

Climate Innovations in Finance

Deliverable 2.6

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1 Introduction

1.1 Objective

This report is one of five sector reports published by REINVENT. The project analyses the potential for decarbonisation in four high-carbon sectors: steel, plastics, paper, and meat & dairy. There is one sector report for each of these sectors. This report is intended to provide a cross-sectoral analysis of the role that low-carbon finance plays, and can play, in decarbonising sectors. It is primarily conceptual in nature: it discusses how climate and low-carbon finance (these terms, and their distinction, will be discussed later in the introduction) have been conceptualised to date; the gaps identified in the literature; and how we propose to take these forward in REINVENT, in order to understand the potentials and limitations for innovations in the financial sector to contribute to the decarbonisation of these ‘hard to reach’ industrial sectors.

1.2 What is climate finance?

The importance of climate finance for climate change policy was confirmed by the Paris Agreement of 2015 at COP21 (Andresen *et al.* 2016). Included in Article 2, the Paris Agreement commits its signatories to ‘Making finance flows consistent with a pathway towards low greenhouse gas emissions and climate-resilient development’. Financial markets are thus presented as a key actor and space to prevent global warming in excess of 2°C. The in-built assumption is that a growing capital market for climate finance will deliver significant innovative decarbonisation solutions, if the investment conditions are right.

This emerging focus on the role of financial markets in mitigating climate change (as well as, in some cases, adapting to it) has also been expressed by others, academics and non-academics alike. The transition to a low-carbon society will require a significant investment into ‘green’ sectors (McCollum *et al.* 2013, Campiglio 2016, The Global Commission on the Economy and Climate 2016, European Commission 2018). It is estimated that an additional \$800 billions of investment in low-carbon activities is required each year to decarbonise the economic system (McCollum *et al.* 2013). Nonetheless, current levels of investment in the green economy are still relatively small (The Global Commission on the Economy and Climate 2016), but they are growing rapidly (Campiglio 2016, Buchner *et al.* 2017).

In recent years attention for new forms of investment, which seek to produce more-than-economic benefits, has grown. These new forms of finance have been given various names: ethical investment (Mercer Investment Consulting 2007, United Reformed Church 2015, Kynge 2017), ethical finance, green investment, green finance (City of London Corporation 2016), climate finance (Ballesteros *et al.* 2010, Clapp *et al.* 2012, Godinot *et al.* 2017, World Bank 2017), intentional investing (Jenkins and Rogers 2015, Kay 2017), sustainable investing (DB Climate Change Advisors 2012), and responsible investing (Mercer Investment Consulting 2007, DB Climate Change Advisors 2012).

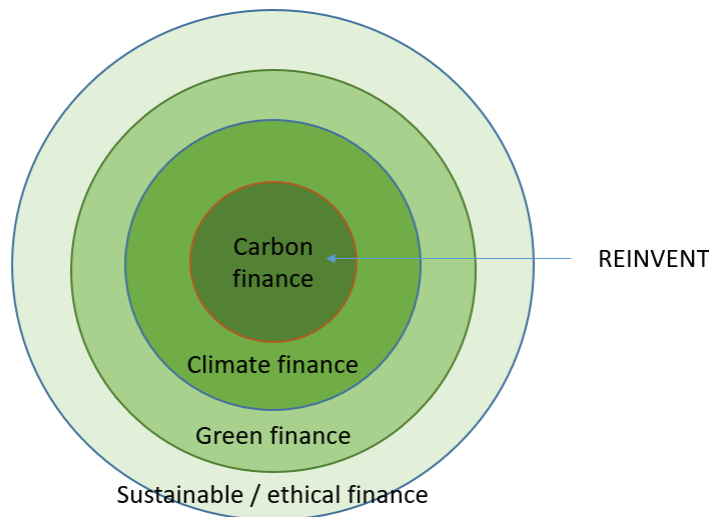


Figure 1: Conceptualisation of finance within REINVENT project

Broadly speaking, each category can be seen as a subset of the previous one, with ethical or sustainable finance being the broadest category, including both ‘green’ and ‘social’ finance, i.e. producing outcomes that have either social or environmental benefits alongside economic benefits. We will discuss these distinctions, and the reason why we are primarily interested in carbon finance, later in this report.

1.3 Where is climate finance from a value chain perspective?

REINVENT adopts a value chain perspective to analyse the potential for decarbonisation in four high-carbon sectors: steel, plastics, paper, and agriculture. Finance and financial actors are not located in a single part of the value chain. Rather, they can appear throughout it. While some companies will finance innovation through their own balance sheets, within REINVENT we are particularly interested in the role external finance plays in funding innovations. These flows of finance can intersect at different points with our sectoral value chains. For example, finance may flow to R&D for the development of new feedstocks and associated production processes, such as the development of lab-grown meat (e.g. Memphis Meats) or bioplastics. In other examples, actors in the REINVENT sectors may seek external finance to fund production process efficiency improvements (for example Dutch dairy company FrieslandCampina). Finance can also flow to retailers seeking to sell sustainable and low-carbon products (e.g. the loans provided by green bank Triodos to health food stores), or to recycling plants as a step towards vertical supply chain integration (for example, Ikea).

