

# Analytical Framework: Rethinking the dynamics of inertia and innovation

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## Deliverable 1.3

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[This is a revised version of the Analytical framework, based on the feedback from the 1<sup>st</sup> periodic review]



## Summary

The analytical framework for the REINVENT project is intended to open up lines of inquiry that cut across disciplinary boundaries and the different components of the work programme. It operates at three levels. First, it sets out the basis for taking a *whole economy* perspective to our work, such that our analysis pays close attention to the interaction between different components of economic sectors – finance, production, consumption, waste – as well as the ways in which dynamics in one sector affect others. Second, it identifies the key dynamics of our theory of change – the importance of understanding the relation between innovation and inertia and the political economies that shape the potential for transformation. We identify four key areas for analytical focus: understanding multiple forms of agency; developing the conceptualisation of power; engaging with materialities; and understanding the geographical dynamics of transitions. Third, it focuses on how specific interventions designed to enable low carbon transitions can be analysed. Here, we take a layered approach to enable an evaluation of both the innovation taking place – e.g. a new technology or policy – and the governance initiative within which it is mobilised (e.g. an institutional arrangement or scheme) and examine how the capacity to intervene is determined and the ways in which interventions lead to the uptake and mainstreaming of decarbonisation.

## Introduction

REINVENT seeks to analyse the emergence and potential for decarbonisation in energy, emissions and resource intensive sectors of the economy (steel, paper, plastic, meat and dairy). It starts from an understanding of these sectors as socio-technical systems which operate through complex value networks that encompass finance, production, consumption and waste. Within these value networks, the dynamics of low carbon transitions are regarded as shaped by the interplay of *inertia* and *innovation* in socio-technical systems. Drawing on literatures from socio-technical transitions, environmental governance, innovation studies and global production chain analysis, we have identified five key areas where additional work is required in order to develop a full understanding of the nature of decarbonisation in energy intensive industries: (1) taking a system-wide perspective, (2) recognising multiple forms of agency, (3) developing the conceptualisation of power, (4) engaging with materialities, and (5) understanding the geographical dynamics of transitions.

There are many different kinds of research frameworks (prescriptive, descriptive, analytical, deductive, explanatory, interpretative) that can be developed and deployed in a research project. These have different functions, merits and are useful for different purposes. The main purpose of REINVENT's analytical framework is to structure the problem space to be investigated. It is thus a key device to organize the research, and to provide a lens through which to analyse the phenomenon of decarbonisation. In this interpretative research tradition, the purpose of an analytical framework is thus different from a prescriptive framework (normative, evaluative), from a deductive framework (to derive hypothesis), and an explanatory framework (to test hypothesis based on causal inference).

Adopting this interpretive approach, the purpose of REINVENT'S analytical framework is to open up the lines of inquiry that can be fruitful to explore. In this approach, we do not expect that all lines of inquiry are able to be pursued at all points in the project, but instead they can be pursued at particular instances and combined at particular moments. The project coordinator and work package leaders will ensure that all work packages apply the framework in this interpretive manner, opening up the lines of inquiry that are pursued and ensuring that there is dialogue and mutual learning within and between those lines of inquiry.

This Analytical Framework (Deliverable 1.3) provides a guide as to how REINVENT develops its approach in light of the literature review and it serves as an orientation for the rest of the work of the project. The analytical framework is three-fold: first, we situate our investigation of decarbonisation within an systems perspective

and an understanding of the ‘whole economy’ which provides the basis for our approach to understanding economic ‘sectors’ as organised through value chains and production networks; second, we develop our ‘theory of change’ to enable the analysis of how transformation within such sectors takes place and the essential lines of enquiry that need to be pursued if we are to understand this complex process; and finally, we pay specific attention to how we conceive of interventions designed to foster decarbonisation and their role in creating change across and between energy-intensive sectors.

The rest of the report is organised as follows:

