium in order to evaluate whether they were produced without significant direct and indirect carbon emissions (near climate neutral). Materials complying with the standard, as well as products exclusively containing such materials, could obtain a corresponding label. A variety of actors would benefit from such a labelling scheme. It would allow businesses to provide evidence of the climate impact of their materials to final consumers and demonstrate the viability of their business model to financial investors in a carbon-constrained economy. An example of how voluntary schemes can establish new best practices within global value chains is, among others, the ISO 14000 family of standards, which is used for certifying the environmental management of businesses and organizations.[4]

In a second step and after a predefined period of time, the voluntary standard could be complemented with mandatory PCRs. The sale of basic materials or products containing significant volumes of carbon-intensive basic materials like steel, cement, and aluminium, would only be permitted if the basic materials or the embodied basic materials are certified to be at, or near, climate neutrality. One option for implementation would be to allow companies to use the previously described voluntary standards in order to demonstrate the climate neutrality of their basic materials. In parallel carbon-intensive domestic production processes of basic materials would also need to be banned to avoid that producers export materials previously dedicated to the domestic market. Otherwise the environmental objective and therefore the political legitimacy of PCRs might be jeopardized.

PCRs differ from standards and requirements that address emissions from the use of products, such as emission efficiency requirements for certain road vehicles (ex: Regulation (EC) No 715/2007). They also differ from requirements that only limit the emissions released during the production process, such as limits on conventional pollutants like SOx/NOx for new and existing industrial installations and CO_2 emission limits for the participation of coal power stations in capacity mechanisms (Regulation (EU) No. 2019/943, Article 22 Section 4). When applied to industrial processes, it is often argued that stringent emission limits on their own could result in firms relocating their production to other jurisdictions and thus serving the same demand instead of changing production processes or products to reduce emissions (Pethig, 1976). This can motivate exemptions rules or less stringent implementation of emission limits. By contrast, PCRs allow for a more stringent implementation of environmental targets in line with the global emissions reduction objectives. If firms relocate production and continue to serve domestic demand, they will be subject to PCRs anyway.

PCRs would complement, rather than substitute for, other energy and climate policies. The logic would be similar as the one that has been proposed, in recent years, for the phasing out of coal, which triggered national governments to define phase out plans for coal power stations to supplement the incentives from the EU ETS, in order to accelerate the

[3] We use the term 'Standard' as defined in the Agreement on Technical Barriers to Trade (TBT): "rules, guidelines or characteristics for products or related processes and production methods, with which compliance is not mandatory" (cf. TBT, Annex 1). Under the TBT, standards are to be distinguished from "technical regulations," which are mandatory. Note that the term "Standard," under WTO law, is more narrowly defined than a general definition of standardization often understood as the process of articulating and implementing technical knowledge (Russell, 2005). As a consequence, some legally binding legislations framed at the European level as a "standard" like the EU vehicle emission standards (Commission Regulation (EU) 2017/1154), are – under WTO law – considered to be an emission requirement stated in a "technical regulation" (WTO, 2014). *See,* also, *infra,* section 3.1.1.

[4] ISO 14000 encompasses various voluntary international standards developed by the ISO/TC 207 technical committee of the International Organization for Standardization, chaired by the Canadian Standards Association. The standard can be used to show compliance with regulatory environmental requirements, but is also used by companies to as contractual requirements with suppliers to implement sustainable supply chains, see for e.g. empiric evidence for Italian companies (Chiarini, 2012).

decarbonisation of power production. PCRs would become mandatory once there is sufficient production capacity for climate-friendly materials. Given the current degree of technological readiness, this is not likely before the mid-2030s at the earliest (Bataille et al., 2018). Thus, a first step for adequate incentives is to ensure innovation and investments in the first commercial scale installations of climate-friendly processes and materials. To this end, instruments like innovation funding, a climate contribution added to the EU ETS to ensure full carbon price internalization (Neuhoff et al., 2019), project based carbon contracts for pilot projects (Richstein, 2017; Sartor and Bataille, 2019), and green public procurement (Chiappinelli and Zipperer, 2017) haven been discussed in the literature.

The anticipation of future PCRs could enhance the effectiveness of these other policy instruments. This could be achieved by creating an unambiguous vision or clearly defined targets in terms of the CO_2 performance of the basic materials' sector within the coming 10-20 years. By doing so, PCRs would significantly reinforce incentives for businesses to direct their strategies toward the full replacement of carbon-intensive production processes with clean alternatives over the next 10-20 years. Without anticipated PCRs, there is a risk that past failures of innovation policy for these sectors would be repeated, whereby companies have invested half-heartedly in pilot projects without a strong impetus to take the relevant technologies to commercialisation (Neuhoff et al., 2014). Additionally, uncertain carbon price developments create an additional option value for postponing new investments while waiting for more clarity, thus further increasing the carbon price required to overcome inertia. A credible announcement of PCRs can trigger a shift to climate-friendly production processes at an earlier point in time or at lower carbon prices. Companies would need to change their production processes to ensure their 'licence to operate' and continue to sell into a market. It may therefore result in the prioritisation of investments in climate-friendly production processes by those companies that aim to guarantee that their business model is compatible with the anticipated policy development.

We argue that WTO law would not be an obstacle to the adoption of PCRs, provided they are designed and adopted in a manner consistent with the main legal tests described above. For this, the measure should be designed in a way that does not discriminate against imports (e.g. administrative requirements should not be excessively burdensome for imported products) and it is recommended to favour international cooperation where possible (e.g. international standardisation bodies may help to foster acceptance and streamline compliance mechanisms).

Other environmental product requirements have already been implemented and are politically accepted. They have not been challenged under WTO. However, there is inevitably still some uncertainty regarding the interpretation of some of the relevant WTO provisions given that no ex-ante clearing process is exists. A high likelihood of a successful implementation of PCRs will already be relevant for the decision making process of firms with regard to their innovation and investment strategy, which aims to secure their business model (licence to operate). Thus, governments might well decide to implement PCRs to accelerate the pace of the industrial transition toward climate-friendly production processes.

Introduction

This report is a deliverable of the Service Contract *Industrial Innovation and Decarbonising the EU Industry: a 2050 and beyond horizon*, undertaken by ICF in association with Fraunhofer ISI and DIW Berlin. The report for Task 1 and 2 can be accessed in the following links:

Task 1: https://ec.europa.eu/clima/sites/clima/files/strategies/2050/docs/industrial_innovation_part_1_en.pdf

Task 2: https://ec.europa.eu/clima/sites/clima/files/strategies/2050/docs/industrial_innovation_part_2_en.pdf

The purpose of this report, falling under task 3 of the Service Contract. The general nature of the work required by DG CLIMA under task 3 was a combination of a broad overview of policy options with some more detailed assessment of few selected options. The task was structured as follows:

- 3.1: Review of public policy and finance instruments of importance for innovation in industrial decarbonisation and assessment of selected funding instruments (selected jointly with DG CLIMA based on prioritisation including from Task 1 and 2).
- 3.2: Review of public policy and finance instruments of importance for the commercialisation of low-carbon processes, materials and practices and assessment of selected commercialisation instruments and their interaction (selected jointly with DG CLIMA based on prioritisation including from Task 1 and 2).
- 3.3: Provision of ad-hoc support as requested by the DG CLIMA.

The structure was implemented through a set of final deliverables agreed with DG CLIMA. These deliverables were in principle twofold.

This final tranche of analysis under this task involves a review of selected government programs for supporting climate or energy innovation in industry, in Germany, Italy and the United Kingdom (requested for by DG CLIMA in January 2018) with the results presented in section 5 of this report.

The second tranche of analysis includes four parts, which had been identified by CLIMA colleagues as relevant for their work and were completed by DIW, accordingly. The four parts (results presented in sections 1-4 of this report) were defined as follows:

1. **Green Public Procurement (GPP)**. This section presents the findings from the review and assessment of existing experiences on GPP implementation in different countries, in light of existing economic literature, and what can be learnt for the design of public procurement practices and schemes in Member States to draw synergies with the Innovation Fund.
2. **Carbon Contracts for Difference (CCfD) – an overview**. This section provides an overview on CCfD, including policy papers, case study on Contracts for Difference (CfDs) for renewables, and a numeric example for CCfD.
3. **Non-financial data and ESG reporting**. This section provides a short qualitative exploration of the reporting and use of non-financial data in the context of the fitness check of the EU framework for public reporting by companies.
4. **Product carbon requirements**. This section explores the role of product carbon requirements (PCRs) as one of the instruments that could help phasing out the production of carbon-intensive processes.

Methodological considerations

Green Public Procurement (GPP)

The objective of the study, as agreed with the Commission, was to look how the public procurement practices and schemes could be designed in Member States so that a low-carbon project could benefit from both the Innovation Fund support and national Public Procurement framework. Therefore the task was agreed to amount to review and assess existing experiences on climate-friendly GPP implementation in different countries, and summarize, also in the light of existing economic literature, what can be learnt for the design of public procurement practices and schemes in Member States so to allow synergies with the Innovation Fund

Carbon Contracts for Difference (CCfD) – an overview

Project-based carbon contracts for difference were identified as a promising policy instrument to support investment in innovative low-carbon technologies in a series of workshops prior to this project. Based on these discussions it was agreed with DG Clima, that a policy report on CCfDs, a numerical case study as well as design options should be developed, to shed further light on this policy instrument from the point of view of policy makers. The financing example was developed based on a project-finance calculation (using a debt-servicing coverage ration requirement). The analytical results and the expected effect of the policy instrument on investments in innovative low-carbon technologies, were validated with stakeholder interviews in the materials producing industries.

Non-financial data and ESG reporting

The aim of the short literature review was defined as analysing the emerging reporting practices in the context of the non-financial disclosure directive and its different national transpositions, with a particular focus on consistency/quality and availability of ESG data. As far as possible, the literature has been assessed with a view to understanding eventual differences between different types of firms and across EU member states.

Regarding the interviews, questions were defined together with a group of experts and practitioners in the field including vfu's Henrik Ohlsen and Sven Remer; Julia Bingler (ETH Zürich), Ralf Frank (DVFA), Christian Klein (Kassel University), Sylvia Kreibiehl (Frankfurt School of Finance), Nils May and Karsten Neuhoff (DIW Berlin), Frank Schiemann (Hamburg University), Franziska Schütze (Global Climate Forum) and Jan Stede (DIW Berlin).

The questions were then refined in close coordination with DG CLIMA and FISMA, in order to focus on those areas most relevant for them. 15 finance professionals participated in the survey, including 4 ESG specialists, 4 from strategy/business development, 2 asset managers (fund management), 2 senior managers, 2 people working in financial reporting and 2 sustainability consultants. The participants' institutions varied in size (measured by assets under management) from 350 million to 2 trillion. The participation rate was 44%, which is extremely high and underlines that the survey was considered relevant by those who started looking at it. The full survey questions and results are included in the annex.

Product carbon requirements

Previous analysis on the effect of EU ETS on basic material producers (e,g The Steel Report, The Cement Report from Climate Strategies) had illustrated the scale of the policy

challenge to facilitate a transition to carbon neutrality in basic material production. The objective of this task was therefore an exploration of further policy options based on traditional command and control regulation. Such a regulation, if merely applied at the level of production, inherently triggers concerns related to carbon leakage. This could weaken the implementation and therefore also any anticipation effects. Hence, the focus of this analysis was on the potential use of product standards.

The analysis was therefore initiated with a review of experiences with standards and product requirements – reflected in a set of case studies describing the objective, details of implementation, and wherever available reviewing evidence base on effectiveness. In parallel, a review of the WTO related literature helped to structure and inform an assessment.

Based on both of these inputs, the interdisciplinary research team developed a straw-man proposal for a product carbon requirement so as to explore how the policy objectives can be aligned with administrative and WTO considerations. It is not meant to offer the optimal or political most suitable solution, but primarily aims to test whether it is in principle possible to define product carbon requirements and to illustrate what aspects will be of particular importance in the design.

1 Green Public Procurement

Olga Chiappinelli, DIW Berlin, July 2019

1.1 Background

Public procurement accounts for around 15% of GDP in the EU.[5] In sectors like infrastructure, transport systems and buildings, governments and other public authorities command substantial shares of the market. These sectors are also responsible for large shares of GHG emissions. The large impact of public sector's purchases implies, on one hand, that public buyers are responsible for a relevant share of emissions but, on the other hand, have the opportunity to leverage their purchasing power not only to reduce their carbon footprint but also to create demand and lead markets for low-carbon products, services and practices.

Green Public Procurement (GPP) offers public authorities the opportunity to purchase climate-friendly options, therefore creating lead markets which carbon pricing alone may struggle to create in the short term. Furthermore, like other "demand-side" innovation policies (e.g., regulation and standards), it can provide incentives for innovation with limited impact on public finances, which in times of fiscal consolidation can be an advantage relative to other schemes (e.g. tax credits). Last, it allows increasing the visibility of low-carbon options, which could enable a multiplier behavioural effect in the economy.

GPP and the Innovation Fund can mutually support each other. GPP can create markets and demand for low-carbon innovative processes, products and practices that are demonstrated with IF-funded projects. In turn, the Innovation Fund could help creating incentives for a broader uptake of GPP in Europe, which, despite its potential, is currently overall little implemented.

The aim of this report is to review and assess existing experiences on GPP implementation in different countries, and summarize, also in the light of existing economic literature, what can be learnt for the design of public procurement practices and schemes in Member States so to allow synergies with the Innovation Fund.

The focus will mostly be on the procurement of construction that, together with transport, account for the largest emissions of the public sector.[6] In addition, to the extent that the GPP can provide market for low-carbon materials, construction represents a relevant application.

The report is structured as follows: Section 1 reviews current implementation options of GPP. Section 2 characterizes best practice examples in different countries. Section 3 summarizes main learnings from broader cross-country experiences, also in light of insights provided by economic literature. Section 4 suggests options for synergies and mutual support between procurement schemes and Innovation Fund. Section 5 concludes.

[5] This number excludes procurement by state-owned enterprises https://ec.europa.eu/growth/single-market/public-procurement_en.

[6] Buildings and construction contribute close to 40% of global GHG emissions (WGBC 2018). In Sweden, the life cycle climate impact of construction sector (buildings and infrastructure) is estimated to be in the same order of magnitude of car traffic (IVA 2014). In UK infrastructure accounts for 16 % of total emissions (HM Treasury 2013).

1.2 Implementation options of GPP

As there is a soft broad regulatory framework at the EU level on GPP (set by the Directives 2014/24/EU and 2014/25/EU), both the extent and specific mode of implementation of GPP is a decision of single national or local government or single contracting authorities.[7]

Current implementation options of GPP, i.e. modes of taking into account environmental and climate quality of bids in the award of public contracts can be broadly classified as follows:

Award criteria. Environmental quality (e.g., carbon performance) of a bid or a bidder is included in tender evaluation as part of the award criteria to determine the Most Economically Advantageous Tender (MEAT). There are two sub-options. *Weighted criteria*: specific environmental quality dimensions (e.g., material use, energy efficiency) are given an explicit weight relative to the economic part of the bid (i.e., price offered) and the bid with the highest weighted average ("score") wins the tender. *Bid discounts*: the environmental impact of the bid and/or the bidder is quantified, monetized (e.g., using shadow prices), and used to discount the economic part of the bid. The lowest discounted bid wins the tender.

Technical requirements. Bids and/or bidders are required to satisfy certain (minimum) environmental standards or technical specifications (e.g., relative to construction processes, material, component, energy use). Observed examples include: type of fuel for vehicles, type of lighting (e.g., LED), minimum percentages of cement clinker replacement, minimum percentage for electricity from RES sources, standards for the environmental performance of materials, e.g. Environmental Product Declarations (EPDs) and carbon management plans.

Functional requirements. In this case, the production or the product is required to have a certain level of environmental quality, but flexibility is allowed on how to implement the level. For example, a carbon reduction requirement can specify that an infrastructure should deliver 30% emission reduction relative to a baseline.

Sustainability Assessment and Certification Schemes (e.g., CEEQUAL, BREEAM) can be included in award criteria or as technical requirements.

Combinations between the different modes characterized above are common.

[7] There are a few sector specific EU legislations e.g., requiring certain energy efficiency standards of office IT equipment or road transport vehicles.

1.3 Review of experiences of GPP implementation

Different countries and different authorities adopt different (combinations of) implementation modes of GPP. This section reviews best practices in GPP in four countries that are frontrunners in the implementation of GPP i.e., Netherlands, Sweden, UK and California.[8]

1.3.1 Netherlands

In the Netherlands, the best practice for GPP is provided by the Dutch Infrastructure Authority, Rijkswaterstaat (RWS), the main public road and waterways authority. RWS has a key role in setting carbon reduction requirements and GPP practices, which are then often followed by other authorities at the regional and municipal level.[9] The current system for the procurement of low-carbon infrastructure has been developed in 2005 by RWS in collaboration with the Dutch Public Procurement Expertise Centre (PIANOo), with the aim to improve procurement standards for all public authorities.

RWS uses two tools for considering environmental quality and in particular carbon performance as part of award criteria for sustainable and low-carbon infrastructure. The former is the CO2 Performance Ladder (CO PL), a sustainability assessment scheme that rates the overall sustainability of the company on a scale from 1 to 5 based on the company's management efforts and systems to reduce carbon caused by the company's activities and processes. The latter is Dubocalc, a tool that assesses and monetizes the environmental impact (by using shadow prices of environmental damages including carbon footprint, mostly from materials and energy use) of infrastructure design on a Life Cycle Costing (LCC) basis relative to a business-as-usual baseline set by RWS for each project.

Both dimensions of environmental performance are assessed and monetized and the contract is awarded to the bidder with the lowest "corrected bid" i.e., bid price minus i) a discount depending on the level of certification of the bidder according to the CO2 PL, where each step on the ladder corresponds to a one percent reduction of the price (e.g., level 3 gets a 3% discount), and ii) a discount based on the monetized LCC environmental impact of the infrastructure design, where a smaller environmental impact results in a larger discount.[10]

Both the level declared on the Ladder and reduction level in the winning bid become contractual requirements after the award. Compliance of the winning bidder with CO2 PL is verified via ex-post certification and the environmental impact of the infrastructure is checked at delivery by an independent authority. If either of the levels is not met, the contractor incurs a penalty of 1.5 times the discount.

[8] This section is mostly based on the cross-country case study analysis on the procurement of low-carbon infrastructure by Kadefors et al. (2019). Check the report for a more comprehensive review of the schemes. See reports by EU Commission (2009), CEPS&College of Europe (2011) and UN Environment (2017), for broader cross-sectoral cross-country analysis on the current uptake of GPP.

[9] In the Netherlands, a Climate Act is currently being developed. However, since a few years a soft framework for carbon reduction is already in place. For example, Green Deals are coalitions between companies, civil society organizations and local and regional governments to collaborate and share knowledge to achieve certain sustainability goals. One deal, DGW 2.0, involved a wide range of infrastructure construction purchasers and suppliers.

[10] For each project a maximum and minimum level of environmental impact in relation to a baseline are established and a maximum and minimum discounts accordingly. In recent projects (see e.g., A6 Almere) the maximum discount awarded with Dubocalc was 5%.

Such tools have been combined in various projects with technical requirements (e.g., Energy Neutral obliges contractors to compensate for the energy use in the operational phase of the infrastructure, so they use PV panels to compensate for operation energy or LED lighting).

For largest projects, reduction requirements are used in combination with the Competitive Dialogue (CD), a special procurement scheme where the contracting authority engages in parallel planning and design with several bidders.

Experience so far can be summarized as follows:

- CO2 PL helped raising the level of awareness in industry but most companies are now certified at the highest level so the tool does not help anymore in the ranking of the bidders.
- Dubocalc gave incentives for reducing the amount of material (e.g., thinner layer of asphalt), increasing use of recycled materials and optimizing on transportation (e.g. reducing transportation distances for materials, transporting by boat).
- The system led to an estimated reduction in the overall LCC emissions from the infrastructure—of 24 to 50 percent compared to standard tenders.[11]
- Difficulties where encountered in setting the baseline and the level for maximum reduction potential.
- The viability of CD was questioned as the system is expensive and slow and a lot of input from the contracting authority is required. It was concluded that it is probably only worth for big projects.

1.3.2 Sweden

The Swedish Transport Administration (STA) is responsible for planning, building and operation of transport infrastructure (state roads and railways) and has been a key actor in driving sustainability and climate action already before the Climate Act was passed in 2018.

Since 2016 STA has been used functional carbon reduction functional requirements for all projects with contract value above 5 M Euro. Requirements mandate a minimum emission reduction from planning, design and construction relative to a baseline calculated by using Klimatkalkyl, a carbon calculation tool, and aim at triggering cost-effective reductions by letting bidders choose the reduction measures at the lowest cost.[12]

In line with national climate strategy, STA has set the goal that construction, operation and maintenance of national infrastructure should be carbon neutral by 2045. Therefore STA has a long-term perspective were reduction targets are raised over time and are communicated to industry and the baseline are continuously adjusted to reflect the targets (i.e., -15% relative to baseline for project in operation 2020-2024, -30% for projects start operation 2025-2029).

[11] These figures refer to seven big infrastructure contracts awarded in 2015 and 2016 by RWS in the context of the GPP2020 Initiative.

[12] The baseline is calculated using the bill of quantities used for project cost estimates. Klimatkalkyl calculates carbon footprint from materials and construction activities with emission factors described as representative for business-as-usual technology in 2015.

Compliance with the requirements has to be demonstrated with a climate declaration for the finished project, developed through Klimatkalkyl. The contractor gets a bonus of maximum 1% of the contract value if emission target is exceeded by more than 10%.

The experience so far can be summarized as follows:

- The system provided incentives for implementation of measures to reduce carbon without increasing cost, mostly related with optimization of material use and optimized logistics).
- Development of carbon baseline has proven to be problematic and a lot of effort, time and resources were spent revising and recalculating the baselines. The model lead both authority and bidders to focus more on the calculation than on the actual mitigation measures. In addition, the baseline has been reported to be based on calculations that do not reflect current industrial practices.
- Bonus threshold has been too easy to reach.
- Incentives from functional requirements have not affected the value chain (i.e. materials producers). As the potential from most transformational reduction measures (i.e., from material production and material substitution) has not been achieved, it cannot be concluded that the most cost-efficient measures are implemented.

Because of the implementation issues above, the model is currently under review and the following steps are being considered:

- To speed up implementation and make incentives effective in the value chain, functional requirements should be combined with technical requirements on carbon content caps in materials to affect materials suppliers directly. While EPDs for materials and standards on fuel use (e.g., x% energy used in construction from RES) are already required for projects with contract value below 5M Euros, these should be extended to all projects. Such technical requirements for materials and fuel use should be also updated to reflect target developments.
- An alternative to rely less on the baseline could be to focus on the detection of carbon mitigation hot spots in each project and calculate reductions ex-post when there is more time. Another possibility is to use the same tools for cost calculation and carbon footprint, which means that routines used for changing the cost could be used for continuously updating baselines.
- The bonus system should reach all the way to 100% reduction so to induce prioritization of measures with higher mitigation potential.
- The system should be updated in dialogue with industry to make sure that it is relevant and representative (of current practices, materials etc.).

1.3.3 United Kingdom

Based on the Climate Change Act (2008) and the carbon budgets, the Government's industrial strategy sets a target of 50% reduction in carbon emissions in the built environment by 2025 relative to a 1990 baseline. Infrastructure Carbon Review (2013) stimulated effort in this direction by stating that reducing carbon not only reduces cost because of saving materials, reducing energy demand and maximizing operational efficiencies (“cut carbon cut cost”), but it also stimulates innovation.

The best practice in the UK is currently provided by Anglian Water, the largest water and wastewater company in England and Wales, which since a few years is internationally seen as role model in both innovative carbon reduction and collaborative contracting.[13]

Anglian Water (AW) has established an alliance with key suppliers in the value chain (called @one Alliance). The Alliance delivers all projects within the Asset Management Plan (AMP), so not in traditional procurement way.

The business model works as follows. AW signs a 5+5+5-year alliance contract with seven partners, who are selected based on collaboration commitment and skills, high competence and leadership.

Every 5 years each partner's performance is evaluated, and the partner is either confirmed (with contract renewal) or replaced. A "zero-fee" model is employed, i.e. when costs are incurred, only the basic staff costs, without overhead and profit, is paid to the partners. AW sets project-specific targets and baselines for both carbon and cost reduction, and partners receive profits only if both targets have been exceeded. In 2009 AW set targets of 50% reduction in capital carbon, in line with UK Government construction strategy, and 10% reduction in operational carbon by 2015 from a 2010 baseline.

Experience with the model can be summarized as follows:

- AW exceeded both targets and showed that reducing carbon reduced costs. Targets have been updated to 60% reduction carbon by 2020 and 100% by 2050.
- Such challenging targets conveyed the message that partners would have needed to develop innovative practices, since BAU solutions would have not been enough. The model is designed so that partners can be rewarded for not building asset, which is of crucial importance to reach targets, as well as reduce the number of variants, focus on digitalization and circular economy focus (e.g., leasing of assets and returning products to manufacturer for recycling)
- The collaborative approach of the alliance allowed to develop longer-term and more holistic approach to projects, as well as exploit better highest mitigation potentials. Integration of the supply chain and breaking of silos (separate specialties) was crucial. For example, it allowed early involvement of constructors in the design, allowing improvements at the stage responsible for the biggest share of overall savings.
- Relationship-based contracting with long-term perspective of business established trust and mutual commitment and provided security.
- AW set the standards for other projects. For example, the flagship project High Speed 2 (HS2) adopted the same reduction target of 50%. In addition, a collaborative two-stage early contractor involvement model was used, where the carbon baseline was calculated in the first stage along with the design and target cost. Baseline calculation model was developed in collaboration with the contractors, and they jointly agreed that the baseline should be realistic and represent industry practice and not a worst-case scenario.

[13] A Publically Available Specifications (PAS) published in 2016 emphasized the need for value chain members to work collaboratively to reduce carbon, and defined the role and actions for all value chain members regarding a number of activities (i.e., leadership and governance, carbon management process, quantification of carbon, target setting, baselines and monitoring, reporting, continual improvement).

1.3.4 California

In 2017, the state of California passed the Buy Clean California Act, which focuses on production and transport of materials used in public infrastructure projects and requires all public authorities to request EPDs from contractors and suppliers of materials. The requirement establishes the maximum allowed carbon content of specific construction materials (carbon steel rebar, flat glass, mineral wool board insulation and structural steel). It is also required that the authorities review the carbon caps downwards every 3 years.

Before the Buy Clean Act was put in place, procurement requirements were directly influenced by a Sustainability Policy one of the main objectives of which is to maximize carbon reduction.

