REINVENT – PROJECT NR 730053

Policy coherence between the EU climate regime and the global sustainable development agenda

Deliverable 5.2

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Summary

Deliverable 5.2 analyses the policy coherence within EU climate policy, and between EU climate policy and the global sustainable development agenda, as expressed in the UN Sustainable Development Goals (SDGs). Coherence in this task refers to the systematic promotion of synergies between climate policy objectives for the four sectors under study (food, steel, paper and plastic), as expressed, for instance, in the EU's 2050 low-carbon economy climate action and associated roadmaps, and relevant Sustainable Development Goals. The task also examines the competing, overlapping or synergistic relationship between decarbonisation innovations initiated by private actors and relevant Sustainable Development Goals, what some scholars refer to as institutional coherence (Bernstein 2017), as part of our policy coherence analysis. Our analysis demonstrates coherence within EU climate policy, particularly evidenced in the EU's revised bioeconomy strategy, the Circular Economy Package, renewed industrial policy strategy, rural development policy and the continuing calls for changes to the Common Agricultural Policy. Additionally, the majority of sector-based decarbonisation innovations showed coherence with the objectives of the Sustainable Development Goals. A pattern emerges here where those innovations incoherent with their related EU policy areas remain incoherent for achieving the Sustainable Development Goals. Finally, we find that, while the EU has made a concerted effort to improve synergies in policy coherence, this has dominated over the aspect of removing inconsistencies within a system.

1. Aim & deliverable structure

In this deliverable we unpack the concept of coherence itself, and examine how coherence has been approached within EU climate policy, as well as how coherent EU climate policy is with the 2030 Sustainable Development Agenda, and specifically the Sustainable Development Goals (SDGs). Coherence in this task refers to the systematic promotion of synergies between climate policy objectives for the four sectors under study (food, steel, paper and plastic), as expressed, for instance, in the EU's 2050 low-carbon economy climate action and associated roadmaps, and relevant Sustainable Development Goals. The task also examines the competing, overlapping or synergistic relationship between decarbonisation innovations initiated by private

actors as identified in WP3 and relevant Sustainable Development Goals, what some scholars refer to as institutional coherence (Bernstein 2017), as part of our policy coherence analysis.

Overall, D5.2 aims to contribute to a better understanding and long-term vision on low carbon technological development and deployment in Europe, within the context of broader global governance. In the context of the overall REINVENT project, the work undertaken here is complemented by D5.3 in which the integrated modelling framework IMAGE is used in order to examine the interlinkages between the four sectors and the associated economic, environmental and social equity impacts for the EU and for the globe, providing a more comprehensive approach between decarbonisation innovations and their impacts.

The report is structured as follows: after the introduction (section 2), we discuss the concept of policy coherence as it appears within academic literature (section 3). This is followed by the methodology (section 4), and the presentation of results (section 5). In section 6 we discuss what our results mean for policy coherence between the EU climate regime and the global sustainability agenda, before we conclude the analysis (section 7).

2. Introduction

Sustainability challenges, such as decarbonisation, are coupled with and aggravated by strong path-dependencies and lock-ins observed in existing sectors. In order to address issues of how to promote and govern a sustainability transition, dilemmas of collective action must be resolved. One such dilemma is that of coherence within policy mixes. Policy coherence is considered by scholars and practitioners as a necessary condition for achieving sustainable development goals (Stafford-Smith et al., 2016). Coherence is seen as being able to provide a way to overcome fragmented institutional arrangements, agendas and actions (OECD, 2019).

This is especially the case when the achievement of the goals themselves require action across a wide spectrum of socio-economic activities and are multi-causal with complex interactions – such as the environmental goals within the Sustainable Development Goals (SDGs) agenda. This is also noted within the SDGs agenda, with target 17.14 focused specifically on enhancing policy coherence as a key means of implementation (OECD, 2019). To achieve this, the OECD acknowledges that policy coherence will require meaningful collaboration and co-ordinated action across policy sectors and level of government, alongside the reconciliation of short-term priorities with long-term goals. Importantly, this means that coherence is not primarily about

sorting out the zones of overlapping competency and competition, nor does it reside in particular institutions (Bernstein, 2017). We therefore consider coherence among institutions (institutional coherence) an element of policy coherence within this study.

Despite the calls for policy coherence on an international level and the emphasis on its importance in achieving the SDGs, there is little empirical research on the topic. Furthermore, policy coherence as an analytical concept is ambiguous and lacks a standardised definition (Rogge & Reichardt, 2013). It is also closely related to other terms and concepts, such as policy integration, policy interaction, policy interplay and policy mixes, which all deal with the compatibility and consistency of policies (Huttunen et al., 2014). For a concise definition, coherence in this report will refer to the systematic promotion of mutually reinforcing policies and synergies between the EU policy objectives after the establishment of the SDG agenda in 2015 and the decarbonisation of four sectors under study: meat & dairy, steel, paper and plastic. However, as policy coherence as an objective is loosely defined, this report goes further to examine the role of policy coherence within the EU policymaking. In particular, the understandings of policy coherence and the processes in creating policy coherence itself must be analysed. This is particularly pertinent given that many calls for policy coherence for sustainable development work under an *a priori* assumption that more policy coherence will equate to better outcomes. The analysis of policy coherence is approached in three parts: the first part addresses policy coherence between EU climate policy and decarbonisation objectives within the steel, paper, plastic, and meat & dairy industries. The second part then addresses the coherence between decarbonisation innovations highlighted by REINVENT and the SDGs, followed by the third part which assesses the coherence between key EU climate policy documents and the SDGs. Finally, these results are combined to answer the question of policy coherence between EU policymaking and global sustainability objectives.

The four sectors

This report focuses on the steel, plastic, meat & dairy, and paper sectors four industrial areas that are financially important, but where low-carbon transitions are still relatively unexplored. This section explains the importance of these sectors and their relevance for this study.

Steel is a core material in modern societies, essential for construction but also demanded by the automotive industry and required for machines and metal-ware. The properties of steel can be adjusted to fit a wide range of applications by adding alloying elements and through casting and rolling into different shapes and physical properties. Despite the advantages of steel as a

material, the sector is one of the most energy intensive industries, causing 7% of global energy-related GHG emissions (IEA 2017). These GHG emissions are due to the use of fossil fuels as reduction agent and energy source for the production processes: reduction of iron ore, melting of the steel, the rolling, forming and fabrication as well as to the characteristics of steel as iron-carbon alloy (World Steel Association 2018b). The track record of innovations in the steel industry has been incremental and focussed on productivity and efficiency gains. The steel industry is characterised by large companies, high market entrance barriers (particularly to primary steelmaking) and a pressure to merge. The industry typically faces high fixed costs and low profit margins. In combination with long investment cycles the development and implementation of radical innovations has been slow.

Plastic

Plastics are integral to modern and sustainable societies. Their applications range from protecting food and helping reduce food waste, enabling the design of lighter vehicles, facilitating efficient transmission of electricity as an insulator in cables, and are key components in modern buildings and constructions. Plastics offer many solutions to environmental problems, not least to reduce greenhouse gas emissions in other sectors, but they also generate new ones. The problems associated with plastics are not new and include the use of limited feedstocks, greenhouse gas emissions, toxicity, littering and pollution, and low levels of collection and recycling, but awareness has increased in recent years. Especially the issue of accumulation of plastic materials in marine environments has risen on the global agenda, largely thanks to a recent report which pointed out that there could be more plastics than fish, by weight, in our oceans by 2050 if current trends continue (World Economic Forum et al. 2016). The fundamental question of resource use for the production of plastics, which is currently completely dominated by petroleum fractions as feedstock, has however hitherto largely been ignored in the public discourse. A society that aims to become independent of petroleum for energy purposes must also address other uses of the resource, such as chemicals and plastics. The European Commission published its plastics strategy in early 2018 as part of the circular economy package in order to lay the foundation for a new and more sustainable use of plastics (European Commission 2018a). The EU Plastics Strategy does however make few claims about the problems of using fossil feedstock, e.g. carbon dioxide emissions, but is highly concerned about the sustainability of feedstock for bio-based plastics. Increased recycling will reduce the need for fossil feedstock but due to downgrading of plastics in the use and recycling phases

there will be a continued need for virgin material. In addition, global production is expected to increase.

Paper

The pulp and paper industry belongs to the energy intensive industries, a group that also includes producers of for example cement and iron and steel. Compared to other energy intensive industries, pulp and paper has a fairly low carbon intensity due to the high share of bioenergy which accounted for 59 % of the fuel use in 2016 (CEPI, 2018). This industry handles large volumes of wood and thus has an important role in the development of the bio-based economy. It has so far focused primarily on producing pulp and paper but is showing a growing interest in developing forest biorefineries with a more diversified product portfolio that also includes for example chemicals and transportation fuels. The development of forest biorefineries is considered to be central to the decarbonisation of the transportation and chemical/plastic sectors.

Meat & Dairy

Research conducted by Ritchie (2017) recorded the global production of meat and dairy products in 2016 at 330 Mt carcass weight and 810 Mt raw milk, respectively. This represents a 4-fold increase from 50 years ago (for meat) and more than double increase for milk, with consumption increasing as the world gets richer. Agricultural land accounts for 50% (51m km2) of the habitable land on the planet and as of 2019, nearly 80% of this available land was dedicated to meat and dairy production (including grazing land and arable land for animal feed). Despite only accounting for 18% of the global calorie supply, and 37% of the global protein supply, the meat/dairy industry commands a large portion of land use and resources. Food production accounts for nearly a third of our global CO2 emissions. Production related emissions for the meat/dairy industry account for 31% of these, not including land use and supply chain emissions, which represent a further 24% and 18% of global emissions respectively. With more than 570 million farms producing in almost all the world's climates and soils, finding pathways for decarbonisation appears high on national agendas. (Poore & Nemecek, 2018).

3. Coherence in the academic literature

To analyse policy coherence, the term must firstly be defined. A term which has a multiplicity of definitions within organisations and academic literature, policy coherence can be understood

through the established OECD (2004) definition used in the field of international development - the systematic promotion of mutually reinforcing policy actions relevant to developing countries, creating synergies across government departments. It is the acknowledgement of the 'trade-offs and potential synergies across such areas as trade, investment, agriculture, health, education, the environment and development co-operation in support of the internationally agreed development goal' (OECD, 2004).

Within the academic literature on policy coherence, definitions vary but revolve around two distinct actions: the reduction of conflict between policies, and the promotion of synergies. Nilsson et al. (2012) define policy coherence as "an attribute of policy that systematically reduces conflicts and promotes synergies between and within different policy areas to achieve the outcomes associated with jointly agreed policy objectives". Alternatively, it can be seen as the "systematic promotion of mutually reinforcing policy actions across government departments and agencies creating synergies toward achieving the defined objective" (OECD, 2004) or "the processes of policy making and implementation, ensuring that the elements of the policy mix are not in contradiction with one another or may even reinforce one another" (Rogge and Reichardt, 2013). Kivimaa and Virkamäki (2014) further elucidate the concept of policy coherence in the realm of sustainability transitions. Transition-related policy coherence, based on Kivimaa and Virkamäki, not only implies the absence of contradictory policies but also includes support for the variety of processes behind niche formation. Policy coherence for sustainability transitions requires policy mixes supporting several processes behind new niche formation, coupled with the identification and removal of policies hindering transitions.

When assessing the synergies and trade-offs between policy areas it is necessary to understand how different policies interact. This has been identified by Oberthür and Gehring (2006) as a cause-effect relationship in which decisions made under one (source) policy or institution affect the effectiveness of another (target) policy or institution, which can occur at any level of institutional structure or policy making . These interactions exist on horizontal and vertical levels; where *horizontal interplay* is the interaction between policies and institutions at the same level of governance (e.g. national or regional policies), while *vertical interplay* is the interaction between policies and institutions at different spatial scales of governance (Young, 2002). These interactions can be positive (enabling) where the direction of one policy is supported by measures from another or negative (constraining) where one policy undermines the effectiveness of another (Oberthür & Gehring, 2006; Urwin & Jordan, 2008). Furthermore,

positive interactions in one direction (horizontal or vertical) have been observed to create positive interactions in another (Kalaba et al., 2014). Nilsson et al. (2012) highlight that, in the context of policy analysis, the equivalent of interactions between institutions can be interactions between policy outputs and implementation practices, and outline the multi-scalar and multi-domain interactions between policy mixes in relation to coherence (see Figure 1), focusing their approach on coherence said outputs (e.g. objectives and associated implementation arrangements, such as decarbonisation roadmaps). In this context, some scholars use the term institutional coherence to refer to synergistic and inter-institutional coordination among organisations to develop mechanisms for monitoring the impact of overlapping policies, assessments of progress in implementing agreed commitments or common goals, and mechanisms for addressing poor or negative performance (Bernstein, 2013, 2017). Within this study institutional coherence is recognized as part of the broader field of policy coherence. Empirically, this is mainly addressed in the analysis of coherence between decarbonisation innovations in the four sectors and the Sustainable Development Goals.