What is also important here, is what a value chain perspective can add to the study of climate finance. Specifically, it enables us to investigate the question why particular stages of the value chain may be (or, can be made) (1) more amenable to investment, (2) by which investors, (3) and with what (carbon reducing) impact. For REINVENT it is also important to understand how these different questions may be answered across the different value chains. As we will discuss later, the different materialities and geographies of our different supply chains are expected to play an important role in the realisation of climate finance.

As we will explain in more detail in Section 3, it is important to note, however, that climate finance does not only refer to investment, it can also, for example, refer to divestment. To date, most commitments to divest have focused on the extractive industries (e.g. coal, oil, and gas). As these are

important feedstocks for the steel and plastics sector, a withdrawal of investors could potentially impact these sectors' value chains.

1.4 How might climate finance for energy intensive industries be important or different?

For carbon financing to take place, it requires the carbon content to be made visible in some places and invisible in others (see also Chiapello 2015). This raises the question: what *institutions, rules, practices or norms* make this carbon content (in)visible in the different sectors? Such practices of authorisation could for example include monitoring, branding, legitimisation and auditing.

One interesting example is the United Reformed Church (2015, p.68), who suggest that oil/coal for fuel and oil/coal for plastics and steel should be seen as 'functionally different', requiring different investment approaches. They suggest potential divestment from fossil fuel companies, but not from companies that use fossil fuels to produce e.g. steel or plastics (United Reformed Church 2015). This thus raises the question of legibility. While the carbon in plastics is visible, it appears not (yet) commensurate with other values, goals and drivers of the URC.

The European Commission (2018) recognises that timescales are often mismatched between investors and industries. For example, the EU report argues that the long-term horizon of end-beneficiaries such as pension funds is generally not reflected by financial intermediaries, due to principal-agent issues and misaligned performance metrics and incentives, including a lack of informed consent. Similarly, the report found that the need of businesses for long-term capital are undermined by a focus on short-term price performance, particularly on listed equity and bond markets (European Commission 2018, p.12). There are thus important challenges in enabling the realisation of low-carbon finance.

1.5 Why is it important to specifically focus on carbon finance, rather than climate finance?

In the literature the terms 'carbon finance' and 'climate finance' are often used interchangeably (e.g. Christophers 2016, 2018). We prefer the term carbon finance because it is more inclusive and, at the same time, more specific.

Climate finance, can be conceptualised (as it has been, above) as a broader category than carbon finance. This is, as it generally includes finance for both climate change mitigation or adaptation projects. It can also include other forms, such as catastrophe bonds, which seek to diversify the risk of extreme weathers to the larger capital markets, hence decreasing the exposure for such events for (re)-insurance companies (Jagers *et al.* 2005). One of the challenges of including both adaptation and mitigation in a single definition, as Kennedy and Corfee-Morlot (2013) remind us, is that these are not always compatible. Air conditioning and desalination may be important coping strategies, but are also energy intensive processes. They argue, it is thus justifiable to consider funding for mitigation, of which carbon reduction is a key component, separately from adaptation-focused projects (Kennedy and Corfee-Morlot 2013). It is here, that carbon finance may be considered more specific, as its primary focus is on financing climate change mitigation interventions.

In a different way, carbon finance is also more inclusive than the term climate finance. Climate finance has conventionally been used more narrowly to refer to donor funding or development aid that is consistent with the principles of the United Nations Framework Convention on Climate Change (UNFCCC) (Ballesteros *et al.* 2010, Clapp *et al.* 2012, Godinot *et al.* 2017, World Bank 2017).

The world of carbon finance is more extensive and varied than these particular forms of aid and donor funding, as we will explore in section 3 of this report. Finally, within REINVENT we are especially interested in the question how carbon is translated into financial value, and exploring the extent to which this takes place across different forms of finance and across the different REINVENT value chains. A focus on carbon finance, rather than climate finance, thus enables us to examine this rapidly developing subset of finance activity, which is most relevant to the geographical and sectoral focus of REINVENT.

1.6 Why do questions of agency, power, materiality & geography matter to the sector?

Question of **agency** in finance has often been considered as two separate agents at two ends of a hierarchical relationship. *Existing research has primarily sought to explain how stakeholders influence a firm to change its practices, but tend to see firms as reactive rather than proactive in improving sustainability practices and engaging with stakeholders* (Sulkowski et al. 2017)

We propose a different approach, however, building on work by Lansing (2012) and Knox-Hayes (2013). Our proposed approach considers agency as a relational concept, where the agency emerges through the relationship between these actors. This is important/relevant because, as the next sections will show, it helps us go beyond identification of the ‘finance gap’, instead showing how carbon or low-carbon becomes investible/bankable.