In the case of the California High Speed Rail (CHSR), one ongoing lighthouse project that receives 25% of the ETS proceeds yearly[14], reduction of carbon is mandatory but specific carbon targets for construction have initially not included due to the concern that using procurement requirements can reduce competition in the market and bidding process. However, requirements will be gradually introduced so to give suppliers time to invest. In addition, industry-wide EPDs are accepted rather than product specific ones, which would be too costly for SMEs. Moreover, contractors are provided a list indicating analysis they should undertake and are required to state measures they have taken to reduce climate impact in relation to normal industry practice. For example, renewable energy should be used when feasible and LCC carbon data need to be provided. Such more guided approach helps overcome potential lack of competences and capacity constraints due to important presence of SMEs in the tender.[15]

[14] In California 60% of the revenues from the ETS are used to support transportation and sustainable community programs.

[15] In the US, the Small Business Act aims to support the access of SMEs to public contracts with preferential treatment e.g., in the form of bid discount or reservation of a percentage of contracts.

1.4 Learning from experiences: main insights

This section summarizes what can be learnt from cross-country experiences across i) different types of GPP implementation and ii) different procurement contracting schemes and project types in terms of a) (LCC) emission reduction potential (incremental vs transformational), incentives for innovation, as well as impact on competition and cost, and implementation issues.

1.4.1 Comparison of different modes of GPP implementation

Table 1 summarizes comparative advantages and disadvantages of different types of GPP implementation. The following main messages can be derived for the case of infrastructure procurement.

First, while carbon mitigation potential lies in the entire supply chain, because of time constraints in the projects, the focus of main contractors is on design optimization and transport of masses, and the opportunities to involve subcontractors and material suppliers are limited, so that the mitigation from low-carbon production processes and alternative materials is not supported.[16] To achieve full potential of carbon emission reduction and speed transformation, functional reduction requirements (or award criteria), to stimulate innovative technical solutions, should be combined with specific requirements (e.g., on carbon caps in materials) to influence directly materials producers and spread technologies and practices already tested (e.g., low-temperature asphalt, LED lighting).

Second, setting carbon requirements (or criteria) at the right level and inducing carbon reduction from suppliers requires a very clear incentive framework combined with transparent and comprehensive systems for calculation of baselines, verification of performance and penalties for non-compliance. High competence of contracting authority is required as well as awareness of both the supplier's competence and of the opportunities for carbon reduction in the specific project.

Third, it is crucial that the contracting authority has long-term perspective, and that requirements are raised over time to reflect targets and are communicated clearly and timely so that industry can adjust. It is also important to increase collaboration between different departments of the contracting authority (e.g., purchasing department and sustainability department).

Table 1 Comparative advantages and disadvantages of different types of GPP implementation

	PROs	CONs
Award criteria	provide economic incentives for carbon reduction and other sustainable action by giving an advantage in the competition	To give meaningful incentives for carbon performance, the weight given to carbon reduction/shadow carbon price needs to be sufficiently high (vs many criteria and priorities, especially in big projects)

[16] "The measures to achieve carbon reductions in infrastructure projects are multifaceted: they involve encouraging or allowing for new construction materials, optimizing design to use less materials and energy over the life cycle, coordinating use of masses within and between projects, minimizing emissions from transport and site operation, as well as documentation, reporting and verification of requirements. A wide range of project functions and supply chain partners is affected" (Kadefors et al., 2019).

	PROs	CONs
		Using MEAT rather than price only increases i) the capacity needs and effort for both contracting authority and bidder ii) risks of higher costs, longer evaluation time, lawsuits. As a consequence of this, risk of driving the market towards large companies
Technical requirements	They are efficient to spread technical solutions, practices, materials or components that have been successfully tested They can pass the incentive in the value chain and therefore create incentives where carbon requirements are slow to do so.	They may exclude some innovative solutions If too ambitious, can risk limiting competition, since SMEs cannot afford developing them.
Functional requirements	Can encourage innovation and cost efficiency (relative to technical requirements) and ensure minimum level of carbon reduction (relative to award criteria)	Requires high competences, time and effort to set the (right level of the) baseline. If too high: accounting manipulations. If too low: no incentive Take time to trickle down to supply chain. Inconsistent/insufficient with short time-window imposed by project
Certification schemes/Sustainability Assessment Schemes/ Rating Schemes	Can facilitate implementation of sustainability actions when known to suppliers	over time tenderers may develop similar competences so that requirement does not longer help ranking bidders Include many requirements, which imply i) administrative costs without a substantial impact/focus on project's emissions ii) risk of overlapping/gaps/inconsistencies with other requirements.

1.4.2 Comparison of different contracting and project types

The following insights can be derived in relation to contracting types and projects.

First, cost-plus or incentive contracts perform better than fixed price contracts when it is more important to give the contractor incentives to explore innovative mitigation options with higher potential but also higher technological risk and risk of overrun, rather than giving him incentives for cost-reduction (see e.g., Laffont and Tirole 1993, Albano et al 2006).[17] Similarly, negotiations (including Competitive Dialogue) can be superior to tenders for big and technically, legally and financially complex projects for which it is worth to explore in dialogue with the private sector non-standard mitigation opportunities and to minimize the risk of costly renegotiations (see e.g., Bajari and Tadelis 2006).

Second, contracts where the design and the construction phases are bundled may perform better than schemes where the two phases are unbundled, as synergies between the two stages (e.g. with the early involvement of constructors in design) can be exploited and higher mitigation potential detected and realized (see e.g., Bennet and Iossa 2006).[18]

Third, as demonstrated by the successful experience by Anglian Water, collaborative and alliance contracting can give strong incentives for mitigation and innovation. Breaking the silo thinking between different tasks and areas of expertise through integration of or at least more collaboration within the supply chain allows to detect and realize greater carbon reduction potential. Also, long-term contractual relationships allow for continuous learning and more transformational innovation and can enhance trust and minimize opportunism problems arising from information asymmetries and contractual incompleteness (see e.g., Albano et al 2006). However, it should be emphasized that strong leadership and commitment by the contracting authority are essential to realize the potential of such collaborative models and to prioritize and make suppliers prioritize (especially in complex projects) carbon mitigation over other objectives.

Fourth, the relationship between size of project and innovation incentive is ambiguous. On one side, big and mega projects might have larger innovation and mitigation potential, because of visibility, scale and opportunity to engage the most competent individuals and pushing limit of conventional procurement requirements. However, they are also often organizationally complex, which makes it hard to include and prioritize new technologies and practices, and bureaucratic and have many societal goals to fulfil, not only sustainability.

Furthermore, it takes time to develop a new product, technology or practice, and carbon reduction, and adoption of untested solutions is challenging in the tight timespan of a project. A possibility to reduce risks, overcome the time and resource constraints imposed by the project, and speed up innovation is to use smaller pilot projects for quicker testing of new materials, tools and technologies and, once, proven, use procurement requirements in large projects to spread their adoption in the market (Kadefors et al. 2019).

In addition, the schemes provided at the EU level for the procurement of innovative products, can be useful in this direction (see e.g., Baron 2016). Pre-commercial Procurement (PCP)

[17] In cost-plus contracts, the procurer reimburses all (documented) production costs related to the project and pays a fee on top of that. In fixed-price contracts, the procurer pays a fixed price for realizing the project that satisfies a predetermined quality standard. In incentive contracts - a scheme in between the other two - the parties share the costs (see Albano et al 2006).

[18] Other conditions when bundling of sequential stages can be preferable to unbundling are that i) there is little role for SMEs in the market addressed by procurement, as handling complex long-term contract would discourage their entry; ii) there is no significant risk of market foreclosure and supplier lock-in; iii) there are strong institutional incentives within the procurer organization - so that low-value projects are not continued; iv) there are clear performance targets and project value is observable and measurable ex post (low informational asymmetries) so to avoid risk of low-value projects (see e.g., Iossa et al 2018).

can be used to create incentives for radically innovative materials or production processes. This could be combined with Public Procurement of Innovation (PPI), which can create markets for innovations generated through PCP, allowing the contracting authority to act as an early adopter for solutions that are not yet available on large-scale commercial basis. When the benefits of bundling outweigh the costs, an alternative to PCP + PPI is Innovation Partnership, a new scheme where R&D and commercialization stage are bundled in the same contract (see Iossa et al 2018).

Finally, dividing big projects in smaller consecutive sub-projects can enable long-term learning, and limit the risk of deterring SMEs and limiting competition.

1.4.3 Other Barriers to implementation

So far, GPP has been little implemented in Europe. Best practices reviewed in the previous sections are exceptions to the trend. They are not indicative of the average conditions of procurement implementation, as they refer to countries with higher than average commitment to decarbonization and implemented by big contracting authorities with larger administrative, professional and technical capacity than average.

The modest uptake of GPP is due to two main barriers and lack of incentives for implementation.

One major barrier is the perception that GPP increases the cost of the purchase for the contracting authority. While (in the case of infrastructure), best experiences so far have demonstrated that substantial emission reduction (up to 50%) can be achieved without an increase in cost by reducing material use and optimization in logistics and construction, using GPP to create demand for low-carbon material production processes or alternative materials would likely imply an incremental cost. However, current research suggests that such incremental cost is likely to be very contained and therefore could be compensated by savings from optimization at the design and construction stage.[19]

Furthermore, public procurement remains overly focused on the purchasing price and not on the overall costs that the contracting authority has to incur over the entire lifetime of the purchased good, service of infrastructure. By basing the award decision on a more comprehensive cost concept, like total cost of ownership (TCO) or life cycle cost (LCC), a green product would not only imply lower life cycle emissions, but possibly also lower overall cost, because potentially higher initial purchasing costs (e.g., because of more expensive low-carbon materials) would be compensated by lower operating cost (e.g., because of higher energy efficiency), maintenance cost (i.e., because of longer lasting materials) and disposal costs (e.g., because of eased deconstruction and reuse of materials).[20]

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[19] For example Rootzén & Johnsson (2017) show that in the case of the cement supply chain, the increase in total production costs for construction due to the incremental cost of low-carbon cement would be in the order of 1%, even in the case where the price for cement is assumed to be almost doubled. This would be due to substantial decrease of the incremental cost at each transformation stage. See Rootzén & Johnsson (2016) for a similar analysis on the steel supply chain.

[20] European Commission (2009) studies performance of GPP in the Green 7 (UK, SWE,NL,A, DE, F, DK) over 10 sectors in 2006/2007 funding that GPP led to an average of 25% of CO2 emission reduction relative to standard procurement and implied an average reduction of life cycle cost of around 1%, the latter driven by large cost reduction in construction, transport and cleaning services, which compensated for cost increases in other products such as textiles, green paper and RES electricity.

GPP it is also perceived to increase the cost of procurement indirectly, by reducing entry of bidders in the competition. This effect is however a priori not clear, as more innovative/greener suppliers that were not entering in tenders based on price only might be now attracted to enter, and incumbents might react to this by bidding more aggressively.

The second main barrier relates to administrative capacity constraints (see Chiappinelli and Zipperer 2017 and Casler and Wuennenberg 2017). As also witnessed in best practice examples, climate-effective GPP can be very complex to implement. Especially at the local level (i.e., regions and cities) procurement teams are often small and officials lack both technical expertise (e.g., on including carbon requirements/criteria and assessing offers against requirements/criteria and on ex-post compliance), information and resources (e.g., software and databases) and legal expertise for the implementation of GPP (e.g., on the risk of breaching competition and procurement law). Moreover, GPP is perceived a time-consuming and effort-intensive activity that is not compatible with the tight timeline of the procurement process and resource constraints of the team.

The mentioned barriers hinder the uptake of GPP especially at the local level where often most of the procurement activities take place (OECD, 2017) but where budget constraints are tighter (and reluctance to stress the tax base higher) and capacity constraints are larger.

1.5 How to maximize synergies between procurement schemes in Member States and Innovation Fund?

Public procurement schemes in Member States (MS) and the Innovation Fund can be mutually supportive.

First, public procurement schemes in MS can support projects supported by the Innovation Fund by creating demand and a market for production with low-carbon processes (e.g. electricity-based steel making) and low carbon substitute materials (e.g. recycled cement). Thus, GPP could help to overcome the so-called valley of death that is haunting technologies after initial support through R&D funding, like H2020, or demonstration funding, like through the Innovation Fund.

To achieve this objective, MS or single contracting authorities could enhance the demand for low-carbon materials by imposing significant functional carbon requirements or shadow carbon prices that increase the economic viability of low-carbon materials, and/or require them as part of specific technical requirements. This could overcome the following barriers:

Lack of familiarity and experience with substitute low-carbon materials: The construction sector is inherently conservative in material choices, so as to limit effort required to train personal on, adjust equipment for and reduce uncertainties in handling new materials. GPP could help to overcome this inertia and thus catalyse development and diffusion of low-carbon materials, and overcome risk aversion of private actors in engaging with new materials.

Incremental costs of low-carbon substitute materials: In the current design of EU ETS, the pass-through of carbon costs from carbon intensive production processes is partial and uncertain. Free allowance allocation to carbon intensive production processes thus has the effect of a subsidy to carbon intensive materials that undermines the economic viability of low-carbon alternatives. To create a level playing field for low-carbon substitutes this needs to be corrected either through a climate deposit (inclusion of consumption of carbon intensive materials in emission trading) or trough shifting to full auctioning of allowances potentially complemented with border adjustments.

In the meantime, GPP could provide early local lead markets for low-carbon substitute materials by fully accounting for the carbon embodied in the production process in the tender specification, and thus operate at the scale at which different actors in the construction sector and supply chain have to coordinate in shifting to an alternative construction material (i.e., architects, engineers, constructors). Local authorities could have an incentive to develop such lead markets, so to provide prospects for the local construction industry. However, while GPP may create some (local) niche markets, it is unclear how large and long-term robust these will be. Private firms will only invest in innovation and commercialization of new materials, if they do see a sufficient market potential to make it a viable business case. Therefore, in parallel further progress in the EU ETS design to ensure full carbon price pass through is necessary.

Incremental costs of clean production processes: The current EU ETS allowance price is insufficient for the operation of clean production processes like CCS based clinker production, renewable electricity/hydrogen based primary steel making. If GPP does account for the carbon intensity of the production process, it could provide an additional incentive for the use of such production processes and allow for early and quick implementation. However, the concern remains that scale and long-term credibility of the demand for materials from low-carbon production processes may be insufficient to warrant the investment in capital intensive facilities (will cities continue to demand such materials for the 15-year horizon required for refinancing a plant?). In addition, incremental costs of low-carbon production processes translate into incremental costs of GPP and may thus limit motivation for local authorities to implement such procurement. Third, the combined incentives through EU ETS and GPP are difficult to calibrate, as scale of incentives in both systems linked to multiple mitigation options. Thus, the resulting effective incentive may be insufficient (no effect) or excessive (windfall profits). Alternative mechanisms to ensure economic viability of low-carbon production processes, like for example project-based carbon contracts for difference may thus be more suitable.

To the extent and with the caveats argued above, GPP can have potential to work as a market pull incentive for innovation and demonstration of low-carbon processes and materials, therefore complementing the push incentive provided by the Innovation Fund.

This would give companies that apply for Innovation Fund the perspective of a market for the developed innovative solution. While creating synergy between Innovation Fund and Horizon Europe would allow to create a project pipeline for Innovation Fund, as well as guaranteeing continuity and consistency of funding, and limit administrative burden and foster collaboration and learnings with industry), creating synergies between Innovation Fund and public procurement schemes can guarantee continuity and other benefits ex-post.

In order to maximize synergies in this direction, steps should be established and implemented in order to align methodologies for evaluation and ranking of projects in the Innovation Fund with evaluation of offers in GPP, and innovation procurement. For example, consistency should be ensured in terms of tools and measures to assess carbon content in materials.

In addition, the Innovation Fund (possibly in combination with other EU programs such as Connecting Europe Facility, Modernisation Fund, Cohesion Funding and national funding) can provide financial support for GPP implementation in Member States, similarly to the practice in California, where revenues from the ETS are used to support low-carbon infrastructure projects.

For example, the Innovation Fund could be extended to open competition between ambitious GPP pilot projects at the local level (e.g., Green Cities). Authorities could compete for example i) for a payment per ton of CO2 saved in a winning tender relative to a baseline or ii)

for a payment per winning tender that meets certain specifications. This would allow to overcome the concerns of incremental costs and initial risks of climate friendly options, as well as rewarding the pro-active authorities and increasing signaling and visibility of low-carbon options in cities. This would trigger behavioral change on a bottom-up approach as well as setting the standards for other local contracting authorities, therefore accelerating and spreading the transition.

Besides supporting specific GPP lighthouse projects, technical assistance and coordination from EU as well as dedicated funding will be crucial to drive the uptake of GPP especially at the local level, by addressing barriers mentioned in the previous sections, which are likely better addressed at EU level with harmonized solutions. These include for example (see Chiappinelli and Zipperer 2017 and Casler and Wuennenberg 2017):

- The establishment and/or funding of education and training programs for public officials to get professionalization of and commitment to GPP
- The establishment of a professional consultancy service on the technical and legal implementation of GPP, to be used by contracting authorities until sufficient capacities are reached internally
- The development of guidelines for the implementation of GPP, and at local-, national- and international-level platforms to share and promote best-practices
- The development and standardization of practices that consider LCC as the relevant best-value-for-money concept in procurement, as well as standard tools for the quantification of LCC. While LCA databases will need to be country or region specific, calculation tools, as well as standards for monitoring, evaluating ex-post compliance and reporting, can be harmonized.
- Supporting collaborative contracting practices and development of multi-stakeholder initiatives (like e.g., Green Deals for construction in NL)
- Supporting cooperation and coordination between authorities and countries (like e.g. GPP2020 initiative), and joint public procurement initiatives for smaller contracting authorities, to allow creating the necessary scale for suppliers to invest for low-carbon solutions, as well as pooling resources and capacities.

1.6 Conclusion

Green Public Procurement can have a large potential as a decarbonization policy. There is a track record of successful implementations of GPP, where purchasers have achieved substantial emissions reductions without this necessarily leading to higher overall costs.

However, overall GPP has been little implemented in Europe so far, because GPP with high mitigation potential can be very complex to execute and can imply an incremental cost, especially when it is meant to create demand for innovative low-carbon processes and products. Incentives for a broader uptake of GPP are currently missing.

Creating the incentives and realizing the potential of GPP in Europe requires two things. First, high-level political commitment and clear communication at both EU at national level, that public money will be used to cover the incremental cost. Second, solutions and dedicated funding are needed to build capacity in authorities to realize effective GPP.

Among other possible solutions, such type of support can be provided by extending the Innovation Fund to GPP projects, and enable governments, contracting authorities, local communities that have high commitment to act as champions and forerunners in the transformation. Moreover, procurement schemes in Member States can in turn support the

Innovation Fund by creating markets and demand for climate-friendly innovative products, practices and processes financed through the scheme.

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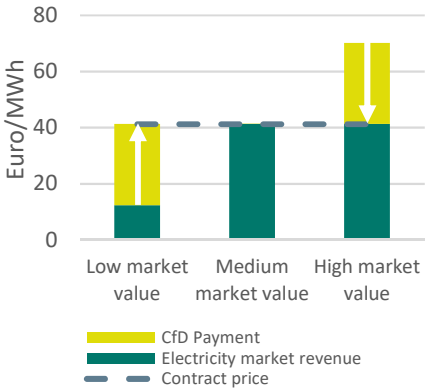
2 Carbon Contracts for Difference – an overview

Jörn C. Richstein & Karsten Neuhoff, DIW Berlin, July 2019

2.1 Background: What to learn from renewable Policy

Climate targets can only be achieved with a shift to new technologies and practices for production and use of basic materials, as this account for around 16% of European greenhouse gas emissions (Chiappinelli et. al., 2019). The moderate price level of EU ETS and the uncertain price development does however not provide sufficient incentives for significant investments in innovative climate-friendly options. Here experiences from policies for wind- and solar energy can provide important lessons.

Figure 1. Example of CfD in the electricity market



While renewable technologies already have become competitive in terms of production costs, they are still affected by uncertainty of revenues. An efficient solution to address this financing challenge have been public tenders for contracts for difference, which have been implemented in the UK since 2014, and in France since 2017. These guarantee a stable power price to producers by filling up missing revenue from power markets in case of low prices but also entail an obligation to pay back money when power market prices exceed the agreed contract price (also referred to as strike price). Due to the more stable revenues, financing costs are lowered reducing the overall cost of delivering wind and solar energy by around 30% as several analyses have shown[21]. Additional advantages of such contracts are that they enable competition between small and large actors and, as compared to privately organised Power Purchasing Agreements (PPAs), avoid the downgrading of counter-parties due to uncovered liabilities in terms of long-term contracts on their books.

Learning from best practices in renewable policy, national governments could offer investors, in novel climate-friendly technologies and practices, project specific long-term carbon contracts for differences (CCfD) for emission reductions on the EU emissions allowance price. Such contracts would guarantee investors a fixed price for each ton of emissions reductions below today's emission benchmark of the current best available technology at a price level that reflects expected CO_2 price developments during a contract duration extending up to 20 years of, for example, 50 Euro/ton$_{CO2}$. The innovativeness in reaching deep emissions reductions of these projects could be ensured by granting the carbon contracts only to those projects that are compatible with the net climate neutrality objective, as for example assessed for provision of innovation support e.g. through the EU ETS Innovation Fund or national equivalents.

If investors in climate-friendly production use the contract, they can lock in carbon benefits at a fixed price. They are however not required to sign such a contract if they expect that the carbon price developments during the contract duration would exceed the contract price and if they would not require the revenue stability from emissions reductions.

The key benefits of carbon contracts for differences as a policy instrument for supporting innovative projects are the 1) increased stability of revenues, lowering the financing cost for low-carbon investment projects, and resulting in a reduced need for innovation funding

[21] Aurora Energy Research (2018); Gunar Hering, (2019); May & Neuhoff (2017)

(Richstein, 2017), 2) potential for recuperation of costs for governments as the carbon price rises 3) full incentives for investment and operation, as revenues are linked to delivered emission reductions with integration in the EU ETS and its monitoring requirements and 4) clear signalling of governments' commitment to long-term policy goals (Chiappinelli & Neuhoff, 2017) 5) confidence that clean production technologies can be operated rather than stand still should carbon prices not reach sufficient levels.

2.2 How do carbon contracts work & lower financing costs

Numerical example with free allocation

(Without free allocation linked to production and without international trade, in equilibrium the product price would increase by the carbon cost, having an equivalent effect)

- Benchmark: 1 t_{CO2} / $t_{Product}$
- Innovative project: 0.1 t_{CO2} / $t_{Product}$
- Project signs CCfD at 50 €/t_{CO2}

Low price example: Revenue per ton production of product at spot ETS price of 20 €/t_{CO2} :

- **Allocation:** 20 € /t_{CO2} * (1 t_{CO2} /$t_{Product}$ free allocation – 0.1 t CO2/$t_{Product}$ emissions from process)
  = 18 €/t
- **CCfD:** (50-20) € /t_{CO2} * 0.9 t_{CO2} / $t_{Product}$= 27 € /$t_{Product}$
- **Total:** 45 €/$t_{Product}$

High price example: Revenue per ton production of product at spot ETS price of 70 €/t_{CO2} :

- **Allocation:** 70 €/t_{CO2} * 0.9 t_{CO2} / $t_{Product}$
  = 63 €/$t_{Product}$
- **CCfD:** (50-70) €/t_{CO2} * 0.9 t_{CO2} / $t_{Product}$ = -18 €/$t_{Product}$
- **Total:** 45 €/$t_{Product}$

The CCfD pays out the difference between the yearly average auction price of emissions allowances (EUAs) and the contract price, thus effectively ensuring a guaranteed carbon price for the project[22]. In exchange for this insurance, investors are liable for payment if the carbon price exceeds the contract's strike price.

Emissions reductions are calculated by subtracting the verified emissions of an installation from the emissions that would have been expected with a traditional technology calculated by multiplying production volumes with the EU ETS benchmark of emissions of the best available technology per ton of material production at the time of investment.

2.2.1 Financing example & effect on the required carbon price level

One major advantage of Carbon Contracts for Difference is the reduction of financing costs, which results in lower levels of required CO_2 prices to realise the investments in clean technologies. An example is described in the following and depicted in Figure 2 where three investment choices are compared for an (abstract):i) a conventional technology, ii)a clean breakthrough technology financed without CCfD and iii) the same clean breakthrough technology financed with a CCfD. In line with expectations by several producers, the investment is structured as project finance[23]: A new company is set up to realise the investment. The project receives its capital from shareholders in the form of equity and from creditors in the form of debt. Debt is significantly cheaper than equity (the interest rate is lower than the required rate of return for equity). Creditors like banks or bond markets require high levels of confidence that debt is paid back. Hence debt has priority in being served from revenues and is usually dimensioned such that it can be served in almost all instances even of worst-case scenarios, such as falling product or emissions prices.

[22] Earlier literature suggested giving projects carbon price guarantees (Groenenberg, H. and de Coninck, H.,2008; von Stechow et. al., 2011), or even carbon contracts (Helm & Hepburn, 2008), however, not in detail the context of an implementation within an existing Emissions Trading system and for specifically funding innovative projects.

[23] Also in other modes of financing, increased risks lead to higher required returns on investment.

For the purpose of the comparison, we define the benchmark case for product prices as one where a new investment in the conventional technology is just profitable at expected price levels and can serve its debt payments as well as pay for its variable costs in the worst-case price scenario.

The conventional technology has emissions of 1 ton_{CO2} /$ton_{Product,}$ operational costs of 100 Euro/$ton_{Product}$ and at a 40% debt rate capital costs of 200 Euro/$ton_{Product}$ of which around 50 Euro/$ton_{Product}$ are for debt payments, and 150 Euro/$ton_{Product}$ for equity over a period of 20 years. In this case the debt can be served, even if the revenue halves (variable cost and debt equal the lower bound of revenue). Equity is thus needed to cover the uncertain part of revenue.

In the following, we determine the required expected CO_2 price levels the breakthrough technology needs with and without a CCfD. The CCfD reduces the expected CO_2 price that is required for the technology to break-even because it allows for the use of more debt to pay for the investment and thus reduces the overall financing cost as compared to the case without a CCfD. The amount of debt is determined by utilising the same product price (and revenue) scenarios as for the conventional technology, but with the additional assumption that the project without a CCfD can experience a 2/3 drop of CO_2 price levels and needs to be able to serve the debt in this case, while the CCfD stabilizes the revenue from selling its free allocation of emissions certificates and thus allows for a higher share of debt to be served. In the case of the breakthrough technology without a CCfD the uncertainty of CO2 prices in addition to the usual revenue uncertainty needs to be covered by additional expensive equity. In contrast, in case of a CCfD there is no additional uncertainty due to CO2 prices, and the secure revenue from the CCfD can be used to raise additional debt. Thus, in the example, the same level of equity as for the conventional technology is sufficient to secure the investment.