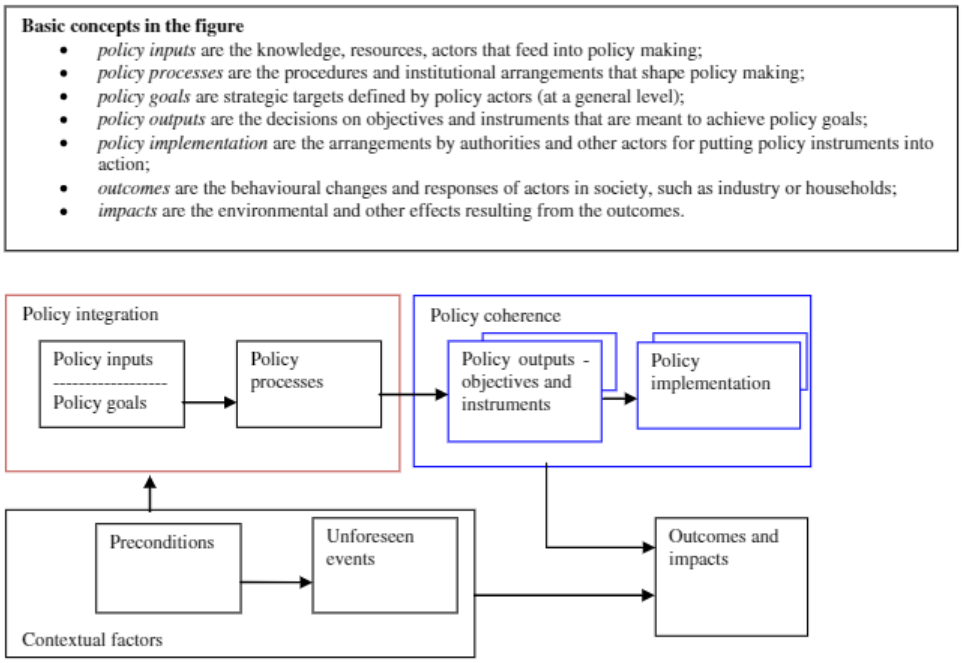

Figure 1 Policy coherence in a policy-analytical framework, taken from Nilsson et al., (2012)

Overall, coherence for this study refers to the synergies within a *policy mix*, in this case relating to the EU's climate policy and the four sectors of steel, meat & dairy, plastic, paper. A policy mix represents a combination of several policy instruments, alongside the processes by which said instruments emerge and interact, and the effects of this interaction (Flanagan et al., 2011). Following Rogge and Reichardt (2013), a policy mix can be envisioned as a combination of

elements, processes and dimensions. Broken down into these attributes and based on this framework, it is possible to examine the areas which are (in)coherent with others. *Elements* comprise of the policy strategy (its objectives and plans) as well as the interacting policy instruments. *Processes* refer to the processes of policymaking and implementation. Elements and processes have attributes, or *dimensions,* such as policy field, governance level, geography, sector, technology, value chain position, actor and time.

Given the many different understandings of policy coherence, Rogge and Reichardt (2013) identified three important points to take into account to reduce ambiguity when discussing policy coherence. Without first establishing a consistent understanding the ambiguously defined characteristics may impact the performance of a policy mix, particularly regarding effectiveness and efficiency. When characteristics are referred to without clarifying which definition they are applying, it renders it difficult to assess what is actually meant. The three points are as follows: firstly, consistency and coherence are either seen as identical or different characteristics affecting policy mixes. The authors define consistency as the *absence of contradictions,* while coherence calls for an *achievement of synergy or positive connections.* Here, coherence is defined to encapsulate both characteristics and will be describe as 'weak' coherence (no contradictions) and 'strong' coherence (generating synergy).

Secondly, there must be a distinction between a *state* and *process perspective* of coherence, i.e. coherence in **what** is being achieved and coherence in **how** it is achieved. For this analysis, coherence will follow Nilsson et al. (2012) in defining it as coherence within policy objectives – as in coherence in what is being achieved in relation to the main objective of decarbonisation. Finally, there is no common understanding of the terms consistency and coherence, and how they relate to other concepts such as coordination and integration. There should be a focus on the tools – such as policy instruments - for enhancing consistency and coherence, a discussion closely linked to policy coordination (formal policy process aiming to get the various institutional and managerial systems which formulate policy to work together) and integration (the incorporation of environmental objectives into all stages of policymaking in non-environmental policy sectors). Policy instruments reveal a specific mode of conceptualising the practice of governance, and the instruments themselves constitute a form of social control (Lascoumes & Gales, 2007). The instruments themselves are not neutral, they produce specific effects, independently of the aims ascribed to them, and structure public policy according to their logics (ibid.). Thus, focusing on policy instruments, and on the implicit assumptions of

the policy instruments themselves, can illuminate whether or not the instruments provide a coherent strategy towards sustainability goals.

Rogge and Reichardt's three points touch on answering a main critique of policy coherence as a policy objective – the fact that the term is left ambiguous. Further criticism includes the move towards what Schmitz and Eimer (Schmitz & Eimer, 2019) term as 'coheritization'. This is the move from viewing coherence as a discourse on the effectiveness of external policy, towards a broader practice which legitimizes certain practices (in their case, free trade policies in the relation to discourse on international development) via the integration of limited critique to said practices. Schmitz and Eimer note that the SDGs have played a role in transforming coherence to a whole-of-government approach, done through the integration of environmental goals into other policy domains. The primary focus on increasing policy coherence – in a way which emphasises coherence as a state rather than a process – has given primacy to the positive sides and potentials for synergies over the potential negative effects between policy-areas (Schmitz and Eimer, 2019).

The overlooking of these potential negative effects of policy coherence may affect the efficiency in achieving the SDGs. By placing focus on coherence as process to be achieved, it focuses the energy of policymaking on creating internal consistency in the form of improving instrument rationality. As noted by Parsons (2004), it could be possible that the focus on building the capacity for instrumental rationality – so as to secure specified outcomes and targets, such as the target state of coherent policy – risks actually reducing the capacity for flexibility, innovation and adaptability which is vital for planning for the uncertain world. Given the necessity to foster innovations and transitions towards a decarbonised economy – especially through linking sectors and actors in the form of integrated development plans for sustainable development (Stafford-Smith et al., 2016), it is important to explore the understandings of policy coherence within the EU.

4. Methodology

The methodology of this report was executed in three parts: 1) coherence of EU climate policy within the four industry sectors of steel, plastic, paper, and meat & dairy; 2) coherence between sector-based initiatives and the SDGs; and 3) coherence between key EU policy documents and the SDGs. The aim of the first step was to examine the horizontal interplay of policies regarding climate and the four sectors to establish the extent of coherence within EU policy development.

The second and third step both refer to vertical interplay, examining first the interactions between multi-scalar decarbonisation innovations from the four sectors and the objectives of the SDGs, followed by the interactions between EU policies the four sectors and the SDGs.

4.1 Coherence of EU climate policy within steel, plastic, paper, and meat & dairy sectors

Firstly, the understanding of coherence in the EU was analysed. This was done through a literature review combined with a review of policy documentation which used the specific term "policy coherence" in EU policymaking. Regarding the literature review, academic literature and evaluative reports were used. Here, policy coherence related specifically to policy coherence for development (PCD) and policy coherence for sustainable development (PCSD) as this is the EU's understanding of the term. Regarding the review of policy documentation, the results contained brief early mentions of policy coherence in the 1990s, to the development of policy coherence as an objective in the 2000s post-Lisbon Treaty. This provided the foundational basis for comparing coherence within the EU with the academic literature's understandings of coherence.

Secondly, a scoping search of policies relating to the four sectors were completed. This was completed in order to get a broad sense of the discussion pertaining to the four sectors, whether or not the discussion was related to the objective of decarbonisation. This directly assisted in the creation of the exclusion and inclusion criteria, used to determine which documents were selected for analysis. Furthermore, it identified the associated policy objectives connected with these domains, which led to the creation of the 'cross-cutting policies' category for policies which affected the four sectors, but were not within only the domain of the four sectors (Appendix 1). Based on this search, the relevant policy domains include the sector-specific policies of the four sectors; environmental protection policies, regional development policies, industrial policy, innovation and research policies, energy policy and waste management policy.

To operationalise the inclusion criteria during the scoping search, key terms were selected through the use of the EuroVoc thesaurus. The EuroVoc thesaurus is a multidisciplinary tool in which the EU's activities are sorted into 21 domains and 127 sub-domains, and is used to label the content of the EU's document output. Documents were gathered through the EU legal database www.eur-lex.europa.eu for the time period beginning from 2015 to 2019. If key terms were not present in the EuroVoc thesaurus, specific search terms were used instead (e.g.

'sustainable dairy'). The scoping search followed an inductive iterative approach, wherein the contents of documents selected would generate further search terms. Given the breadth of EU policy, the iterative approach simultaneously defined the selection criteria and created the database.

122 policy documents were collected during the scoping search for the database (Appendix 2). This was then a qualitative content analysis. A qualitative content analysis was carried out on 14 selected policy documents pertaining to the four key sectors – meat and dairy, pulp and paper, steel and plastics – alongside cross-cutting policy documentation relating to the four sectors. The documents gathered relate to the European Commission, the European Parliament, European Committee of Regions and the European Economic and Social Committee. The 14 documents selected for Section 4.1 were determined based on the inclusion and exclusion criteria. The following conditions were considered for document inclusion: firstly, the documents must relate to the four sectors. Furthermore, documents should broadly relate to climate change and/or sustainable development. Regarding exclusion criteria, only documents which placed a substantive focus on the sectors (i.e. more than a brief mention or repetition from a previous document) were considered. When considering policy documents which had amendments or follow-ups, the most recent version was considered while the older versions were excluded.

The qualitative content analysis involved identifying the objectives and instruments within the policies, and if they are coherent with the goal of decarbonisation. Using the definition of coherence as presented in the introduction, coherence can be assessed through the policies objectives and instrumentation (Nilsson et al., 2012). This section relates to the analysis of horizontal interplay or *internal* coherence within the EU policies themselves. Here, policy objectives within and across the relevant domains and the associated instrumentation were assessed as to whether or not it is coherent. In order to do so, the typology as presented in the study by Huttenen et al. (2014) (see Table 1) was used to categorise policy instruments by function. The policy instruments listed in this typology are seen as necessary 'system functions' to assist in transitioning to new technologies and innovations. Based on the existence (or non-existence) of all the necessary 'system functions' within the EU's chosen policy instrumentation in order to enact the objectives outlined, it is possible to assess whether or not the EU's policies can be

Table 1
Analytical framework for using technological innovation systems for policy analysis (slightly modified from Kivimaa and Virkamäki, 2014).

System function	Description	Type of policies related to the function
Knowledge development and diffusion	Knowledge base and networks; how the knowledge is developed, combined and diffused	R&D funding schemes, educational policies, informational instruments
Influence on the direction of search	Incentives and pressures for organisations to enter a field, including visions, expectations and demand	Policy discourse, targets set in strategies, regulations, tax incentives, foresight exercises
Entrepreneurial experimentation	Testing of new technologies, applications and markets in a way that new entrepreneurship and diversification forms	Funding for research and demonstration projects, tightening regulations, educational policies
Market formation	Factors driving new market formation, e.g. changes in customer or institutional demands and prices	Regulation inducing niche markets, fiscal policy, market-based policy instruments, public procurement, demand-side management
Legitimation	Social acceptance and compliance with institutions and society	Problem and justification framing in policies, public participation in the legislation preparation and permit processes, stimulating public debate, educational policies
Resource mobilisation	Financial and human factors and complementary assets as inputs for development	Subsidies, educational policies, secondment of expertise, provision of risk funding
Development of positive externalities	Benefits to other actors, e.g. by reducing uncertainty, cost sharing or lobbying influence	Policies for R&D funding, investment support, informational instruments, open and participatory policy processes

Policy documents were firstly identified via a scoping search, leading to 122 documents. This was then followed by the creation of a database, and then the content analysis. A qualitative content analysis was carried out on 14 selected policy documents pertaining to the four key sectors – meat and dairy, pulp and paper, steel and plastics – alongside cross-cutting policy documentation relating to the four sectors. The documents gathered relate to the European Commission, the European Parliament, European Committee of Regions and the European Economic and Social Committee. Documents were gathered through the EU legal database www.eur-lex.europa.eu for the time period beginning from 2015 to 2019.