Part I: Develops the Whole Economy & Systems Perspective

Part II: Outlines our Theory of Change

Part III: Establishes our approach for analysing low carbon interventions

Part IV: Outlines how the Analytical Framework is used

## **Part I: Developing a Whole Economy & Systemic Perspective**

REINVENT’s starting assumption is that ‘the economy’ is fundamentally (although not exclusively) about processes of transformation through which materials (‘natural resources’) are turned into different commodities and by-product waste (Bridge 2009). In everyday language among business and policy-makers these processes of transformation are thought to take place in ‘a sector’. While sector is a slippery concept, derived from graphic visualisations of economic activities, and with many different connotations, REINVENT conceives of sectors as economic realms through which value is financed, produced, consumed and wasted. The focus for the work of REINVENT are the dynamics of low carbon transitions taking place in four sectors in which there is an intensive use of (fossil carbon-fuelled) energy and feedstock: plastics, steel, paper and food (specifically, the meat and dairy industries). While we recognise that in each of these broad sectors, distinctions can be made (e.g. between ‘fresh’ milk and ‘dried’ milk), we suggest that the commonalities in terms of the resources used, the structure of the market, the actors involved and forms of end consumption is sufficient to make these meaningful categories for initial analysis. Throughout the research conducted, we will explore how the dynamics of decarbonisation play out differently in relation particular forms of production, consumption and waste within these sectors. Our review of the literature (D1.1) found that within these sectors, there is an increasing evidence base of the potential for particular innovations/initiatives (e.g. energy efficiency technologies) to realise decarbonisation, particularly within the production process.

Despite the insights that can be derived from examining particular parts of the economic sectors involved, a key limitation in our existing understanding is that upstream/downstream dynamics are not often captured in the literature. For example, whether significant changes in building design and practice related to pressure to create low or zero carbon structures would create a shift in demand for steel. To address this limitation, rather than focusing on the production phase of the economy in isolation, REINVENT takes a *whole-economy* perspective. That is, it is concerned with the potential for decarbonisation in the ‘economies’ of energy-intensive sectors from the stages of investment financing (e.g. in how capital is secured to maintain existing production infrastructures or support innovation), resource extraction (e.g. agricultural, mining and forestry processes), production (including many different stages from primary goods to the creation of consumer objects), distribution, consumption (including business to business as well as end-use consumer), and process of waste making and recycling (Albrecht 2017). Our literature review (D1.1) suggests that important insights can be derived from perspectives developed to analyse global production networks and value chains for understanding these economies, though this work has been less concerned with the issue of decarbonisation or with processes of innovation. In order to understand these dynamics, insight is also needed from studies of *technological and social innovation* and the forms of *climate governance* that are emerging within and beyond

nation-states as part of the response to the ambition for deep decarbonisation (a point which is expanded in Part II and Part III).

Although we recognize that literatures on value chains and global production networks have tended to take an aspatial and linear approach to the working of the economy (Bridge and Bradshaw 2017), we use this approach as an entry point for analysing *the different forms of economy that decarbonisation give rise to*. In particular, a value chain/global production network perspective draws attention to the important relations across different components of the economy – finance, production, consumption, waste – that shape the possibilities for decarbonisation. For example, while attention tends to be focused on the capacities of industrial processes to be made more efficient in order to reduce GHG emissions, the ways in which shifting markets for consumption shape production are rarely considered in existing studies of decarbonisation in these sectors.

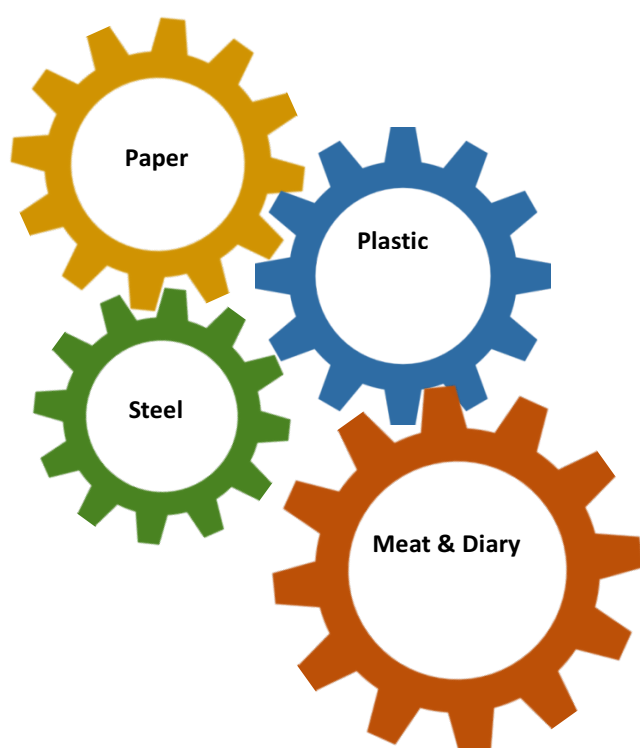


Figure 1: Interactive effects of low carbon transitions

One significant line of inquiry opened up by this perspective is the extent to which growing calls for implementing forms of ‘circular economy’ are emerging as a decarbonisation strategy. In just a few years, the idea of the circular economy (Stahel 2016) has emerged as a shared imaginary for governments, international organisations, business firms and civil society organisations as to how economies may be made more resource (and cost) efficient whilst also achieving sustainable development goals. Through engaging with the literature on value chains and global production networks which enables us to connect the drivers, pressures, demands and dynamics taking place across the whole ‘economy’ of any one sector, we will examine how far ideas and practices of circular economy are taking root in the sectors under investigation.