Figure 2. Effect of CCfD on financing structure and total cost of production

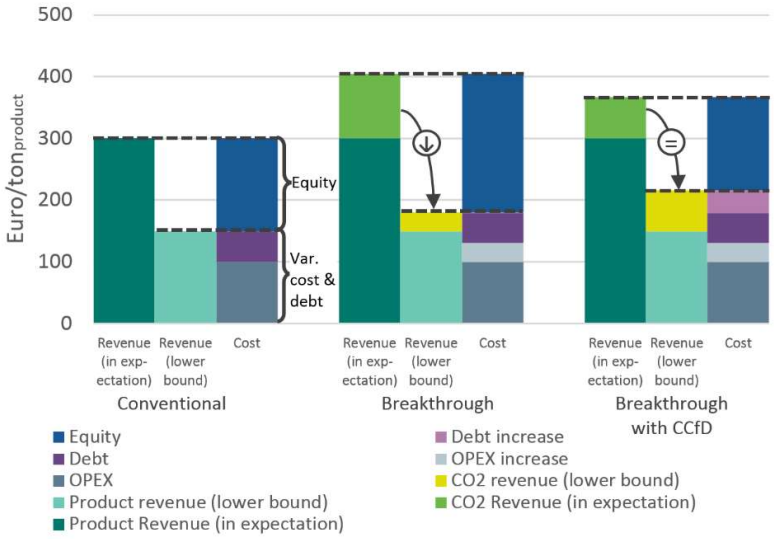
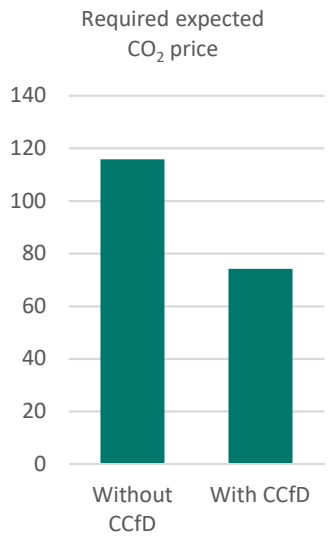


Figure 3. Effect of CCfD on CO_2 abatement cost

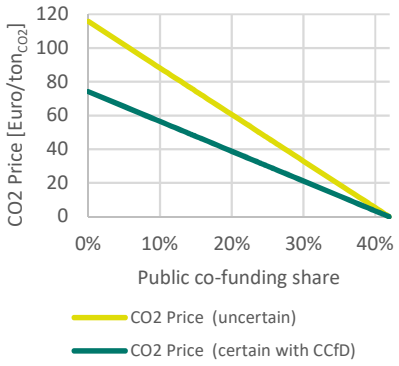


For the breakthrough technology we assume 30% higher variable costs and 30% higher overnight investment costs than the dirty technology, and that it is being allocated free allowances per ton of material produced based on the same benchmark as the conventional technology, which it will sell at the carbon price level[24]. The breakthrough technology achieves emissions reductions of 90%.

As compared to the breakthrough case without the CCfD, the latter reduces the amount of equity needed to finance the project and thus also lowers the required CO_2 price level needed in expectation to realise the project (from around 115 Euro/ton$_{CO2}$ to around 75 Euro/ton$_{CO2}$, a reduction of around 35%).

2.2.2 Closing the funding gap

Figure 4. Effect of CCfD on public co-funding and necessary CO_2 price for investment



Carbon contracts for difference can be combined with innovation funding, for example from the European Innovation Fund. Given a fixed carbon contract price, this can reduce the necessary public co-funding as assessed for example in tenders for innovation support. In our illustration, a CCfD with a contract price of, for example, 50 Euro/ton$_{CO2}$, would reduce the necessary public co-funding from around 24% to around 14% of the investment cost. In this calculation, volume and technology risks are not considered. These risks are also further mitigated by a combination of up-front innovation funding and a CCfD (Richstein, 2017).

2.3 Design & Harmonization Options

There are several design options for realizing and awarding carbon contracts in general (of which project-based carbon contracts for difference are already a subgroup), which will affect the financing conditions projects can obtain and the incentives during operation. The award procedure and eligibility are also important parts of the overall policy framework.

A common European design with harmonization on key parameters of CCfD signed by EU member states would reduce complexity for private sector decision makers engaging in multiple countries and thus also strengthen the common European market, enhance transparency, and contribute to a level playing field where projects participate in tenders for the EU Innovation Fund. Such harmonization may be a result of natural (but potentially slow) convergence, may be supported by a common template, and may be incentivized if a common template is used as a reference in the context of EU state aid assessment.

In the following, a set of potential design elements are outlined. Given the multitude of options and their combinations, one combination of these options was selected as a straw man proposal and marked with an asterisk (*) and bold in the graphs. The preliminary selection was informed by the following criteria, which are added by footnote in the following graphs:

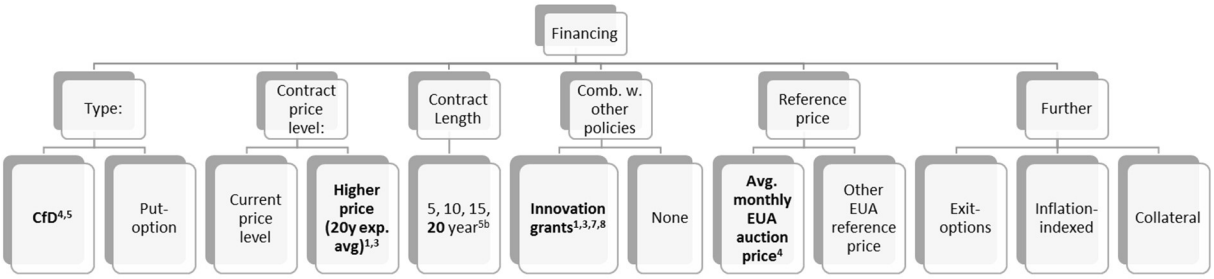
- **Investment incentives:** Sufficiently strong incentives to invest in a project.

[24] The calculation is the same if there is no free allocation, but there is a 100% pass-through of emissions costs to the product price by the price-setting conventional technology.

- **Operational incentives:** Continuous incentives to operate the low-carbon technology, even if emissions market prices drop (this is especially relevant for incremental operational costs technologies, e.g. CCS, which at very low CO2 prices have variable costs above product prices, and thus no incentive to operate)
- **Market entry of innovative technologies:** The policy focuses on innovative technologies with the prospect of reaching climate neutrality by 2050.
- **Lowering of financing cost for companies:** Lowering of financing costs to companies, via ensuring access to affordable capital.
- **Cost to** government/consumers (product price, grant volumes) **and fairness:** This indicator represents the cost to government and to consumers, as well as the subjective aspect of fairness (symmetric payments). Both the a) Total amount, as well as the b) temporal distribution is relevant.
- **Incentives for the government for ambitious carbon policy:** The policy provide incentives for government to further pursue an ambitious climate policy (e.g. by increasing costs to governments in case of a low CO2 market price).
- **State-aid compliance:** The design conducive for state-aid compliance.
- **Minimise administrative hurdles:** The design keeping administrative hurdles, as well as hurdles for participation and coordination with other funding options low.

It needs to be stated, however, that this is an initial assessment only, and further in-depth analysis is needed on the individual design elements.

2.3.1 Financing



Contract type: Carbon contracts could be realized as *Carbon contracts for Difference** on the EU ETS price, or as *put options* on the EU ETS price**.** In the first case, companies would receive payments if the carbon price level is below the contract price, but are obliged to pay back money, if the EU ETS price is above the carbon price. This effectively guarantees a fixed carbon price. Put options would only be utilized by companies if they benefit from exercising the option. If the contract price is above the market price, companies could keep the benefits. This establishes an individual carbon price floor for a project. CCfDs would lead to overall lower financing costs than put options and would probably be more acceptable to governments and the public, as it is a reciprocal agreement.

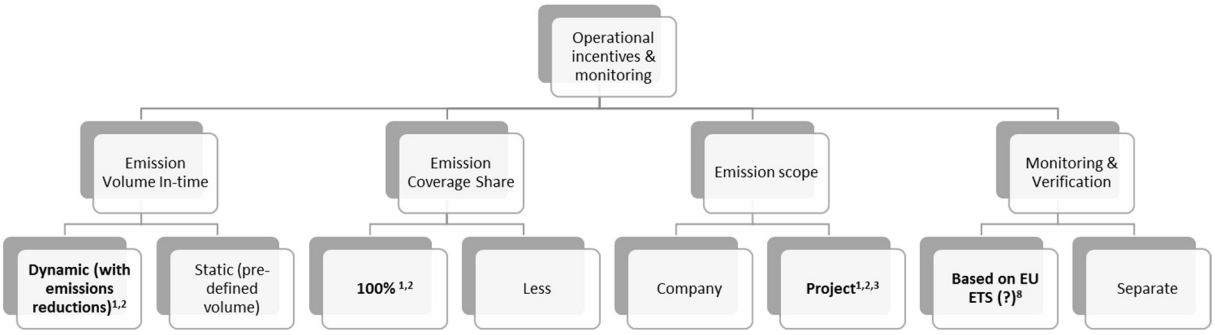
Contract price level: The price level could be set at the *current EU ETS price level*, *above EU ETS price level** (e.g. expected price over contract duration) or *determined by tender*. The second and third options could be used to provide additional innovation support (if eligibility is constrained to innovative projects). The contract price should be set in such a way that (jointly with additional innovation funding) sufficient investment incentives are given for break-through technologies. If the contract price level is set above the expected EU ETS price level over contract duration, state-aid compliance needs to be ensured via other criteria (e.g. exceptions for innovation or environmental reasons)

Contract duration: The contract duration could be *short (e.g. 3 years)* up to *long (e.g. 20 years)*. Longer contract duration enables long-term financing, important for capital-intensive projects (see the last section).

Combination with other policies: Carbon contracts could be combined with *innovation grants**, *other policies* or *no other policies*. Combining carbon contracts with innovation grants would allow keeping administrative hurdles low, by setting a uniform carbon contract price, and letting projects compete on innovation grants (see below).

Other design options: Other options affecting financing include i) the exact reference price (for example the *Average Monthly EU ETS auction price*, which as an auction price, can be traded without basis risk; however, price averages liquidly traded common reference prices, such as end-of-year futures, might also be an option*), ii) *exit-options* from the contract*, iii) Indexed contract prices (e.g. to Inflation)***,** as well as iv) rules on collaterals and settlement *(end-of-year*, monthly, marked-to-market)***.**

2.3.2 Operational incentives and monitoring

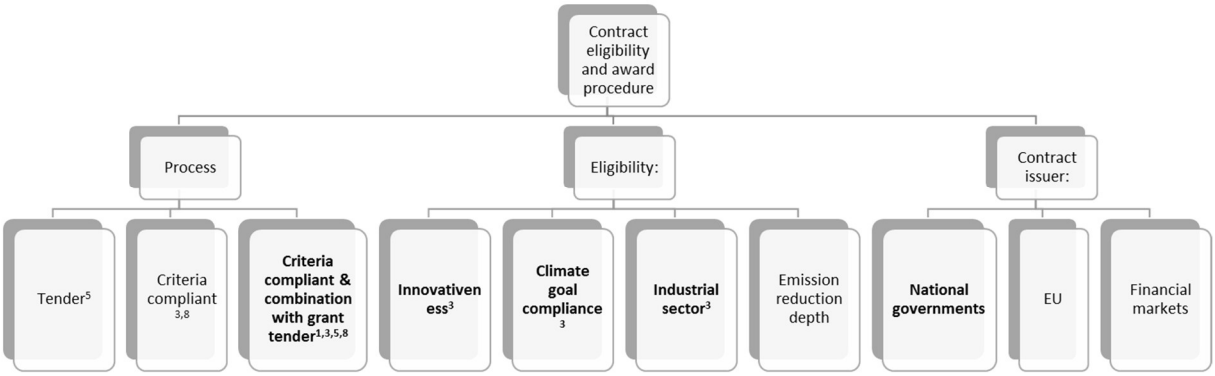


Contract volume: The contract volume can be *dynamic with realized emissions reductions** or *static (ex-ante)***.** This influences operational incentives, but also financing. In operation, only a dynamic contract volume ensures incentives to deliver emission reductions at the contract price, especially if there are abatement decisions to be made in operation (e.g. in the case of CCS). These would otherwise need to be ensured via additional, complex contract clauses and be monitored. Secondly, in case a risky project does not succeed in achieving its abatement target, no additional clauses are necessary, and neither the public nor the company are exposed to an additional carbon price risk. For the same reason, the contract should cover *100% of emissions reductions**, although contracts could in principle only cover a *share of emissions reductions.*

Emission scope: The scope could be defined at *company* or *project level**, in case of project finance, the two scopes would be identical. In case carbon contracts are employed as an innovation policy, a project level scope is necessary to ensure that innovation funding is actually directed at emissions reductions by innovative processes, instead of company-wide abatement.

Monitoring & verification: Delivered emissions reductions could either be monitored, reported and verified by *EU ETS MRV processes** or this could be done by *separate MRV processes*. The first option would keep administrative burdens low; however, it is only feasible if the project is an independently registered installation within the EU ETS.

2.3.3 Contract eligibility & award procedure



Contract issuer: The first design option is the choice of who the counter-party is: it could be *national governments**, the *European Union* and its institutions like the European Investment Bank, or *Financial Markets*. This analysis is focused on the first two options linked to public policy choices, but may also need to assess whether and under what provisions non-public actors could and would serve as counterparty.

Eligibility: This is an important consideration, especially if the contract price is set above current market prices. In that case, eligibility could be determined by *compatibility with climate neutrality goals**, that is the emissions reductions are sufficient to fit into the 2050 goals of the European Union. The contracts could also be limited to the *industrial sector**, or open to *all sectors*. As designated policies exist in the power and other sectors, and emissions reductions in the industry are one of the key challenges for the 2050 goals, limiting contract eligibility to the industrial sector seems warranted.

Award process: Awarding contracts may be a separate question from eligibility. It could be done via *tenders* (with projects bidding the carbon contract price), contracts could be awarded to *all eligible projects* or the *CCfD could be coupled to an innovation grant tender**. The last option has, at least for the coming years with the focus of various type of demonstration and commercialization projects, two advantages: the contract price of the CCfD could be set uniformly across projects (and a coalition of several countries could coordinate on a price level), and competition could still be ensured by the innovation grant tender. Such a tender could also include the determination of eligibility.

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3 A short qualitative exploration of the reporting and use of non-financial data in the context of the fitness check of the EU framework for public reporting by companies

by Ingmar Juergens and Katharina Erdmann, DIW Berlin[25]

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Above all, the survey would not have been possible without the support of vfu's[26] Henrik Ohlsen and Sven Remer, and their substantial contributions in terms of content, scope and logistics. Vfu's Martin Hillebrandt set up the entire online configuration of the survey.

Extremely helpful comments on survey content and scope were received by: Julia Bingler (ETH Zürich), Ralf Frank (DVFA), Christian Klein (Kassel University), Sylvia Kreibiehl (Frankfurt School of Finance), Nils May and Karsten Neuhoff (DIW Berlin), Frank Schiemann (Hamburg University), Franziska Schütze (Global Climate Forum) and Jan Stede (DIW Berlin). The remaining shortcomings of the survey are entirely the responsibility of the (first) author.

3.1 Summary

3.1.1 Key Messages from the Literature Review

The results of the various studies discussed here are not easily comparable, as they are using different definitions, scope and levels of aggregation. However, the variety of approaches is useful to inform the design of the required systematic assessment of reporting practices across all EU member states, which should be pursued by the European Commission. Some qualitative insights, which we found particularly relevant, have been taken from the review and are summarized here.

Regarding reporting quality, a survey across various European member states finds that only 20% of the 80 top-listed companies included a specific climate change policy section in their reports. 80% disclose GHG emissions, 30% report GHG targets. TCFD-aligned disclosure and climate-scenario analysis are still the exception and human-rights related disclosure turns out in various reviews of different national reporting practices to be least extensive and concrete.

Some of the reviewed reports point out that effective disclosure is not just about indicators but also about context, which should be considered when evaluating disclosure quality and effectiveness.

The evidence on changes in reporting practice after the transposition of the NFRD are very sparse as of the writing of this review. Initial findings suggest little change in Germany and significant increases of non-financial reporting in Italy and Poland.

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[25] The report, including the literature review, the survey and the interviews, was carried out at short notice and within a very limited period. Its objective is to generate QUALITATIVE insights and to inform the discussion about key issues and questions that will need to be addressed when trying to improve our understanding of the role, importance and use of non-financial reporting (and its regulation) in general and ESG and carbon and climate data in particular. More robust and representative scientific analysis is required to answer more definitely the remaining questions.

[26] Vfu is a leading network for sustainability professionals from financial institutions (www.vfu.de)

Different countries implement the directive differently and exemptions to the directive's scope and in particular the degree of precision in the reporting requirements differ significantly between EU member states.

3.1.2 Key Messages from the Survey

Data Sources, reporting frameworks and drivers of demand for and availability of ESG data

60% of respondents consider ESG rating agencies as most important data source for ESG data,

GRI and TCFD are confirmed as most useful reporting framework by 73-80% of the participants

Key drivers for ESG data availability according to the participants are increased investor engagement, the NFRD and its non-binding guidelines and the TCFD recommendations.

Reputational risk is seen as number one driver (73%) of the demand for ESG information by investment professionals, followed by a range of other drivers which around 50% of participants considered important.

Use of ESG data and importance of different types of ESG/carbon data

Asset management (Fund managers) are named by far the most frequently (80%) as main users of ESG/carbon data, while on the other hand all major firm functions mentioned in the survey are confirmed by between 20 and 47% of the respondent to also use it. The use of ESG data hence seems to be spread across firms' different departments/functions.

No single class/type of data stands out as being more important than others, but it may be noteworthy that forward looking climate transition risk assessment features in the top group (57%).

The majority stated that carbon emissions are incorporated in their firm valuation models (47%),

The number one driver of the materiality of carbon emissions according to survey participants was climate regulation (9 out of 15 or 60%), followed by reputational risk (6 out of 15 or 40%).

Only 20% consider ESG information about smaller companies as important or very important

3.1.3 Follow-up questions related to the findings of the survey and interviews:

Data Sources, reporting frameworks and drivers of demand for and availability of ESG data

1. Could a representative study confirm/reject the important role of ESG rating agencies?
2. Which data sources are used by ESG rating agencies?
3. Can GRI and TCFD be confirmed by user numbers as most useful reporting frameworks?
4. How dynamically is the use of GRI and TCFD reporting formats evolving? Can this be linked to regulation?
5. Does investor engagement differ between different types of institutions?
6. Which role does ESG play in engagement?

7. Can we measure the effects of investor engagement empirically?
8. Can we confirm this individual observation about the increased interest by private clients in ESG reporting?
9. What exactly is driving the recent boost of interest in and demand for considering ESG explicitly in investment decisions? Which (policy) measures could sustain this development?

Use of ESG data and importance of different types of ESG/carbon data

10. Can we confirm, in a representative survey, the dominant user role of Fund Managers as main users of ESG data?
11. Can we confirm the increasing positive attitude toward the importance and business case for considering ESG-data?
12. In how far do the specific ESG data/information requirements differ between functions/departments?
13. Can we quantify the share of assets subject to different “sustainability requirements” and how it changes over time?
14. Can we establish (in a representative study) any variation between:
15. Different data users (institutions)
16. Different data users (functional groups/departments)
17. Different objects of analysis, I.e. das the relative importance and usefulness of different types of ESG data vary with the type of firm or its sector/country/size?
18. In how far does the presence of other relevant (or even directly disclosure related) national regulation (like the UK company act or the French “loi grenelle I and II” and “Art.173”) affect the various transpositions of the NFRD and how do different regulatory regimes affect actual reporting practices and information asymmetry?
19. On which data basis exactly are the carbon performance or risk of a firm being evaluated and what are the differences between different institutions/actors, like rating agencies, analysts, asset managers, etc.?
20. How important is the role of scope-3 reporting related pressure from (particularly) downstream clients?
21. What would a proportionate reporting framework for smaller companies look like? What would be ESG risk filters/triggers that could be used to switch reporting requirements on/off depending on the risks?

3.1.4 Background

In the EU, certain companies are required to disclose (so-called) non-financial information (which is generally related to environmental, social and governance aspects) along with their traditional financial disclosure.

Amending directive 2013734/EU (the so called “accounting directive”), Directive 2014/95/EU (commonly referred to as non-financial reporting directive) specifies the corresponding reporting requirements of large public-interest entities with more than 500 employees. Public interest entities means listed companies, banks and insurance companies, as well as any additional categories of entity specified at the level of member States.

The directive defines the reporting scope only in broad terms and in particular, in terms of mode and place of reporting the directive leaves a lot of flexibility to the reporting entities.

Against this backdrop, the European Commission drafted non-binding guidelines in order to support companies in particular as regards their environmental and social disclosure.

The European Commission will publish a "Fitness check on the EU framework for public reporting by companies" [27] in the second quarter of 2019. The Commission will also update the Non-Binding Guidelines on Non-Financial Reporting in the second quarter of 2019, specifically with regard to the reporting of climate-related information.

In this context, DIW Berlin executed a 4-week project to contribute to this fitness check, through a targeted literature review, exploring the consistency, quality and availability of ESG data across different types of entities and member states.

This literature survey was complemented by a small survey, and a few longer interviews to get some additional qualitative information in relation to the use of and demand for ESG data by investment professionals.

The results are presented in this short report.

3.2 Literature review of reporting practice in the context of the non-financial reporting directive

The aim of this short literature review was defined as analysing the emerging reporting practices in the context of the non-financial disclosure directive and its different national transpositions, with a particular focus on consistency/quality and availability of ESG data. As far as possible, the literature has been assessed with a view to understanding eventual differences between different types of firms and across EU member states.

[27] https://ec.europa.eu/info/law/better-regulation/initiatives/ares-2018-744988_en

3.2.1 Quality of disclosed ESG data and information and differences across different ESG dimensions

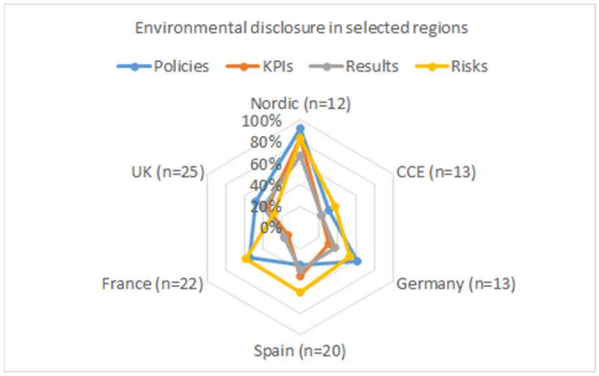
The Alliance for Corporate Transparency (ACTF) analyses non-financial disclosures of 105 companies with different sizes from three sectors (energy, health care, ICT) and six European regions. Around 60% of the companies indicate the GRI or national standards as reference framework. The vast majority of the firms stressed the importance of ESG related issues, however, the environment related information of only half of the companies are clear and concrete (<n 30% for social and anti-corruption matters).

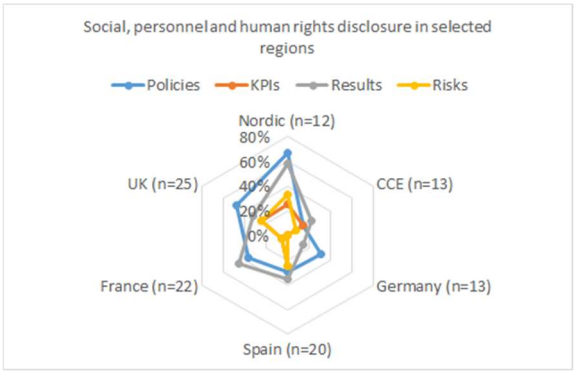
Almost one third of the companies did not outline ESG risk associated with their business model (ACTF, 2018).

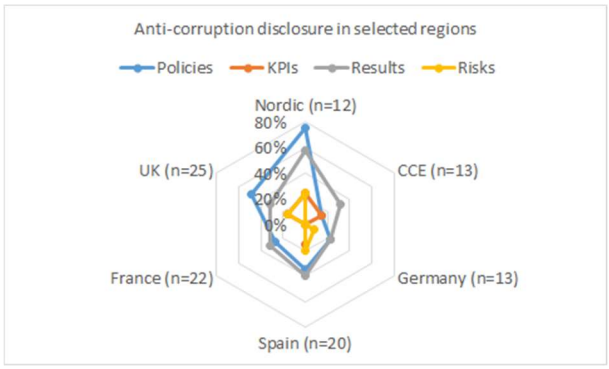
Climate/carbon disclosure

In current practice, there is especially a lack of reporting in the energy sector on short and long-time horizon (reported by 26% of the companies) and on the transition to a below 2° scenario (reported by 21%). More than the half of the companies have a climate target, even 71% of the energy and mining companies, but considerably less align it with the Paris Agreement. Almost 80% report their GHG scope 1 emissions and the aggregated GHG emissions, while only slightly over the half disclose their scope 3 emissions and emission intensity. With respect to climate-related issues, Nordic companies reported specific information on their policies and their targets the most often (67%), followed by Germany (62%). The provided information of the Central and Eastern European Countries (CEE) were the least clear and specific (8% of the companies), according to ACTF (2018).

Figure 5. Disclosure across regions in comparison[28]







N.B.: Numbers in brackets indicate sample size

[28] While the analysis by ACTF presented above allows for a comparison between regions/countries, it has to be pointed out that the sample size of their assessment is well below that of the studies discussed in the following paragraphs, resulting in this case in a lower level of representativity.

Carbon Disclosure Standards Boards (CDSB) and Carbon Disclosure Project (CDP) examine environmental related disclosure practices of the 80 top-listed European public companies falling under the scope of the NFRD (CDSB and CDP 2018a). In a related study, they provide a snapshot of a sub-sample of 30 of these 80 firms (CDSB and CDP 2018b), briefly characterizing each firm's reporting practice individually. They examined a gap between environmental and climate related reporting. While more than two thirds of the companies published a specific environmental or sustainability policy/ strategy section, only 20% prepared a specific climate change policy/ strategy section. As also stated by ACTF, reporting of non-financial Key Performance Indicators (KPI), seemed to be more frequent the higher the market capitalization of the companies (but the sample size and methodological set-up does not allow for a causal interpretation). Further, more than 80% reported greenhouse gas emissions, while only around 40% publish GHG emission targets. In contrast to France and the UK, where more than two thirds of the companies disclosed progress against non-financial KPIs. only 38% of the Germany companies report progress against their non-financial KPIs. They found no direct evidence that the publication of the Commission´s non-binding guidelines were having a positive impact on disclosure in alignment with the recommendations of the guidelines or TCFD (CDSB and CDP 2018a).