The **materialities** of different sectors affects how their (low-)carbon qualities can be turned into bankable assets. For example, regarding steel: do significant sunk costs may make finance for disruptive innovations less likely? As we will discuss in more detail in section 3, interrogating the relations between carbon’s material form, its abstraction, capitalisation and political economy will be key for understanding the potential for carbon finance to act as the game changer for low-carbon futures that it is heralded to be (Bridge et al. forthcoming).

There are also important questions to be asked around whether carbon finance enables reconfiguration of **power** or further solidifies the position of already powerful actors. More broadly, analyses of climate finance can also enable us to develop new conceptualisations of power in value chains and the reconfiguration of value chains through new forms of finance, as well as question the ability of finance to reconfigure power relations across space (discussed below).

Questions of **geography** matter to the finance sector in numerous ways. Climate finance has traditionally been characterised as an issue of flows from actors in the Global North to ones in the Global South, but recent years have seen an increased focus on flows of climate finance within regions and states, and along product chains. Attention to the geography of climate finance is also especially important for emissions-intensive sectors, as these sectors are often characterised by particular geographies of manufacturing (e.g. steel) or complex production chains (e.g. plastic).

It is thus closely connected with questions of power, and the extent to which finance enables the configuration of new power relations across space, or consolidates existing configurations. Within the field of carbon finance, similar discussions are also relevant. Financial centres, such as the City of London (and indirectly, the UK) are already trying to position themselves the international centre for green finance (see for example City of London Corporation 2016). We can thus expect the growth of carbon finance is accompanied by multiple attempts to reconfigure the geographies of finance/financial flows.

1.7 Structure of the report

Section 2 of this report will challenge the idea of the presence of a/multiple finance gap(s). The challenge (and opportunity) of climate finance is often discussed in terms of either (1) a gap in the availability of finance to support low-carbon innovation (referred to as the ‘valley of death’ in the innovation literature) and/or (2) as a gap between the amount of finance available and the number of ‘investable’ projects that have been developed to which this finance can be put. For some, there is a finance gap for innovation, for others there is an innovation gap for finance. There is some truth in both these perspectives, but it does not offer much in terms of understandings why these gaps can exist at the same time. Section 2 will analyse the construction of these gaps, how and why they may exist at the same time, and whether these gaps are present in the same way in the REINVENT sectors.

Following on from this, **Section 3** develops a three-fold typology of (low-)carbon finance to help us understand the multiple forms and roles of finance within the REINVENT sectors. In this section, we argue that properly grasping the carbon finance sector requires insights from both political economy and cultural economy perspectives. Using these perspectives, we identify three main modes or types that carbon finance takes (as exchange, as investment, as divestment) within REINVENT.

Finally, in **Section 4** we identify ways in which finance can be incorporated in the future work of REINVENT, through its different work packages. It sets out how the role of finance in the REINVENT sectors will be analysed through qualitative case study research, how it may be integrated in the Integrated Assessment models used in REINVENT, and how it may inform our policy analysis.

2 Mind the Gaps

2.1 Deconstructing the finance gap for innovation and the innovation gap for finance

The key challenge for finance and innovation is often described as a matter of closing the gap between available investment capital and new innovations. In some cases, a gap may exist in the availability of capital for an innovation as it is developed and becomes commercially viable. In other cases, a gap may exist between an investor with capital to invest in new projects and their ability to identify innovations that are expected to provide a satisfactory return on investment. In this section we discuss the existence of these gaps for climate finance and low-carbon innovations.

Beginning with the finance gap for innovation, the first and most obvious driver of this gap is the lack of public funding. Public climate finance currently mobilises around 140 billion USD per year, whereas private climate finance mobilises around double that amount (Buchner *et al.* 2017). Development finance institutions (DFIs) – of which there are national, multilateral, and bilateral varieties – remain the largest public source of climate finance. While national DFIs have been reducing commitments over the last years, this decrease is being mostly offset by increased funding for multilateral and bilateral DFIs.

Although there are more than 20 major multilateral funds dedicated to climate change action, these funds have had just under 50 billion USD pledged to them in total (Buchner *et al.* 2017). This is a far cry from the ‘clean trillions’ needed to reach Paris commitments. The low quantity of climate finance is also spread too thin over a complex architecture of funds and organisations with overlapping remits. This complexity causes at least some governments to struggle with accessing funds that could be put to effective use in their countries (Callaghan 2017).

Private climate finance, currently standing at double the amount of public climate finance, makes a much-needed and welcome contribution to decarbonisation. However, it is important to keep in mind that private funders come with a specific set of priorities that differ from public funders. One of the key drivers of private climate finance is solar and wind energy installations, which are proven and profitable technologies. Riskier and more long-term projects are typically left to public funders to initiate at the early stages (Brown & Granoff 2018). Public funding is not *only* for the early stages, though - there is substantial evidence to support a strong role for public climate finance throughout the commercialisation and deployment stages (Mazzucato *et al.* 2015). This is why the lack of public funding, particularly for multilateral DFIs, is an important finance gap.