In order to filter the database before conducting the scoping search, inclusion and exclusion criteria were determined. The following conditions were considered for document inclusion: firstly, the documents must relate to the four sectors. Furthermore, documents should broadly relate to climate change and/or sustainable development. Regarding exclusion criteria, only documents which placed a substantive focus on the sectors (i.e. more than a brief mention or

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4.2 Coherence between sector based innovations and the SDGs

This section details the approach for assessing coherence between the SDGs and decarbonisation innovations from the steel, plastic, meat & dairy and paper sectors, identified from the REINVENT Work Package 3 report. While D5.3 uses qualitative modelling techniques to create an integrated analysis of the possible economic, environmental and social equity impacts of decarbonisation innovations at the EU and global levels, this task takes a qualitative approach by seeking insights from subject-matter experts in the form of industry professionals and academics to assess the coherence between these innovations and the SDGs.

EU policymaking post-2015, broadly speaking, has aligned its objectives with the SDGs [This is further outlined in Results section 5.1 – 5.3]. The innovations put into practice technologies and methods for decarbonisation and represent tangible actions which have been supported through the EU's policy mix. Within the policy mix arrangement these can be treated as 'policy in action'; conceptualising the innovation case studies as a materialisation of the policy actions towards the overarching SDG goals. This then allows for the analysis of the nature and extent the innovations, as a part of the EU's broader institutional arrangement, are coherent with the SDGs.

The innovations in question were framed as implementation practices for decarbonising their respective sectors and were aligned with the broad policy goals in terms of their shared objectives (Figure 2). For instance, an innovation which emphasises the re-use of materials

aligns with the policy goal of circular economy and an innovation which focuses on digitalisation to reduce material consumption aligns with the goals of industrial modernisation.

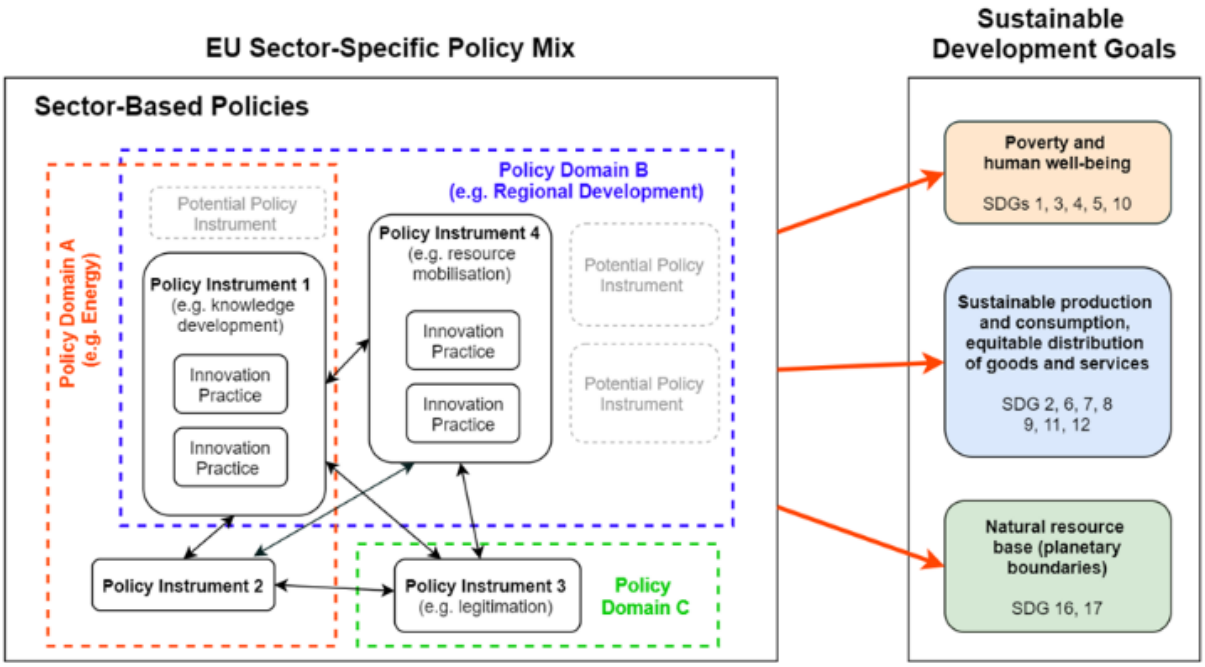


Figure 2: Conceptual Framework for the EU Policy Mix for Decarbonisation, adapted from Huttenen et al. (2014). Here, the innovation practices are nested in the policy instruments and their respective innovation system function which supports the practice

Following Nilsson's (2012) approach towards understanding policy coherence, the main tool used in this assessment was a screening matrix. This is a mapping tool which presents the SDGs along the horizontal axis and the innovations and connected EU policy areas along the vertical axis. The SDGs are clustered into thematic groups according to the Netherlands Environmental Assessment Agency (Lucas et al., 2016). One screening matrix was created for each sector under study, which guided the data collection activity from focus groups populated by sector and decarbonization experts. These were collected from a list of researchers from the REINVENT project who studied these innovations, speakers and participants who attended a separate workshop on the Transition to Fossil-Free Industries (REINVENT, 2019), as well as experts from academia and REINVENT sectors linked to the innovations. Typical focus groups' discussions usually last between 1 and 2 hours and consist of between 6 and 12 participants, however in the case of participants having specialised knowledge and experiences, Krueger (1989) endorses the use of very small focus groups, what he terms "mini-focus groups" which include 3 or 4 participants. Such was the case in this research, where participants were grouped into small specialist groups by sector with each participant specializing in a different aspect of the sector such as; industry development, sustainability, policy development, resource use, societal impacts, and current state and developments. This allowed for a more robust dialogue

to emerge based on a deeper understanding of the areas covered. Experts were asked mainly to fill in the information that pertained to their areas of expertise but were allowed to speculate on innovations that were still in their experimental phase or linked with their sector. The focus groups took place in the month of May 2020 and were organised online due to the ongoing COVID-19 crisis which prevented participants from travelling and gathering in groups. In order to qualify for the studies, participants had to have both in-depth sector knowledge and a familiarity with the SDGs. A total of 150 invitations were sent out to academics and industry professionals, from which 32 responded positively and 74 responded negatively stating that the change to their working conditions, This is response rate is lower than what is normally expected from focus group invitation, The experts were divided as follows; 6 for food, 5 for paper, 7 for plastic, 14 for steel.

4.2.1 The Screening Matrix

The first objective of this step was to create the axes for the screening matrix. Table 2 presents the results of the innovation-policy alignment – displaying the four sectors, the interventions that fall under the sectors, the innovations related to these interventions, and finally their connection to EU policy areas. These innovations were selected and analysed as decarbonisation case studies by the REINVENT project and represent a mix of social and technical means of achieving reducing carbon within their respective sectors. 'Intervention' here is used to describe the specific case study for initiating and rolling out an 'innovation'. E.g. within the steel sector, the HYBRIT project is the intervention currently engaged in fossil-free steel making using hydrogen as a reductant. The innovations and policies connected with each sector here served as the vertical axes of each screening matrix. For the focus group exercise, the names of interventions were withheld to reduce bias in the event a participant was connected directly with the case study. The criteria used by REINVENT in selecting innovation case studies covers the following aspects:

- **Carbon significance** – to capture major CO2 mitigation potentials in the considered key sectors; the CO2 mitigation potential for most case studies should be significant in relative terms (as compared to a reference product/process) and/or absolute terms (for decarbonisation of the sector) – either at the current level of maturity or in the mid-to-long term when rolled out broadly. Case studies with low relative and absolute mitigation potential both in the short-to-long term can be considered in case they imply innovative aspects, which could indirectly inspire emission reduction within or across sectors.

- **Spread across value chain** – ensure that the portfolio of case studies covers all or most value chain stages in each key sector, from resource and production to consumption to recycling waste.
- **Different types of innovations** – the case study pool should encompass different types of innovations and interventions including technical, social, political and economic cases
- **Linkages to other work packages** – a fair number of case studies should be linked to work packages 2 (innovation database and innovation biographies) and 4 (long-term low carbon pathways for REINVENT key sectors); thus the set of case studies should include both past innovations that are already mature and rolled out (focus of WP2) and forward-looking innovation which re still at an earlier level of development and deployment (focus of WP4).
- **Scale up** – cases should imply a certain transformative potential and opportunities for scale up within or across sectors
- **Feasibility** – case studies need to be feasible and accessible with regard to interviewees, data, etc. and can be undertaken within the time and resource budget available.

REINVENT Sector	**Innovation**	**Intervention**	**Connection to EU Policy Objective(s)**
Steel	Wire Arc Additive Manufacturing (WAAM) for Steel	*M3XD*	Industrial modernisation policy, digitalisation
	Strip casting in steel production	*Castrip*	Industrial modernisation policy
	Fossil-free steelmaking through direct reduction of iron ore using hydrogen as reductant (H-DR)	*HYBRIT (Hydrogen Breakthrough Ironmaking Technology)*	Industrial modernisation policy, energy transition
	Voluntary low-carbon building standards	*BREEAM 2018 New Construction standard (UK)*	Circular economy
	Improved process technology and co-design with end users	*DOCOL Steel*	Industrial modernisation policy
Plastic	100% bio-based jacket	*Tierra's deterra-jacket*	Bio-based materials / bio-economy, circular economy
	Chemical recycling of hydrocarbon wastes (e.g. plastics, biomass)	*Enerkem – Waste-to-Chemicals project Rotterdam*	Circular economy, industrial modernisation policy

	Zero-waste grocery stores	*Plastic-free Supermarkets (Malmö) and (Copenhagen)*	Circular economy
	CCU (Carbon Capture and Usage) within the steel and chemical industry	*Carbon2Chem*	Circular economy, industrial modernisation policy

REINVENT Sector	**Innovation**	**Intervention**	**Connection to EU Policy Objective(s)**
Paper	Biorefinery	*Aanekoski bioproduct mill*	Circular economy, bio-based materials / bio-economy, energy transition
	Lime kiln fired with biofuel	*New lime kiln at SCA Ostrand (Bioloop)*	Bio-based materials / bio-economy, energy transition
	Biocomposite	*Durasense*	Bio-based materials / bio-economy, circular economy
Meat/Dairy	Green Bonds	*Friesland Campina Green Schuldschein*	Agricultural reform
	Private governance initiative to promote dietary change	*Green Protein Alliance*	Agricultural reform
	Oat-based dairy analogues	*Oatly*	Agricultural reform, bio-based materials / bio-economy
	Meat analogues	*Cultured (lab-grown) meat*	Agricultural reform, bio-based materials / bio-economy

Table 2 Outline of decarbonisation innovations and connected EU policy area(s)

The horizontal axis was therefore populated with the SDGs. To allow for a deeper discussion to develop between the focus group participants within the allotted time, the SDGs were clustered into 4 overarching domains - social, economic, environmental, and institutional. All SDGs interact with one another – but the nature, strengths, and potential impact of these interactions are largely context-specific and depend on the policy options and strategies chosen to pursue them. The clustering here follows one conducted by the Netherlands Environmental Assessment Agency (Lucas et al, 2018), who based their clustering on the work done by Raworth (2012, 2017). This ‘doughnut’ model builds on Rockström et al’s (2009) planetary boundaries framework, with the inclusion of a social floor (see below).

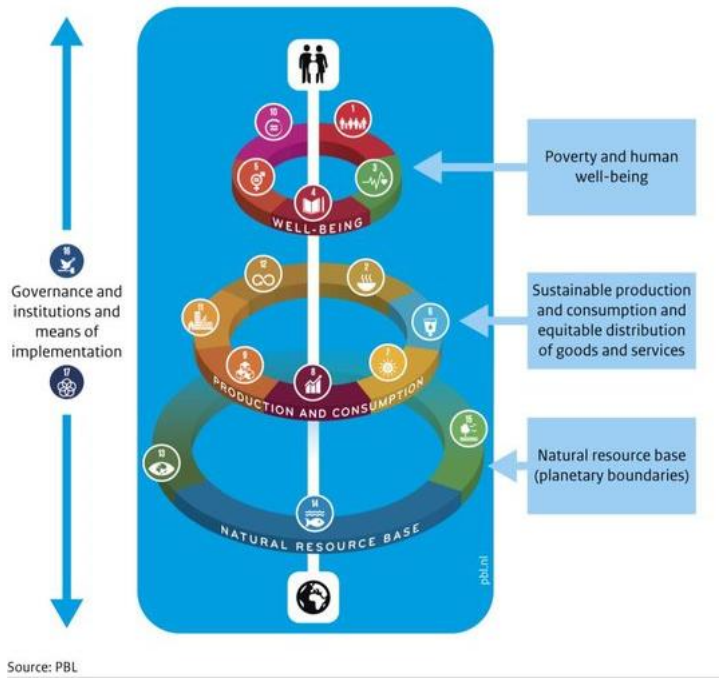


Figure 3 Clustering of SDGs by Lucat et al (2018)

This exercise was originally carried out to translate environment-related sustainable development goals (SDGs) into national policy targets for the Netherlands – requiring the authors to define global quantitative targets where none existed, and determine an individual country's 'fair' share of the related safe operating space or contribution towards mitigating global environmental pressures and impacts. The SDGs are interlinked by design, with overlapping objectives a common feature. Broadly, they can be clustered into 4 groups linked to their social, economic, environmental, and institutional objectives (Lucas & Wilting, 2018); Poverty and Human well-being, Production and consumption, Natural resource base, and Governance. Linking to Raworth's Doughnut model, the 'social floor' is represented by the 'Poverty and Human well-being cluster'. These are people-centred social goals that represent the minimum standards for human well-being. These are represented by the goals; SDG 1 (No poverty), SDG 3 (Good health and well-being), SDG 4 (Quality education), SDG 5 (Gender equality), and SDG 10 (Reduced inequalities).