Only 20% of the 80 top-listed companies included a specific climate change policy section in their reports

80% disclose GHG emissions

30% report GHG targets

The Dutch Authority for the Financial Markets[29] or in Dutch, Autoriteit Financiële Markten (AFM 2018) show for the Netherlands, that "companies do not systematically report on the effects of [companies on] [30] climate change. Only 14 of the 89 companies (approximately 16%) devote attention to the TCFD recommendations and apply them to some extent."

Finansinspektionen, Sweden's financial supervisory authority conducted a survey of sustainability-related reporting of 25 firms and 42 groups from different sectors (Finansinspektionen 2018). Only four out of the sample mention climate-related scenario analysis and around a quarter reports their total GHG emissions, only a few distinguish between different emission scopes. They highlight further that there is a general lack in transparency and comparability of the non-financial disclosures (FI, 2018).

TCFD-aligned disclosure and climate-scenario analysis still the exception

Almost three quarter of German companies surveyed by Global Compact and Econsense (2018) reported on environmental indicators, although DGCN does not further specify which indicators.

Ciavarella et al (2018) assessed best practice in materiality reporting based on "involvement of the internal bodies and/or the top managers [...], and involvement of stakeholders" and the characterisation of the processes used for these engagements. In terms of the variation across different types of firms, they find that "Best practices in the materiality analysis are more frequent among largest companies (involving 53% of Ftse Mib, versus 19% of Mid Cap,

[29] More information about AFM's sustainability related activities can be found at their website @ https://www.afm.nl/en/professionals/onderwerpen/duurzaamheid

[30] The formulation „effects of climate change" could be misleading. AFM (2018) refer to "the effects companies have on climate-related and environmental issues. This concerns direct or indirect emissions of greenhouse gases, energy use, waste processing and water use."

10% of the Star and 3% of small firms) and service firms (32%, followed by 20% in the financial sector and 15% in the industrial sector."

Human-rights related disclosure seems to be taking the backseat

AFM (2018) analysed the reporting practice in 2017 of all 89 Dutch companies falling under the scope of the national decree implementing the NFRD. They found that "Employee-related and environmental aspects receive the most attention, with human rights, anti-corruption and bribery receiving the least." The reporting on the effects of climate change on companies in terms of risks and opportunities is described as "minimal". "49% of the companies report voluntarily on the UN's sustainable development goals (SDGs)."

For Germany the situation is similar to that in the Netherlands, with human rights reporting lagging behind the other dimension in terms of policy, results and KPIs (see Figure 8 for the more representative sample, and Figure 5); in Sweden human rights comes also last, but is reported more frequently than in the other countries.

That point was also confirmed by pwc's (2018) assessment of the 30 earliest reporters listed at FTSE 350, where impact reporting on the five "content areas" was lowest for human rights (20%) and anti-corruption/bribery (17%), with the other three areas ranging between 90 and 100%.

Figure 6 shows the share of reporting firms for the five dimensions and per type of reporting (for the Netherlands), while figure 2 captures the situation for Sweden. While the Dutch report includes the share of firms with KPIs in the 5 areas, the Swedish report includes instead the category "follow-up" in addition to the results indicator, to capture whether insights (through results) lead to follow-up activities or no.

Figure 6. Share of Dutch companies under the scope of the NFRD-implementing decree that are reporting on policy, risks, KPIs and results (Source: AFM 2018)

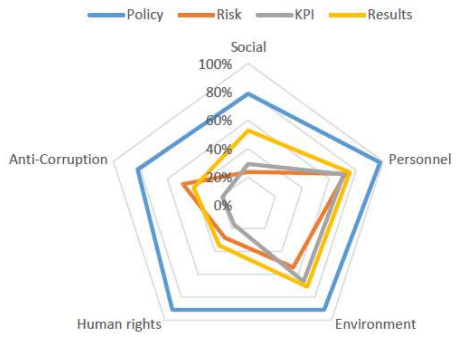


Figure 7. Share of Swedish companies under the scope of the NFRD-implementing law reporting on non-financial aspects (Source: Based on data from KPMG 2019)

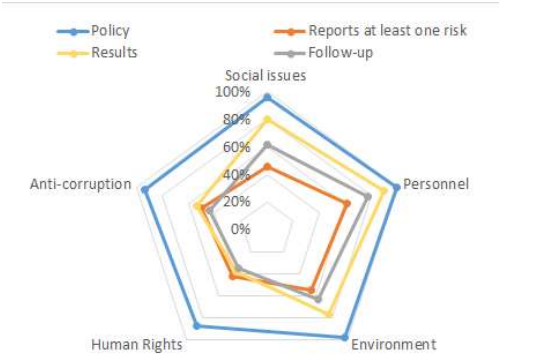
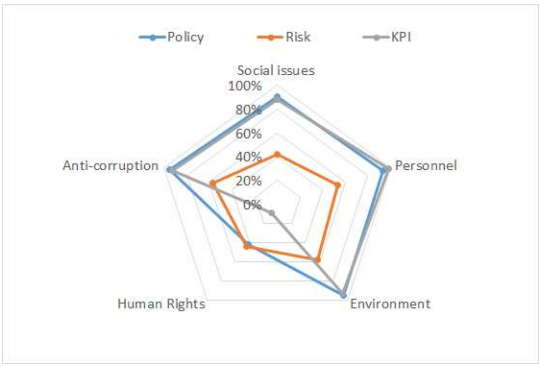


Figure 8. Share of German companies under the scope of the NFRD-implementing law reporting on non-financial aspects (Source: Global compact and Econsense 2018)



KMPG (2019) find a similar deficiency of human rights reporting for Swedish firms[31] (with 13% of the report not referring to human rights at all), "while a majority of the companies do report fully and efficiently in the areas of personnel".

The share of companies from their sample reporting on the five areas specified in §12 of the Swedish law (Figure 7). The majority of companies in the Swedish sample "do no communicate forward looking sustainability targets in their reports" (KPMG 2019) and only 35% report risks for all 5 areas. Figure 8 shows the findings of Global compact and Econsense (2018) for Germany.

AFM (2018) point out that relevant non-financial reporting is not only about reporting on specific indicators but also on the context without which it is difficult to evaluate the information provided. Their review shows that the context is not always included, and non-financial information is often reported in a non-specific manner, in particular as regards human rights and the combating of corruption and bribery.

Effective disclosure is not just about indicators but also about context

"One example is a company in the auto sector that addresses the environmental aspects of its own business operation, but does not mention the effects of its current business model on the environment. Another example is a company that does not report any social or community aspects although it is involved in mining in various parts of the world with all the local effects and risks that this entails."

Pwc (2018) come to a similar conclusion, referring to a lack of "integration" of impacts (on the five content areas) into the "narrative" and a need for better explaining the "wider significance" of the areas for the activities of the firm.

3.2.2 Did the directive change reporting practice?

Global Compact and Econsense (2018) focused its evaluation of German companies[32] on capital market orientated companies. 111 out of the 212 analysed firms are publicly listed. 90% of all capital market orientated firms[33]published non-financial information in various formats prior to the German NFRD-implementing law (CSR-RUG). More than half of the capital market orientated companies that participated in an online survey (in total 81) answered that they had not changed or did only minor modification in their reporting practice as a result of the German CSR-RUG. The remaining companies stated a large or a very large change. 31% do not consider making any changes in their reporting practice in future, while one third aims to disclose more comprehensively and one fifth to increase the number of indicators. Only 7% planning to report their progress. The majority of the online survey participants experiences an increased awareness and appreciation of the supervisory board for sustainability issues than prior to the German CSR-RUG.

Sparse evidence on changes in reporting practice after the transposition of the NFRD – initial findings suggest little change in Germany and significant increases of non-financial reporting in Italy and Poland

[31] The analysis was based on a random sample of 130 firms out of those 2300 firms above the applicability threshold of the Swedish law (proposition 2015/16:193 which entered into law on 1 December 2016). Out of this sample only 112 sustainability reports were available to KPMG, which form the basis of KPMG's analysis.

[32] According to the study, 487 German firms fall under the scope of the CSR-RUG out of which 238 are capital market oriented. The study assessed non-financial reports of 212 capital market orientated versus 43 non-capital market orientated companies

[33] Based on the online survey with a sample size of 81

In Italy, the number of firms issuing a non-financial statement increased from 83 (two had already voluntarily published a report on non-financial information in 2017) to 151 in 2018. Regarding the materiality analysis, 73% of the FTSE MIB[34] firms had already carried this out in 2017 on a voluntary basis (Ciavarella et al 2018).

In Poland, a survey with 87 reporting experts from companies falling under the scope of the NFRD-implementing law showed that more that 50% of the respondents issued non-financial reports for the first time, while almost 30% stated that they had reported non-financial information before on a voluntary basis (FRS 2018).

3.2.3 Differences in the Directive's national transposition, scope and coverage

CSR Europe and GRI (2017) provide a comprehensive overview of the member state implementation of Directive 2014/95/EU. Their report shows that national-level transposition differs in the company scope, the disclosure format or in the non-compliance penalties, among others, which may partly be related to differences in business practices across the European Union.

Different countries, different interpretations of and exemption to the directive's scope and required precision of reporting

Frank Bold (2017) emphasizes that in Germany, the UK, France and Italy, the national implementation did not provide further clarity at passages where the Directive is not clear about its intention. In addition, the mentioned countries did not expand the scope of the Directive. Nordic countries, like Denmark and Sweden, enhanced the scope compared to the Directive. There are no special KPIs mentioned in the Directive and the states took different approaches. On a positive note and unlike Germany and the UK, Italy and France did not only replicate the ESG factors from the Directive but prescribe more details or specific factors to report (Frank Bold, 2017). Italy formulated specific reporting requirements for each ESG factor coming "close to setting our specific KPIs by which each ESG factor can be assessed". France goes even beyond this approach by more and more specific reporting requirements, for example "'the impact of the company's activities as well as its services and products on climate change'" (Frank Bold 2017, p.3). In total, the French provisions list 42 specific aspects/indicators (in line with the "Loi Grenelle II") against which to report.

With almost all member states including exemption clauses (in line with the provisions of the NFRD), German NFRD-implementing law (CSR-RUG) for example includes exemption clauses which refer, a/o, to a vague notion of disadvantage, which a company could incur if it were to report the required non-financial information. What exactly constitutes such a "disadvantage" would still need to be clarified (Deloitte 2019).

The Italian "Legislative Decree no. 254 of (30 December 2016), defines the reporting scope in line with the directive while adding energy on top of the other five areas. The company scope is limited to "*large public interest entities" (ibid.)* while similar to Germany, *"firms included in the non-financial statement prepared by their parent company can be exempted."* Accordingly, the decree's scope covered 149 out of the 228 Italian firms with ordinary shares listed on the main exchange (at the end of 2017), with 70 firms outside the scope of the Directive due to their size.

In Poland, 167 out of 470 listed companies fall under the scope of the national law (Foundation for Reporting Standards 2018)

[34] FTSE MIB is the benchmark stock market index for the Italian national stock exchange.

3.2.4 Where/how do companies report their ESG disclosures?

Half of the reporting companies included in the ACTF report placed their ESG disclosure in the annual management report; the remaining published a separate report. (ACTF, 2018).

None of the German companies examined by CDSB and CDP provided the climate related disclosure within their management report, as the German law allows companies to alternatively publish it on their website. In the UK, almost one third did so. CDSB and CDP (2018a) recommend removing the possibility of publishing the non-financial information outside the management report (CDSB and CDP, 2018). In France and in the UK, it is required to include the non-financial information statement in the annual management report rather than publishing it separately and with a time lag like in Germany or Italy (Frank Bold, 2017).

Out of the 212 capital market orientated companies evaluated by DGCN, one third published an independent non-financial report, while 40% included the separated non-financial report outside the management report. In only 3% of the cases it was included in the management report, six out of seven of these companies are DAX companies. The average length of the non-financial reporting of all companies amounted to 17 pages. The structure was mainly orientated on company-specific action areas, 28% followed the structure given by the German CSR-RUG (DGCN, 2018).

In Italy, "of *the 151 firms publishing the NFS in 2018, […] 139 companies have only published the information required by the Decree, either in a stand-alone document (called Sustainability Report in 53 cases) or into the management report; six firms have published an Integrated Report (IR), embedding the NFS; two issuers have published both an Integrated Report and a separate Sustainability Report (SR); one firm has released an Integrated Report and a Sustainability Report as a NFS; three companies have circulated both a NFS and a Sustainability Report"* (Ciavarella et al 2018).

In Sweden, the applicable accounting law prescribes that the sustainability report shall be included in the Administration report (in Swedish: "förvaltningsberättelse") and otherwise referenced therein. KMPG (2018) found that most commonly the sustainability report was included in the financial statement, yet separate from the management report.

In Poland, 35% of firms disclosed the non-financial information in a separate report and 65% inside the management report (Foundation for Reporting Standards 2018).

3.2.5 Further research, open questions, key issues

ACTF concludes that with respect to climate change, legislation must further clarify disclosure requirements in line with TCFD recommendations of companies' long-term transition plans to a carbon neutral economy. It is not described in sufficient detail which information and KPIs must be reported by the companies (ACTF, 2018). Furthermore, the NFRD could be complemented with the concept of forward-looking information encouraging the identification of opportunities arising for the business from natural capital and climate change. To achieve the desired outcomes of generating information to better inform allocation of capital in support of a more sustainable economic system, it will require a significant step change in the effectiveness of disclosure and a mandatory implementation of the 11 TCFD recommendations (CDSB and CDP, 2018a).

The definitions of terms or concepts, like "materiality" or the description of the business model are not perfectly clear or transparent and accordingly, inconsistencies in reporting between companies and across jurisdictions are likely to occur.

Providing clarity on relevant KPIs and their measurement would enhance comparability.

The Directive could be further enhanced by a clarification of how non-financial disclosure should reference aspects of financial reporting (Frank Bold, 2017).

CSR Europe and GRI (2017) see the Directive as the beginning of the activities around the topic of non-financial disclosure and discuss the extension towards SDG reporting.

DGCN (2018) also stresses the lack of clarity as regards terminology and the variety of ways in interpreting it in the German CSR-RUG. Further they see difficulties regarding the availability of indicators four months after the balance sheet date, especially for environmental matters, and see potential for improving the auditing process (DGCN, 2018).

DGCN (2017) evaluates the early impact on the relevance of non-financial reporting within German companies and detect an increased awareness. However, they criticize that members of the supervisory boards did not consider the new reporting regulations at an early stage and are not able to adequately assess the consequences (DGCN, 2017).

The greatest challenges incurred by the evaluated capital market orientated companies were related in particular to limited internal resources, the auditing process of the report, the availability of pertinent indicators and the determination of risks (DGCN, 2018).

The results of the various studies discussed here are not easily comparable, as they are using different definitions, scope and levels of aggregation. But the variety of approaches is useful to inform the design of the required systematic assessment of reporting practices across all EU member states, which should be pursued by the European Commission.

3.3 Survey and interviews - investors use of and views on ESG data

15 finance professionals participated in the survey, including 4 ESG specialists, 4 from strategy/business development, 2 asset managers (fund management), 2 senior managers, 2 people working in financial reporting and 2 sustainability consultants. The participants' institutions varied in size (measured by assets under management) from 350 million to 2 trillion. The participation rate was 44%, which is extremely high and underlines that the survey was considered relevant by those who started looking at it. The full survey questions and results are included in the annex.

The questions and answers in detail

The structure of this section is as follows: First, the key finding in relation to each question is stated (in bold), followed by key insights and quotes from the interviews related to this question (in italics), followed by key issues or questions for potential follow-up (in boxes with blue filling).

60% of respondents consider ESG rating agencies as most important data source for ESG data, while on the other end none of the participants used data from mainstream rating agencies and only 2 used publicly disclosed quantitative data, with all other main sources/providers of ESG data ranging in between.

Interview (Portfolio Management): In the interviews, the use of data from ESG rating agencies was confirmed, yet one fund manager pointed out that this data is not taken at face value but verified and compared to other data sources. Even though the interviewed investor has employed 10 sustainability analysts (in addition to their 40 mainstream analysts), they do not use individual data points for individual firms from their ESG disclosure. This is just done in single cases, where this data is important for the specific company and its valuation. But harmonised disclosure at firm level is still seen as crucial, as it will increase the quality of the data provided through ESG rating agencies!

Interview (Sustainability Data provider): We use disclosed data directly, which is then included in their score. Standard data platforms are hardly used by investors for ESG data anymore. But we have to remember that 95% of all carbon data is estimated and not based on comprehensively reported data!

Besides algorithms used for "harvesting" firms web-based information for ESG-relevant information, client engagement and direct interaction with firms is very important in informing the ESG assessments.

Follow-up:

1. Could a representative study confirm/reject the important role of ESG rating agencies?
2. If confirmed: What data sources are used by ESG rating agencies?

GRI and TCFD are confirmed as most useful reporting framework by 73-80% of the participants

Interviews: Questionnaires are super inefficient; after all the reporting frameworks should be helpful for companies to understand their own ESG challenges. GRI is excellent, after all, everybody is using it!

Follow-up:

1. Is this confirmed by user numbers?
2. How dynamically is the use of GRI and TCFD reporting formats evolving? Can this be linked to regulation?

Key drivers for ESG data availability according to the participants are increased investor engagement, the NFRD and its non-binding guidelines and the TCFD recommendations.

Interviews: Regulation is the most important driver for improving the availability of ESG data. We are now seeing a lot of companies who are disclosing ESG data for the first time. But they [firms] are also confronted with increasing expectation of investors. And all firms, even smaller ones, feel the pressure from their (regulated) down-stream customers, who want to understand the ESG-risks in their supply chain.

"The transparency of sustainability data is today where financial data was 20 years ago." Still, data availability has strongly improved over the last 3-4 years in particular.

The regulators are always lagging behind the market developments, still, regulation is super important to improve ESG data availability: The EU plays an important role! At national level the Scandinavian regulators and financial institutions, and the French

"Art.173" are excellent examples, while the German government's track record is atrocious!

Follow-up:

1. Does investor engagement differ between different types of institutions?
2. Which role does ESG play in engagement?
3. Can we measure the effects of investor engagement empirically?

Reputational risk is seen as number one driver (73%) of the demand for ESG information by investment professionals, followed by a range of other drivers which around 50% of participants considered important.

Interview: Analysts are keen on having the mandate to fully reflect ESG data in their analysis of risks and opportunities! And ESG is seen as material, and specific ESG-related events can have a strong impact on the bottom-line through, for example, the reputational risk channel.

Another important demand driver are client requests, in particular institutional clients. Only recently, as in this year, there is a sudden boost in demand for ESG investing from private clients.

A third driver is clearly the broader societal trend, with the "Friday for Futures" movement.

Last but not least, the competition for talent was mentioned, as a lot of the younger prospective employees consider the ESG performance of their employer.

Follow-up:

1. Can we confirm this individual observation about the increased interest by private clients?
2. What exactly is driving the recent boost of interest in and demand for considering ESG explicitly in investment decisions? Which (policy) measures could sustain this development?

Who uses carbon/climate and ESG data? Here asset management (Fund managers) are named by far the most frequently (80%), while on the other hand all major firm functions mentioned in the survey are confirmed by between 20 and 47% of the respondent to also use it. The use of ESG data hence seems to be spread across firms' different departments/functions.

Interviews: Senior management wants to be seen as part of the solution, also on the product side and hence ESG data is used across the investment firm.

While even with the more sustainability orientated investment firms only around 10% of assets under management are "compliant" with some "sustainability requirements", new products are increasing sustainability orientated and overall the share of assets managed and subject to "sustainability requirements" is increasing.

Even sell-side analysts are increasingly referring to ESG, for example in the context of mergers, when a "dirtier" company is bought by a "cleaner" one, with a negative impact on the overall carbon performance/risk.[35]

[35] Insights from a corresponding sell-side analyst report were kindly shared with the authors by Jochen Fischer at Sanford C.Bernstein on 11 April 2019 (Venkateswaran, Menon and Becker 2019)

When we compare older studies and surveys about "Who uses ESG data" or "Does it pay to consider ESG", we can see a clear trend that more recent studies show an increasing share of positive replies.

"Fund management is the main user, but this is not mainstream yet in Europe; DK and SE are way ahead of the rest."

Follow-up:

1. Can we confirm, in a representative survey, the dominant user role of Fund Managers?
2. Can we confirm the increasing positive attitude toward the importance and business case for considering ESG-data?
3. In how far do the specific ESG data/information requirements differ between functions/departments?
4. Can we quantify the share of assets subject to different "sustainability requirements" and how it changes over time?

No single class/type of data stands out as being more important than others, but it may be noteworthy that forward looking climate transition risk assessment features in the top group (57%).

Interviews: "We are not systematically assessing individual data points, but we are more looking it whether firms are reporting ESG and whether they are making an effort." (Portfolio Manager).

"Two-thirds of the assessment is based on static- ex-post ESG data [like past CO2 emission], as forward-looking information is not really there yet. But it has a positive signalling effect when firms are making an effort to improve their forward-looking disclosure. And when future action, measures, investments are raised by the clients in the sustainability engagement with investors, investors will always follow-up on whether these plans have been put into action. Greenwashing does not really work with investors and if you announce plans to cut your emissions in the future you better follow suit!"

"The Science-based targets initiative generates very helpful insights that are used for our score."

Follow-up:

1. Can we establish (in a representative study) any variation between:
2. Different data users (institutions)
3. Different data users (functional groups/departments)
4. Different objects of analysis, I.e. das the relative importance and usefulness of different types of ESG data vary with the type of firm or its sector/country/size?

The set of questions about the materiality of carbon emissions were more specific and hence for some survey respondents more challenging to answer.

The majority stated that carbon emissions are incorporated in their firm valuation models (47% or 11), while 27% (or 4) said that it is not included. The rest did not know.

The number one driver of the materiality of carbon emissions according to survey participants was climate regulation (9 out of 15 or 60%), followed by reputational risk (6 out of 15 or 40%).

Among the only 7 out of 15 participants who answered the question "On which basis do you evaluate the carbon performance or risk of a firm?", the majority picked the fact that a firm discloses forward looking climate transition risk as an important factor (5 out of 7), followed by carbon performance relative to its peers and the firm's sector (i.e. whether it pertains to a carbon/energy intensive sector), selected by 4 out of 7.

Interview: Carbon emissions are included in the firm valuation model and the materiality of this is driven by regulatory risks and CO2 price risks. Sector affiliation also plays a role (energy/carbon intensive sectors) but carbon risk is also assessed and consider relevant for non-ETS sectors, as for reaching the Paris targets, also buildings, industry and transport needs to reduce emissions.

Follow-up:

1. Which regulation is how important in driving carbon emissions' materiality? What would be the relative importance of current regulation versus expected regulatory dynamics?
2. In how far does the presence of other relevant (or even directly disclosure related) national regulation (like the UK company act or the French "loi grenelle I and II" and "Art.173") affect the various transpositions of the NFRD and how do different regulartoy regimes affect actual reporting practices and information asymmetry?
3. On which data basis exactly are the carbon performance or risk of a firm being evaluated and what are the differences between different institutions/actors, like rating agencies, analysts, asset managers, etc.?

When asked to weigh **comparability against detail of firm level ESG information,** 4 out of 15 gave an equal weight to both, while preferences for either more detail or more comparability were almost equally distributed.

In relation to the **place of reporting ESG disclosures**, the first preference was for a separate CSR report (60%), followed by website (53%), and integrated report (47%).

Finally, a set of two questions referred to smaller companies.

Only 20% consider ESG information about smaller companies as important or very important, while the majority (40%) settled on medium importance (or score 3 of 5).

11 out of 15 respondents found that the ESG data situation of smaller companies is best described by "limited data availability"

Interviews: There is lack of clarity and some sense of uncertainty about ESG reporting when talking to medium and small companies. But the pressure is on also for smaller companies: on one hand this comes from the business clients, which are themselves disclosing and demand clarity about the ESG risks in their supply chain; on the other hand, while currently there is an appreciation by investors that we are in a transition period, being small will in the medium run not be sufficient to not report

Follow-up:

1. How important is the role of scope-3 reporting related pressure from (particularly) downstream clients?
2. What would a proportionate reporting framework for smaller companies look like? What would be ESG risk filters/triggers that could be used to switch reporting requirements on/off depending on the risks?

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3.5 Additional report "Some ideas and anecdotal evidence about the use of ESG data and scores

Ingmar Juergens[36] and Katharina Erdmann, DIW Berlin, 22 May 2019

a) Who uses ESG data and/ or scores?

- portfolio and asset managers, fund managers
- ESG Research / ESG committees
- index providers (mostly stock exchanges, together with (ESG) data providers (like S&P)
- access to sustainability rating products from one of the large ESG rating providers can be expensive, some prefer alternative data (like data from Bloomberg, which is cheaper) (FT, 2019)

b) More differentiated: Who uses which information?

ESG data/ score usage depends on the investment strategy and approach, the customer order and the value proposition of the company.

And using ESG-data comprehensively and beyond the aggregate score requires asset managers to have data infrastructure and the analytical capacity and personnel to deal with it. Smaller institutes do not have that.

So besides differences in size (assets under managements, employees, specialized ESG staff), we can for example distinguish between three types of portfolio managers regarding ESG reporting:

- "mainstream asset managers" who are interested in ESG data instead of the score (data selection depends on sector and the asset managers´ perception of key indicators)
- asset managers who follow a more determined ESG approach complement their own research by ESG scores
- asset managers who belong to the "new school" rely on algorithms rather than on ESG ratings

Typical ESG approaches are still the classic "negative screening/filtering" or exclusion policy; and "impact investing" (Sustainalize, n.d.). The Financial Times (2019) also refers to portfolio managers who favour the existence of more granular scores and further breakdowns in contrast to a composite ESG score. The portfolio managers, indicated above as "mainstream", aim at reflecting those ESG characteristics which are the most important to them/their clients, correctly in their portfolios. The FT article points out that there is a danger of relying on a simple final score for the investment decision since there are inconsistencies between different ESG sources, even though they use the same data (FT, 2019).

Besides these differences at aggregate level, Timo Busch (in his presentation at the academic Sustainable Finance Conference in Brussels in January) showed stark differences also at the individual data level (for CO2 data across different data providers).