When looking at the sectors primarily targeted by both public and private climate finance, other gaps become apparent. In 2016, 93% of climate finance targeted mitigation activities - of those investments, 74% were in renewable energy generation (Buchner *et al.* 2017). For public climate finance, energy efficiency is the most prominent sector at 39 billion USD, but renewable energy is a close second with 34 billion USD. Sustainable transport is also a growing target for investments, receiving 22 billion USD in public climate finance in 2016. As for adaptation activities, water and wastewater treatment takes more than half the funding at 11 billion USD, with agriculture/forestry/land use coming in second with 4 billion USD. High-cost carbon abatement sectors, such as the REINVENT sectors, have not yet been brought within the remit of climate finance. Nonetheless, a decarbonised economy requires that all sectors shift away from fossil fuels, not only the energy, building, and transport sectors.

2.2 Financial metrics in climate finance

One issue that contributes to the existence of a finance gap for innovation with particular relevance for the REINVENT sectors is the inadequacy of standard financial metrics used in climate finance when measuring investment progress against mitigation outcomes (Brown & Granoff 2018). The orthodoxy of getting the best immediate ‘bang for your buck’ (focusing on commercially available carbon abatement technologies that maximise near-term emissions reductions) means that action is too often delayed within high-cost abatement sectors. The REINVENT sectors are victims of this orthodoxy. It is important that this standard approach to investment is challenged because focusing only on near-term emissions reductions makes reaching mid-century targets impossible (Vogt-Schilb *et al.* 2018). Indeed, it is likely that holding off on investing in the decarbonisation of the highest-cost abatement sectors until such time that it is deemed more ‘economical’ puts us at greater risk of overshoot while precluding the necessary investments being made that can reduce decarbonisation costs within these sectors.

Standard financial metrics used to assess climate finance investments measure progress by benchmarking towards aggregate volumetric goals, such as those mentioned previously (i.e., the ‘clean trillions’, the 100 billion USD at the 2009 Copenhagen Accord, and so on). They have at least four shortcomings (Brown & Granoff 2018):

1. Being input-focused, they do not reflect decarbonisation outcomes.
2. They do not account for reductions in technology costs (see the rapidly falling cost of solar photovoltaic), such that the impact of each dollar invested changes over time.
3. They isolate the decarbonising parts of the economy from the whole – reductions in one area mean nothing if investments are increasing in other high-carbon activities.
4. Mere tracking of financial volumes tells us nothing about how or why specific investments have beneficial impacts on decarbonisation.

Taken together, these four shortcomings have contributed towards an emphasis on finance quantity rather than finance quality. Even with increasing quantities of climate finance, the REINVENT sectors and other high-cost abatement sectors risk falling into the finance gap – being stuck in the ‘valley of death’ – if investment logics do not shift towards emphasising quality and long-term emissions reductions (Mazzucato & Semieniuk 2018).

Several potential routes exist for improving the quality of climate finance and the ability of climate finance to target long-term, high-cost, or technologically challenging forms of decarbonisation. These include improving the complexity and appropriateness of financial metrics from volumetric or dollar/Euro counts toward impact-based or outcome-based measures, articulating alternative investment priorities and values to align climate finance with goals of impact investors and institutional investors, and developing innovating forms of investment and risk sharing tailored to high-cost abatement sectors.

2.3 The investibility gap and the attractiveness of low-carbon innovations

Alongside the finance gap and concern about the dearth of capital available for low-carbon investment, there is reason for an inverse concern about an ‘investibility gap’ – a dearth of projects that offer both verifiable emissions reductions and sufficient potential for return on investment. To attract investment from private capital, innovations must be ‘rendered investible’ by articulating their potential and contrasting this potential against existing investment paths. It is claimed that one of the persistent challenges for environmental innovations is that it requires ‘patient capital’ – investors that are willing to accept lower rates of return or increased risk (Mazzucato 2016). Public-

sector investment has traditionally provided a large share of the capital for public-goods oriented projects with high degrees of uncertainty, low rates of return or increased risk. As articulated within the Paris Agreement there remains a significant role for public funds in climate finance. However, innovation within the finance sector is necessary to improve the scale, scope, and quality of private-sector investment.

One strategy for attracting patient capital, or for convincing more investors to be patient, is the establishment of classifications, metrics, and standards on what can be considered low-carbon investment. Such systems not only direct investors toward innovations with the most potential for decarbonisation, but can also differentiate investment in low-carbon innovations from business-as-usual. As noted above, the metrics used to assess climate finance must be capable of recognising the importance of innovations with long-term potential for decarbonisation as well as innovations that offer substantial emissions reduction potential. To attract private capital and divert investment from business-as-usual high carbon activities, carbon finance innovations need a stable, coherent risk/return profile beyond that which has yet been established.

There are other reasons why climate finance may not be finding the right targets. Another omission caused by the finance quantity focus concerns geography. The dominant criteria guiding official development assistance (ODA) for climate adaptation and mitigation is based on a principle of social justice or on a country's potential for carbon abatement. Such measures do not tell us anything about an economy's potential to reach 'tipping points' that set off self-reinforcing market dynamics towards decarbonisation (Brown & Granoff 2018). Looking at other indicators, such as the levelised cost of electricity, may hold greater promise in this regard.