Despite the significant advance such a ‘whole economy’ approach provides for thinking about the dynamics and sites of low carbon transition, it should be acknowledged that it tends to reinforce an assumption that each sector can be treated as largely

separate from one another. In short, it presents a ‘siloed’ approach to the analysis of each sector. One outcome of the review of relevant literature (Deliverable 1.1) is the acknowledgement that this approach needs to be extended if we are to understand the full nature and potential consequences of low carbon transitions. Specifically, our review suggests important interactive effects between sectors which may be lost from a focus on each sector in isolation (Figure 1). One example is the rise of bio-plastics which sits at the intersection of the plastics and pulp and paper industries. The work programme is specifically designed to develop our knowledge about the interactive effects of interventions (WP3 & WP4) and their wider implications in terms of social, economic and environmental consequences (WP5).

Our analytical framework is therefore based on adopting a ‘whole economy’ approach, informed by the literature on global production networks and value chains. We use this approach to open up lines of inquiry about the ways in which different components of the economy – finance, production, consumption and waste – interact to shape possibilities for decarbonisation, but we also explicitly focus on the interactive effects

taking place between sectors and the wider consequences of low carbon interventions for economic, social and environmental issues. In WP2 we will consider the interactive effects and wider consequences of specific low carbon innovations and include the capacity to record these attributes of low carbon interventions within the database. Within WP3 we will select case-studies which enable an in-depth examination of how low carbon innovation in one sector effects other sectors, as well as their broader social, economic and environmental consequences. WP4 will develop 'sectoral innovation pathways', but we will also create scenarios that allow for the development of insights into the consequences of low carbon transitions in one sector for the others under analysis. WP5 will also enable us to follow the consequences of low carbon interventions into different societal agendas and environmental domains.

## **Part II: Theory of Change – between inertia and innovation**

While the 'whole economy' perspective developed in Part I provides the starting assumptions and scope for analysis, here we turn our analytical attention to the *dynamics of transformation* within the economies that will be in focus. Within REINVENT we adopt a broadly socio-technical theory of change, which views stability and transformation as a result of the interaction between *inertia* and *innovation*. In REINVENT we understand inertia in political, economic and technical terms – capital assets and their depreciation are interwoven with institutional systems and everyday practices that create stability around these economies.

Innovation is taking many forms, from technological developments, to the creation of 'niches' within dominant regimes, forms of social innovation and grassroots projects, to policy and governance innovations. There is a rapidly growing but highly diffuse literature examining each of these different kinds of innovation. Despite all of the different ways in which innovation is defined across these bodies of work, at their core these analyses are concerned with the ways in which *interventions* are taking place – *deliberate attempts to change existing systems*. These interventions are characterised by an *experimental* quality (of trial and error, learning by doing) and *novelty* in particular contexts and conditions. They differ in terms of the actors involved and their intentions.

Whilst some interventions are akin to the kinds of 'entrepreneurial state' action advocated by those who suggest that technological innovation and state support can create economic growth through the creation of new markets (e.g. Mazzucato 2016), others suggest that there are equally important roles for a range of intermediary actors in fostering and sustaining innovation for sustainability. These dynamics can be conceptualised through theories of socio-technical transition, which largely locate inertia within *regimes* and innovation within *niches*, though recently there is also an interest in *endogenous change* in which incumbent and obdurate regimes demonstrate the capacity for innovation and transformation. Hence, REINVENT will focus on the interplay between inertia-innovation without an a priori determination of where such dynamics might be located.

Our literature review (see D1.1) has shown that the dynamic between inertia and innovation is largely understood as shaped by conditions of political economy (the relations between the state and capital), as well as the structure of markets (density of actors, relationship between supply and demand etc.); and forms of infrastructure and investment deployed. However, the predominance of a focus on the *production* stage of economic sectors (as found in the literature survey) can serve to limit our understanding of how inertia and innovation are constituted. Broadening our analysis across the literatures on socio-technical change and climate governance suggests that in addition to the importance of moving from a 'sectoral' to 'systems' (whole economy) perspective, four entry points can reveal new insights about the dynamics of inertia-innovation, which currently receive relatively limited attention.