Although it seems conclusive that the portfolio or asset analysis should not be based on a single ESG score, this is not necessarily always the case in current practice. Investors

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who are new to sustainable investing use the scores as starting point, overstrained by the range of data products (GreenBiz, 2019). PRI (Principles of Responsible Investing) emphasizes that portfolio managers may not have time to conduct comprehensive ESG research or may not be sufficiently familiar with ESG issues and trends to identify material ones (PRI, 2016).

This is in line with the findings that the share of passive managed funds increased recently, due to the lower time investment and costs, namely from 16% in 2010 to 27% in 2017 of total managed funds worldwide (money marketing, 2018). In this context, Sustainalize differentiates between two investor types, regarding ESG information:

- active investors, who use multiple data sources and perform their own analyses rather than solely relying on data of a third-party data provider.
- passive investors who use single-source third party ESG-data, i.e. a single ESG rating score can determine their investment decision.

In the case of Germany, we can reasonably differentiate between “the big four”, namely Allianz GI, DEKA, Deutsche Bank Asset (DWS), and Union Investment on one hand and a range of medium and small sized asset managers on the other hand.

The “big4” have teams of analysts that are using the whole range of data from the ESG-Rating Agencies, feed them into their own databases and then carry out their own parametrization for evaluations. They do not use ESG-scores/ratings one-to-one.

With bigger asset managers, internationality is an issue. Exposure to, say, Danish or Dutch clients (institutional investors like pension funds in particular) would tend to drive up the demand for a thorough ESG-assessment.

For many asset managers the sustainability/ESG reports received from the ESG-rating agencies are important, and as smaller asset managers have also often much fewer investments, they may sometimes (be able to) spend several days on carefully reading the report. Besides the reports, smaller asset managers, rather than using the whole range of data provided by ESG-rating agencies, would tend to use a handful of filters (of particular relevance to them or their clients) and combine that with the aggregate ESG score by the ESG-rating agencies.

However, one individual conversation with one of the oldest private banks in Germany as well as at least two of the interviews we carried out for the survey underlined that mainstream investors may still not go very much beyond using aggregate scores, in particular where neither regulation nor their clients require them to do that.

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3 further personal conversations with asset managers

4 A legal and administrative assessment of product carbon requirements

Timo Gerres, Manuel Haussner, Karsten Neuhoff, Alice Pirlot[37]

4.1 Background

Basic materials are, and will be, essential for the functioning of our societies and economies. However, their production is highly emission-intensive, contributing a quarter of global GHG emissions (IEA, 2017). As recognized by the Paris Agreement, there is wide scientific consensus that, in order to limit the catastrophic impacts of climate change on our societies, the world community must limit the global temperature rise to well below two degrees. This requires a reduction of GHG emissions toward climate neutrality, as, for example discussed for a 2050 horizon in Europe (COM (2018) 773 final). Therefore, a drastic reduction of GHG emissions from the production of basic materials along with enhanced recycling and material efficiency is urgently needed. This implies the replacement of carbon-intensive production processes with clean production processes and, thus, involves large capital expenditures and, often, higher operating costs.

This section explores the role of product carbon requirements (PCRs) as one of the instruments that could help phasing out the production of carbon-intensive processes.[38] PCRs would establish near-zero emission limits for the basic materials to be sold within a jurisdiction: only basic products that are near carbon neutral would be allowed for sale. This requirement would apply both to domestic and imported products. From a practical viewpoint, the implementation of such PCRs would need to ensure that low-carbon production processes or substitute materials have reached a certain technological readiness. However, the announcement of a future implementation of PCRs would impact the long-term viability of carbon intensive business models and investments as of today, potentially enhancing the efforts of firms toward aligning their business models and technologies with European and global climate objectives.

A labelling standard for basic materials linked to their emission-intensity could be a first possible (voluntary) step towards the implementation of PCRs.[39] Such a standard would set criteria for traditional carbon-intensive materials like steel, cement, plastics, and aluminium in order to evaluate whether they were produced without significant direct and indirect carbon emissions (near climate neutral). Materials complying with the standard, as well as products exclusively containing such materials, could obtain a corresponding label. A variety of actors would benefit from such a labelling scheme. It would allow businesses to provide evidence of the climate impact of their materials to final consumers and demonstrate the viability of their business model to financial investors in a carbon-

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[38] Please note that we use the term "carbon" as a generic reference to all GHG emissions released during the production process of basic materials.

[39] We use the term 'Standard' as defined in the Agreement on Technical Barriers to Trade (TBT): "rules, guidelines or characteristics for products or related processes and production methods, with which compliance is not mandatory" (cf. TBT, Annex 1). Under the TBT, standards are to be distinguished from "technical regulations," which are mandatory. Note that the term "Standard," under WTO law, is more narrowly defined than a general definition of standardization often understood as the process of articulating and implementing technical knowledge (Russell, 2005). As a consequence, some legally binding legislations framed at the European level as a "standard" like the EU vehicle emission standards (Commission Regulation (EU) 2017/1154), are – under WTO law – considered to be an emission requirement stated in a "technical regulation" (WTO, 2014). *See,* also, *infra,* section 3.1.1.

constrained economy. An example of how voluntary schemes can establish new best practices within global value chains is, among others, the ISO 14000 family of standards, which is used for certifying the environmental management of businesses and organizations.[40]

In a second step and after a predefined period of time, the voluntary standard could be complemented with mandatory PCRs. The sale of basic materials or products containing significant volumes of carbon-intensive basic materials like steel, cement, and aluminium, would only be permitted if the basic materials or the embodied basic materials are certified to be at, or near, climate neutrality. One option for implementation would be to allow companies to use the previously described voluntary standards in order to demonstrate the climate neutrality of their basic materials. In parallel carbon-intensive domestic production processes of basic materials would also need to be banned to avoid that producers export materials previously dedicated to the domestic market. Otherwise the environmental objective and therefore the political legitimacy of PCRs might be jeopardized.

PCRs differ from standards and requirements that address emissions from the use of products, such as emission efficiency requirements for certain road vehicles (ex: Regulation (EC) No 715/2007). They also differ from requirements that only limit the emissions released during the production process, such as limits on conventional pollutants like SOx/NOx for new and existing industrial installations and CO_2 emission limits for the participation of coal power stations in capacity mechanisms (Regulation (EU) No. 2019/943, Article 22 Section 4). When applied to industrial processes, it is often argued that stringent emission limits on their own could result in firms relocating their production to other jurisdictions and thus serving the same demand instead of changing production processes or products to reduce emissions (Pethig, 1976). This can motivate exemptions rules or less stringent implementation of emission limits. By contrast, PCRs allow for a more stringent implementation of environmental targets in line with the global emissions reduction objectives. If firms relocate production and continue to serve domestic demand, they will be subject to PCRs anyway.

PCRs would complement, rather than substitute for, other energy and climate policies. The logic would be similar as the one that has been proposed, in recent years, for the phasing out of coal, which triggered national governments to define phase out plans for coal power stations to supplement the incentives from the EU ETS, in order to accelerate the decarbonisation of power production. PCRs would become mandatory once there is sufficient production capacity for climate-friendly materials. Given the current degree of technological readiness, this is not likely before the mid-2030s at the earliest (Bataille et al., 2018). Thus, a first step for adequate incentives is to ensure innovation and investments in the first commercial scale installations of climate-friendly processes and materials. To this end, instruments like innovation funding, a climate contribution added to the EU ETS to ensure full carbon price internalization (Neuhoff et al., 2019), project based carbon contracts for pilot projects (Richstein, 2017; Sartor and Bataille, 2019), and green public procurement (Chiappinelli and Zipperer, 2017) haven been discussed in the literature.

The anticipation of future PCRs could enhance the effectiveness of these other policy instruments. This could be achieved by creating an unambiguous vision or clearly defined targets in terms of the CO_2 performance of the basic materials' sector within the coming

[40] ISO 14000 encompasses various voluntary international standards developed by the ISO/TC 207 technical committee of the International Organization for Standardization, chaired by the Canadian Standards Association. The standard can be used to show compliance with regulatory environmental requirements, but is also used by companies to as contractual requirements with suppliers to implement sustainable supply chains, see for e.g. empiric evidence for Italian companies (Chiarini, 2012).

10-20 years. By doing so, PCRs would significantly reinforce incentives for businesses to direct their strategies toward the full replacement of carbon-intensive production processes with clean alternatives over the next 10-20 years. Without anticipated PCRs, there is a risk that past failures of innovation policy for these sectors would be repeated, whereby companies have invested half-heartedly in pilot projects without a strong impetus to take the relevant technologies to commercialisation (Neuhoff et al., 2014). Additionally, uncertain carbon price developments create an additional option value for postponing new investments while waiting for more clarity, thus further increasing the carbon price required to overcome inertia. A credible announcement of PCRs can trigger a shift to climate-friendly production processes at an earlier point in time or at lower carbon prices. Companies would need to change their production processes to ensure their 'licence to operate' and continue to sell into a market. It may therefore result in the prioritisation of investments in climate-friendly production processes by those companies that aim to guarantee that their business model is compatible with the anticipated policy development.

The paper is structured as follows. First, we analyse examples of various product standards and technical regulations and their implementation. We focus on examples that are relevant to EU consumers but aim to provide insights that may also be of relevance for other regions and their implementation of climate policies. Indeed, the analysis of European environmental standards and technical regulations offers insight in the political, legal, and technical background for the adoption of PCRs, which could be useful for policymakers in the EU and beyond (*section 2*). Second, given the relevance of WTO law for the adoption of standards and technical regulations on products, we analyse the compatibility of PCRs with WTO law and identify possible risks with regard to their implementation (*section 3)*. Moreover, we discuss the legal arguments in support of the view that PCRs would not be found incompatible with WTO law, if they are designed carefully and with foresight. Finally, the paper concludes with a summary of the key finding and an outlook (*section 4)*. Our overall objective is to support today's investors, operators and policymakers in their considerations of PCRs.

4.2 Environmental standards and technical regulations: examples in the EU

Legislation that sets sustainability criteria for products, defines emission levels, or aims to ensure an environmentally friendly production process for products and services is an ongoing area of focus for European policymakers. The European Single Market is shaped by the design and implementation of these product rules concerning safety, health, and environmental protection.

This section provides an analysis of a (non-exhaustive) set of EU legislation that addresses the resource efficiency and environmental impact of certain products produced and sold on the EU single market, namely: requirements of CE-Marking, the Ecodesign Directive, road vehicle emission requirements, the Environmental Management and Audit Scheme (EMAS), Biofuels Certification, Forestry Law Enforcement Governance and Trade Voluntary Partnership Agreements (FLEGT VPAs) and the EU Timber Regulation. All these examples set rules for the market participation of domestic and non-EU market producers. Therefore, they provide useful insight in the context and design of environmental product requirements, which could serve as a basis for the introduction of PCRs.

4.2.1 Conformity with safety, health and environmental protection requirements: CE Marking

One of the oldest and most prominent criteria for products to be sold within the European Economic Area (EEA) is the CE marking (Conformité Européenne).[41] Introduced in 1985, CE-marking allows distributors to show the conformity of their products with safety, health, and environmental protection requirements laid down in relevant EU Directives. Conformity is expressed by affixing the CE-label to a product.[42]

CE-marking is mandatory for all product groups sold on the EU market that are covered by the relevant CE directives and regulations.[43,44] It applies to both imported and domestically manufactured products. Non-compliance can lead to the permanent removal of the product from the EU market. Considered as a success story with regard to end-consumer safety and producer liability, it is limited to physical product specific characteristics and does not address products' production processes.

CE-marking is required for 25 product groups, ranging from medical devices, various types of electrical and mechanical equipment, to explosives, and to toys.[45] Requirements for different product groups vary significantly. The distributor´s obligations are stated in product specific directives like the Toy Directive (2009/48/EC), Explosive for Civil Use Directive (2014/28/EU), and the Pressure Equipment Directive (2014/68/EU). Directives and regulations are restricted to "essential requirements." This means that technical details, such as the quantification of limits, dimensions, design characteristics, or production process requirements, are not specified.[46] Essential requirements remain mostly descriptive and often refer to harmonised standards as an option to demonstrate compliance.[47] Hereby, harmonised standards are defined as "non-binding technical specification adopted by a standardisation body, namely the European Committee for Standardisation (CEN), the European Committee for Electro-technical Standardisation (CENELEC) or the European Telecommunications Standards Institute (ETSI)" (2006/42/EC Article 2(l)). [48]

The EU provides guidance to distributors on how to ensure compliance with the different directives concerning CE marking. For this purpose, the European Commission published its first 'Blue Guide' on the implementation of EU product rules in 2000 (European Commission, 2000). This 'Blue Guide,' which is regularly revised (e.g. with Commission Notice 2016/C 272/01), is not legally binding and distributors can opt to either comply by

[41] *See* Regulation (EC) No 765/2008 of the European Parliament and of the Council of 9 July 2008 setting out the requirements for accreditation and market surveillance relating to the marketing of products and repealing Regulation (EEC) No 339/93, OJ L 218, 13 August 2008, pp. 30-47.

[42] *See, article 30, § 2 and 4 of* (EC) No 765/2008. *See* also Commission Notice 2016/C 272/01 Section 4.5.1).

[43] For a complete list of the relevant directives see, https://ec.europa.eu/growth/single-market/ce-marking/manufacturers_en

[44] *See* Article 26 of Regulation (EU) 2019/1020 (suspension of release for free circulation in case of false or misleading CE marking).

[45] *See* footnote 7.

[46] 'Blue Guide" Commission Notice 2016/C 272/01 Section 1.1

[47] Some directives, however, set quantitative criteria, e.g. limits for lead stated in the Toy Directive (2009/48/EC) have been notified to the WTO (Notification: G/TBT/N/EEC/184/Add.1 on 05.10.2009). The "Proposal for a Regulation of the European Parliament and of the Council laying down rules and procedures for compliance with and enforcement of Union harmonisation legislation on products and amending Regulations (EU)" ((Notification: G/TBT/N/EU/626 on 10.12.2018) list and refers to most CE marking related directive and regulations.

[48] See, Regulation (EU) 1025/2012 on European standardisation, which sets the rules of standard setting and stakeholder participation in European standardisation.

following harmonised standards or by applying their own technical specifications. Even though, for most product groups, the directives cover only product characteristics rather than the production processes, module D of the Blue Guide lays down quality management and assurance criteria, which apply for specific product categories that are defined within the different directives, such as pressure vessels of category III and IV according to the EU Pressure Equipment Directive (2014/68/EU Article 14 & Annex II).

In addition to the CE directives, the Product Liability Directive (Council Directive 85/374/EEC Articles 1 and 3.2, as later modified by Directive 1999/34/EC) requires the distributor to comply with safety, health and environmental protection requirements for products placed on the European market, for which he can be held liable. In case of domestically manufactured goods, the producer is normally also the distributor. For imported products, the liability remains with the distributor. As such, the legislation ensures that products that are produced in countries outside of the EEA comply with European safety, health, and environmental protection requirements.

In general, CE marking relies primarily on the concept of self-control for distributors and producers, which only indirectly implies third party certification in certain cases. This system is not immune to fraud, and cases have been reported for applications like medical devices (de Bruijn et al., 2009). CE-marking has a global reach in as much as it also applies to products neither produced but sold in the EU as well as products neither produced nor sold, strictly speaking, in the EU, but sold within the customs union (e.g. CE-marking is logically applied by Turkey (TSE, 2019)). From a WTO law perspective, CE-marking has not been challenged.

4.2.2 The Ecodesign Directive

The Ecodesign Directive (2009/125/EC) and the Energy Labelling Regulation (EU) No 2017/1369 target both the operational and material efficiency of products and form part of the Ecodesign framework legislation. The Ecodesign framework primarily targets product characteristics and not the production process. This means that products that fulfil operational and material efficiency requirements can be brought onto the market, regardless of their global carbon footprint resulting from the production process and transport. The Ecodesign Directive, though, provides legislators with the option to implement requirements targeting recyclability and enhancing material circularity, a potential that is considered to be untapped so far (Dalhammar, 2016).

The Ecodesign Directive covers a broad range of products, for which requirements are defined in product specific regulations.[49] Heating and water heating equipment, electric motor systems, lighting, domestic appliances, office equipment, consumer electronics, HVAC (heating ventilating air conditioning) systems, as well as measures reducing stand-by losses for a group of products are covered by this legislation. For each of these product groups product specific regulations contain binding requirements about product design and functioning[50]. One prominent example is the Commission Regulation with regard to Ecodesign requirements for non-directional household lamps (EC) No 244/2009. Its implementation resulted in the quasi-phase out of 60W and 100W incandescent light

[49] All product-specific Ecodesign regulations is provided online: https://ec.europa.eu/energy/en/list-regulations-product-groups-energy-efficient-products

[50] The (framework) Ecodesign Directive aims to improve the environmental performance for the entire product life cycle, while trying to drive the least efficient products out of the market. See also Ismer (2009) at p. 46.

bulbs in Europe and fostered the transition toward LED based lighting for domestic applications.[51]

Since the product specific regulations apply to products sold on the EU Market, they also apply to imported products. Such technical regulations must be notified to the WTO[52]. This gives other WTO members the opportunity to assess the impact of the measure on their exports and spot non-compliance with the TBT Agreement. As such, the unconditional conformity of the Ecodesign Directive with WTO law is not a given[53].

So far, the Ecodesign legislation is very successful at establishing minimum operational energy efficiency and material resource efficiency requirements for certain product groups sold on the European Single Market. It illustrates the ability of the EU to impose European product requirements on non-EU producers. For example, for some product groups, like televisions, which are mainly produced by non-European manufacturers (Schlösser and Stobbe, 2014), binding resource efficiency criteria have been set (Commission Regulation (EU) No 642/2009) and have affected the product characteristics of imports.

4.2.3 Euro Emission Standards for Road Vehicles

The first emission standards for road vehicles were introduced by the European Economic Community as early as 1970, with the adoption of Directive 70/220/EEC in order to reduce air pollution. The current regulation was established with the introduction of the Euro 1 emission standard in 1992 (Directive 91/441/EEC). Subsequent tightening of emission standards and its role in the Air Quality Framework Directives (96/62/EC and 2008/50/EC) led to the subsequent introduction of Euro 2 to Euro 6d. According to definitions provided in the TBT (Annex 1), Euro emission standards form part of technical regulations, and set obligatory emission requirements rather than (voluntary) standards.

The Euro emission standards set requirements for new cars, light commercial vehicles, and heavy-duty truck engines sold in the EU. These concern the operational characteristics of vehicles (not the process-intensity of vehicle manufacturing). Both locally and imported vehicles need to conform to the Euro emission requirements. Initially, Euro 1 defined limits only for carbon monoxide (CO), hydrocarbon (HC) and nitrogen oxygen (NO_x) emissions for petrol engines and, in addition, limits for particulate matter (PM) emissions for diesel engines. Over the years, limits have been tightened while additional limits were introduced for NO_x (Euro 3) and the particle number (PN) (Euro 5 and Euro 6).[54] Moreover, latter Euro emission requirements (5,5a to 5d and 6,6a to 6d) also set stricter requirements for fuel quality with regard to the cetane number and the sulphur content. Interestingly, various municipalities and regions in the EU have used the Euro emission regulations to restrict access of emission-intensive vehicles to city centres with the aim of improving the urban air quality (Holman et al., 2015).

[51] *See,* (EC) COM(2015) 443 final 'Market assessment on mains-voltage lamps as required by Commission Regulation (EU) No 1194/2012'

[52] For example, for the aforementioned Commission Regulation with regard to Ecodesign requirements for non-directional household lamps (EC) No 244/2009, *see* Notification G/TBT/N/EEC/277/Add.1 under the TBT Agreement. *See* TBT Agreement article 2.9.2.

[53] For a review of legal issues in relation to resource requirements set under the Ecodesign Directive, see Dalhammar et al. (2014), Section 6.

[54] Regulation No 715/2007 and No 692/2008 (passenger cars and light vehicles) and Regulation No 595/2009(trucks).

While the implementation of the standards can be considered a success, monitoring and compliance mechanisms need to be improved[55]. Moreover, even though Euro emission standards have helped to reduce certain types of vehicle emissions significantly, they have failed in reducing NO_x emissions, due to non-compliance and test-cheating problems (Hooftman et al., 2018). The discrepancy between laboratory test cycles as the NEDC (New European Driving Cycle) and tests performed with portable emissions measurement systems (PEMS) showed discrepancy of up to 35 times the limits required by emissions standards (Thompson et al., 2014). In the aftermath of the NO_x emission scandal, the new "Real Driving Emissions" (RDE) and the "World Harmonised Light Vehicle Test Procedure" (WLTP) have been introduced in the EU (Commission Regulations (EU) 2017/1151 and (EU) 2018/1832). The WLTP is the outcome of a global effort under the leadership of the United Nations (UNECE, 2019). The development of new technical regulations in an international forum like the UNECE might facilitate global acceptance and improve the reach of new legislation. All the emission standards and later amendments, such as the aforementioned test procedures, have been notified to the WTO as technical regulations (e.g., Notification: G/TBT/N/EU/553 on 01.03.2018 for Commission Regulations (EU) 2017/1151).

4.2.4 The Eco-Management and Audit Scheme: EMAS

The Eco-Management and Audit Scheme (EMAS) was first introduced in 1993 with Council Regulation (EEC) No 1836/93. Its aim was to track emissions that originate from the economic activities of an organisation. In other words, EMAS can be described as an audit scheme that requires certified organizations to monitor multiple environmental aspects of their organization, including greenhouse gas emissions. Due to its organization view on resource efficiency, EMAS has been criticised for not capturing the concepts of a circular economy (Korhonen et al., 2018).

Among others, companies, registered associations, NGOs, and public institutions can be certified according to EMAS. In contrast to the CE-marking and the Ecodesign Directive, it focuses on environmental process management (instead of product physical characteristics) and it is fully voluntary. The non-mandatory character of EMAS implies that it qualifies as a standard under WTO law. All private and public organizations can opt for being certified according to EMAS through an accredited third-party certifying body. Although EMAS is not obligatory, it can be advantageous to be part of the scheme given that EMAS is a key instrument of the European green public procurement guidelines, according to which public authorities are advised to require evidence of an environmental management system from their contractor (European Commission, 2016b).

EMAS fulfils a similar role as the voluntary global ISO 14001 standard for environmental management systems. ISO standards are published by the International Non-governmental Organization for Standardization and provide "rules, guidelines or characteristics for activities or for their results" (ISO, 2019). However, EMAS covers additional aspects compared to ISO 14001 (Testa et al., 2014).

4.2.5 Biofuels Certification

A mechanism to validate the sustainability of domestic and imported biofuels became necessary in 2009 after the adoption of the Renewable Energy Directive (Directive 2009/28/EC) on the promotion of the use of energy from renewable sources.[56] This Directive sets sustainability criteria for biofuels and bio-liquids to account for the different environmental impact of land-use practices at the origin of different bio-energy sources.

[55] Improved monitoring and compliance mechanisms is one of the objectives of the EU's new Clean Mobility Package (Directive (EU) 2019/1161)

[56] Now Recast Renewable Energy Directive (EU) 2018/2001.

Among others, the use of biofuels needs to result in greenhouse gas emissions savings of at least 35% in comparison to fossil fuels and it shall not be from land with a high biodiversity value and not from land with a high-carbon stock (Directive 2009/28/EC, Article 17). Under the Directive, only sustainable biofuels are eligible to comply with EU renewable energy targets, while member states need to take national measures to respect the sustainable criteria.[57]

The EU system for the certification of biofuels was developed to help demonstrate compliance with the Renewable Energy Directive´s sustainability criteria. The backbone of the system comprises voluntary sustainability certification schemes, which contain specific rules to certify biofuel production.[58] Both domestic and international producers can benefit from these schemes to certify and quantify the sustainability of their production processes.

In practice, multiple issues regarding the European approach to biofuel certification remain unsolved. In 2016, the European Court of Auditors evaluated the implementation of the voluntary certification schemes and concluded that in its current state, "the EU certification system for the sustainability of biofuels is not fully reliable" (European Court of Auditors, 2016), pointing to weaknesses in the supervision of voluntary schemes by the European Commission and concerns regarding the transparency of the certification process. These issues are addressed in the recast Renewable Energy Directive (EU) 2018/2001, which formulates stricter sustainability criteria and calls for new regulation addressing biofuel certification (Commission Delegated Regulation (EU) communicated with C(2019) 2055 final).

As to compliance of the EU system for the certification of sustainable biofuels with WTO law, some aspects of the scheme might be problematic (Echols, 2009; Mitchell and Tran, 2010; Perišin, 2014; Ponte and Daugbjerg, 2015).[59]

4.2.6 FLEGT VPAs and EU Timber Regulation

The EU uses two complementary sets of policy instruments to prevent the import of illegally harvested timber and timber products: the Forest Law Enforcement, Governance and Trade Voluntary Partnership Agreements (FLEGT VPAs) and the Timber Regulation.

FLEGT VPA are bilateral trade deals between the EU and third countries that oblige the partner country to implement national legislation and strengthen institutions to prevent illegal logging. In exchange, wood imported from these countries is considered, *per se,* as legally harvested. It is argued that FLEGT VPA with countries like Indonesia and Ghana reduced illegal logging significantly (Overdevest and Zeitlin, 2018).

The Timber Regulation (No 995/2010) applies to timber imported from countries without a FLEGT VPA in place. This Regulation forbids placing illegally harvested timber and products derived from such timber on the EU market. Operators placing timber or timber products on the EU market are required to exercise "due diligence" and keep records of their suppliers and customers. Similar to biofuel certification, this legislation targets the production process of goods placed onto the European Single Market. Some voluntary certification schemes, like the FSC (Forest Stewardship Council), can be used by importers to comply with these due diligence requirements. The effectiveness of the due

[57] *See,* Directive 2009/28/EC, Article 17(7)

[58] *See* the list of approved schemes on this website: https://ec.europa.eu/energy/en/topics/renewable-energy/biofuels/voluntary-schemes

[59] *See* also Argentina's complain against the EU (*European Union and a Member State – Certain Measures Concerning the Importation of Biodiesels,* 17 August 2012, DS443*; European Union and Certain Member States – Certain Measures on the Importation and Marketing of Biodiesel and Measures Supporting the Biodiesel Industry,* 15 May 2013, DS459).

diligence approach is reviewed biannually by the European Commission (e.g. COM (2018) 668 final), which evaluates Member States' implementation of the Timber Regulation.