More broadly, the greater challenge is that 79% of climate finance is raised domestically, meaning that the bulk of climate finance is made up of domestic investments in high or middle income countries (Buchner *et al.* 2017). Low income countries rely primarily on international sources, but there is more work to be done to support cross-border climate finance flows. This also underscores the importance of increasing funding for the multilateral DFIs. Changes to the intra-national orientation of climate finance are needed to overcome the challenges of decarbonising transnational value chains.

3 (Low-)Carbon Finance: a three-fold typology

In this section we want to introduce conceptual framework which can aid understanding of the (low-) carbon finance sector in general, as well as in the REINVENT sectors in particular. Primarily, we argue that to properly grasp the carbon finance sector requires insights from both political economy and cultural economy perspectives. Using these perspectives, we can identify three main modes or types that carbon finance takes: (1) as exchange (carbon markets) (MacKenzie 2009, Knox-Hayes 2013, Lovell *et al.* 2013, Lovell 2014, SEI 2014, McAfee 2016); (2) as divestment (Ansar *et al.* 2013, Linnenluecke *et al.* 2015, Grady-Benson and Sarathy 2016, Ayling and Gunningham 2017, Knuth 2017); and (3) as investment (McCollum *et al.* 2013, The Global Commission on the Economy and Climate 2016).

The form of carbon finance that has been the primary focus of social researchers and policy makers during the last two decades, is that of **carbon markets**. In economic terms, this form of carbon finance can be conceptualised as a form of exchange. Carbon markets price and trade two kinds of carbon credits, each equivalent to 1 tonne of carbon dioxide: allowances, which are permits for regulated organisations to emit carbon dioxide; and offsets, transferrable credits that result from reduced emissions. This is for example expressed through the suite of economic instruments that accompanied the 1997 Kyoto Protocol (such as the Clean Development Mechanism); the EU Emissions Trading Scheme; and other regional and urban carbon markets based on carbon allowances. Carbon markets are widely envisaged as a response to market failure that hinges on creating a market for so-called 'negative externalities' - i.e. the emissions that are produced but not owned - such that their producers are incentivised to not only reduce emissions but to 'direct investment into lower-carbon technologies' (Keohane 2016, p.27).

The second form of carbon finance, is **carbon finance as investment**. To date, this has been primarily expressed in the energy sector, which has made extensive use of project finance and green bonds to finance low-carbon developments. Investment in green sectors has been characterised by significant investments into renewable energy production capacity (Campiglio 2016). The significant contribution of the energy sector to global greenhouse gas emissions has made it a logical first target of public and private initiatives aimed at governing carbon. A recent report by (Buchner *et al.* 2017) estimates that 93% of climate finance goes towards mitigation activities, 74% of that goes to renewable energy generation. It has to be noted, however, that limited data availability for private sector investments in energy efficiency and other sectors may have contributed to the high proportion of reported renewable energy investment (Buchner *et al.* 2017).

Within the energy sector, decarbonisation efforts have tended to target electrical power generation, given the prevalence of large point-source emissions (e.g. coal-fired power stations) and concentrated patterns of ownership (e.g. utility companies) in electricity generation, and the opportunities for shifting investment towards renewable energy sources (Bridge *et al.* forthcoming). Low-carbon investment in the power sector is a process that requires first the classification and categorisation of carbon qualities (low vs high-carbon) of different forms of electricity generation. Subsequently, it requires the assembly of assets that qualify against these criteria, in other words, forms of property with an associated income stream, which are sufficient to bear debt. We will explore this process, and the implications for REINVENT sectors, in more detail in the next section.

The third, and final, form of carbon finance is **divestment**. Divestment, builds on earlier approaches of ethical investment: exclusion of sinful sectors or stocks has long been most common approach to broader category of ethical finance (Jenkins and Rogers 2015, Kay 2017). For example, Research by the Association of Charitable Foundations shows that of those charitable organisations that have an ethical investment policy, 78% exclude specific companies or industries (Jenkins and Rogers 2015). This form of ‘negative screening’ long predates the fossil fuel divestment movement. There is a history of Christian investors avoiding ‘sin stocks’ (e.g. tobacco, alcohol), which goes back to 1920s. Subsequently, the proliferation of ethical mutual funds in the US in the early 1970s was a reaction to the Vietnam War (adding the stocks of the nuclear industry and military and defence contractors to the list of sin stocks). Later in same decade and into 1980s, campaigns for divestment from South Africa’s apartheid regime also generated support for ethical mutual funds on both sides of the Atlantic. Ansar *et al.* (2013) suggest that the apartheid divestment campaign has provided inspiration for relatively recent turn to fossil fuel divestment.