### *Identifying & understanding the potential of new agents of change*

Our review found in analysis of the dynamics of transformation, few actors are usually taken into account (nation-states, industrial production firms and end-use consumers). However, within any one of these economies there are multiple forms of consumers, as well as different actors working across the value-chain - for example institutional investors and knowledge providers (e.g. Burch and Lawrence 2005, Chkanikova and Lehner 2015) – that are important in constituting the dynamics of low carbon transition. Opening up the question of which are the most important agents of change in transitions and understanding their individual and collective effects would significantly enhance our understanding of how and where change might happen.

### *Developing the conceptualisation of power*

Questions of power tend to be more implicitly than explicitly discussed in much of the literature concerned with technological innovation and niche-regime dynamics. Underpinning these approaches is an assumed political economy where it is the relationship between the nation-state and the interests of economic capital invested in the production phase of energy-intensive industries that has the most significant effect in shaping the conditions of possibility for transitions. There is certainly much to support this approach, yet it also has the potential effect of discounting or neglecting other forms of power that are critical in shaping the existing inertia in systems of production and consumption and at the same time missing critical forms of power that are essential for achieving change.

### *Understanding how materialities matter*

Although analysis of the energy-intensive sector acknowledges the material and carbon embedded in such economies as central to the ways in which they extract and process resources and to their carbon intensity, the ways in which the material dimension of these economies actually shapes the possibilities for transformation are not often considered. With regard to energy-intensive value chains, the material *qualities* of resources are central in shaping the extent to which forms of circular economy are regarded as viable. Equally, concerns about the qualities and properties of material are central in shaping the dynamics of technical innovation – whether or not bio-plastics can provide the kinds of quality/value that existing plastics provide, for example, is seen as central to their development. We also found that the literature on governance initiatives indicates that being able to demonstrate particular qualities (for example through monitoring, certification and standardisation) are critical to understand the dynamics of change (e.g. Boström et al. 2015). Our theory of change therefore seeks to open up lines of inquiry as to how materialities matter in shaping the possibilities for low carbon transitions.

### *Geographies of deep decarbonisation*

While REINVENT has a specific focus on Europe, our ‘whole economy’ perspective requires that we take seriously the global economic production and circulation of resource flows, investment, product and forms of consumption/waste which characterise these sectors. This raises questions about how the spatial organisation of different value chains (within and beyond Europe) shapes their carbon intensity and capacities for transition (E.g. Coenen et al 2015). For example, the production of paper in Scandinavia has a very different carbon footprint to that in central and southern Europe, due to the availability of different resource flows, forms of power generation, markets and cultural practices (e.g. Bergquist et al 2016). The ‘telecoupling’ of different regions in global economies (e.g. of soy production in Brazil and cattle farming in Germany) shows how specific regional economic, political and cultural conditions shape the global circulation of value and material (Lenschow et al., 2016: 146). The capacities for circular economies are shaped by geographies of the flows of resource and materialities. For example, Crang et al. show how the geographies of waste materials differ for various reasons. Old ships end up in Bangladesh because of laxer environmental regulations, while discarded clothes are shaped by the different taxes, values and demands depending on whether they are processed as clothes for re-use or fibres for reweaving in India (Crang et al., 2013: 22).

Identifying these areas provides a clear basis for the REINVENT project to develop its specific contribution to advance a distinctive approach to low carbon transitions.