The conformity with WTO law of some aspects of the EU Timber Regulation (such as the due diligence approach) remains under discussion (*see* Geraets and Natens (2013)).[60]

4.2.7 Results

Over the last decades, the EU has adopted various pieces of legislation ensuring that goods traded within its single market fulfil minimum safety, efficiency and sustainability requirements (Table 2). Our review of selected examples demonstrates that product characteristics specific policies like CE-marking, Euro vehicle emissions standards, and the Ecodesign Directive, have a long history and are well established in EU policy making. Product specific requirements apply equally to domestic and international producers who sell their products on the EU single market. For imported goods, the importer or distributor who places the product on the single market becomes responsible for the product conformity.

More recently, the EU has also gained some experience with standards that relate to the production process, for example in order to ensure the sustainability of biofuels and timber products. Biofuel certification is technically based on voluntary standards, which can be used by Member States to demonstrate that biofuels consumed on a national level meet the EU sustainability criteria. The timber regulation obliges importers to exercise due diligence when verifying the origin of timber products so as to ensure that production processes comply with criteria set by the EU legislation. Questions remain as to the compatibility of the EU Biofuel Certification and the EU Timber Regulation with international trade law, although they have not been found incompatible with WTO law so far. Finally, voluntary schemes like EMAS can play an important role in reducing the carbon footprint of certain parts of the relevant markets, e.g. in public procurement, by making it obligatory for contract partners in public tenders. Moreover, VPAs could help to reduce the carbon-intensity of imported products from specific partner countries, but their reach is limited to bilateral deals and requires the willingness of partner countries to cooperate.

Table 2 Summary of reviewed legislation

	Objective	Scope	Type	WTO Compliance
Requirements for CE Marking	Safety, Health and Environment	Product	Technical regulation (+ conformity assessment procedure)	No challenge
Euro Emission Standards	Emissions	Product	Technical regulation	No challenge
EMAS	Environmental management	Process	Standards	No challenge
Biofuel Certification	Sustainability	Process	Standards	Disputes (*see* Perišin (2014))
Ecodesign Directive	Resource efficiency	Product	Technical regulation	No challenge

[60] *See* also Saul and Stephens (2012).

	Objective	Scope	Type	WTO Compliance
Timber Regulation	Sustainability	Process	Due diligence requirements	No challenge but questioned in the literature
FLEGT VPA			Bilateral treaty	No challenge

4.3 Climate product requirements and WTO Law

PCRs have an international trade component: they do not just apply to domestic products but also to imported products. Therefore, they are likely to fall under World Trade Organization (WTO) agreements – in particular the General Agreement on Tariffs and Trade (GATT) and the Agreement on Technical Barriers to Trade (TBT). The former includes general rules on how international trade in goods is to be organized. The latter specifically addresses technical regulations, product standards, and conformity assessment procedures.

If they fall under one of these two agreements, implementing countries should verify that the design of PCRs does not violate any of these agreements in order to ensure their long-term viability and, thus, relevance for innovation and investment choices. Against this background, we provide a detailed analysis of PCRs under international trade law and propose design recommendations that are unlikely to violate the GATT or the TBT. Our objective is to anticipate and prevent the risks of future international trade disputes.

To this end, we discuss the application of the GATT and the TBT to PCRs (section 3.1). If PCRs fall under the scope of one or both of these agreements, they will be subject to the requirements set in their provisions, including the National Treatment Obligation (GATT Article III:4 and TBT Article 2.1) and the prohibition of import restrictions (GATT Article XI) (section 3.2). We show that, depending on the interpretation of the provisions of the GATT and the TBT, PCRs are more or less likely to be found incompatible with WTO law. Therefore, it is key to draw the attention of policymakers to the design and administrative procedures that help reduce the likelihood that PCRs will violate WTO law (section 3.3.). In any case, if PCRs breach of substantive GATT provisions, they could still be justified under the general exception provision (GATT Article XX).[61]

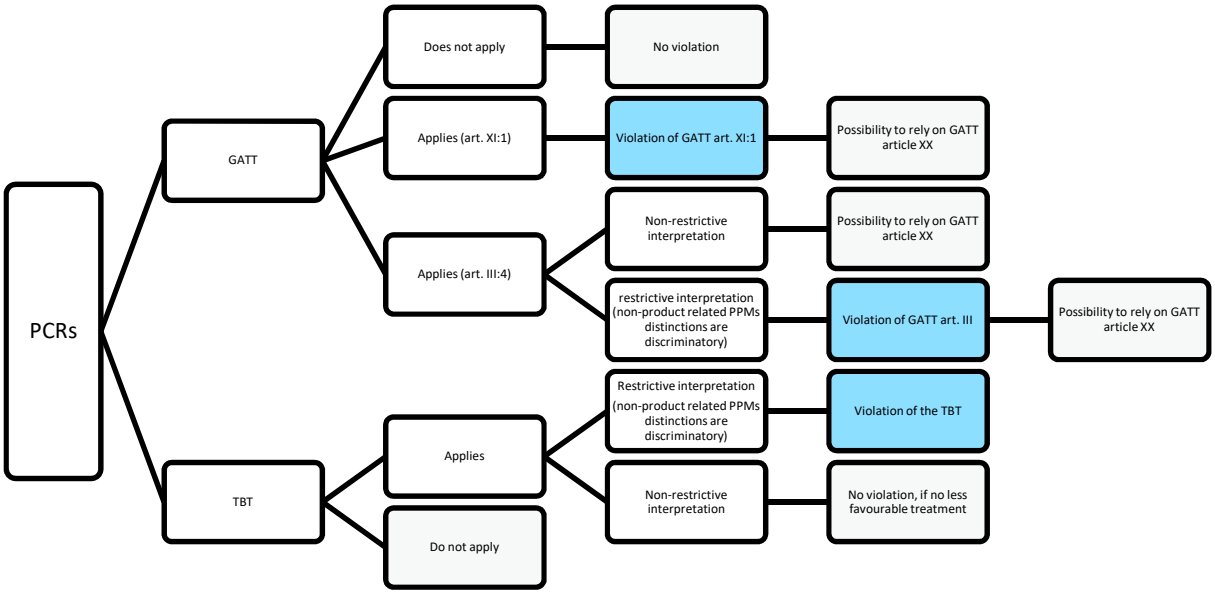

Figure 9. Structure of Section 3 and consequences of an application of one or both agreements.

[61] The different steps of our legal reasoning are summarised in Figure 1 (infra).

4.3.1 Applicable legal regime: The GATT and the TBT

World Trade Law only puts constraints on PCRs if they fall within the scope of WTO Agreements. Considering that PCRs apply to imported products, PCRs are most likely to fall under the GATT and the TBT, specifically GATT Article III:4, GATT Article XI and TBT Articles 2.1 and 2.2. Both agreements are not mutually exclusive but can apply at the same time once the measure falls within their scope.[62] While the GATT has a broad scope of application and clearly covers PCRs (section 3.1.1.), it is not fully clear whether PCRs would fall under the TBT (section 3.1.2).

4.3.1.1 General Agreement on Tariffs and Trade (GATT)

GATT Article III:4 lays down the National Treatment Requirement. It mandates that imported products may not be treated less favourably than like domestic products. GATT Article III:4 applies to all laws, regulations, and requirements affecting the internal sale, offering for sale, purchase, transportation, distribution, or use of imported products.[63] As this provision is drafted broadly, it is likely that it would apply to PCRs. Consequently, it is critical to design PCRs so as to ensure that they do not discriminate against imported products. Otherwise, PCRs will face a high risk of being found incompatible with this provision.

GATT Article XI:1 covers quantitative restrictions that are specifically targeted at imports and/or exports and it is unclear whether PCRs would fall within its scope.[64] It mandates, among other things, that no prohibitions or restrictions other than duties, taxes, or other charges, shall be instituted or maintained on the importation of products. If a PCRs qualifies as an import ban, it would violate GATT article XI:1.[65] Given that PCRs are applied indiscriminately to highly-CO2-intensive basic materials, it can nevertheless be argued that they should not qualify to import bans and, therefore, are not covered by GATT article XI:1, but rather by GATT article III:4.[66] Yet, it is not always clear whether a measure falls under GATT article XI:1 and/or III:4. In the dispute *EC – Asbestos,* France's ban on asbestos was analysed under GATT article III:4 and the panel did not consider it necessary to examine the measure under GATT article XI:1.[67] In contrast, in the case *US – Shrimp,* which concerned an import prohibition on certain shrimp and shrimp products, the analysis focused on GATT articles XI and XX.[68][69]

[62] In case of the application of both agreements, but with a conflict in outcome, the TBT prevails over the GATT (*lex specialis* to GATT, see General Interpretative Note to Annex 1A of the WTO Agreement, which states that, "[i]n the event of a conflict between the provisions of General Agreement on Tariffs and Trade 1994 and a provision of another agreement in Annex 1A to the Agreement Establishing the World Trade Organization […] the provision of the other agreement shall prevail to the extent of the conflict"; see also Van Huffel (2006) at pp 348 et seq).

[63] On the scope of GATT Article III:4, *see* Matsushita et al. (2006) at p 252.

[64] WTO, Appellate Body Report, United States – Import Prohibition of Certain Shrimp and Shrimp Products (US – Shrimp), 12 October 1998, WT/DS58/AB/R,

[65] This provision is analyzed *infra* (under 4.2.) in case of a violation of GATT Article III:4. This analysis would also be valid in case of a violation of GATT XI:1.

[66] The question as to whether PCRs would qualify as import ban is intrinsically connected to the question as to whether or not products can be differentiated based on non-product related process and production methods (*section 3.2.1.).* If such differentiation is prohibited, PCRs could be described as import bans.

[67] WTO, Panel Report, European Communities – Measures Affecting Asbestos and Products Containing Asbestos (*EC – Asbestos)*, 18 September 2000, WT/DS135/R, para. 8.159.

[68] WTO, Panel Report, United States – Import Prohibition of Certain Shrimp and Shrimp Products (*US – Shrimp),* 15 May 1998, WT/DS58/R. On the differentiation between GATT Article III and XI see Pauwelyn (2005).

[69] In section 3.2., we analyse only GATT article III:4 and GATT article XX. We do not provide an analysis of GATT article XI:1 as its application on import bans is straightforward. Moreover, section 3.2. does not include an analysis of GATT article I, which requires WTO members not to discriminate between imported products from other WTO members. PCRs are not supposed to be targeted at certain specific countries: they will apply indiscriminately to all basic materials. Therefore, we consider that they would not violate GATT article I, *per se*.

In case PCRs violate general GATT provisions, such as GATT article III:4 and/or XI:1, they could still be justified under the general exemption provision of GATT (Article XX). Under this provision, Members to the Agreement can justify measures that would otherwise have been found incompatible with other GATT provisions because they pursue certain goals that are deemed to be legitimate (e.g. certain social and environmental objectives). The Dispute Settlement Body (DSB) applies a two-tier approach to testify the legal conditions of Article XX GATT. First, the policy measure at issue must align with one of the exhaustive eight grounds of justifications listed under Article XX GATT, including the "protection of human, animal, plant life or health" (item b of the list) or "the conservation of exhaustible natural resources" (item g of the list).[70] Second, the measure must comply with the chapeau of Article XX and, thus, not constitute an arbitrary or unjustifiable discrimination between countries where the same conditions prevail or a disguised restriction on trade. It is important that policymakers keep these requirements in mind when designing proposals to establish PCRs, in case the measure were to fail the legal tests under GATT articles III.4 and/or XI.

4.3.1.2 Agreement on Technical Barriers to Trade (TBT)

The scope of the TBT is drafted narrowly. It applies only to technical regulations, standards, and conformity assessment procedures. Under TBT, PCRs are most likely to be assimilated to a "technical regulation," which Annex I of the TBT defines as a "[d]ocument which lays down product characteristics or their related processes and production methods, including the applicable administrative provisions, with which compliance is mandatory".[71] According to the WTO Dispute Settlement Body, a technical regulation "applies to identifiable group of products," is "mandatory," and lays down "product characteristics or their related production and process methods."[72]

While PCRs are undoubtedly mandatory and apply to a predefined group of materials and products containing such materials, it is not clear whether they lay down "product characteristics or their related production and process methods." Indeed, PCRs impose emission requirements on certain materials and products containing these materials, which cannot be fully assimilated to "product characteristics". Indeed, PCRs are aimed at limiting the types of products that can be sold in the EU based on how much greenhouse gas emissions were released during the production of basic materials. In other words, PCRs do not regulate the characteristics of basic materials and products containing basic materials but their non-product related process and production methods (PPMs) instead.[73] Whether such non-product related production methods fall within the scope of the TBT is yet not fully clear.

WTO case law makes clear that labelling requirements linked to non-product related PPMs fall under the scope of the TBT, but it is not clear whether non-product related PPM-based measures that go beyond labelling requirements would also fall under the TBT.[74] In the *EU – Seal products* case concerning an EU ban on the importation of certain seal products (with the exception of seal products that were hunted by Inuit or indigenous

[70] Interestingly, the Appellate Body Report referred to "measures adopted in order to attenuate global warming and climate change" when discussion GATT article XX(b). The United Nations Framework Convention on Climate Change was also mentioned – unsuccessfully - in relation to GATT article XX(d) in the case *India – Solar Cells* (AB, para.5.141 and 5.149).

[71] On the application of the provisions on conformity assessment procedures to PCRs, *see infra, section 3.3.2.*

[72] *See,* i. a., WTO, Appellate Body, EC – Asbestos, *supra* n. XX para. 61-77.

[73] The difference between product-related and non-product related product characteristics is based on the question whether or not they modify product characteristics.

[74] *See* the case United States – Measures Concerning the Importation, Marketing and Sale of Tuna and Tuna Products (US – Tuna II) where the Dispute settlement body analysed US "dolphin-safe" label requirement on tuna products (WTO, Appellate Body Report, US – Tuna II, 16 May 2012, WT/DS381/AB/R).

communities or that were justified by marine resource management purposes), the Appellate Body rejected the findings of the panel, which seemed to assimilated certain PPMs (such as the requirement related to the identity of the hunter) to "product characteristics."[75] According to the Appellate Body, neither the text of Annex 1.1. of the TBT (which defines technical regulations) nor prior case law can be used as a basis "to suggest that the identity of the hunter, the type of hunt, or the purpose of the hunt could be viewed as product characteristics."[76] Yet, these findings of the Appellate Body do not fully imply that non-product related PPMs-based measures fall out of the scope of the TBT. Indeed, the Appellate Body explicitly recognised that "the line between PPMs that fall, and those that do not fall, within the scope of the TBT Agreement raises important systemic issues" and refused to rule on the matter as "more argumentation by the participants and exploration in questioning would have been required."[77] Consequently, no clear statement can be delivered on the applicability of the TBT on PCRs.[78]

As mentioned before, if PCRs fall out of the scope of the TBT, they can be designed regardless of the requirements mentioned in this agreement. However, if PCRs fall within the scope of the TBT, they face the risk of being found incompatible with Article 2 of the TBT if they discriminate against imported products. We analyse this risk in the next section.

4.3.2 The national treatment principle (NTP)

We now turn to the question whether or not PCRs would stand the NTP Test. Both agreements contain similar wording, which requires that imported products are not treated less favourably than "like" domestic products (GATT Article III:4 and TBT Article 2.1). However, the WTO Dispute settlement Body (DSB) seems to apply the Nation Treatment Obligation slightly differently under the GATT and the TBT.

GATT Article III:4 rules out both *de facto* and *de jure* discrimination. TBT Article 2.1 also prohibits both kinds of discrimination. However, the DSB seems to interpret Article 2.1. of the TBT less restrictively with regard to *de facto* discriminations.[79] Where an origin neutral measure pursues a legitimate regulatory objective and where it is applied in an even-handed way, the DSB seems to consider that the measure does not violate Article 2.1. of the TBT.[80] Further requirements are then set by TBT Article 2.2, according to which a technical regulation shall not be more trade-restrictive than necessary to fulfil a legitimate objective.

4.3.2.1 Likeness

One key question under both the TBT and the GATT is the definition of products' likeness. Indeed, products that are not "like" can be subject to different legal requirement (different and "less favourable treatment," in the words of WTO law). It is only when imports and

[75] WTO, Appellate Body Report, *European Communities – Measures prohibiting the importation and marketing of seal products* (EC – Seal Products), 22 May 2014, WT/DS400/AB/R, WT/DS410/AB/R, paras. 5.41 to 5.45 and para. 5.58.

[76] *Ibid.,* para. 5.45. *See* also footnote 942.

[77] *Ibid.,* para. 5.69.

[78] Some scholars assume that PPMs-based measures, like emission-intensity requirements for products, are unlikely to be assimilated to technical regulations. This implies that PCRs could fall out of the scope of the TBT (*cf.* Bhala and Kennedy (1998) at p 127; Mathis (2006) at p 14.) See also the discussion in McDonald (2005) at p. 255. *See* also Ismer (2009) at pp. 48-49.

[79] *See* sections 3.2.3. and 3.2.4.

[80] See WTO, *United States – Clove Cigarettes – AB Report* (4 April 2012) WT/DS406/AB/R at para 182 and para 215 et seq. The legitimate character of a technical regulation was also discussed in the case *US – Tuna II (Mexico).*

domestic products are considered "like" that imports may not be treated less favourably than domestic products.

In the case of PCRs, any difference in treatment for both domestic and imported products is made based on the emission-intensity of the product. Unlike current legislation that set emissions standards calculated based on how much emissions are released during the *use* of certain products (e.g. emissions standards for certain types of vehicles), PCRs set emissions standards that are calculated based on how much emissions were released during the production of certain basic materials.

Such a requirement linked to the PPMs of basic products is controversial under the national treatment principle. Indeed, the legal scholarship is divided as to whether or not WTO members are allowed to distinguish between domestic and imported products based on non-product related PPMs, namely factors that are not directly related to the product and its physical features. While some authors consider that products' differentiation cannot be based on process and production methods under GATT article III,[81] others seem to suggest that GATT article III should be read so as to allow such form of differentiation as long as the objective is not a protectionist one (aims-and-effect test).[82] If differentiation based on non-product related PPMs is not permitted under the GATT and the TBT, PCRs would most likely be found in violation of the national treatment principle because it would be presumed to be less favourable vis-à-vis imported products.

Case law does not help draw a clear line in this debate. Some earlier cases seem to support the view that the national treatment principle allows for distinctions based on PPMs.[83] By contrast, latter decisions of the WTO Dispute Settlement Body may indicate the opposite.[84] Nevertheless, case law also suggests that the dispute settlement body might consider elements that are not directly related to products' physical characteristics to assess whether two products are "like" products. In the case EC- Asbestos, the Appellate Body analysed whether a regulatory ban aimed at reducing health risks linked to asbestos was incompatible with GATT article III:4.[85] The Appellate Body did not find a violation, which could support the view that the GATT does not prevent the adoption of regulations differentiating between products based on legitimate regulatory objectives.[86] In justifying its decision, the Appellate Body referred not just to the "physical properties" but also to "consumers' tastes and habits" of chrysotile asbestos fibres compared to PCG fibres.

[81] *See,* e.g., Schön (2004) at p. 289; Conrad (2011) at pp 487-488. See also Matsushita et al. (2006) at pp 240 et seq.

[82] *See,* e.g., Lydgate (2011) at p. 185 ("In fact, the AB seemed to employ the same 'subjective' approach to consumers that it had so clearly rejected both in *Japan-Alcohol* and *EC-Asbestos* itself. This temptation to use consumer preferences as a stand-in for discretionary action, may recur in disputes that concern public policy regulations"); Regan (2002).

[83] GATT, Panel Report, *United States – Measures affecting alcoholic and malt beverages* (US – Malt Beverages), 19 June 1992, paras. 5.24-5.25, which introduced the so-called "aim-and-effect" test. In para. 5.25, the Panel stated as follows: "The purpose of Article III is thus not to prevent contracting parties from using their fiscal and regulatory powers for purposes other than to afford protection to domestic production. Specifically, the purpose of Article III is not to prevent contracting parties from differentiating between different product categories for policy purposes unrelated to the protection of domestic production. The Panel considered that the limited purpose of Article III has to be taken into account in interpreting the term "like products" in this Article. Consequently, in determining whether two products subject to different treatment are like products, it is necessary to consider whether such product differentiation is being made "so as to afford protection to domestic production"…."

[84] *See* WTO Appellate Body Report, *Japan – Taxes on Alcoholic Beverages* (Japan –Alcoholic Beverages II), 4 October 1996, WT/DS8/AB/R, WT/DS10/AB/R, WT/DS11/AB/R.

[85] WTO, Appellate Body Report, *EC – Asbestos.*

[86] *Ibid.,* para. 113.

While the Asbestos case does not provide explicit support to differentiations based on non-product related PPMs under WTO law, it suggests that properties – whether product or non-product related – can impact likeness if they impact the relevant market as demonstrated by consumers' tastes and habits.[87] The Appellate Body clearly stated that "[u]nder Article III:4, evidence relating to health risks may be relevant in assessing the competitive relationship in the marketplace between allegedly "like" products."[88] It further said that "evidence about the extent to which products can serve the same end-uses, and the extent to which consumers are – or would be – willing to choose one product instead of another to perform those end-uses, is highly relevant evidence in assessing the "likeness" of those products under Article III:4 of the GATT 1994."[89]

Against this background, one could argue that high and low-carbon materials must not be considered as "like" products as they serve different markets. The argument would go as follows: within the last years, consumers and investors have become more and more interested in their environmental footprint and adapted their consumption decision so as to minimize their environmental impact. As such, the embedded GHG emissions in products are one parameter against which consumption and investment decisions are taken. Consumers choose "environmentally friendly" products over high-carbon products. Products' carbon footprint help differentiate between "near carbon neutral" and "carbon intensive" products. As such, the carbon footprint of products does affect tastes and habits. Consequently, high- and low-carbon products cannot be considered like products.[90] Based on this argument, Members to the Agreement would be able to implement policies, such as PCRs, that treat differently low and high-carbon products.

4.3.2.2 Less favourable treatment

If products are considered not "like," then national policy may treat products differently without running afoul of WTO Law. However, if products are considered "like," then imported products may not be treated less favourably than "like" domestic products. Hence, we turn to the question, weather there is a less favourable treatment of "like"

[87] *Ibid.* On this case, *see* Lydgate (2011), *supra* n. **Error! Bookmark not defined.**, pp. 176-180. *See,* also, Appellate Body Report, *US-Clove Cigarettes*, para. 119: "…the regulatory concerns underlying a measure, such as the health risks associated with a given product, may be relevant to an analysis of the 'likeness' criteria under Article III:4 of the GATT 1994, as well as under Article 2.1 of the TBT Agreement, to the extent they have an impact on the competitive relationship between and among the products concerned."

[88] This statement was delivered by the Appellate Body on the discussion whether any differentiation based on the health risk between products would render GATT Article XX meaningless (see WTO, Appellate Body Report, *EC – Asbestos, a*t para 115).

[89] *Ibid* at para 117.

[90] Evidence for the relevance of carbon embodied in products for consumers and investors is illustrated for (i) construction materials like cement and steel (ii) green electricity (iii) corporate reporting on carbon intensity of electricity and other input factors.

(i) Leadership in Energy and Environmental Design (LEED) is globally the most widespread building labeling system, and includes, since version four, the carbon footprint of building materials into rating criteria (Gelowitz and McArthur, 2016). Studies assess the impact of LEED certification on market value and rental premiums typically in the order of 10% (Mangialardo et al., 2018). Environmental Product Declarations are used to determine the carbon footprint, in Europe based on common Product Category Rules from the European Committee for Standardization (EN 15804 - https://www.cen.eu/Pages/default.aspx).

(ii) Stigka et al. (2014) find that consumers are willing to pay up to 16.6% extra for green electricity and Sundt and Rehdanz (2015) find that consumers are on average willing to pay a premium of about EUR 12 per household per month for electricity from a higher share of renewable energy sources.

(iii) The Task Force on Climate-related Financial Disclosure (TCFD) of the Financial Stability Board (Carney, 2017) recommended that firms disclose not only direct greenhouse gas emissions (Scope 1), but also electricity input related emissions (Scope 2), and, if appropriate, emissions along the value chain including from embodied carbon in inputs (Scope 3). Given that the TCFD limited reporting requirements to relevant information (so called materiality), this suggest that Scope 3 emissions are relevant for investors. This is reflected in Scope 3 reporting by firms, gathered in data basis for investors like for example for 3600 firms by CDP (www.cdp.net).

products (GATT Article III:4 and TBT Article 2.1). Both provisions prohibit *de jure* discrimination. This refers to measures that differentiate based on the origin of the product. Such a different treatment would be ruled out under PCRs. Indeed, these climate measures would apply indistinctively to both domestic and imported products, regardless of the origin of the products. Hence, there would not be *de jure* discrimination under this scheme.

Both provisions also prohibit *de facto* discriminations, namely when a formally neutral measure unfolds more restrictive effects on imports than on domestic products.[91] In the context of PCRs, such *de facto* discrimination could arise if climate requirements mostly affect imported products; accordingly, where the measure predominantly applies to imported products whereas domestic products are hardly affected by it. Moreover, *de facto* discrimination could stem from administrative requirements imposed on imported products.[92] This point could possibly be problematic for PCRs if their implementation impose higher compliance costs on importers than on domestic producers. For example, importers might face difficulties in providing the required information regarding the emission-intensity or production technology that was deployed during the production of input materials. Importers could then face high costs in obtaining this information, which would not have to be borne if the intermediary or final product are fully produced within the EU. Consequently, the importation of such products would be potentially disfavoured. Policymakers should ensure that they keep these costs to a minimum and also ensure that they do not require pieces of information from importers that are not necessary to fulfil the climate objective of PCRs (*see also* section 3.3.2).[93]

In the next sections, we analyse in more details the tests applied under the GATT and the TBT. Since they are slightly different, we analyse them separately.

c) Under the GATT

The DSB assesses *de facto* discrimination by analysing whether the disputed measure "modifies the conditions of competition" in the market to the disadvantage of imported products.[94] Therefore, it is important to design PCRs such that domestic and imported products are subject to "equal competitive conditions."

There are two situations where this requirement to provide "equal competitive conditions" could possibly be violated. First, in the hypothesis that high-carbon and low-carbon products are considered "like" products, PCRs would necessarily be problematic because

[91] See e.g. Matsushita et al. (2006) at p 253. See also the discussion on *de facto* discrimination in Ehring (2002).

[92] In the case *US-COOL* that dealt with certificates of origin, the Appellate Body held that "the recordkeeping and verification requirements impose a disproportionate burden on upstream producers and processors," in particular, because the information delivered to the final consumers was "far less detailed and accurate than the information required to be tracked and transmitted by producers"(AB, US – Cool para 349). Further, it created higher compliance costs for imports than costs to situations where only domestic livestock had been used. Combining its argumentation, the Appellate Body considered that the scheme was not designed to pursue a legitimate objective and was rendered incompatible with Article 2.2 (ibid paras 342-350). This judgement does not rule out certificates of origin on the emission-intensity or production technology deployed per se. However, it requires that recordkeeping is limited to a minimum.