Divestment campaigns focus on encouraging investors to add fossil fuels companies to these lists of excluded investments. Despite recent high-profile pledges to divest from fossil fuels (e.g. Ireland, Church of England), it is noticeable that not all pension funds (Stausboll 2015) or other institutional investors (e.g. Church of Scotland) regard divestment as necessary or as the most appropriate response to climate change, with some investors arguing that their preferred route is to engaging with fossil fuel companies through shareholder activism (Stausboll 2015). To date almost 900 institutions across the world, representing funds over \$6 trillion have made some form of divestment commitment (Go Fossil Free 2018). Faith-based organisations make up the largest group of organisations that have committed to divest (see figure below).

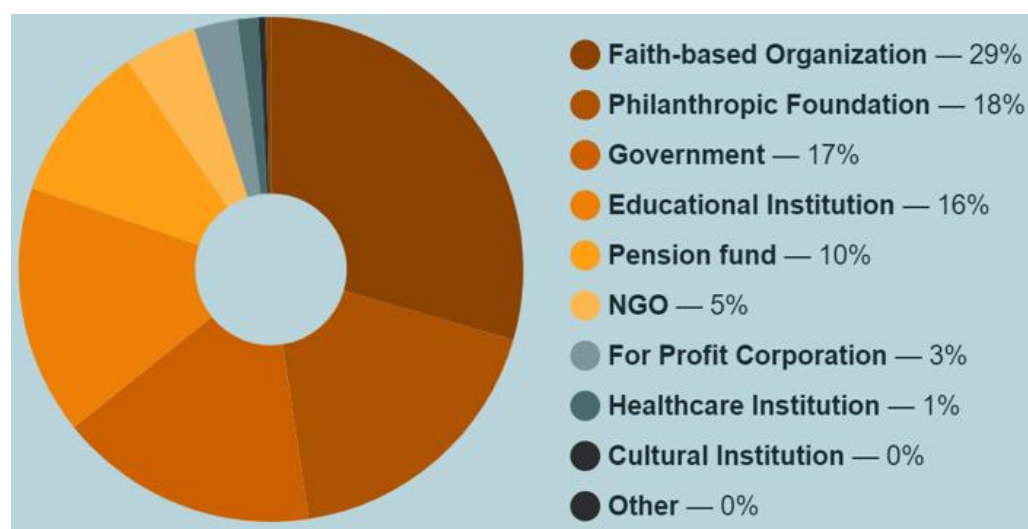


Figure 2: Types of organisations who have committed to divest (Go Fossil Free 2018)

3.1 Insights from cultural and political economy into the making of low-carbon assets

As we discussed in Section 2, the literatures on carbon and climate finance, have often focused on the quantity of finance required to enable innovation and/or the presence of a finance gap to explain the limited finance flowing towards low-carbon innovations. This literature has, for example, shown us that an additional \$800 billions of investment in low-carbon activities is required each year to decarbonise the economic system (McCollum *et al.* 2013).

This literature, has also, tended to conceptualise finance as a relatively frictionless flow from A to B, with little concern for how such flows are made possible. Such a perspective is grounded in the assumption that if investors and investees can be matched, then investment will flow, and a low-carbon transition will take place. The barriers to this are most often framed in terms of risk and externalities, i.e. the need to bring ‘the long-term [environmental] consequences of financial practices into today’s decisions’ (European Commission 2018, p.9).

To complement this literature, we have analysed the growing conceptual bodies of work in political economy and cultural economy, concerned with the making of markets. As Ouma *et al.* (2018) argue, ‘capital does not simply flow from A to B’ (p.5), so what we propose is a conceptual approach that focuses on the relations between carbon and finance that mutually constitute finance’s productive capacities. In doing so, these bodies of work can help us understand *how* low-carbon markets are constituted. In particular, this literature provides us with the insight that the availability of finance for low-carbon transitions cannot only be attributed to a lack of finance or lack of investable innovations, but instead, can be attributed to:

1. Assumptions concerning what constitutes an asset and difficulty translating carbon into assets

‘Low-carbon’ can become an asset via several financial mechanisms and organisational structures (cf. (Birch 2017)). The work involved in assembling low-carbon-as-asset – i.e. as an abstraction and organisational form that is sufficient to bear debt – is however not straightforward. Research from the renewable energy sector shows that mainstream finance has conventionally perceived low-carbon projects as illiquid and relatively high risk, as they involve relatively new technologies across in a limited number of locations. The financial sector also has relatively little experience to draw on with the renewable energy sector, especially when compared to core asset classes, like infrastructure or commodities. Adapting energy finance to the material qualities of renewables has also been a challenge: in the case of wind power, for example, the intermittent and weather-dependent character of generation accentuates commercial risks for developers. We expect that adapting finance to the material qualities of the REINVENT sector will also require a set of unique and potentially challenging processes, which are yet to be explored.