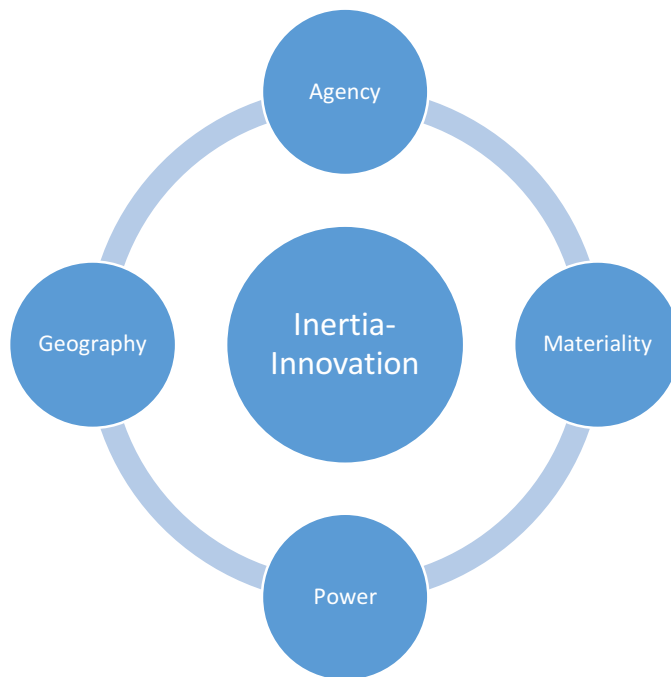


Figure 2: Conceptualising low carbon transitions

### Part III: Analysing Interventions for a Low Carbon Transition

As we elaborate in Part II, at the heart of our theory of change are deliberate interventions designed to foster low carbon transitions. Our literature review (D1.1) identifies two dominant approaches for understanding such interventions: the literature on socio-technical transitions regards such interventions as forms of social or technical *innovation* while the literature on environmental governance suggests that it is the *initiatives* (institutional, political and cultural) through which such innovations are mobilised and governed that are most significant in shaping the potential of low carbon transitions. Both approaches are *analytical* in focus – seeking to examine from the evidence generated how the dynamics of intervention unfold. This is in contrast to more *normative* approaches to interventions which seek to prescribe particular forms, techniques, policies, technologies etc. as the means through which transitions can be achieved. In line with the interpretative approach adopted within the project, our analytical framework does not seek to predetermine which forms of interventions might (and might not) be significant in terms of fostering low carbon transitions. Rather, within REINVENT we draw on both these approaches to conceptualise the dynamics of intervention, acknowledging the diverse competencies and interests of the research team and the importance of retaining a requisite diversity of perspectives in order to generate the explanatory power required for complex problems such as sustainability transitions. To generate this approach, we develop a *layered* analytical approach to analyse how interventions are developed and deployed and with what consequences according to the following stages:

- a. Innovation dynamics: conditions for the emergence and acceleration of social/technical innovation
- b. Governance initiatives: arrangements and forms of governance through which innovation is mobilised
- c. Intervention Capacities: social and material practices through which interventions are/not realised
- d. Uptake: the processes through which innovations are circulated, embedded and normalised

We can define a low carbon *innovation* as a social/technical novelty that seeks to develop a product, process, practice or service that reduces carbon (in comparison to existing modes). Innovations may be technical, social, economic, institutional and so forth. Such an innovation may operate in multiple sites (e.g. Meat free Mondays) and its 'biography' could be traced at multiple scales, through different sites and iterations. We define a *governance initiative* as the institution, arrangement or mode of governing through which such innovations emerge and are mobilised. This could take the form of a transnational partnership or a specific institutional context (e.g. local government, an industry body, hospitals, schools) within which innovations are promoted, trialled, enacted etc. Hence while such governance initiatives may themselves be experimental (e.g. new forms of public-private partnership) they do not necessarily need to be in order to provide the contexts through which innovation decarbonisation takes place.

It is the intersection between innovation/governance initiatives that we focus on this project. Rather than tracing individual innovations through multiple sites/geographies, we are interested in understanding the conditions, drivers, practices and consequences as innovations are embedded and circulated through particular forms of governance initiative. We describe these as specific interventions (e.g. Meat free Mondays enacted by public schools in Sweden) and seek to understand their *capacities* and degree of *uptake*.

### ***Innovation Dynamics***

The conditions for innovation are shaped (as discussed above) by the forms of agency, power, materiality and geographical dynamics that produce both inertia and the possibilities for change. Adopting the perspective of socio-technical approaches for the understanding of sustainability transitions, we see that such dynamics are shaped by the relation between existing *regimes* and emerging *niches*. In keeping with recent work in the field, we suggest that regimes can be multiple, fragmented and partial, and that niche innovations may emerge both from within and outside existing regime configurations. The conditions for the emergence of innovations relate to three set of dynamics: shielding, nurturing and empowerment (Smith & Raven 2012). Key processes that create these conditions *within niches* are thought to include the production of collective visions, the development of social networks, and learning (Frantzeskaki et al. 2012; Frantzeskaki et al. 2014; Raven et al. 2008; Schot and Geels 2008). Recent work also suggests that processes *within regimes* are critical. Rather than single niches 'out competing' the regime and leading to a transition from one socio-technical configuration to another, the process of change can be theorised as one of 'endogenous enactment' in which shifts between transition pathways occur as the result of shifting actor coalitions, struggles and adjustments in formal rules and institutions (Geels et al. 2016). Deliberate processes of 'creative destruction' which seek to destabilise existing regime configurations may also be important in creating the conditions for the emergence and acceleration of social and technical innovation (Kivimaa and Kern 2016).

Within REINVENT we will draw on these key analytical entry points to consider the dynamics of shielding, nurturing and empowering that take place in relation to specific innovations; the roles of visions, social networks and learning in fostering innovation; and the ways in which shifting coalitions, struggles and changes in rules and institutions create the conditions for the emergence of alternatives. We will pay particular attention to the forms of agency at work, the ways in which alternative perspectives on power can reveal new insights about the dynamics of inertia-innovation, how the qualities and distinction of particular materialities shapes the possibilities for change, and the geographical dynamics of emergence and stability.