Achieving these minimum standards of wellbeing relies on goals that relate to production, consumption and distribution of goods and services. These represent not only economic activity but also a decoupling of human development from environmental degradation and are represented in the 'production and consumption' cluster. For these goals to be achieved, standards must be set for the sustainable living and working conditions. These ideals are encompassed by; SDG 2 (Zero hunger), SDG 6 (Clean water and sanitation), SDG 7 (Affordable and clean energy), SDG 8 (Decent work and economic growth), SDG 9 (Industry,

innovation, and infrastructure), SDG 11 (Sustainable cities and communities), and SDG 12 (Responsible production and consumption).

Realising these resource and economy goals depends on conditions in the biophysical systems, including climate, oceans, land and biodiversity. These goals are encapsulated by Rockström's planetary boundaries framework, addressing protection, conservation, restoration and sustainable use of critical parts of the Earth system and directly relate to the planetary boundaries The goals representing this due diligence are encapsulated by: SDG 13 (Climate action), SDG 14 (Life below water), SDG 15 (Life on land).

Finally, the goals mentioned thus far need to be underpinned by mechanisms for governance and a means of implementation. For example, government programmes for the circular economy, agri-food systems, and energy transition guide development towards achieving the goals within all clusters. These are ensured by: SDG 16 (Peace, justice, and strong institutions), SDG 17 (Partnerships for the goals).

Cluster	Sustainable Development Goal
Poverty and human well-being	1 – No poverty 3 – Good health and well-being 4 – Quality education 5 – Gender equality 10 – Reduced inequalities
Sustainable production and consumption	2 – Zero hunger 6 – Clean water and sanitation 7 – Affordable and clean energy 8 – Decent work and economic growth 9 – Industry, innovation and infrastructure 11 – Sustainable cities and communities 12 – Responsible production and consumption
Natural resource base	13 – Climate action 14 – Life below water 15 – Life on land
Governance	16 – Peaceful and inclusive societies 17 - Partnerships for sustainable development

Table 3 SDGs and the Clusters

4.2.2 Coherence Scoring within the Screening Matrix

The second step was to construct the screening matrix. This matrix is used to identify areas of synergy and areas of conflict between the policies and the SDG clusters, resulting in a mapping of key interactions and areas for further evaluation of coherence (Nilsson et al., 2012).

Following Nilsson et al. (2016), the interactions are ranked on a seven-point scale (see Table 4).

The scoring matrix outlined here was developed to assess the coherence between the actions in achieving one goal, and the other SDGs. In this case, the specific goal being accessed is the decarbonisation of the REINVENT sectors. Thus, grading the EU's plastic sector decarbonisation policy mix with a +3 would mean that it is inextricably linked to the achievement of another goal. The results of the screening matrix do not analyse the nature of the interaction itself but looks at the importance of each interaction towards achieving the goals of the other SDG clusters. Within the focus groups the synergies, trade-offs, and underlying causal and functional relations between the innovation-policy coupling and the SDGs were classified using Nilsson's 7-point grading system (Nilsson et al., 2016), allowing for a quantitative assessment of coherence to be made. This ranges from indivisible (+++) to cancelling (). This system did not measure the strength of interactions but only classifies them as follows:

Interaction	Name	Explanation
+++	Indivisible	Inextricably linked to the achievement of a goal.
++	Reinforcing	Aids the achievement of a goal.
+	Enabling	Creates conditions that further another goal.
0	Consistent	No significant positive or negative interactions.
-	Constraining	Limits options on a goal.
--	Counteracting	Clashes with a goal.
---	Cancelling	Makes it impossible to reach a goal.

Table 4 Grading score adopted from Nilsson et al. (2016)

The experts were asked to use only the given framework to score the interactions, ensuring standardized responses. This exercise was initially piloted with a small subset of the target group to ensure clarity of questions being asked. The scores for each sector served as indicators

for synergies and trade-offs between the two axes, and the quantitative nature of the data collection allowed for visual analyses of each sector to be conducted.

The importance of context cannot be understated when undertaking an exercise such as this. Some respondents raised concerns saying that the scores at the SDG levels were arbitrary as they found it challenging to grade the innovations without considering the entire range of available alternatives. (e.g. if given the choice between cultured meat, improved agri-food systems, and industrialised meat production – there would be three different answers as each has its own synergies/drawbacks). Due to this the interactions innovation have with the SDGs could be positive or negative depending on what they are being compared to, the extent to which they are being implemented, as well as the regional contexts of where they are being implemented. Additionally, some are still within the experimental phase, requiring participants to speculate and build narratives for the interactions that innovations could have with the SDGs. Furthermore, some respondents stated that it was hard to judge potential synergies and trade-offs as this depended on how the innovations were carried out and used. Given this, participants were encouraged to grade the interactions based on their expertise and to make their positions clear during the discussion. This resulted in a broad range of answers that covered each persons' area of specialty. Many of the positive impacts were also conditional on the optimal circumstances in which they operate, i.e. that they are based on sustainable business models, operate in the most sustainable manner available to them, and that they are used for sustainable causes (e.g. 3D printed steel technology carries many potential positives, but if it is used to build infrastructure for fossil fuel facilities these impacts become redundant). Some sectors were objectively easier to grade than others due to the lack of available alternatives. The steel sector for instance, innovates at a slower rate than the meat/dairy industry and offers fewer alternatives to the identified innovations. In this instance participants measured the strength of innovation/SDG interactions based on the status quo of steel production whereas in the meat/dairy sector, the wide range of alternatives in terms of product and process presented a challenge for participants.

4.3 Coherence between key EU policy documents and SDGs

This step in the research process utilized the screening matrix and grading scale set in Part 2; this time using EU climate policy documents in the place of decarbonisation innovations in order to assess their coherence with SDG objectives. The grading scale here is applied to the policy as a whole – that is, acknowledging both the objectives and instruments outlined within the policy. Whilst assigning the ranks, the timescale and spatial scale of action is acknowledged

within the SDG cluster interactions. For instance, relating to timescale, intensifying the forestry sector or agricultural sector for bio-based materials may assist in decarbonisation targets, but may lead to long-term issues relating to ecosystem health. Spatially speaking, this would also have effects to ecosystems due to land use changes.

The results of the screening matrix were then analysed in an in-depth discussion utilising a qualitative document analysis (England et al., 2018; Chaya et al., 2019) to address the areas of synergy and/or conflicts. A critical assessment of the nature of the interaction is discussed based on the content analysis.

4.3.1 Content Analysis

The content analysis of the policy documentation follows the screening matrix in order to identify associated instruments, their mechanisms of function and to provide an assessment of the coherence between the policies and the SDGs. Following England et al. (2018) and Chaya et al. (2019), a qualitative document analysis was conducted, which established the criteria for policy document selection (outlined in Section 3.3 Data Collection). This approach to policy document analysis includes the consideration of the meaning and implications of the texts (England et al, 2018), and acknowledges what is emphasised in the texts and what is potentially omitted. Specific focus is placed on the policy instruments and objectives outlined within the policy texts, which are the areas in which coherence can be measured (visualised in Figure 1), and their relationship to the SDGs.

The analysis was carried out on the policy documents pertaining to the four key sectors – meat and dairy, pulp and paper, steel and plastics. Additionally, cross-cutting policy documentation which did not specifically relate to one sector but would have implications for the sectors were also considered. Examples of these policies include the energy transition, circular economy and green employment initiatives. The resulting content analysis will also examine the policy instruments and objectives in relation to their feasibility and suitability in achieving the SDGs. The policy coherence analysis undertaken can be described as a ‘top-down analysis’ (Chaya et al., 2019). While Chaya et al. (2019) use expert interviews to verify the validity of the screening matrix, the expert interviews required are beyond the scope of this report. Rather, the results of the screening from this report will be used within the larger REINVENT project.

4.3.2 Data Collection

The first steps of the qualitative document analysis involved data collection and the screening of the documents. 32 policy documents (presented in Appendix A) were gathered through the REINVENT project. This database is the empirical foundation of this research project. The database was created by filtering out EU policy documentation based on the following inclusion and exclusion criteria. The following conditions were considered for document inclusion: firstly, the documents must relate to the four sectors. Furthermore, documents should broadly relate to climate change and/or sustainable development. Regarding exclusion criteria, only documents which placed a substantive focus on the sectors (i.e. more than a brief mention or repetition from a previous document) were considered. When considering policy documents which had amendments or follow-ups, the most recent version was considered while the older versions were excluded. The documents gathered relate to the European Commission, the European Parliament, European Committee of Regions and the European Economic and Social Committee. Documents were gathered through the EU legal database www.eur-lex.europa.eu for the time period beginning from 2015 to 2019.

5. Results

Presented in this section are the results from the content analysis of EU climate policy papers, the assessment of synergies and trade-offs between SDG objectives and climate policy instruments (expressed as decarbonisation innovations), and both the screening matrices and the content analysis focusing on EU climate policy and the SDGs. An inventory of policy objectives and instruments were collated throughout this process, providing a comprehensive view of the key sectoral initiatives and associated instruments related to the overarching goal of decarbonising the European economy.

5.1 Coherence within EU Climate Policy

5.1.1 Policy Documents

The policy documents selected for content analysis are listed in Table 5 alongside the key issue areas they address. The documents were chosen as they touched upon the four REINVENT sectors, as well as outlining the policy instrumentation used by the EU in facilitating changes to the sectors. They include communications from the European Commission (such as road maps and strategic plans), European Parliament resolutions and own-initiative opinions from the European Economic and Social Committee.

5.1.2 The EU's Understanding of Coherence Over Time

In context of the EU, policy coherence as an objective first came into prominence in the 1990s within the international development and environmental domains. The objective of increased policy coherence occurred in tandem with the growing international interest in the domains and an increased understanding of the effects of economic growth to environment and society. Initial mentions of policy coherence include the Maastricht Treaty in 1992, which states that 'the Community shall take account of the objectives referred to in Article 130U [which refers to development cooperation] in the policies that it implements which are likely to affect developing countries'; and the Fifth EC Environmental Action Programme in 1993, which explicitly states in Chapter 9 that previous environmental action has not been adequately implemented due to a "lack of overall policy coherence partly due to an evolving, sometimes shifting, agenda as the scope of environmental policy grew, and partly because much of the environmental legislation was developed in an ad hoc manner". Policy coherence has become a central pillar within the EUs attempts to increase effectiveness in function - in particular for policies relating to international development, and later to sustainable development following the establishment of the SDGs in 2015. This is visible in the EUs commitments to Policy Coherence for Development (PCD).

Policy/Initiative/Communication Title	Year	Issue Area
2050 Clean Planet for All	2018	Decarbonisation, energy efficiency and energy transition, heavy industry
Circular bio-based Europe: sustainable innovation for new local value from waste and biomass	2019	Circular economy, waste management, plastics, pulp and paper
A sustainable bioeconomy for Europe: Strengthening the connection between economy, society and the environment	2018	Bio-based materials, waste management, plastics, agriculture, pulp and paper
Investing in a smart, innovative and sustainable Industry A renewed EU Industrial Policy	2017	Industrial policy, clean technology, steel
Sustainable inclusive bio-economy — new opportunities for European economy'	2018	Bio-based materials, waste management, plastics, pulp and paper
Green Employment Initiative: Tapping into the job creation potential of the green economy	2015	Industrial policy, job creation, just transition, decarbonisation
On the implementation of the circular economy package: options to address the interface between chemical, product and waste legislation	2018	Circular economy, waste management, chemicals industry

European Parliament resolution on accelerating clean energy innovation	2018	Decarbonisation, energy efficiency and energy transition
Policy/Initiative/Communication Title	Year	Issue Area
European Strategy for Plastics in a circular economy	2018	Plastics, waste management, circular economy
European Parliament resolution on developing a sustainable European industry of base metals	2015	Steel, decarbonisation, heavy industry
European Parliament resolution on the future of food and farming	2018	Agriculture, meat and dairy, just transition
Towards a sustainable EU food policy that creates jobs and growth in Europe's Regions and Cities	2017	Agriculture, urban areas, supply chains
Promoting short and alternative food supply chains in the EU: the role of agroecology	2019	Agriculture, supply chains
Steel: Preserving sustainable jobs and growth in Europe	2016	Steel, decarbonisation, heavy industry

Table 5 Selected Policy Documents

Commitments to PCD were first introduced in the Treaty of Maastricht, however, understandings of this commitment as a legal obligation for coherence were only established in 1994 after a case relating to meat exports to West Africa highlighted the incoherence between agricultural policy and development policy (Núñez-Borja et al., 2018). The PCD approach aimed firstly to remove inconsistencies – what Rogge and Reichardt refers to as 'weak' coherence – by acknowledging the impacts that internal EU policies may have an effect on partner countries. The aim of PCD in the EU context is the overarching long-term goal of poverty eradication in partner developing countries. It is built on the idea that non-development policies (those of which are likely to affect developing countries) take into account development objectives, and are adapted in order to ensure their compatibility with said development objectives through assessing the likely impacts they might have (European Commission, 2019). PCD has transitioned from a 'do no harm'/minimising adverse impacts approach to a synergies approach, a broader approach which seeks mutually reinforcing policies to enhance policy coherence with development objectives. This emerged after the Millennium Development Goals, which noted that success could only be achieved if every sector was focused on the goals – leading to the development of the post-2015 framework and the transition to a universal development agenda as conceived by the SDGs (Núñez-Borja et al., 2018).