[93] In contrast to the US – COOL case, an emissions certificate as part of PCRs would not be contrary to the legitimate objective but rather necessary to fulfil it. Therefore, it could be argued that the scheme is in line with the NTR under TBT Article 2.1.

[94] WTO, Appellate Body Report, *European Communities – Regime for the Importation, Sale and Distribution of Bananas (EC – Bananas III),* 9 September 1997, WT/DS27/AB/R, para. 213; WTO, Panel Report, *Korea – Measures Affecting Imports of Fresh, Chilled and Frozen Beef (Korea – Various Measures on Beef),* WT/DS161/R, paras. 629-639; Appellate Body Report, WT/DS161/AB, para. 144; WTO, Report of the Panel, *Turkey – Measures affecting the importation of rice (Turkey – Rice),* 21 September 207, WT/DS334/R, paras. 7.227-7.240.

"like" products would be treated differently. Second, where high-carbon and low-carbon products are not considered as "like" products, discrimination could stem from administrative procedures that put a higher burden on imports than on domestic products (de facto discrimination, as explained above). If the Dispute Settlement Body concludes on a less favourable treatment, PCRs will be incompatible with WTO Law unless justified under GATT Article XX.

d) Under the TBT

Just like under GATT Article III:4, *de jure* discrimination is prohibited under TBT Article 2.1.[95] However, the analysis undertaken under the TBT seems to be slightly different: the national treatment principle is interpreted as "not prohibiting detrimental impact on imports that stems exclusively from a legitimate regulatory distinction."[96] To make this analysis, the DSB takes into account the design, architecture, revealing structure, operation, and the application of the measure to imports.[97] Moreover, the "even-handedness" of the measure plays an important role in assessing whether there is a violation of TBT Article 2.1.[98]

Consequently, any origin neutral measure that in principle would be considered as *de facto* discriminatory under the GATT could still stand the national treatment test under the TBT.[99] For example, the Appellate Body held in *US – Clove Cigarettes* that "where the technical regulation at issue does not *de jure* discriminate against imports, the existence of a detrimental impact on competitive opportunities for the group of imported vis-à-vis the group of domestic like products is not dispositive of less favourable treatment under Article 2.1."[100] This, however, requires that the difference in treatment stems from a legitimate objective (rather than "reflecting discrimination against the group of imported products") and that the measure at issue is applied in an even-handed way.[101] The condition of "even-handedness" must be understood so as to mean that a measure credibly aligns with the regulatory objective and that the measure is "calibrated" accordingly.[102]

Nevertheless, the allegedly less restrictive interpretation of the national treatment principle under the TBT does not mean that the requirements under the TBT as a whole are looser than under the GATT as a whole. Indeed, Article 2.2 of the TBT also requires WTO

[95] *See,* e.g., WTO, *United States – Clove Cigarettes – AB Report* at para 182 and para 223 et seq.

[96] WTO, *United States – Measures affecting the production and sale of clove cigarettes,* 4 April 2012, WT/DS4006/AB/R, para. 181. *See* also AB, US Cool, para 293. *Contra* Mehling et al. (2019) at p. 462. Their interpretation of GATT Article III:4 is similar to the interpretation of article 2 of the TBT.

[97] *Ibid.* ***

[98] *See,* e.g., WTO, *United States – Clove Cigarettes – AB Report* at para 182 and para 223 et seq. *See* also AB, *EC – Seal Products,* paras. 5.117 and 5.125, where the AB clearly distinguishes between the test applied under GATT III:4 and the TBT with regard to regulatory purposes. *See* also AB, US Cool, paras. 341 et seq. on the even-handedness test.

[99] On the comparison between the test under GATT article III:4 and 2.1. of the TBT, *see* WTO, *United States – Measures affecting the production and sale of clove cigarettes,* 4 April 2012, WT/DS4006/AB/R, paras. 176-182. See also AB, US Cool, para 286.

[100] See WTO, *United States – Clove Cigarettes – AB Report* (4 April 2012) WT/DS406/AB/R at para 182.

[101] AB, *US – Clove Ciagrettes,* para. 182 and para. 215. *See* also para. 95. Even-handedness means nothing more that the measure is origin-neutral; accordingly, that it applies both to imports and domestic product.

[102] For example, in US – Tuna II, the Appellate Body found a lack of credibility in the US measure. While the Dolphin-Safe Label took into consideration the fishing methods in the Eastern Tropical Pacific, it did not "address mortality (observed or unobserved) arising from fishing methods other than setting on dolphins outside the Eastern Tropical Pacific" US – Tuna II (Mexico), para 297. See also Panel Reports, US – Tuna II (Mexico) (Article 21.5 – US), para. 7.116. The requirement of "even-handedness" can also be found in DSB cases on Article XX GATT. There is means that a measure on imports must go hand in hand with measures on domestic production. See WTO, *China — Measures Related to the Exportation of Rare Earths, Tungsten and Molybdenum – Report of the Appellate Body* (20 May 2015) WT/DS431/AB/R, WT/DS432/AB/R, WT/DS433/AB/R at para 5.131. See also Van den Bossche and Zdouc (2017) at pp 577 et seq.

members to design their technical regulation so as not to create unnecessary obstacles to international trade (TBT Article 2.2 first sentence).[103] A measure is deemed to be an unnecessary obstacle to trade if is it is more trade-restrictive than necessary to fulfil a legitimate objective (TBT Article 2.2 second sentence).

If we apply the national treatment principle to PCRs, it seems reasonable to argue that they stem from a legitimate regulatory distinction. Indeed, PCRs are aimed at distinguishing between (a) basic materials and manufactured products that have been produced in a way that significantly contributed to climate change and (b) basic materials and manufactured products that have been produced in a way that does not contribute to climate change to the same extent.

In order to make sure that the measure is considered "even-handed" or "calibrated," PCRs should be designed in such a way that they "make sense" in the light of their policy objective of mitigating climate change. Therefore, it might be worth reflecting on the level of the emissions standards that is considered "acceptable" and on the policy rationale underlying the choice for the threshold. Countries could choose to base the emissions standards on "best available technology" or on the "best average worldwide level" or on any other factors.[104] In doing so, countries should consider how their choice of emission levels affect the effectiveness of PCRs so as not to rule out their regulatory purpose. Moreover, considering the requirement of article 2.2. of the TBT, countries should be able to explain why PCRs are the least trade-restrictive, reasonably available measure, they can use in order to achieve their policy objective.[105]

4.3.3 Design issues

This section provide guidance on the design of PCRs' features so as to lower the risks that they would be found incompatible with WTO law. Guidance on the design of PCRs are given primarily by the TBT, which lays down a list of requirements – besides the national treatment principle – that must be considered when drafting technical regulations. This section draws the attention to the following elements: the role of international climate standards and the use of a precautionary approach (3.3.1.), the need to draft administrative requirements that apply to importers in the least burdensome possible way (3.3.2.), as well as the requirement to notify the measure under the TBT (3.3.3.).

4.3.3.1 Reference to international standards

Where possible and available, PCRs should be based on relevant international standards (TBT Article 2.4). If so, the TBT rewards members with the rebuttable presumption that such technical regulations do not create unnecessary obstacles to trade provided that the technical regulation is used for environmental protection (TBT Article. 2.5 and Article 2.2). Two main arguments can be brought forward for the use of international standards. First, they reduce transaction costs and, as such, are beneficial to international trade.[106] Second, cooperation at international level reduces the risk of lobbying for specific national advantages, such that the rent-seeking behaviour of such groups can be limited.[107]

While the term "standard" is defined in Annex I to the TBT, the term "international standard" is not defined.[108] However, the DSB developed its own definition. Two

[103] See Howse and Levy (2013) at pp. 349-350.

[104] Note that this point could also influence the analysis under GATT article XX in case of a violation of GATT article III:4.

[105] Although, in case of a dispute, the burden of proof would initially rely on the complaining party.

[106] Matsushita et al. (2006) at p 487.

[107] See e.g. Sykes (2000); Matsushita et al. (2006) at pp 486 et seq.

[108] AB Report, US – Tuna II (Mexico), para 350

requirements must be met. First, an international standard must meet the definition of a standard under § 1.2 of Annex I to the TBT. According to this, a standard is a "[d]ocument approved by a recognized body, which provides, for common and repeated use, rules, guidelines or characteristics for products or related processes and production methods, with which compliance is not mandatory". Second, the standard must be developed by a recognized international standardization body.[109] A "recognized body" under the TBT does not have one particular meaning but relates either to the acknowledgement of its existence or to an acknowledgement of its validity.[110] However, to qualify as "recognized body," the meetings must be open to all members of the WTO (§ 4 of Annex I to the TBT).[111] By contrast, it is not required that an international standard is approved by consensus.[112]

As there are no "international climate emissions standards," these provisions are not fully relevant for a proposal like PCRs. However, these rules indicate that countries that wish to adopt PCRs should invite all other members to discuss the level of emission intensity for PPMs used to define PCRs. Such invitations to reach an agreement at the international level could also have a positive impact on the legal analysis undertaken under the GATT. Previous case law indicates that international cooperation can affect whether or not the measure violates the GATT and, if so, be justified under GATT article XX.[113]

4.3.3.2 No burdensome administrative requirements imposed on importers

If conformity assessment procedures are established to implement PCRs, they shall meet the requirements of the TBT.[114]

According to the TBT, these procedures must be prepared, adopted, and applied so as to grant access for suppliers of like products originating in the territories of other WTO members under conditions no less favourable than those accorded to suppliers of like products of national origin or originating in any other country, in a comparable situation (TBT Article 5.1.1). Further, conformity assessment procedures must be designed so as not to create an unnecessary obstacle to trade.[115] This means that they should not be stricter or applied more strictly than necessary (TBT Article 5.1.2). They shall also align with relevant guidelines or recommendations issued by international standardizing bodies for assessment procedures (TBT Article 5.4). Where such harmonized procedures do not exist, states shall support international standardization bodies to develop such procedures (TBT Article 5.5). Similar to the setting of technical regulations, PCR regulators should accept conformity assessment procedures of other states if these differ from their own but are equivalent (TBT Article 6.1).

[109] AB Report, US – Tuna II (Mexico), para 354-356.

[110] AB Report, US – Tuna II (Mexico), para 361-362

[111] AB Report, US – Tuna II (Mexico), para 398.

[112] AB, EC – Sardines, at paras 225-227.

[113] See AB Report, US - Shrimp, para. 172. The duty to enter into bilateral or multilateral agreements is discussed by De Schutter in the general context of human rights. He also makes a reference to the Shrimp/Turtle case (UN, Human Rights Council, Working Group on the Right to Development, Report of Olivier De Schutter on "The international dimensions of the right to development: a fresh start toward improving accountability," 22 January 2018, A/HRC/WG.2/19/CRP.1, para. 40.

[114] Conformity assessment procedure are defined in the TBT (Annex 1) as "any procedure used, directly or indirectly, to determine that relevant requirements in technical regulations or standards are fulfilled". *See* also Panel, Russia – Railway Equipment, para 7.249.

[115] See Panel, EC – Seal, para 7.418-7.419.

4.3.3.3 Notification and acceptance requirement in the absence of international standards as well as conformity assessment procedures

As already mentioned, PCRs should be based on international standards, if existent. Where an international standard does not exist, the regulating state shall publish its intention to implement a technical regulation at an early stage (TBT Article 2.9.1.). This shall include the objective and the rationale of the measure at stake as well as the products covered (TBT Article 2.9.2). Further, the regulating state shall allow other states to comment on the technical regulation and take these discussions into account (TBT Article 2.9.4). At the end of the drafting stage, the technical regulation is to be published (TBT Article 2.11). In any event, the regulating state shall give reasonable time to allow producers of other states to adapt their products or their method of production to the technical regulation (TBT Article 2.12).

Similar rules apply for conformity assessment procedures that are not based on international guidelines. In this case, the regulating state has to publish its intended procedures, must inform about the product scope, and take into account comments made by other states (TBT Article 5.6.1 to 5.6.5). In any event, the regulating state shall give reasonable time to allow producers of other states to adapt their products or their method of production to the conformity assessment requirements (TBT Article 5.9).

4.4 Conclusion

This paper explores the possibility for countries to ban the sale of carbon-intensive materials by means of PCRs. First, we analyse various product standards and technical regulations in the European context. This analysis provides an overview of the types of measures that can be implemented: from product requirements (e.g. energy efficiency of lightbulbs as part of the Ecodesign Directive) to requirements that relate to non-product related PPMs (e.g. the sustainability of biofuels production and timber products). Our analysis of the administrative approaches chosen for the biofuel certification and the EU Timber Regulation highlights how compliance mechanisms for process related requirements could be implemented.

With respect to the legal feasibility, we analyse PCRs under both the GATT and the TBT. Our analysis highlights that the agreement on technical barriers to trade (TBT) would apply to PCRs only if the emission-intensity of basic materials is considered as a technical regulation; in this case the measure would have to comply with the national treatment principle and should be notified to the WTO. Under the GATT, the relevant provisions are Article III:4 and/or Article XI:1; in case of a violation of one of these two provisions, there is still the option of justification under GATT Article XX.

The national treatment principle under GATT and the TBT both require not to discriminate against “like” imported product; thus, the main issue is whether low and high carbon products would be considered “like” products. Our analysis shows that the evidence that consumers are – or would be – willing to choose one product instead of another could be highly relevant in assessing the "likeness" of those products. Such evidence of the choice of consumers and investors seems to exist for building materials, electricity, and other input factors to production process.

Therefore, we argue that WTO law would not be an obstacle to the adoption of PCRs, provided they are designed and adopted in a manner consistent with the main legal tests described above. For this, the measure should be designed in a way that does not discriminate against imports (e.g. administrative requirements should not be excessively burdensome for imported products) and it is recommended to favour international cooperation where possible (e.g. international standardisation bodies may help to foster acceptance and streamline compliance mechanisms).

Other environmental product requirements have already been implemented and are politically accepted. They have not been challenged under WTO. However, there is inevitably still some uncertainty regarding the interpretation of some of the relevant WTO provisions given that no ex-ante clearing process is exists. A high likelihood of a successful implementation of PCRs will already be relevant for the decision making process of firms with regard to their innovation and investment strategy, which aims to secure their business model (licence to operate). Thus, governments might well decide to implement PCRs to accelerate the pace of the industrial transition toward climate-friendly production processes.

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5 Overview about selected government programs for supporting climate or energy innovation in industry, in Germany, Italy and the United Kingdom

This section elaborates on our response to the ad-hoc support requested by DG CLIMA, involving several critical issues that required further investigation. The answers are provided in this document, as far as available and applicable, based on the questionnaire included below, for the following programs (as suggested by CLIMA/C3):

- Contratti di Sviluppo per la Tutela Ambientale (Italy) -> the industrial branch
- Fondo Nationale per L’Innovazione – Brevetti e Modelli (Itlay)
- Industry Energy Accelerator (UK)
- Förderung von energieeffizienten und klimaschonenden Produktionsprozessen (BMWi) (Germany)
- KfW-Konsortialkredit Energie und Umwelt (BMBF) (Germany)

List of questions requested by CLIMA:

- Eligibility criteria in general
- Minimum project size
- How long do projects usually last? Does the programme impose a maximum duration time upon projects?
- Is readiness to demonstrate first results used as an eligibility criteria?
- When is the money provided (upfront, based on milestones, at the end)? If milestones, how are milestones determined? What % of money is provided per milestone?
- Eligibility criteria: Do they include GHG emissions reduction targets? If yes, how are they calculated/accounted for?
- What is the maximum lead time between getting the confirmation that a project is financially supported, and when it will start being operated?
- What eligible costs are covered: CAPEX, OPEX, or both?
- Do they have a high subscription rate? What do they do if they don’t have enough applicants?
- How many selection stages? How do people apply?
- Are applications accepted on a rolling basis or is there a selection/opportunity window?
- Who is responsible for the selection of applications? Are selection criteria weighted? If yes, how?
- If they have tenders, how often do they publish calls? And how long do the calls last?
- What is the annual budget?
- Aid intensity
- How are project funding levels determined?
- Administrative cost of running the scheme?
- Results so far, in terms of market penetration of technologies?
- Did they have instances of unspent funds (and why?) or issues with projects not taking off? If yes, what did they do?
- For equity/debt financing:
  - % of money committed to equity and/or debt financing
  - Amounts distributed to date to equity/debt financing
  - What are the default rate expectations?
- In case of loan guarantees:
  - what is the range for the loss coverage?/ What is the amount % of public money in the first loss piece coverage?

I. Contratti di Sviluppo per la Tutela Ambientale

1. Eligibility criteria in general

The program targets companies, belonging to energy-intensive sectors or that are energy-intensive themselves, that want to realize investments for the reduction of energetic consumption and of GHG emissions. The entities which can participate to the program are energy-intensive companies: producers of materials such as steel, cement, ceramic, glass, and other materials, as well as companies belonging to the *aerospace* industry. A specific list of production activities is identified as target of the program.

The investments shall be realized in the regions of Basilicata, Campania, Calabria, Puglia and/or Sicilia.

The program (Development Contracts for Environmental Protection) is a special edition of the broader category (Development Contracts).

2. Minimum project size

The minimum project size is € 20 m (€ 7.5 m for production activities related to agricultural products).

3. How long do projects usually last? Does the programme impose a maximum duration time upon projects?

a) Big industrial development projects (min € 50 m) can have a duration longer than 36 months, determined in the contract according to project-specific requirements.

b) Fast-track: Projects that follow a fast track (receive the funds within 90 days from the approval of the project), must complete the project within 36 months. The Fast-tracks can be chosen for every type of project.

4. Is readiness to demonstrate first results used as an eligibility criteria?

No.

5. When is the money provided (upfront, based on milestones, at the end)? If milestones, how are milestones determined? What % of money is provided per milestone?

The money can be provided upfront by 30% (max), after 6 months an interim report has to be provided to Invitalia (manager of the program), the successive waves of fund will not be lower than 20% of the total approved sum, but only after interim work in progress reports are provided. The interim milestones can vary according to the projects but cannot be more than 5.

In the case of low interest financing, the funds received from Invitalia are to be reimbursed after the completion of the project in equal tranches every 6 months for a predetermined number of years.

6. Eligibility criteria: Do they include GHG emissions reduction targets? If yes, how are they calculated/accounted for?

To be eligible the projects must be activities expressly for the a) reduction of the environmental impact of production activities, in order to comply with EU regulations or b) also in absence of specific regulations, c) adaptation to coming EU limits that are not in force yet, d) improvement of energy efficiency levels, e) realization of efficient production processes, f) recycle/reuse of waste from production.

The environmental improvement measurement methodology and evaluation criteria are proposed from applicants in the project proposal.

7. What is the maximum lead time between getting the confirmation that a project is financially supported, and when it will start being operated?

The lead time was 120 days in the 1st round of the program, and can be 90 days in the (current) 2nd round.

8. What eligible costs are covered: CAPEX, OPEX, or both?

The eligible costs are consultancy services for the realization of the investment project, capital expenditures related to the acquisition of the land, industrial buildings and plants necessary for the realization of the project, machineries and installations, as well as intangible assets (software, patents, know-how etc). These costs are covered through grants for capital expenditures.

However, beyond capital expenditures, also operating costs can be covered through grants, as well as there are facilitated debt financing instruments such as low-interest credit financing and grants repaying the negative interests of the loans for the financing of the project.

9. Do they have a high subscription rate? What do they do if they don't have enough applicants?

Since the program "Development Contracts for Environmental Protection" has started only in 2017, we can report the broadest figures that refer to the general category "Development Contracts":

- number of applications for the broad category "contracts for development": 633 (240 for industry);

- finalized contracts within the general category "contracts for development": 105 (60 for industry).

10. How many selection stages? How do people apply?

Companies can apply online through the website of Invitalia, manager of the program. Invitalia is the Italian national agency responsible for the attraction of investments and firms development, under the ownership of the Italian Ministry of Economic Development.

11. Are applications accepted on a rolling basis or is there a selection/opportunity window?

Applications are accepted on a rolling basis.

The funds are available on a first come first served basis.

12. Who is responsible for the selection of applications? Are selection criteria weighted? If yes, how?

Invitalia, manager of the program, is responsible for the selection of the applications.

13. If they have tenders, how often do they publish calls? And how long do the calls last?

The program Development Contracts has been open from 2011 to 2014 (first round) and since June 2015. The subcategory Development Contracts for Environmental Protection is open since April 2017.

14. What is the annual budget?

The overall budget for the “contracts for development - environmental protection” is € 100 m.

15. Aid intensity

The size of the incentives depends on the type of project, the location and the size of the enterprise.

Project type	Small enterprises	Medium enterprises	Big enterprises
a) and b)	75-60%	65-50%	55-40%
c)	35-15%	30-10%	25-5%
d)	65-50%	55-40%	55-30%
e)	80-65%	70-55%	60-45%
f)	70-55%	60-45%	50-35%

Big enterprises will receive the 50% of expenditures eligible to receive grants.

With regards to debt financing the maximum share of project that can be supported through public funds is 75%.

The financial incentives are available in the form of grants for expenditures, grants for expenses, low-interest credit financing, grants repaying the negative interests of the loans for the financing of the project.

16. How are project funding levels determined?

Funding levels are determined on the basis of the project, location and size of the enterprise.

17. Administrative cost of running the scheme?

N. A.

18. Results so far, in terms of market penetration of technologies?

N. A.

19. Did they have instances of unspent funds (and why?) or issues with projects not taking off? If yes, what did they do?

To increase the attractiveness of the program, a Fast-track for application and funding has been introduced. Furthermore, also a second preferential track has been set for large-size development projects. Both measures have been introduced in 2016.

For equity/debt financing:

20. % of money committed to equity and/or debt financing

Since the program “Development Contracts for Environmental Protection” has started only in 2017, we can report the broadest figures that refer to the general category “Development Contracts”. Looking at the funds committed to large-size development projects (min € 50 m), we have identified:

- around € 229 m falling in the overall category of “contracts for developments”;

- and € 100 m for the category of “contracts for development – environmental protection”.

21. Amounts distributed to date to equity/debt financing

Until November 2017,

- the total activated investments (broad category “contracts for development”) is € 3.669 m;

- the amount of facilitated funding (broad category “contracts for development”) is € 1.882 m.

22. What are the default rate expectations?

N. A.

II. Fondo Nazionale Innovazione – Marchi e Brevetti

The Fondo Nazionale Innovazione (FNI) adopts two instruments for the enhancement of innovation in the latest TRLs:

- Equity financing (FNI-E)
- Debt financing (FNI-D) through the provision of collaterals (ended in 2014 because unsuccessful)

1. Eligibility criteria in general

Eligible entities are micro-, small- and medium- sized enterprises, which operate in any economic sector apart from the coal industry.

In the case of FNI-E, applicable projects must involve the realization and commercialization of *licensed patents*. The applicant company shall detain the ownership of the license or the right to use the license.

In the case of FNI-D, applicable projects must involve the realization and commercialization of *patents, designs and industrial models*. The aim of the program is the introduction on the market of new products/services or increase the innovative content of the pre-existing ones. The applicant company shall detain the ownership of the license or the right to use the licensed patent, design or industrial model. The projects that already receive debt financing from the commercial banks involved in the program are not eligible.

Projects that have already started are not eligible to funding.

2. Minimum project size

N. A.

3. How long do projects usually last? Does the programmme impose a maximum duration time upon projects?

In the case of FNI-E, the duration of the investment depends on the exit strategy foreseen for the project from the financial intermediary selected for the management of the financial operation, but it cannot exceed 10 years.

In the case of FNI-D, the total duration of the financing project, including its pre-depreciation of maximum 24 months, can be between 36 months and 120 months.

4. Is readiness to demonstrate first results used as an eligibility criteria?

In case of FNI-E, the innovations must be already patented in order for the projects to be financed.

In the case of FIN-D, the innovations shall be patented or it is sufficient that a demand for patenting has been presented to the relevant authority.

5. When is the money provided (upfront, based on milestones, at the end)? If milestones, how are milestones determined? What % of money is provided per milestone?

In the case of FNI-D, upfront 40% of financing is provided once the contract is signed, a further 40% is provided upfront the start of the project, and once the investments are completed the remaining 20% is provided.

6. Eligibility criteria: Do they include GHG emissions reduction targets? If yes, how are they calculated/accounted for?

N. A.

7. What is the maximum lead time between getting the confirmation that a project is financially supported, and when it will start being operated?

N. A.

8. What eligible costs are covered: CAPEX, OPEX, or both?

In the case of FNI-D, eligible costs are material and immaterial investments (such as the creation of a new production plant, the extension of a pre-existing one, the diversification of production through the addition of new products, the structural transformation of a productive process of a preexisting production plant) and external consulting services with ad hoc and non-operational nature whose cost does not exceed the 50% of total admissible costs.

9. Do they have a high subscription rate? What do they do if they don’t have enough applicants?
10. How many selection stages? How do people apply?

In the case of FNI-D, companies can present their applications to the commercial banks involved in the program (see Q12). The banks value the profitability of the patent and the financial creditworthiness of the applicants.

11. Are applications accepted on a rolling basis or is there a selection/opportunity window?

The funds have been available on a continuous (first come first served) basis in the period 2010-2014.

12. Who is responsible for the selection of applications? Are selection criteria weighted? If yes, how?

The financial intermediaries who are responsible for the management of the program will be responsible for the selection of the applications on the basis of the criteria designed from the ministry. However, each will be responsible for the assessment of the applications that are directed to their financial credit institute only.

In the case of FNI-D they are: Deutsche Bank, Mediocredito Italiano, Unicredit.

In the case of FNI-E, Innogest SGR S.p.A is responsible for the management of the program. Innogest SGR S.p.A. is a private investor of risk capital, that shares with the government the ownership of the equity fund IPGEST. Nevertheless, the entity responsible for the selection of applications is a Technical Committee composed by seven members (three representing the Ministry of Economic Development, two representing the Ministry of Education, University and Research, and two representing the Permanent Conference for the Relationship between State and Regions).

Scoring criteria:
1) Legal and patent-related characteristics i.e. type, status and robustness of the patent against imitation risks (or opposition risks), infringement risk etc.;
2) Product-related characteristics i.e. successful testing of the technology, or otherwise evaluation of the planning scheme for the development and testing of the technology, adaptability of the potential user to the innovation, further costs for the development of the product, degree of innovativeness of the product;
3) expertise and skills of the team;
4) Market-enterprise interaction i.e. identification of the market for the innovation, the costs for the testing and development, as well as expectations on the possible positioning of the technology in the market.