### ***Governance Modes***

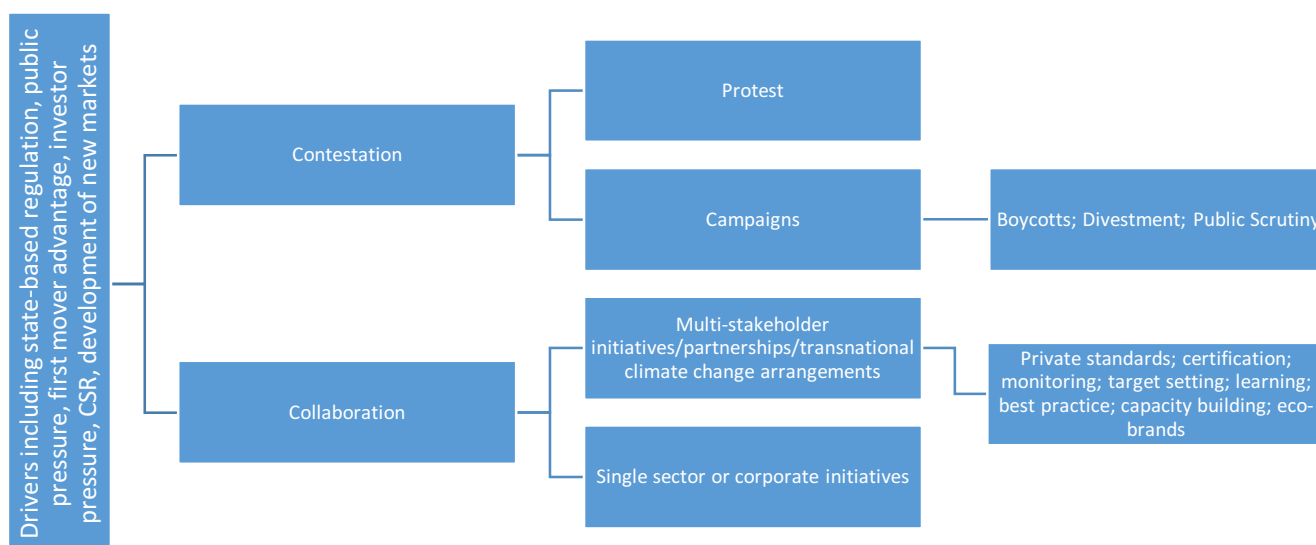
Social and technical innovations are deliberate interventions and as such involve some form of *governance*. Governance can be undertaken by state and non-state actors and is commonly understood as the authorised use of power. Rather than taking place in specific institutions (e.g. multi-lateral agreements), governance



initiatives are arrangements/modes that occur at multiple, diverse sites and across different levels or institutional arrangements (e.g. within a business, community, or city, through transnational arrangements or state-to-state co-operation). Governance initiatives are now widespread in many arenas of climate governance and within some value chains (notably those related to food, fisheries and forests). The literature (surveyed in D1.1) identifies two primary modes – those based on *conflict* and those rooted in *collaboration*. We suggest that such governance initiatives are important means through which forms of social and technical innovation are fostered, deployed and mobilised. Our analysis will seek to understand how features of the governance initiatives established to foster low carbon transitions enable and constrain innovation and serve to foster endogenous change within regimes or maintain inertia. The schematic below (Figure 3) provides an initial illustration of the different forms that governance initiatives may take in relation to the two dominant modes of conflict or collaboration.

Through REINVENT we will examine the agency and power involved in establishing and maintaining governance initiatives, and the ways in which they serve to reconfigure socio-materialities and geographical dynamics in order to enable/constrain the potential for low carbon transitions. Our work will particularly consider how such interventions operate within, between and across different intensive industry sectors, in order to take account of their systemic contribution to low carbon transitions and their consequences for other environmental, economic and social goals. The database developed in WP2 will provide insight into the forms of governance initiative that are emerging on the ground in relation to the sectors included in the REINVENT analysis while the innovation biographies (WP2) and case-study research (WP3) will enable us to undertake in-depth analysis on the relationship between different modes/forms of governance intervention and the innovation dynamics required for a low carbon transition.