This led to the creation of a new term – Policy Coherence for Sustainable Development (PCSD). While closely related in sematic proximity, PCSD represents a move towards broader goals focused on synergistic aims rather than an elimination of inconsistencies. The EU subscribes to

the OECD definition of PCSD – an approach and policy tool to be used at both domestic and international levels of policymaking. Unlike PCD, which is a legal commitment to unidirectional coherence in the interest of inadvertently affecting developing countries, PCSD is a multi-directional principle defined by the SDG agenda (European Commission, 2019). An ever-evolving concept with multiple meanings, policy coherence now features as a facet of the whole-of-government approach in facilitating the SDG agenda. Relating to development, the PCD now plays a fundamental role in the EU's contribution to the SDGs – PCSD as a tool is one of the goals in itself, SDG 17.14 – and the broader objective of PCSD (European Commission, 2019).

Despite this, PCD as an approach is not clearly and sufficiently defined by the EU. The alignment of the EU PCD approach with sector-based policies was found to be heterogenous across policy domains from the period 2009-2016 and lacking in a common understanding, despite legal commitments (Núñez-Borja et al., 2018). While appearing heterogenous across all policy domains, policy sectors such as agriculture, fisheries and climate change were aligned at the strategic level with development goals (Núñez-Borja et al., 2018) – aligning with earlier calls for policy coherence within EU decision-making in relation to environmental regulation.

5.1.3 Sector-Based Coherence

As the EU has committed to PCSD – a whole-of-government approach to sustainable development with a focus on creating synergies – policymaking in the environmental domain post-2015 has followed suit. Increased coherence in goals and environmental mainstreaming and policy integration is particularly evidenced in the EU's revised bioeconomy strategy, the Circular Economy Package, renewed industrial policy strategy, rural development policy and the continuing calls for changes to the Common Agricultural Policy. These policies create interlinkages between economic and developmental goals and environmental and climate goals. The shift towards a whole-of-government approach within policy coherence which encapsulates the economy as a full system has been guided by the SDG agenda. The SDGs, as a whole, present a more integrated system than its predecessor the Millennium Development Goals (which ran in tandem with PCD developments in the EU). This higher level of integration between the economic, social, biophysical and environmental dimensions within the SDGs targets can allow for a collection of potentially unrelated goals within a system to be grounded into a reality that acknowledges the interdependencies and trade-offs (Le Blanc, 2015). The broader, albeit vaguer, policy goals as guided by the SDGs was noticeable during the scoping search of the data collection; wherein the discussions regarding the REINVENT sectors tie in

with overarching goals such as regional development, economic modernisation, clean energy transition and a socially just transition. Due to the levels of integration with other goals, many policy documents pertaining to the REINVENT sectors are cross-cutting policy documents.

One of the first pieces to acknowledge the need for coherence across sectors in the economy is the 2015 Green Employment Initiative from the European Parliament. The initiative outlines the necessity for change and the societal and economic benefits of decarbonisation. The document dedicates a section towards policy coherence to fully develop the job potential of a sustainable economy, with Section 43 calling on "the Commission and the Member States to adopt ambitious, long-term and integrated regulatory, fiscal and financial frameworks for sustainable investment and to encourage innovation, thereby fully unlocking the employment potential of these changes; emphasises that policies should be developed in a framework of long-term horizons that includes targets as well as indicators to measure progress towards their achievement". These long-term strategies have emerged in the following years, including the 2017 revision of the EU's industrial policy, the 2018 European Parliament resolution on the future of food and farming and, the 2050 'Clean Planet for All' decarbonisation roadmap and the Sustainable Bioeconomy roadmap. These documents outline long-term strategic plans affecting the sectors of steel, which is directly addressed; pulp and paper and plastics, which are indirectly addressed under the broader schemes for a bio-economy (requiring wood product inputs) and circular economy (affecting plastics and bioplastic production); and meat and dairy, which is briefly discussed under the broader discourse around food production, agricultural management and CAP reform.

Steel

The 2050 'Clean Planet for All' roadmap, alongside the renewed industrial policy and the 2016 Steel: Preserving Sustainable Jobs and Growth in Europe address the steel industry. The 2016 report addresses the need address the issues of the importation of steel from non-EU countries and the potentials for carbon leakage. Instruments cited relate to Trade Defence Instruments and the Emissions Trading Scheme, alongside research and development measures. Steel, a core sector within EU industry, has been subject to decline due to external imports. The EU has outlined measures to boost the steel industry and industrial regions, and in turn have increased policy coherence through interacting with two other policy domains: energy and regions. The transition to clean energy is interconnected with low-carbon technologies, and the EU has created instruments to invest in clean industrial technologies such as carbon capture and storage. These include the Innovation Fund for the support of new technologies; the Platform for Coal

Regions in Transition, an open forum to gather stakeholders; and structural support action for carbon-intensive regions in member states, which aims to "boost their innovation capacity, remove investment barriers, equip workers with the right skills and prepare for industrial and societal change, on the basis of their smart specialisation strategies" (European Commission, 2018). Smart specialisation strategies are a form of joint undertakings, or public-private partnership bodies aimed at integrating industrial research in specific areas, with specific emphasis on regional competitive advantage. Instruments here fall primarily into the *knowledge development, resource mobilisation* and the *development of positive externalities* (from the stakeholder engagement platforms for a just transition) categories as defined in Table 5.

Pulp and Paper, Plastics

Regarding both plastics and pulp and paper industries, the integrated nature of the EU policy initiatives and the heavy focus on bioeconomy and circular economy allows for both sectors to be grouped as one. Separately, the pulp and paper industry is also addressed within the EU's Forest Strategy and features within environmental policy through the rules on land use, land-use change and forestry (LULUCF) and the Birds and Habitats Directives. Policy discourse surrounding plastic is addressed within the context of plastic as a form of waste which needs to be reduced and managed, or a waste product which can be used within the circular economy. Bioplastics, on the other hand, features within policy discourse related to economic modernisation and an industry required for the development of a sustainable economy – such as the Sustainable Bioeconomy for Europe action plan.

The instruments regarding both sectors are manifold, and some exist already within the domains of agriculture, waste, industry and chemicals. The action plan acknowledges the challenges facing the sectors, and the necessity for coherence in terms of instrumentation to achieve a transition to a bio-based economy. Instruments cited include financial investment in the form of the Circular Bioeconomy Thematic Investment Platform, the InvestEU Programme, the CAP and the aforementioned Innovation Fund; certifications such as the EU Ecolabel; standards and certifications such as the Product Environmental Footprint and the Forest Stewardship Council scheme; and further investment into research and development through Horizon 2020. Here, the instruments present fall under the categories of *knowledge development, influence on the direction of search, entrepreneurial experimentation, legitimation* (via ecolabelling), and *resource mobilisation*. The policy mix presented within the policy documentation shows coherence on the horizontal scale across many policy domains.

When examined internally, the objectives of both the (bio)plastics and pulp and paper industries appear to be less coherent. The broad aims of the forestry sector: ecosystem management, land use as a carbon sink (LULUCF) and biodiversity (e.g. Birds and Habitats Directive) are all in conjunction with pulp and paper forming the basis within the bio-based economy – it must be examined whether or not the sector can fulfil the seemingly conflicting goals of providing a habitat and whilst increasing demand for wood-based products. For plastics, the policy instrument focus lies primarily on researching, developing and the scaling up of bioplastic initiatives. Nonetheless, the European Strategy for Plastics in a Circular Economy does outline the initiatives undertaken to increase the use of recycled plastics through the creation of a coherent set of rules. These include the revision of the Packaging Waste Directive, a review of the Construction Products Regulation, and a review of the End-of-life Vehicles Directive. Further efforts include new eco-design measures to increase recyclability of plastics and improved standards and traceability of chemical substances. The document also calls for the establishment of a market for recycled plastics, however, it does not list any proposed policy instrumentation for market formation. The dual strategies for bio- and fossil-fuel-based plastics, coupled with an unclear separation between the two forms and a lack of addressing virgin plastics, presents an internally incoherent policy. Rather than treating plastics as a policy domain, the role of plastics is separated into discourses on bio-economy and waste management, with little discussion on the interactions between fossil-fuel-based plastics and bioplastics.

Meat and Dairy

The meat and dairy sector, as its own discrete category, is underrepresented within EU policy discourse. Instead, it features within broader discussions on agriculture and CAP reform. Within the European Parliament resolution on the future of food and farming, the document acknowledges that 80% of protein is imported into the EU, and that efforts must be made to develop a protein strategy within the CAP. Discourse on agriculture in general has shifted towards shortening supply chains to locally produced food, increasing organic and agroecological practices, and ecolabel instrumentation to support these sustainable farming practices. Relating to the social dimension of agriculture, there is emphasis on empowering young farmers through educational programmes and supports for smallholder farms. Furthermore, CAP reform includes initiatives which will have an effect on the meat and dairy sector. This includes the streamlining of administrative processes in payments, the development of EU level environmental standards, and a strategic plan for young farmers. The instruments

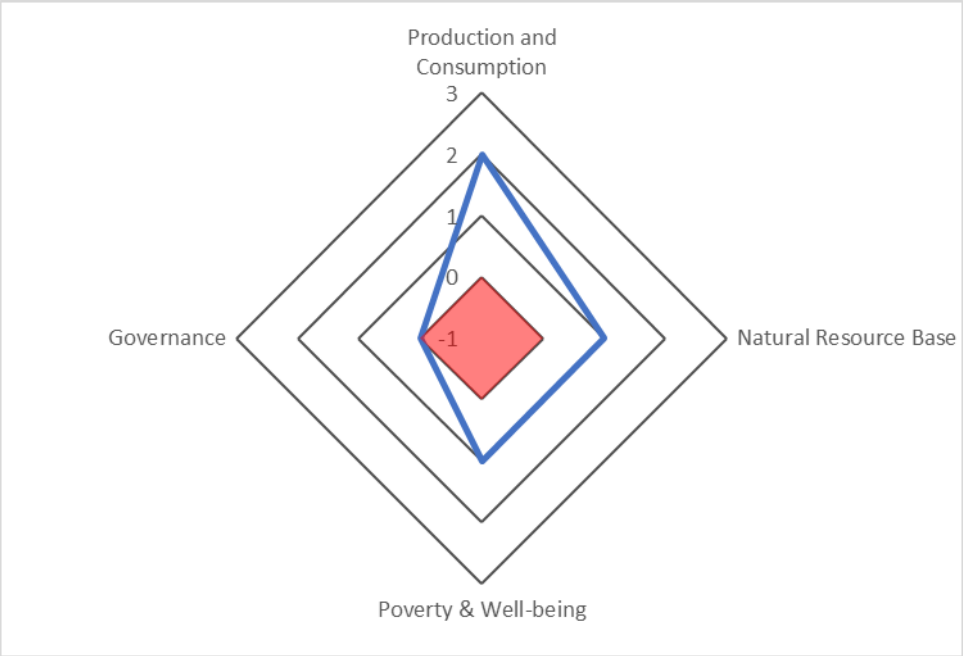
used fall into the categories of *legitimation* through education, *influence on the direction of search* and *development of positive externalities*. Meat and dairy, an intrinsically carbon-intensive industry based on animal agriculture, will be difficult to decarbonise without substitution with plant-based protein alternatives. The actions undertaken within the dairy sector in particular seem to be incoherent with broader climate objectives. The EU projects growth within the dairy sector, through the increased demand from external markets, especially for powered milk products (European Parliament, 2018). While there is emphasis on developing creating a coherent policy mix consolidating agricultural objectives with climate and environmental objectives, it calls into the question whether or not these goals can be consolidated with trade and growth objectives.