13. If they have tenders, how often do they publish calls? And how long do the calls last?

14. What is the annual budget?

In the case of FNI-E the Italian Ministry for Economic Development has allocated € 20 m in a fund called IPGEST, co-funded with Innogest SGR S.p.A., for a total budget of € 40.9 m.

15. Aid intensity

In the case of FNI-E, the investment tranches cannot exceed € 1.5 m over a period of 12 months.

In the case of FNI-D, up to 100% of the eligible costs of a project can be financed for a maximum of € 3 m. The duration of the debt financing is between 36 and 120 months. The loans will be repaid together with an interest rate that can be either variable (computed on the basis of Euribor) or fixed (computed on the basis of Eurirs), plus a spread proportional to the riskiness of the project, and reduced by a discount that may be applicable on the basis of the evaluation of the patent.

16. How are project funding levels determined?

The projects funding levels are evaluated from the financial intermediaries on the basis of the application presented by the companies and the eligible costs to be financed.

17. Administrative cost of running the scheme?

N. A.

18. Results so far, in terms of market penetration of technologies?

N. A.

19. Did they have instances of unspent funds (and why?) or issues with projects not taking off? If yes, what did they do?

Yes, they closed FNI-D. In the case of FNI-E, VC logics apply.

For equity/debt financing:

20. % of money committed to equity and/or debt financing and/or guarantee:

In the case of FNI-E, the Italian Ministry for Economic Development has allocated € 20 m to the equity fund called IPGEST.

In the case of FNI-D, the Italian Ministry for Economic Development has committed € 39.1 m in the form of guarantee to leverage debt financing of c.a. € 375 m.

21. Amounts distributed to date to equity/debt financing

N. A.

22. What are the default rate expectations?

N. A.

In case of loan guarantees:

23. What is the range for the loss coverage?/ What is the amount % of public money in the first loss piece coverage?

In the case of FNI-D, the € 39.1 m provided by the Italian Ministry for Economic Development, represent also a guarantee that banks can retain to cover first losses.

III. Industrial Energy Efficiency Accelerator (UK)

1. Eligibility criteria in general

Open to all UK manufacturing sectors. High-and mid-energy intensity industries are eligible. Examples include but are not limited to: Pulp & Paper, Refining, Microelectronics, Chemicals Maltings, Plastics, Iron & Steel, Metal forming, Laundries, Paper & Pulp, Glass, Oil Refining, Ceramics, Cement, etc.

Open to private sector companies and universities. Public sector bodies are not eligible. Partnerships between developers of energy efficient technologies and industrial companies willing to test these technologies on-site are particularly targeted. Pairs of industry players and technology developers (headquarters can be outside UK).

Industrial company eligibility:
- Demonstration site location in the UK
- Likely high and medium energy intensity sectors

Technology developer eligibility:
- Technology Readiness Level 5 –8
- Not already demonstrated in the sector in the UK (but could already be applied internationally or in other sectors)

Projects from all industrial and manufacturing sectors will be considered so long as:
- The technology is novel[116] or
- The project aims to use commercial technology in a novel way and
- The result of the project will be a reduction in (or avoidance of) energy use and/carbon emissions

Areas that are out of scope include: Buildings or data center related technologies, On-grid electricity generation technologies and water utilities, On-site renewables[117], Carbon Capture & Storage (CCS), Big data / analytics (except for process optimization), Local authority projects (but note that local authorities can propose a UK site for technology implementation).

Eligibility criteria check:

A demonstration site has been secured in the UK
The BEIS grant requested by each partner is compliant with State Aid rules
All partners have secured sufficient matched funding
The technology is not commercial or is unproven within the given sector
Confirmation of acceptance of BEIS terms and conditions

[116] To count as being 'novel' a technology must either have never been commercialized before, or not have been commercialized in the UK.

[117] The generation of energy or heat as part of an industrial process (e.g. the use of waste heat) for use on-site is within program scope; general energy generation technologies will be assessed on a case-by-case basis.

2. Minimum project size

Projects will be awarded from £150,000 to £750,000, but there is scope for smaller or larger projects also.

3. How long do projects usually last? Does the programme impose a maximum duration time upon projects?

Projects will typically run for 12 to 18 months.

4. Is readiness to demonstrate first results used as an eligibility criteria?

When applying the technology must be ready to install. Otherwise, applicants shall wait until that is the case and then apply if there is funding remaining. Nevertheless it is not compulsory to submit the full application from the beginning: applicants can test the project with Carbon Trust (program leader) and they will provide guidance.

5. When is the money provided (upfront, based on milestones, at the end)? If milestones, how are milestones determined? What % of money is provided per milestone?

Money is provided on the basis of milestones. Funds from BEIS flow to successful project in line with the project plan and milestones as stipulated by the applicant.

In the application form, applicants assign stage gates to their projects, indicating the length of each work package, the related milestones and associated deliverables. Stage gates should have clear, quantified success criteria to allow an informed decision to be taken on whether to proceed with the project beyond the stage gate. The main objective is to de-risk the later stages of grant funding.

Typically projects are structured so that grant payments are made when pre-defined milestones are met. A progress report has to be redacted for each milestone. Grant payments are released once milestone reports are approved.

6. Eligibility criteria: Do they include GHG emissions reduction targets? If yes, how are they calculated/accounted for?

The competition targets innovations that can have the largest cross-sectoral impact on energy and carbon reduction. Specific GHG emissions reduction target are not included, however participants must indicate how much energy their technology / process change will save annually (i) per industrial process and (ii) per site. Both baseline and energy savings values for thermal and electrical energy consumption should be stated by applicants, and those estimates are accounted for in the selection process:

- Baseline Fuel* Consumption (kWh)
- Fuel Saving (kWh)
- Fuel Saving (%)
- Baseline electricity Energy Consumption (kWh)
- Electricity Energy Saving (kWh)
- Electricity Energy Saving (%)

7. What is the maximum lead time between getting the confirmation that a project is financially supported, and when it will start being operated?

The project start date should normally be within three months of receipt of the grant offer.

8. What eligible costs are covered: CAPEX, OPEX, or both?

Eligible Costs are: personnel costs, site preparation, travel and subsistence, capital items (any items above £1,000 per unit cost) and equipment, contractual research, sub-contracts, services, overheads, materials and consumables, and other operating expenses such as software licenses but must not include unallocated costs.

Non-covered Costs are: general costs, profit, bonuses, interest payments of any kind, dividend payments, loss of salaries or consultancy income, recoverable VAT.

9. Do they have a high subscription rate? What do they do if they don’t have enough applicants?

Applications are still open therefore it is not possible to identify the complete number of applicants yet. Until today, the Carbon Trust has received inquiries from around 100 organizations, several universities, and 1000 entrepreneurs, tech developers and industry players (small percentage).

In order to avoid the issue of not having enough applicants they have consulted exponents of the target sector and adjusted some features such as the applications timing. In this case, the deadline window has been extended since feedbacks have highlighted the issue that it is difficult to take financial decisions in short time.

10. How many selection stages? How do people apply?

People can apply online through a platform managed by Carbon Trust.

There are five selection stages:

1. Submission of Proposals to Carbon Trust
2. Assessment by Expert
3. Telephone Clarification Interview
4. Preliminary Award – negotiate work plan and budget
5. Contract with BEIS / Project kick-off

11. Are applications accepted on a rolling basis or is there a selection/opportunity window?

The competition is open on a rolling basis from October 2017 to September 2018 (or until funding exhausted). The application deadline is flexible but funding may be allocated already. Applications are reviewed periodically every two months or until funding is exhausted. Projects are evaluated and responses are provided to applicants within 4 weeks of receipt of the application.

12. Who is responsible for the selection of applications? Are selection criteria weighted? If yes, how?

An expert panel consisting of representatives from BEIS, the Carbon Trust and Jacobs is responsible for the review of applications following a series of bi-monthly interim competition deadlines.

Successful applications will come from project proposals that:

a) Demonstrate potential for significant energy (and CO_2) savings, from sector and/or cross-sector replicability;

b) Demonstrate potential to achieve technology commercialization relatively quickly;

c) Have a project team with the required skills and experience to deliver the project plan;

d) Represent value for money, with clearly identified sources of match-funding.

Scoring criteria:

Category	Weighting
Project and technical overview	20%
Potential impact	20%
Commercialisation prospects	20%
Project design and deliverability	25%
Project costs and finance	15%

13. If they have tenders, how often do they publish calls? And how long do the calls last?

The competition is open on a rolling basis from October 2017 to September 2018.

14. What is the annual budget?

A total of **£9.2m in co-funding** is be available through the program, between 2018 and 2021.

15. Aid intensity

Successful applicants should expect to receive between **40-60% of total** project cost, with IEEA contributions typically between **£150,000 and £750,000 per project** – the remainder to be provided by the applicant. There is scope for a small number of exceptional projects to receive more than £750,000.

Where appropriate, demonstrating sites and technology innovators will also receive **project de-risking and incubation support** to help them deploy projects, build a sales pipeline, and raise finance.

Project support (for industrial companies and technology developers):

• Detailed project planning

- Site deployment de-risking
- Ongoing project monitoring

Incubation support (only for technology developers):

- Bespoke incubation plan
- Prioritized support across areas such as sales & business development, strategy & business planning, funding, technology & intellectual property, etc.
- Support after the project e.g. business model refining, building sales pipeline, access to financing

Support for up to 6 months after the project: Skills strengthening, Business model refining, Marketing literature, Awareness raising, Building sales pipeline, Assess to financing.

At the end of the project a dissemination phase is undertaken to help widely share the experience and learnings gained through from each of the pilot demonstrations.

16. How are project funding levels determined?

Successful applicants should expect to receive between **40-60% of total** project cost, with IEEA contributions typically between **£150,000 and £750,000 per project** – the remainder to be provided by the applicant. There is scope for a small number of exceptional projects to receive more than £750,000.

The co-funding that can be received for each project complies with EU state aid guidance.

EU State Aid Guidance	Small Enterprise	Medium Enterprise	Large Enterprise
Industrial Research (earlier TRL)	70%	60%	50%
Industrial Research with collaboration uplift	80%	75%	65%
Experimental Development (later TRL)	45%	35%	25%
Experimental Development with collaboration uplift	60%	50%	40%

Funding intensity cap may be applied at the discretion of BEIS.
Actual funding intensity will be subject to perceived value of the project.

17. Administrative cost of running the scheme?

Administrative cost amounts to € 1.5 m (total cost € 9.2 m). The sum available is dedicated to administrative expenses, marketing and promotion expenses, support of the projects, monitoring of the projects, and projects' incubation (potential) support.

18. Results so far, in terms of market penetration of technologies?

Relevant Case Study: Low Temperature Asphalt (LTA) - New formulations of asphalt produced at lower temperatures.
Main Applicant: Lafarge Tarmac;
Partners: Nynas, Mineral Industry Research Organisation.
Technology description: The project developed a new approach to LTA mixes and demonstrated their in-situ performance on public roads as being equivalent to conventional hot asphalt;
Initial TRL: 8;
Final TRL: fully commercialized;
Demonstration Capital Cost: £680,000;
Funding received: £272,000 (40%);
Results: 14 local authorities within the West Midlands signed up to at least 20% LTA. The results from the project demonstrated that if LTA penetrated the UK market at an equal level to the USA (21%) over the next 10 years, this would result in CO2 savings of 259,000 tons.
Intellectual Property: Held with Lafarge Tarmac/Nynas.

19. Did they have instances of unspent funds (and why?) or issues with projects not taking off? If yes, what did they do?

The application window is still open.

How do they estimate the demand?

The demand is composed by two types of potential applicants:

- tech-developers (entrepreneurs)
- industry players

The first category is easy to embark. Tech-developers are having hard time to find access to industry. Therefore, IEEA is the instrument that can allow them to access to the sector.

The second category is hard to convince about the potential of the IEEA. Indeed, when it comes to industry there is aversion to risk due to 1) Brexit 2) general unwillingness to take risky projects (is the financial contribution that IEEA provides enough?).

In order to overcome the challenges mentioned, the Carbon Trust has been doing joint network marketing (marketing campaigns that reach industry and tech networks' partners). Specifically, to tackle the ignorance and reluctance of industry players, energy managers and CFOs are reached, with the aim to:

- educate them;
- show the potential for cost cutting;
- enlighten short-term and medium-term gains (starting a project is not necessarily a long-term strategic decision).

IV. Förderung von energieeffizienten und klimaschonenden Produktionsprozessen (Promotion of energy-efficient and climate-friendly production processes), BMWi - Germany

1. Eligibility criteria in general

Eligible are

a) Companies of the manufacturing industry with seat or branch in Germany, according to § 1 of the law on the statistics in the manufacturing industry with the exception of the energy supply.

b) Contractors, if they carry out the measures referred to in this Directive under a contracting contract with an applicant company.

Not eligible are

- Companies from agriculture and forestry, fisheries and the energy industry, the federal government, the federal states and their institutions,
- Undertakings which have not complied with a Commission recovery order for unlawful aid,
- Firms in difficulty within the meaning of the Community guidelines on State aid for the rescue and restructuring of firms in difficulty or within the meaning of Article 2 (18) of the General Block Exemption Regulation (AGVO),
- Applicants for whose assets' insolvency proceedings have been applied for or opened are not granted funding. The same applies to applicants and, if the applicant is a legal entity, to the owner of the legal entity who has submitted an affidavit pursuant to § 807 of the Code of Civil Procedure or § 284 of the Tax Code or is obliged to pay it.

In order to be admitted to the competition, in addition to the eligibility to apply and the other formal criteria, in particular the following conditions must be cumulatively fulfilled and proven:

- Additional investment costs of at least 50,000 euros,

- Specific final energy savings with the same production output as measured by the average consumption of the last three years of the considered plant / process of at least 5% and

- at least 100 kg CO2 savings per year in relation to 100 euros additional investment costs.

If no existing plant is replaced, the final energy and CO 2 savings shall be calculated in relation to a benchmark equivalent to the market average.

2. Minimum project size

The additional investment costs must amount to at least 50,000 euros. Maximum project size is 1.5 million euros.

3. How long do projects usually last? Does the program impose a maximum duration time upon projects?

The projects usually last 12 months to 18 months and the maximum duration time imposed upon projects in 2 years. However, some projects may take longer and under some circumstances the duration period are prolonged over two years.

4. Is readiness to demonstrate first results used as an eligibility criteria?

The program does not specifically target innovative technologies. Technological readiness is therefore used as a soft criteria rather than a strict one.

5. When is the money provided (upfront, based on milestones, at the end)? If milestones, how are milestones determined? What % of money is provided per milestone?

Money is provided after the expenses are incurred. In principle, the grant is paid upon receipt and verification of the proof of use and the following documents with the granting authority:

- Proof of operational readiness of the technical system and the energy meter, acceptance protocol,

- Proof of expenditure charged for the construction of the installation and for the energy meters,

- Confirmation by an energy consultant after commissioning that the measures described in the application have been carried out.

6. Eligibility criteria: Do they include GHG emissions reduction targets? If yes, how are they calculated/accounted for?

Yes. Proof of the final energy and CO2 savings as well as the improvement of energy efficiency in upstream or downstream production steps must be provided by an independent and qualified energy consultant or consultant according to VDI standard 3922.

Specifically, this support program seeks to save around 350,000 tons of CO2 and 5 primary energy cumulatively every year.

7. What is the maximum lead time between getting the confirmation that a project is financially supported, and when it will start being operated?

N.A.

8. What eligible costs are covered: CAPEX, OPEX, or both?

Eligible: The additional investment costs are eligible. The basis for the eligible expenditure is the total additional investment costs as well as the directly attributable capitalizable additional costs for planning and installation associated with the investment. Expenditure must be directly linked to the action, necessary and appropriate.

Non-eligible: Personnel costs, operating costs, duties and own contributions of the applicant and of the contractors.

9. Do they have a high subscription rate? What do they do if they don't have enough applicants?

No, generally the subscription rate is low. In fact, the correspondent from PTKA (implementing agency for BMWi) mentioned that in Germany there are not enough applicants for similar programs in general. That is, the program initially set-up as a competition, is instead able to fund all eligible applicants.

To encourage participation, BMWi and PTKA promote the funding scheme at conferences, workshops, and public campaign such as "Deutschland Macht's Effizient".

10. How many selection stages? How do people apply?

The selection of the projects to be supported takes place within the framework of a competition, which is carried out four times a year. However, the budget has always been sufficient and the number of funding applications not particularly high. Thus the program

In the context of the available resources, the measures aiming at maximizing the increase in energy efficiency and, as measured by the use of financial resources, the greatest possible reduction of CO2 emissions or other greenhouse gases effect. In addition, the replication potential and the presence of an energy management system play a role in the selection decision.

Support under this Directive excludes the use of public funds from other support programs of the European Union, the Federal Government and the States for the same expenditure. This does not apply to the use of a subsidized loan, provided that the sum of loans, subsidies or allowances does not exceed the sum of the expenses.

11. Are applications accepted on a rolling basis or is there a selection/opportunity window?

Applications can be submitted continuously. The evaluation of the applications and the subsequent approval is carried out on a quarterly basis by the granting authority. The subject of the valuation are the applications received by the relevant reporting date (as of: 31st March, 30th June, 30th September and 31st December). The basis for the assessment in the competitive selection procedure is the version of the Directive in force on the respective cut-off date.

12. Who is responsible for the selection of applications? Are selection criteria weighted? If yes, how?

The granting authority is the Federal Ministry for Economic Affairs and Energy (BMWi), insofar as the project sponsor has not been entrusted with the granting of the applications.

The implementation of the funding program is carried out by: Projektträger Karlsruhe

Selection criteria are not weighted.

13. If they have tenders, how often do they publish calls? And how long do the calls last?

N.A.

14. What is the annual budget?

Contact at the PTKA was unable to disclose this information. There were 50 projects in 2016, ranging from €14,000 to the maximum project funding level of €1.5 million.

15. Aid intensity

Amount of the grant is up to 20% of the eligible expenditure.

16. How are project funding levels determined?

The amount of the grant is up to 20% of the eligible expenditure.

17. Administrative cost of running the scheme?

Contact at the PTKA was unable to disclose this information.

18. Results so far, in terms of market penetration of technologies?

N.A.

An evaluation of the program has been conducted by Dr. Stephan Heinrich at "**Die Prognos AG"**. More information may be possible from the following source: https://www.prognos.com/ueber-uns/koepfe-bei-prognos/dr-stephan-heinrich/

19. Did they have instances of unspent funds (and why?) or issues with projects not taking off? If yes, what did they do?

Yes, there are instances of unspent funds because the available budgetary resources have been sufficient for all eligible applications. The program is thus less of a competition as previously designed. There are hard criteria (for further selection of projects when budgetary resources are insufficient to be supported) that are seldom used.

Yes, there have been issues with the projects not taking off. In such cases the project is deemed ineligible and consequently PTKA does not provide the project funding after expenses have been realized.

V. KfW-Konsortialkredit Energie und Umwelt (KfW syndicated loan energy and environment)

1. Eligibility criteria in general

- The program is aimed at domestic and foreign companies in the commercial sector, most of which are privately owned and whose group turnover is usually between 500 million and 4 billion euros.

- Companies that provide (energy) services to a third party under a contracting agreement.

Foreign projects of German companies and their subsidiaries based abroad can also be financed.

Financing takes the form of direct loans within the framework of banking consortia, provided that KfW pari passu participates in the syndicated financing with one or more commercial banks. Optionally, a refinancing of the syndicate banks can also take place through a bank-led loan.

2. Minimum project size

The credit value is generally equivalent to 15-100 Million EUR

3. How long do projects usually last? Does the program impose a maximum duration time upon projects?

KfW matches the conditions of the private bank included in the consortium, including the duration/maturity of the loan.

4. Is readiness to demonstrate first results used as an eligibility criterion?

No

5. When is the money provided (upfront, based on milestones, at the end)? If milestones, how are milestones determined? What % of money is provided per milestone?

6. Eligibility criteria: Do they include GHG emissions reduction targets? If yes, how are they calculated/accounted for?

No, but for energy efficiency measures a final energy saving of at least 10% needs to be achieved.

7. What is the maximum lead time between getting the confirmation that a project is financially supported, and when it will start being operated?

8. What eligible costs are covered: CAPEX, OPEX, or both?

Both CAPEX and OPEX are covered.

9. Do they have a high subscription rate? What do they do if they don’t have enough applicants?

N.A.

10. How many selection stages? How do people apply?

N.A.

11. Are applications accepted on a rolling basis or is there a selection/opportunity window?

Continuously

12. Who is responsible for the selection of applications? Are selection criteria weighted? If yes, how?

13. If they have tenders, how often do they publish calls? And how long do the calls last?

N.A.

14. What is the annual budget?

The total volume for loans is expected to be around EUR 250 million per year.

15. Aid intensity

The maximum risk share of the debt financing borne by public source (including from non-KfW sources) is 50% of total debt financing of the project.

16. How are project funding levels determined?
17. What are the administrative cost of running the scheme?
18. What are the results so far, in terms of market penetration of technologies?
19. Did they have instances of unspent funds (and why?) or issues with projects not taking off? If yes, what did they do?
20. For equity/debt financing:

For questions 16-20 information was not available.

Appendix: Project-based Carbon Contracts for Difference

Several issues regarding carbon contracts for difference were not covered in the main document, but merit additional explanations, which are covered in this appendix.

Harmonisation in Europe & Coordination with other policies

In order to ensure harmonisation in Europe and coordination with other public funding instruments (such as the innovation fund), one promising option is to not tender CCfDs themseles, but announce a fixed strike price before the tender of, for example, the innovation fund, and automatically award the CCfD to winners of the tender (but may also be given to further participants if they fulfil the eligibility criteria). This way market participants can consider the income of the CCfD when taking part in the tender and submitting their bids. This enables an easier cross-country coordination for bidding into the Innovation Fund, creates a level playing field for participants in the tender and avoids complexities in financial closure for projects that require support by both instruments.

In this case, such harmonisation would be done via convergence of different national CCfD prices; it could be taken iteratively, or ex-ante, but may be guided by the EU commission.

Setting the price is naturally a difficult task, due to asymmetry of information. However, in combination with a innovation fund tender, this can be achieved easier, as there is an element of competition. For this to work, the CCfD strike price should be below the abatement cost of the cheapest participating industry, so that all participants in a grant tender need to bid above zero to realise the projects.

State-aid compatibility

A full legal assessment is necessary to investigate options to ensure compatibility with state-aid and WTO regulations. However, three routes seem in principle feasible to achieve state-aid compatibility (without precluding other options):

- The project is sufficiently innovative or promises sufficient environmental benefits to justify exemptions from state aid rules (the latter points may relate to the insufficient internalisation of the carbon externality).
- It is classified as a project of common interest
- The CCfD price over the period of the contract duration is reasonably close to market expectations over the same period (for example 50 Euros over 20 years could be seen as a reasonable expectation). This corresponds to the case of electricity CfDs in the UK for nuclear power.

Application to electricity-based processes and electricity-based uncertainty

The CCfD could equally apply to direct and indirect emissions using the ETS benchmarks and benchmarks from state aid rules on power price compensation as benchmarks. Thus, incremental costs of H2/RE electricity beyond conventional processes could be supported. However, abatement costs strongly fluctuate with the electricity price level, thus additional hedging of electricity price risks is necessary, which is better covered by (existing) electricity market related instruments. Initial analysis suggests, that the scale of required RE electricity (for direct electricity use and H2 production) would exceed the capacity of basic material producers to sign long-term off-take contracts (PPAs). Hence, it might be warranted to combine publicly guaranteed carbon contracts for difference with publicly guaranteed contracts for difference for renewable projects (as in several EU countries already the case).

Example of cost recuperation for a fund

In principle, the question arises whether a fund with a limited volume is the best way to finance CCfDs, as a large part of the money needs to be kept unused in the fund, to cover operational costs in later periods. Furthermore, on a cautionary basis there would always be to the need to keep a big buffer in order to serve the CCfDs in case of low carbon prices (further state guarantees would be needed to remove any doubt about the credit worthiness of such a fund). A fund that would be yearly replenished by a government seems to be a more solid basis on which to finance CCfDs. Sartor and Bataille (2019) show the yearly cost of supporting CCfDs for materials production in France. A fund with a limited budget may be better suited to give CAPEX support to projects, thus reducing the financing risk present due to the risk of technological failures (Richstein, 2017). It also avoids the situation where a public fund keeps money with currently rather low (or negative) interest rates to fund future CCfD payments, which in turn will be discounted by investors in basic material processes at their significantly higher costs of capital. This would ultimately imply, that the scale of green investment that can be supported is reduced.

Nonetheless, in the following an example is developed for a fund with 2 billion Euros for funding projects of a size of 2.5 million tons of emission savings a year (37.5 million tons of emissions savings of 15 years). This roughly corresponds to a large steel producer who produces around 7 million tons of steel a year, and emits 10 million tons CO2 a year, substituting 25% of its production to a zero-emission technology. This example is for illustration purposes only; it ignores discounting rates, non-linear development of EU ETS prices and assumes that the new technology benefits from 100% free allocation, as well as a ignoring the need for a precautionary buffer.

If the CO2 strike price of CCfDs is 50 Euro/ton, and the average CO2 price in the coming 15 years is 40 Euro/ton (50-40=10 Euro/ton on average coming from the innovation fund), 2 Billion Euros would be enough to finance around 200 Million tons of emissions savings with CCfDs over 15 years. In this case around 5 pilot projects of such a scale (each 1.4 million tons steel and 2.5 million tons CO2 savings annually) could be realised. If, however, the average emissions price is only 30 Euros/ton over 15 years, only 2.5 projects could be financed. If the average price in the EU ETS was 50 Euros, and the price was increasing linearly yearly between 30 and 70 Euro over 15 years, 10 and more projects could be funded (the fund would be depleted after 7.5 years, but then refill to 2 billion euros after 15 years).

Average EUA price over 15 years	# projects (1.75 mn t steel /year each)	Avoided emissions (mn tons/year)	comment
40€	5.333333333	13.33	
30€	2.66	6.66	
50€, increasing linearly from 30€ to 70€	10	25	At the end, fund fully replenished

Table 3 Number of CCfD projects at 50 Euro/ton financed from a fund depending on realised carbon prices

References

Sartor, O. and Bataille, C. (2019), “Creating a business case for carbon-neutral basic materials: How Carbon Contracts-for-Difference could help kick-start commercial-scale projects”, IDDRI Study no. ST06-19, IDDRI, Paris