Figure 3: Schematic of Modes & Forms of Governance Initiatives for Low Carbon Transitions



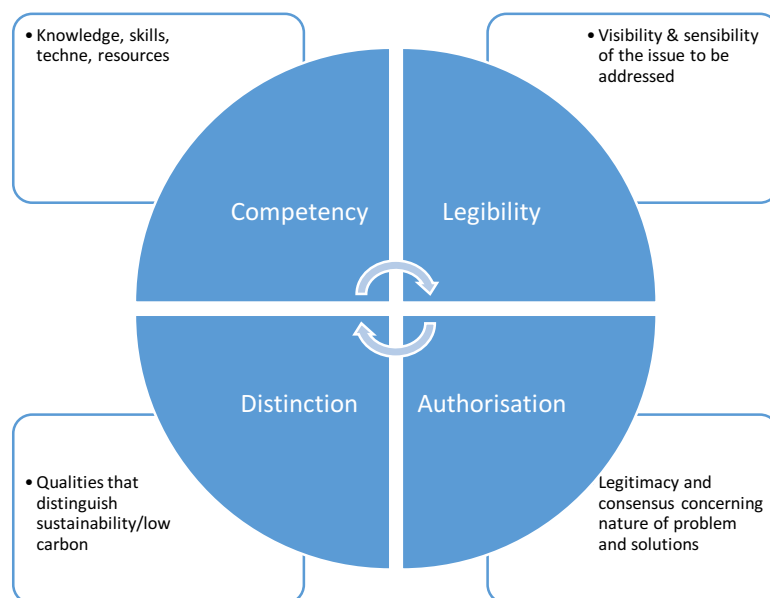
### ***Intervention Capacities***

Our third layer of analysis will attend to the capacities that enable interventions to realise their potential. This analysis operates at the ‘micro’ level, examining the work and practice of interventions (understood as the combined input of governance initiatives and social/technical innovations that they undertake) and how this shapes their ability to realise their objectives. Our initial analysis of the literature suggests that four sets of capacities may be important in realising the potential of innovations and governance initiatives (Figure 4). First, issues of *competency*, which include forms of knowledge, skills and resources to undertake the work of

transitions. Second, *legibility* – the capacity to create a shared vision and sense of the potential for innovation and how its effects can be calculated and made commensurate with other values, goals and drivers. The third, *authorisation*, relates to the ways in which the capacity to govern is afforded through generating legitimacy and consensus in relation to the nature of the problem to be addressed and the viability of the solutions that are proposed. Finally, the capacity of being able to generate *distinction* relates to the work involved in being able to distinguish low carbon entities/processes/practices from incumbent high carbon alternatives in ways that allows their value to be recognised, communicated and mobilised.

This assessment of the requisite capacities of interventions is necessarily preliminary, given the limited research that has sought specifically to analyse how interventions in the emissions intensive industries are able to create the capacity to be realised on the ground. Our case-study work (WP3) will start with these preliminary categories, which will be refined as the work is undertaken in an iterative manner and further capacities identified and added to the explanatory framework.

Figure 4: Capacities Required to Realise the Potential of Interventions for Low Carbon Transition



### ***Uptake***

Our final level of analysis involves examining the dynamics through which innovations are ‘taken up’ in the wider economy. There is a lively and ongoing debate within the research field as to how, if at all, niche innovations are ‘scaled up’ such that they are circulated, embedded and normalised. Review of existing research on these dynamics is ongoing and hence the specific dynamics and criteria that will be analysed in REINVENT has not yet been finalised, but this will provide an important aspect of the scoping of the case-study work (D3.1).

## **Part IV: The Framework Put to Use**

It is key to the success of REINVENT (being an integrate project; making a distinct contribution to the literature) to let the joint framework guide our work in specific WPs. REINVENT works towards the four areas: (1) Identifying new agents of change, (2) Developing the conceptualisation of power, (3) Understanding how materialities matter, and (4) Geographies of deep decarbonisation, and has the potential to advance the agenda of low carbon transitions/pathways (the how/why) significantly forward through innovative work at the intersection of inertia/innovation and a wide suite of empirical work.

The layered approach developed primarily for analysing interventions (i.e., the case studies in WP3) is also highly relevant to other WPs. Innovation dynamics, governance modes, intervention capacities and uptake are key dimensions that will guide the work in several tasks. Below is a list of how the framework is, and tentatively will be, used in each WP.