Based on the policy documents and instruments outlined, there is ample evidence to support the notion that the EU has increased policy coherence in aligning economic policy relating to sector-specific legislation and climate goals. Regarding horizontal coherence, it can be said that the EU's policy agenda for PCSD has led to a wide-reaching set of policy actions – particularly relating to the promotion of the bio-economy and circular economy projects. The emphasis on monitoring materials for reuse, increased funding for research and development, scaling up innovations and promoting SMEs will have strong effects on the pulp and paper industry and the plastics industry, as the policy focus turns towards on encouraging re-use and bio-based materials. The picture for internal coherence within the sectors themselves is more heterogeneous. Within the meat and dairy and pulp and paper sectors, there is incoherence in the policy objectives of scaling up the industries sustainably, while also utilising the industry for environmental objectives such as habitat restoration and carbon sinks.

5.2 Coherence between sector based innovations and the SDGs

5.2.1 Steel Sector

Wire-arc Additive Manufacturing (WAAM)



Traditional Additive Manufacturing (AM) processes form objects from metal powders using laser or electron beams. These processing technologies were limited in terms of minor deposition rates and the limited size of objects that could be created. WAAM addresses these limitations by combining industrial welding robots, wires for welding, and software that translates Computer Aided Designs (CAD) into the movement of welding robots to 3D print objects. This was used by the MX3D company to construct a fully welded pedestrian bridge in the city of Amsterdam using stainless steel wire, a cheaper but as reliant material.

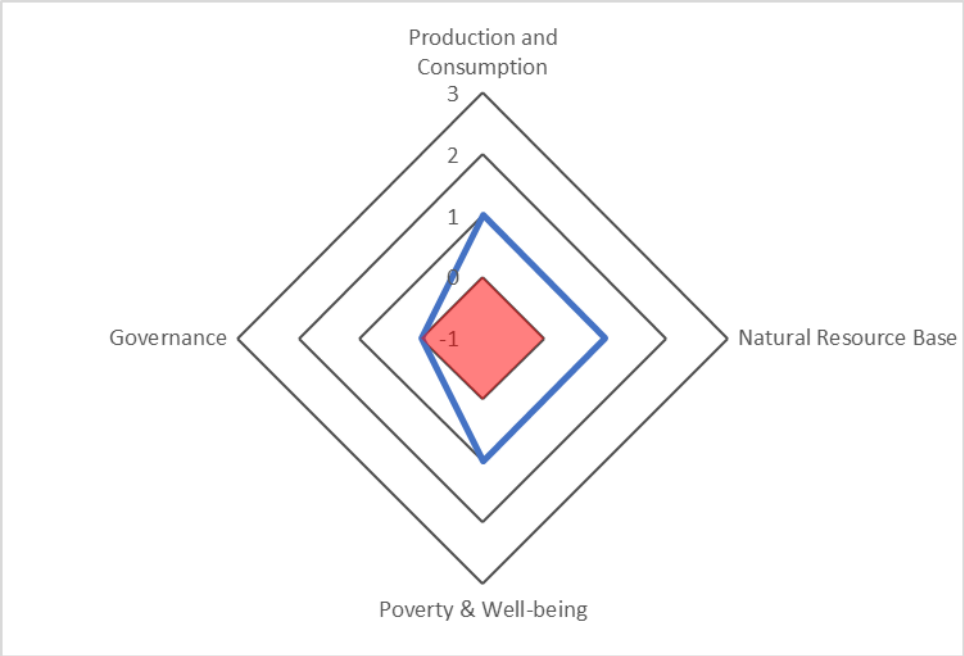
This innovation concerns material efficiency rather than material reduction. The technology relies on virgin material and currently has no option for integrating recycled material in its feedstock. Despite this the innovation was positively received during focus groups and is seen as a step forward in sustainable steel making, with experts foreseeing that as much as 70% of future carbon reductions in the steel industry will be based on material efficiencies. Additionally, the potential to achieve higher resource efficiency was recognised, along with reduced material transportation and synergy effects of producing construction components on site as this will allow companies to produce components and infrastructure in remote regions where there might be limited transport options. By facilitating the development of new

infrastructure in remote regions, this innovation carries a potential to reduce regional inequalities in developing nations. Building on site would also have further enabling effects in the form of reduced transport fuel consumption and therefore lead to fewer emissions. While there were advantages seen to this innovation, they came at the risk of rebound effects caused by an increase in construction activity and the subsequent energy consumption linked to this. Additionally, it was emphasised in focus groups that the purpose for which the technology is used will largely affect its interaction with the SDGs. For instance, if this is used to build infrastructure for fossil fuel facilities it will be creating sustainable materials for an ultimately unsustainable end goal.

Few connections were identified by the experts between the innovation and governance-based goals. Within industry partnerships, experts saw the potential for decentralization arises, allowing for actions to be made based on local information and incentivizing players to act in co-operation, making the entire supply chain more efficient. Nevertheless, the efficiencies presented by this innovation made it highly relevant for an industry seeking more sustainable pathways and aligned well with goals relating to industrial innovation and sustainable cities. It was perceived to carry the potential to build more efficiently and would benefit from more circular activities such as using recycled materials as feedstock and designing projects for future reassembly. With 3D printing of metals appearing high on research agendas, this innovation links well with goal 9 (Industry, Innovation, Infrastructure).

Experts saw this innovation reinforcing conditions for meeting goals relating to *Production & Consumption* through its potential for carbon reduction within manufacturing processes and transport, which indirectly created enabling conditions for goal progress within the *Natural Resource Base* and the *Poverty and Human Well-being* clusters to be met. The reduction in emissions is coherent with Goal 13 (Climate Action), as well as Goal 3 (Good Health and Well-being) to a lesser extent. The introduction of new technologies brings the prospect of job creation, reducing both poverty and inequalities within countries.

Strip Casting

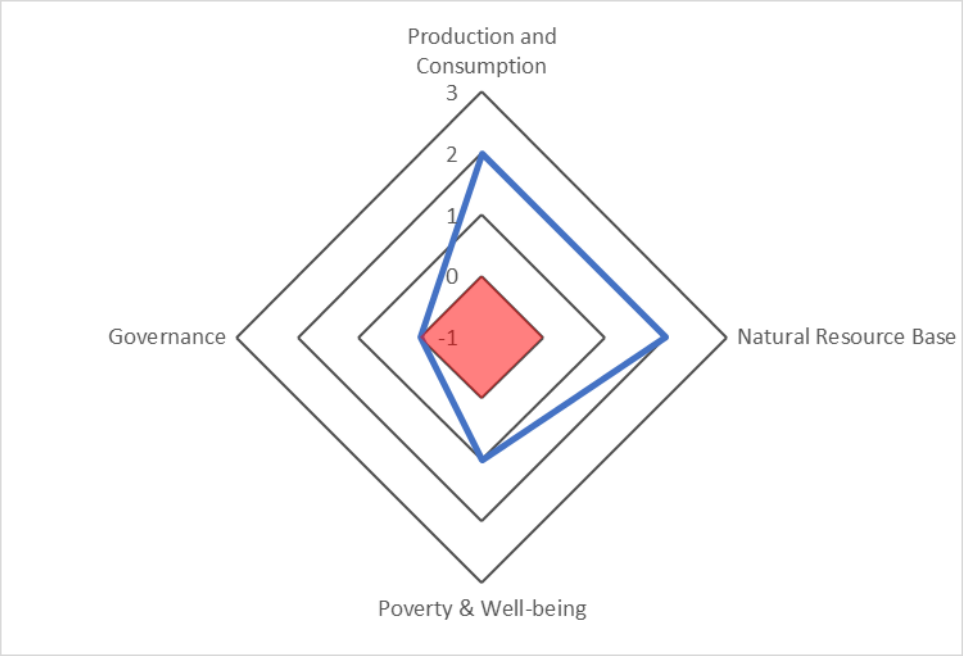


This innovation addresses the lesser and often overlooked finishing steps within the steelmaking process. The traditional set-up involves a two-step process involving a continuous caster (casting liquid steel into slabs) and a hot rolling mill (rolling slabs into steel strips). This has high demands on space, energy, and time as the slabs cools down significantly after the rolling process and require reheating before being ready for hot rolling. Strip casting combines the two processes into one by casting liquid steel directly between two rolls, manufacturing processes in order to reduce energy inputs and carbon emissions.

Strip casting was viewed as a novel innovation within steel processing, however it's impacts were not as positive as other technologies in addressing global sustainability targets. It was viewed as a traditional process improvement supporting the value-add and economic growth and though the main benefit lay in significantly reducing energy consumption, strip casting only addresses one step of the iron and steel production process and does not address the key energy and emission intensive activities which are concentrated in the post-production stage. However, the knock-on effects of reduced energy consumption were not overlooked. Experts noted that this helps mitigate carbon emissions, which could contribute to health and well-being in industrially intensive areas, as well as contribute to climate action goals. Overall, this was viewed as a step forward in achieving sustainability objectives, albeit a small one when compared to the other innovations for this sector.

Strip casting, in the view of the experts, created enabling conditions for goal progress within the clusters of *Production & Consumption, Natural Resource Base, and Poverty & Human Well-being* through its reduction in energy consumption and therefore emissions, contributing to health in industrially intensive areas. Due to its nature as a process-based technology, the effects here were seen to be less enabling than other steel innovations investigated.

Direct reduction of iron ore using hydrogen as reductant (fossil-free steel making)



This innovation represents a development project with the aim of implementing fossil-free steelmaking in all stages of production; from iron-ore extraction, through pelletisation and reduction (iron-making), to the final steel making (in electric arc furnaces). This requires fossil-free electricity production to create 'green' hydrogen for the electric arc furnaces, and for parts of mining and processing the iron ore.

Experts saw this technology carrying a great potential to reduce the overall consumption of energy while increasing the value add of the steel industry and could be a key pillar in future industrial strategies. This was viewed as the most revolutionary of the innovations studied here. The common view expressed here identified hydrogen direct reduction as the most promising solution to decarbonised steel making. Experts pointed to studies highlighting this idea, but warned of bias within the research as many studies were funded by the gas industry (which is involved in the creation of more carbon intensive 'blue' hydrogen). The contribution to sustainability goals therefore depends on the where the hydrogen is sourced from.

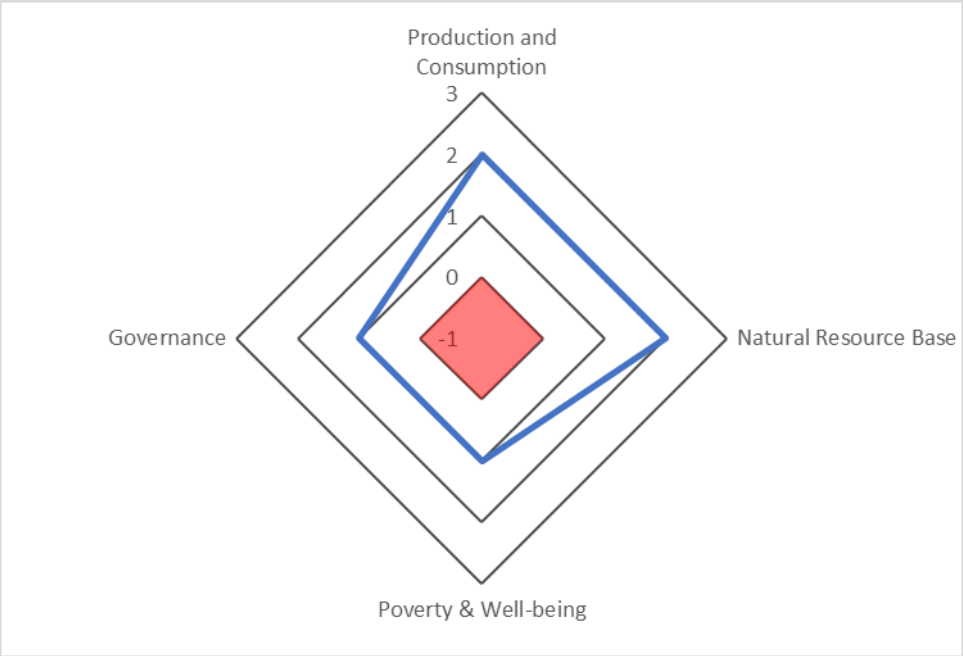
The fossil free aspect here contributed strongly towards goals in the *Natural Resource Base* category. Multiple impacts could be seen by experts from reduced emissions to energy savings from reduced mining and resource extraction, as well as strong contributions to climate targets by reducing CO2 emissions, and if rolled around the world would have significant reductions on global CO2 quantities. This aligned strongly with climate related goals as well as those connected with biodiversity to a lesser extent. The reinforcing connection here comes from the knock-on effect of no fossil resources being used, reducing extraction efforts around the world.

This technology could, to experts, replace the demand for coal with the demand for hydrogen, as well as replace the demand for natural gas with the demand for renewable electricity. From that perspective it may have some influences on global peace, considering where natural gas and coal are purchased from. This means that vulnerable communities that rely on mining for work could be heavily impacted. This has smaller impacts in the European context, where it appears as a form of creative destruction – making fossil fuel supply chains defunct while constructing new supply chains for hydrogen creation.