2. The process of distinguishing low-carbon qualities from other forms of investment to realise value

Producing low-carbon-as-asset across capital markets requires complex work that distinguishes different forms of carbon in order to generate those particular qualities (‘low-carbon, ‘green’) of assets that are capable of bearing value. In the renewable energy sector in particular, the uncertainties of low-carbon-as-asset are manifest in a variety of financial techniques and instruments that distinguish the material properties and qualities of carbon in ways that make them investable for different investors. As we will return to later, this typically require significant state intervention and support. Not dissimilarly, the green bond market also shows important tensions in the production of low-carbon-as-asset. First, the valuation and capitalisation processes for green bonds are essentially the same as for brown (i.e. conventional/non-green) bonds. Furthermore, the returns on investment are not necessarily tied to decarbonisation outcomes, meaning that the low-carbon qualities are not necessarily clearly distinguished and able to realise value. This also seems to be at the root of a host of wider tensions undermining the potential of these instruments for financing a low-carbon transition (Bridge *et al.*, forthcoming). Debates around ‘additionality’ (i.e. the additional environmental benefit to be achieved through green financing mechanisms) are especially pertinent to the green bond sector. As the green bond market continues to grow, and is also moving into the

REINVENT sectors (e.g. FrieslandCampina Green Bond issuance – explored as a case study in WP3), the insights of this literature are increasingly relevant to REINVENT’s work.

In summary, the cultural economy and political economy literature provides important insights for our work around *how* low-carbon assets, and low-carbon markets, come to be. To date, the making of low-carbon assets is primarily evident in the renewable energy sector. This raises the question for REINVENT, what can be done to overcome the existing institutional, economic, and social conditions where carbon finance can be secured in relation to some forms of carbon – for example to its *absence* in renewable electricity generation – rather than others, such as the carbon content of the retail sector or of energy-intensive industries, such as steel, plastic or cement (Bridge *et al.*, forthcoming).

3.2 Divestment and asset devaluation

We also suggest that the dynamics of divestment are equally important to consider when taking a value chain perspective on low-carbon transitions, and consider the ways in which assets may become stranded or devoid of value.

Reaching a goal of limiting climate change to less than 1.5 or 2 degrees warming, requires us to keep a large proportion of fossil fuel reserves in the ground (McGlade and Ekins 2015). These are known as stranded assets. The term ‘stranded assets’ can also refer to other assets which are no longer able to earn an economic return at some time prior to the end of their economic life (as assumed at the investment decision point), as a result of change associated with the transition to a low-carbon economy (Carbon Tracker 2017). While the stranded assets discussion often focuses on fossil fuel companies, other companies that use fossil fuels as inputs for production or are otherwise energy-intensive – i.e. the REINVENT sectors – could also be affected. This is important for investors in the REINVENT sectors. The possibility of stranded assets increases the risk of a future anticipated income not materialising. As such, there is a higher risk associated with maintaining investments in carbon, either through direct fossil fuel investments or through investments in companies that are indirectly reliant on fossil fuels.

Conceptually, to understand divestment as a form of carbon finance that seeks to generate and capture financial value, it is crucial to recognise that here carbon is translated as a form of stranded asset and financial risk. In the previous section, we discussed the idea of ‘(low-)carbon’ becoming an asset and, subsequently, an object of investment. Here, the notion of stranding should be seen as (high-)carbon *ceasing to be an asset*, and ‘unbecoming’ an object of investment. This means that rather than through investment, divestment means a financial return is generated through *avoiding* carbon as asset.

Although this may affect the REINVENT sectors, at the moment there is no clear indication whether divestment can or will take hold beyond the energy sector. One example of how carbon is thought of in different ways, is evident in the investment strategy of the United Reformed Church (2015, p.68). The Church suggest that the carbon content of plastics and steel should be seen as ‘functionally different’ as that of fossil fuels, requiring different investment approaches. They suggest potential divestment from fossil fuel companies, but not from companies that use fossil fuels to produce for example steel or plastics (United Reformed Church 2015). This thus raises the question of both materiality and legibility. While the carbon content of plastics has become visible, it appears not (yet) commensurate with other values, goals and drivers of the URC.

As such, the implications of divestment for REINVENT is currently not fully clear, but there are a number of different possibilities. First, while the divestment movement to date has focused on fossil

fuel companies, the impact of stranded assets in the REINVENT sectors may lead investors to divest from these sectors in the future, if they continue their reliance on fossil feedstock. The second possible implication is whether investment in the REINVENT sectors will increase as a result of divestment from fossil fuel companies, and investors are seeking new assets to invest in. The preceding discussion on insights from political and cultural economy, indicates, however, that money divested from fossil fuel companies, will not necessarily be re-invested in low-carbon alternatives, either in the primary energy sector, or in low-carbon alternatives in the REINVENT sectors. Rather it requires the configuration of low-carbon assets as described before. Empirically, there is currently little evidence for where divested money is reinvested, and this is one of the questions we are seeking to address in Work Package 3.

3.3 The role of the state

We close this section by reflecting on what these perspectives suggest in terms of the dominant ways in which 'closing the gap' is attempted, through state finance or support for innovation. Within the energy sector the state has played a fundamental role in 'closing the gap' between finance and innovation. Carbon finance as investment in low-carbon energy initially emerged as a result of deregulatory initiatives, limits on public sector borrowing, and the introduction of price-based competition in the electricity sector (Jensen and Dowlatabadi 2017, Knuth 2017). Nonetheless, state support has been shown to have played a very significant role in creating carbon-as-asset in the energy sector (Bridge *et al.* forthcoming).