### **WP2**

The framework has shaped the structure of the sectoral ‘review of potentials and capabilities’ (Task 2.1) through highlighting agency, power, materiality and geography, as well as ‘interactive effects’. One example is the implications of bio-based plastics on forestry and agriculture through increased demand for biomass. Plastics, paper and food are strongly connected through land-use. Another example is the importance of assessing intervention capacities linked to the potentials that are identified. The capacities required (as well as the agency, power, materialities and geographies involved) for hydrogen steelmaking are very different from those required for plastics recycling. In the mapping of interventions for a Low Carbon Transition (Task 2.2), part 6 of the database (i.e., Drivers of innovation) draws directly on the governance initiative part of the framework. Task 2.3 does not explicitly relate to the analytical framework since it builds on a well-defined method for “innovation biographies” as detailed in the Work Plan.

Consecutive work on quantification (Task 2.4) and pathways (2.5) needs to pay close attention to the ‘third layer’ of analysis; including the capacities that enable interventions to realise their potential (Figure 5). Do emerging low carbon pathways contain the necessary capacities (competency, legitimacy, authorisation, distinction) that allow them to be taken up, and shape, the wider economy.

### **WP3**

The framework has directly informed and shaped the Research Protocol (D3.1). The research protocol provides the conceptual basis and guidelines for selecting and conducting case studies in Tasks 3.2 and 3.3. Based on the analytical framework, the research protocol adopts the layered approach which distinguishes between innovation dynamics (a), governance initiatives (b) intervention capacities (c) and uptake (d). These layers are consistently translated into research themes and research questions which are used by the case study teams to develop questionnaires for their specific case studies. Notably, not all research themes and questions deriving from the analytical framework can be addressed at the same depth and level of detail in all case studies. However, the scope of themes and questions builds a comprehensive framework for the case study process. The comparative structured analysis of case studies in Task 3.4 then automatically follows the analytical framework. Task 3.5, however, on environmental, economic and social impacts ask questions that partly go beyond the analytical framework

#### **WP4**

A major part of the work in WP4 concerns meta-analysis of scenarios as well as modelling and development of scenarios for decarbonisation and the analytical framework is not directly applicable (but useful e.g., in highlighting the importance of innovations that are not production oriented). The framework will be directly used to structure the work under the important task of co-creating and co-designing pathways in Task 4.3. Whereas underlying scenario analyses show the potentials of decarbonisation (i.e., what, including interactive effects, not least between sectors and with the energy system) the workshops will address questions concerning how and who (i.e., building on the layered approach where inquiries are made about governance, capacities and uptake) thus adding this important dimension to the scenarios. The workshops will be partly stakeholder-driven but narratives based on the layered approach is a desirable outcome.

#### **WP5**

WP5 enables us to follow the consequences of low carbon interventions into different societal agendas and environmental domains. The different approaches used in WP5; input-output models, global value chain analysis, IAM modelling, global governance approaches are in different ways sensitive to insights that have emerged in the framework. WP5 adopts a higher level systemic perspective in order to investigate non-climate synergies and trade-offs associated with decarbonisation processes. Hence, it fits within the broader philosophy of the analytical framework, which is holistic and systemic. Specifically, Task 5.1 falls immediately under Part I of the framework 'Developing a Whole Economy & Systemic Perspective'. Tasks 5.2 and 5.4 are guided by the conceptualisation of governance and governance modes as explained in Part III of the analytical framework 'Analysing Interventions for a Low Carbon Transition' in pursuing their analysis on policy coherence and multi-level governance analysis. Task 5.3 includes material and geographical implications and fits into Part III of the framework particularly with regard to 'intervention capacities' but the links can be more clearly articulated.

#### **WP6**

In REINVENTs analytical framework, interventions are key to understand how change comes about, between the dynamics of inertia and innovation. The layered approach is key for understanding how decarbonisation can be scaled-up (Task 6.1) and how momentum for transformation (Task 6.2) can be achieved. Task 6.3 is about building capacity for low carbon transformations and the layered approach focus on four key capacities: competency, legibility, authorisation, and distinction. The decarbonisation portal will focus on these capacities oriented at 'the micro level', the level of decision making in organisations, administrations, cities, and business firms etc. The portal will provide easy examples and checklists of the capacities that enable interventions to realise their potential. The framework is directly related to Task 6.4 (to develop a new approach to transition policy evaluation). The need to develop new forms of evaluations arise from the insight that large-scale system change — the dynamics between innovation and inertia — cannot be evaluated with the same methods that have been traditionally deployed with regard to policy evaluation (typically focused on single instruments). REINVENT will evaluate change with a much broader scoping of the 'agents of change', required capacities, and a good sense of the political, geographical and material contexts. In Task 6.5 we have the opportunity to reflect on implications of the framework for modelling in the future and Task 6.6 can draw on cases that illustrate how the required capacities (competency, legibility, authorisation, distinction) needed for decarbonisation can be supported and developed.

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