From a jobs and employment perspective, novel technologies create new roles for younger people to learn. As a project, the structure of this innovation suggested to experts the capabilities of generating skills, knowledge and resources within steel making, however it is too early to say for sure if this will be the case. This, along with the reduction of carbon emissions may have a small impact on well-being but it could also be more expensive than conventional steel making practices which would make it inaccessible for poorer countries.

To the experts, this technology reinforced conditions for goal progress within the *Production & Consumption* and *Natural Resource Base* through energy savings. Indirectly, this was seen to enable conditions for goals in the *Poverty and Human Well-being* cluster.

Voluntary low-carbon building standards



These standards assess the environmental impact of new commercial buildings, seeking to reduce embodied emissions by utilising measures such as Life Cycle Assessments, integrating outcomes in the design process, responsible sourcing of products, and optimizing material use.

Experts stated that standards allow for the differentiation of construction materials and, if widely adopted, could result in reduced resource consumption while creating the conditions necessary for achieving sustainable cities and infrastructure. Though these standards consider greenhouse elements reduction this would not impact climate action to the same extent as the other innovations in this sector but would create the conditions necessary for achieving the goal.

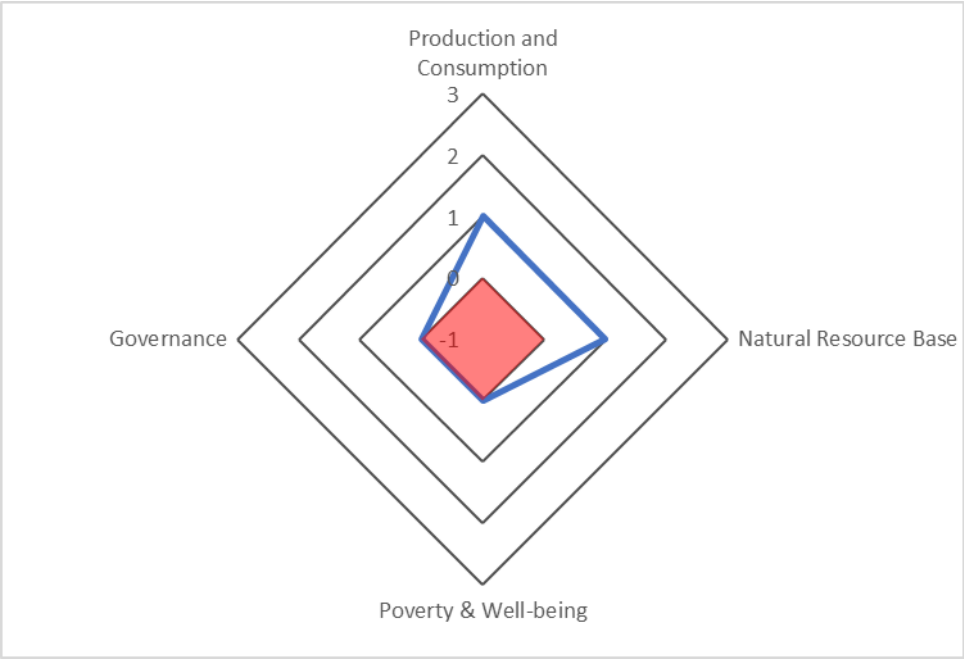
Standards were seen by experts to have a huge impact on several SDGs, however their 'voluntary' nature was perceived to have both enabling and constraining effects. On one hand, as they could be opted into whenever companies please, they hold back the potential of this innovation and limit the reinforcing effects. On the other, they could bring actors and stakeholders together especially when the state isn't a very active role, and the voluntary it encourages collaboration and transparency – strengthening links between actors.

In terms of developing regions, while this could contribute to buildings being more sustainable it would also increase the price of buildings which could increase poverty and inequality in developing countries. However, the responsible material sourcing aspect considers labor conditions in source countries – examining labor laws and the presence of child labor. This has

positive implications for wellbeing in developing regions by enabling progress towards the goals.

Overall, experts saw this innovation reinforcing conditions for goals in the *Production & Consumption* and *Natural Resource Base* clusters while enabling conditions within the *Poverty and Human Well-being* and *Governance* clusters.

Improved process technology and co-design with end users



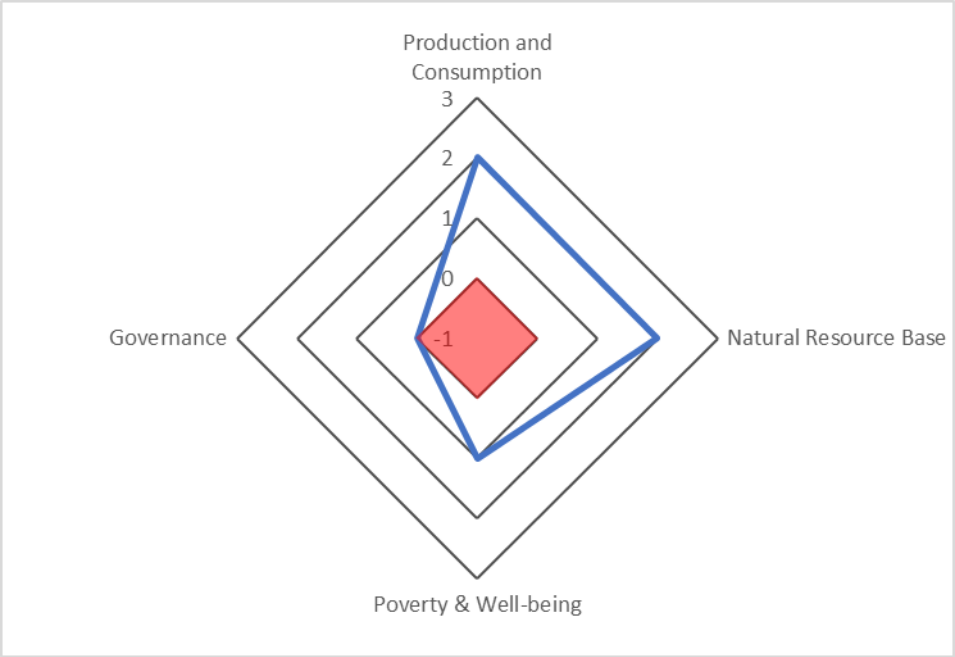
This innovation represents a range of steel grades produced specifically for automotive applications. This co-designing process reduces the amount of steel needed for a given part while increasing the vehicles overall strength.

Industry professionals expect a minor enabling effect on *Natural Resource Base* goals due to small material savings from this innovation. As highlighted in other innovations, much of the future efficiencies in the steel industry will come from material efficiencies. Otherwise, this innovation drifts the least distance from traditional steel making and does not itself address emissions in the steel-making process. Rather, emissions reduction here is caused indirectly as a consequence of creating lighter vehicles and thus improving transport energy efficiency. This was seen as an important concept by industry professionals due to its material savings, but the strictly aligned supply chain makes the whole process sensitive to disruptions, as seen recently by the COVID-19 crisis.

Few enabling factors were otherwise seen from by experts this technology as it does not seem to be different from current activities. Due to the specialisation aspect, it carries a chance of pushing out smaller producers.

5.2.2 Plastics Sector

100% Bio-based jacket



This is a bio-based clothing innovation developed out of bio-nylon (using castor oil as feedstock) – the novelty of which was its utter lack of fossil-based components. This innovation aims at full circularity and a closed loop where virgin materials are no more.

To the experts, this contributed greatly to goals concerning responsible production and consumption, seeing as it is a fully circular loop and aims at eliminating virgin materials. It may result in a slight increment in energy consumption if the recycling process is energy intensive but seeing as this is more of a machine-driven process, working conditions could be improved reinforcing synergies for achieving the SDGs.

Understanding this as being a bioplastic, it can be 100% recycled. Most experts' view was that this technology directly created conditions that lead to the achievement of goals in the *Production & Consumption* cluster, as it connects strongly with aspects of waste and overproduction. When discussing bio-based innovations the issue of land capacities and its impacts on food availability must be considered, as the materials may conflict with areas used for food production and thus constrain progress towards the goal of zero hunger. However, unlike previous biomaterial innovation where feedstocks were sourced from (for example) sugar cane, this technology uses wood residue and ideally would not compete with food. The

reinforcement for climate change goals is significant as the emissions from synthetic clothing are quite large, however for life on land – growing the crops that feed into the virgin material for bio-based material could pose a threat to biodiversity. The implications then for water use and life under water are less clear. Traditional clothing production issues have strong links with impacts on water – the knock-on effect being on life below water. Shifting to bio-polyester production increases water consumption, but this may be dwarfed by the total water used in dyeing and other processes.

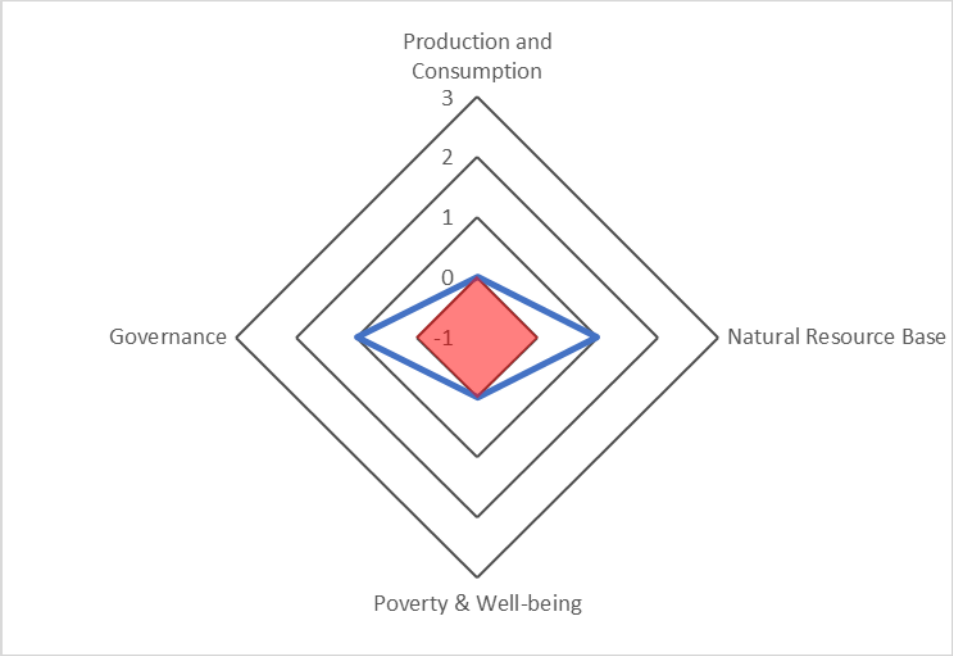
For goals regarding peace and justice, on the one hand, experts identified of injustices connected to the production of clothing, as well as the creation value chains in developing countries. Therefore, this innovation would need to operate alongside responsible sourcing schemes to reduce the possibility of injustice.

Experts stated that this technology both aids and requires governance and value chain transparency in order to work. To be able to create the fully recyclable value chain you need to know exactly what's in each product, if there are contaminants such as chemicals that are not supposed to be there you could destroy the entire batch. This demanded that supply chains be more transparent, which in turn makes better governance and better cooperation. It did however carry a risk here that the production is further centralised, given that the material production is in the recycling plant and not in the fields – which could have a constraining effect on global cooperation and may shrink the value chain and concentrate it more in the West, but on the other hand fossil fuel production and fossil-fuel extraction today is quite a large source of both injustice and conflict which is Goal 16.

Experts postulated that if countries that are currently producing cloth are able to adapt these bio-based technologies, then one could see this innovation helping with reaching goals connected with poverty and Human well-being as issues pertaining to gender equality, education, and injustice are all connected to the production of materials in some way. This required that production stages aren't centralised, and that materials are recycled and shipped back to production sites in developing regions. Though these jobs are generally poorly paid, they bring some form of employment to countries where there is little in the moment. Experts stated that, currently, this industry moves 'like a caterpillar' from country to another depending on where costs are lowest, so it is not a sustainable employer either. It's very complex and depends largely on how the transition is handled in production countries discussed (80% of Bangladesh's GDP comes from the textile industry) and if primary production of cotton in India suddenly disappears that's a huge hit to poverty and inequality, and if a replacement industry

comes in where they can actually get jobs then the outcome would be a net zero impact – otherwise a cancelling effect on progress for goals linked to *Production & Consumption*.

Chemical recycling of hydrocarbon



The intervention identified here is a gasification technology that produces syngas from (hydro)carbon wastes such as biomass, mixed municipal solid waste, plastics. The syngas is converted into methanol, which is used as a platform to make ethanol or produce other (intermediate) chemicals. Other companies achieve similar results using liquification technology.