The first way in which the state has played an important role is through investment in high risk projects. Based on a large dataset of global asset finance deals from Bloomberg New Energy Finance (2004-2014), Mazzucato and Semieniuk (2018) identify significant differences in risk appetite among investors in low-carbon projects, and reveal emergent patterns in low-carbon energy finance. They show how private actors have favoured 'low risk much more than public ones' and how 'individual high-risk technologies (were) pushed mainly by just two or three financial actors' (p.18).

Secondly, of particular importance have been a series of public policy initiatives that includes tax credits, price support mechanisms (e.g. feed-in-tariffs) and renewable obligations (Tang *et al.* 2012). Tax legislation is particularly important in the United States, where the Production Tax Credit available for renewable power is a key influence on techniques of project finance for utility-scale renewables projects (Bolinger *et al.* 2009, Bolinger and Lawrence 2011, Regante 2012, Vasileiadou *et al.* 2016).

Finally, and more fundamentally important, is that classification and capitalisation of low-carbon assets is often directly based on differentiations and qualifications around carbon initiated by the state (Bridge 2018). These include, for example, government rulings on the forms of electricity generation that qualify for price support or tax credits; the systems of green certification around low-carbon generation it either directly supports or rules admissible in law; and enabling acts of legislation that mandate action on decarbonisation, differentiate low-carbon and renewables from other forms of generation and, as in the case of the UK Climate Change Act, set carbon budgets and legally-binding targets (Bridge *et al.* forthcoming).

These insights regarding the interactions between the state, economic sectors, and the financial markets in making low-carbon 'bankable', may be important for the REINVENT sectors, as they are seeking to finance low-carbon innovations.

4 Future Analysis

Research to date has often assumed the existence of one or two finance gaps (a lack of finance for innovation and/or a lack of innovation to finance). Instead, in Work Package 3 we propose a conceptual approach that focuses on the relations between (low-)carbon and finance that mutually constitute finance's productive capacities. This can help us understand *how* low-carbon markets are constituted. In particular, we propose an analysis of:

- Assumptions concerning what constitutes an asset and difficulty translating low-carbon into assets
- The process of distinguishing low-carbon qualities from other forms of investment to realise value

We will do this through four qualitative finance case studies, which consist of a mix of sector-specific and cross-sectoral carbon finance initiatives. These case studies will highlight how each of the main analytical themes in REINVENT (a systemic approach, agency, power, materiality, geography) are taken into account in each form of carbon finance and what these then suggest about the key dynamics at work in the REINVENT sectors in order to understand how carbon finance operates to support (or negate) transitions to zero carbon.

For example, early findings from one of the case studies – on divestment practices by institutional investors - highlights the importance of geography in influencing which companies and sectors are, or are not, the focus of divestment practices. Similarly, this work also points towards the need for a more nuanced analysis of stranded assets to understand the geographies of stranded assets, as well as their agency and materiality, i.e. to ask the questions 'stranded from what? And stranded from whom?'

One other case study, on the use of Green Bonds in the dairy value chain, also highlights the role of geography, as well as materiality in configuring (and to some extent negating the potential for) decarbonisation in the dairy value chain. This case study also shows the importance of a value chain approach: it highlights that even when green investments are made, they are not necessarily directed towards the most emission-intensive parts of the value chain. Combined, the case studies may also provide insights into whether we can identify distinct pathways of low-carbon finance.

This analysis will also inform the work to be conducted as part of Work Packages 4 and 5. Currently, finance is one input in the Integrated Assessment IMAGE model deployed by colleagues at PBL (the Netherlands Environmental Assessment Agency). There is, however, currently a built-in assumption that there is an unlimited availability of finance, and that the allocation of finance is primarily determined by the cost-effectiveness of particular technologies that can help us move to a zero-carbon world. Our analysis which takes into account issues such as materiality, power and geography, could potentially complement this approach to identify more or less likely avenues for decarbonisation. Furthermore, our analysis of the divestment movement as part of Work Package 3, could potentially also feed into the model.

The interaction of our analysis with the proposed work of Work Package 5 is somewhat different. This report, plus our work in Work Package 3 can inform Work Package 5, through our conceptual and empirical analysis on the different ways in which financial actors, flows and instruments interact with the REINVENT sectors *on the ground*. This can subsequently form the basis of a bottom-up analysis of the role, impact and coherence of climate change policy in Work Package 5.

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For Europe to achieve its long-term climate objectives, carbon-intensive industries have to reduce their emissions.

REINVENT focuses on plastics, steel, paper and meat & dairy – industrial sectors that are key to our daily lives, but where low-carbon transitions are still relatively unexplored.

To gain a broader understanding of the possibilities of transition, entire value chains of the industries are studied. This includes non-technical factors such as supply chains, financing, trade, and social and economic impacts. Together with forward-looking industry leaders and policy-makers, we explore potentials and capabilities for making transitions in these resource-intensive industries.

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