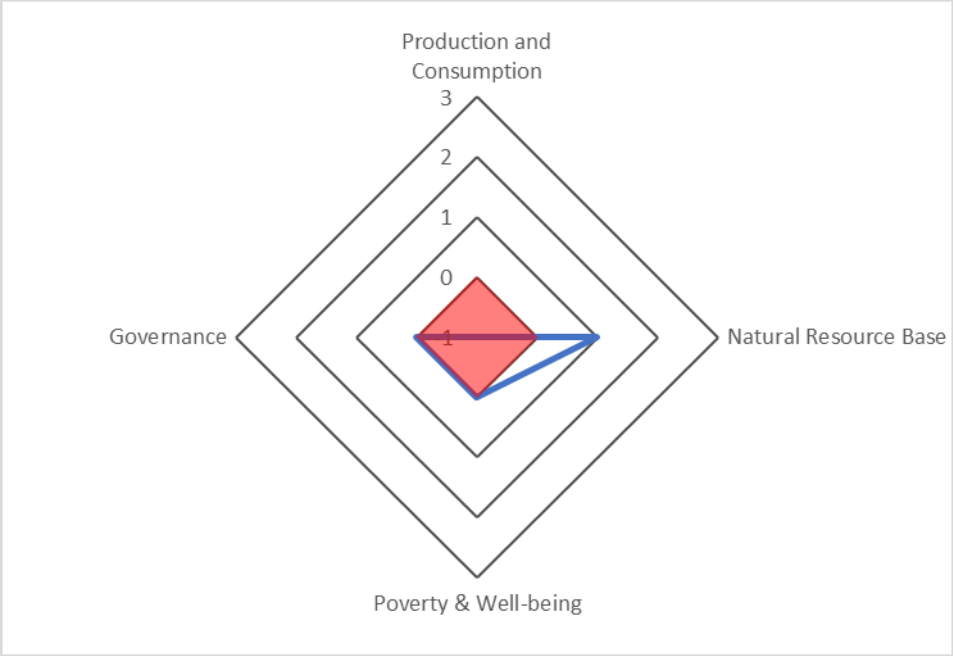
This is an innovation in which part of the waste that goes into it is also used as fuel. In principle, experts saw this creating value from waste material fitting well within the New Circular Economy Strategy set by the EU. This concept of circular economy which reduces the amount of waste that is newly produced, and so would have a reinforcing impact on CO2 emissions, but as this is a syngas process there will be CO2 involved regardless. A key drawback to this technology is that it requires large volumes of hydrocarbon in order to operate, which in turn demands large volumes of waste to be created.

Experts also expressed concerns over this technology causing a lock-in effect to the current way in which we make plastics and manage plastic waste. Furthermore, the energy consumption of this technology is quite high (higher than if one were to recycle the inputs mechanically), and if it uses plastics as fuel it will release CO2 into the atmosphere. Furthermore, if you have a

mix of waste there could also be biomass in it, which could be put to more efficient uses than as fuel for this process (such as putting it into a natural cycle or agricultural, or forestry). Considering that it uses more energy than other ways of dealing with waste it is hard to say what the net impact will be on climate, and water as you need large amounts of this for cooling to create gas.

Despite its drawbacks, there is potential for this innovation to be used as a transformation technology for a certain period of time to move over to other fossil-free materials or to a plastic free world, though this may need some time to come about. If the emissions here are lower than current production methods, then there will be an enabling effect for achieving climate action goals. The experts concluded that this technology could enable conditions for goals in the *Natural Resource Base* and *Governance* clusters to progress.

Carbon Capture and Usage (CCU)



This process uses CO2 and other emissions from plastic and steel production as a raw material for chemical products (fertilisers, methanol, polymers) - powered by renewable energy. It can also offer electricity storage options through the production of synthetic methane, either by the processing of CO2 with renewable hydrogen, or by the direct co-processing of CO2 and water using renewable electricity as an energy source.

From an industry perspective this was seen as a very important innovation – firstly as a more immediately available transformation technology for decarbonisation as little infrastructural

change is needed, and secondly for reducing CO2 emissions in order to meet climate targets. Certain sectors, such as the cement or glass industry will always have CO2 emissions due to the chemical process constantly emitting CO2 regardless of what fuels are being used. As with gasification, some CCU activities will be necessary in the transition to sustainable industry.

The activity is, however, very energy intensive for the volume of inputs needed to create outputs. Experts stated that the CO2 molecule is notoriously difficult to work with, requiring high amounts of energy for the process. For this to work this technology needs massive amounts of hydrogen. Currently the industry is moving toward 'blue' hydrogen which is produced from natural gas, usually via steam-reforming, with carbon capture storage (CCS) – a process which itself produces CO2 emissions that require offsetting. In an ideal state, industrial actors could use 'green' hydrogen for this process – but producing 'green' hydrogen requires large amounts of renewable energy which are currently not available. It was further argued that waiting for a time when enough renewable energy was available to produce green hydrogen would come at the cost of time to build up infrastructures and processes to use the hydrogen.

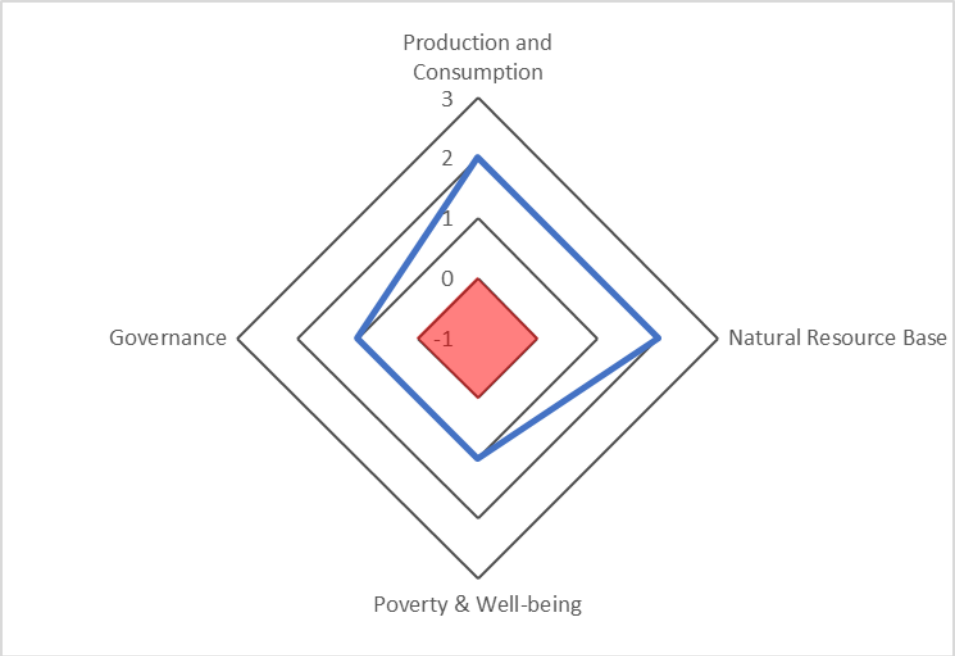
Despite the intense focus on this technology by industrial actors, some experts expressed a niche need for it. The energy net balance dictates that this can only be used in places where there are no other ways to reduce emissions.

There existed the possibility, to experts, that this technology could be viewed by policy makers and industrial actors as the key solution to carbon emissions in the plastics industry, slowing or halting the search for further innovations. This was viewed as counteractive in a decarbonisation context as ultimately the process delays carbon emissions rather than capturing them, by removing emissions from the short term and replacing them through the intensive energy needs of operating. There is a space for this, but not as much of one as there is now.

This was a contentious innovation within the focus groups – despite the high energy needs (and further knock-on effects this causes) of this technology, it may still be viewed as a stepping stone within niche process areas on the path towards sustainable plastic production. Ultimately, the threat of lock-in means that that this cannot be the final solution. While it strengthens the current supply chains by requiring national collaboration to build and maintain the necessary infrastructure, this innovation has otherwise little impact on governance-based goals.

Overall this innovation was viewed by experts to have a counteracting effect on *Production & Consumption* goals, enabling conditions for *Natural Resource Base* goals and having a neutral effect on the final two clusters.

Zero waste supermarkets



The purpose of these stores is to sell retail goods primarily in bulk without the use of plastic and other single-use packaging. Zero waste grocery stores support the use of containers brought from consumers' homes and are usually stock with local organic products. The stores are usually crowdfunded and built within local neighbourhoods.

Several experts viewed this as an indivisible innovation for achieving objectives outlined in the SDGs. In general, this concept is almost entirely positive as it shortens supply chains, is community driven, and deals with plastic packaging which is a major concern. While the potential scale and wider impact of this innovation is uncertain, it attracts the first movers and sets the stage for other grocery chains to follow suit.

When it comes to the *Natural Resource Base,* experts perceived this option to have a very high potential for reinforcing goal progress. As these types of innovation usually supply organic local agriculture, they result in shortened supply chains – this would have a positive impact on life on land and under water as well as on plastic waste. In the experts' view, goal 14 cannot be reached without addressing single use plastics. Most LCAs show that reusable packaging is better than single use packaging, the only trade-off here could possibly be the water use from washing these containers yourself.

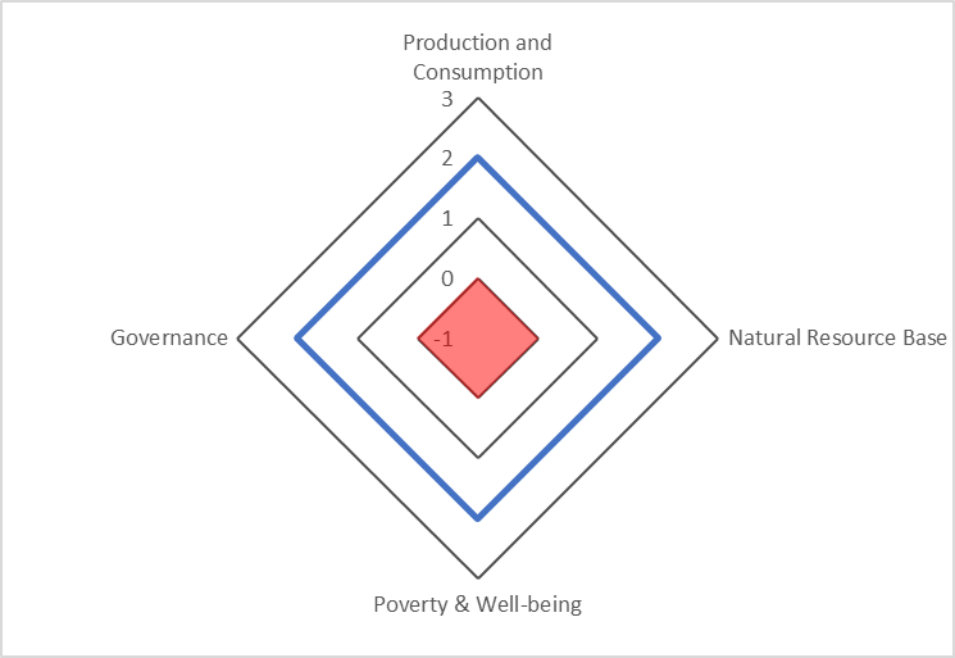
Seeing as consumers buy in bulk from these stores, and their ingredients are organic there is an enabling feedback on health goal progress. As an example of addressing Goal 2 (Zero Hunger),

cooperatives in Poland the food that is near expiration goes out into the community to lower income residents so that they can still enjoy some of the benefits of the innovation. This not only reduces food waste, but also strengthens community bonds.

This innovation, to the experts, reinforced conditions for goal progress within both the *Production & Consumption* and *Natural Resource Base* clusters while enabling goal progress within *Poverty & Human Well-being* and *Governance* clusters.

5.2.3 Pulp & Paper Sector

Biorefinery



According to experts, the biorefinery concept is still in the early stages of production and development. We are only now beginning to see in the Nordic countries what biorefineries could be capable of which is, in their view, extremely promising. This innovation had its highest impacts on responsible production and consumption by replacing fossil-based chemicals with bio-based ones. It has potential to show economic growth in regions without fossil fuels, who may see this as a new industry opportunity.

Biorefineries are an evolution of the refinery industry and this industry, from what is known so far, is strongly linked with a very vertical integration in the sense that the process starts with fossil fuels which are extracted from underground – and then benefits or royalties are paid out for this which are sent to where the refining takes places before being sent to consumers. This represents a very centralised system where there is no real spread of wealth, like in the countries

where fossil fuels are extracted we see a concentration of wealth into very few individuals who reap the benefits, leaving everyone else in poor conditions. The biorefinery model is based on a much more defused ownership of the raw material which would then have to be processed into the biorefineries and requires management of that land be it forest, culture, waste streams. Potentially, this carries the benefits of having a much more distributed welfare system across society because it requires the need to build partnerships across many more segments and actors across society where ownership is much more defused. Rural areas are often the places where the most poverty is seen, the biorefinery model may create an economic incentive in better managing land and include a wider community of stakeholders – contributing to a reduction in poverty and improving the quality of education though upscaling and learning new methods of resource optimization. Experts viewed this as the most positive aspect of the technology.

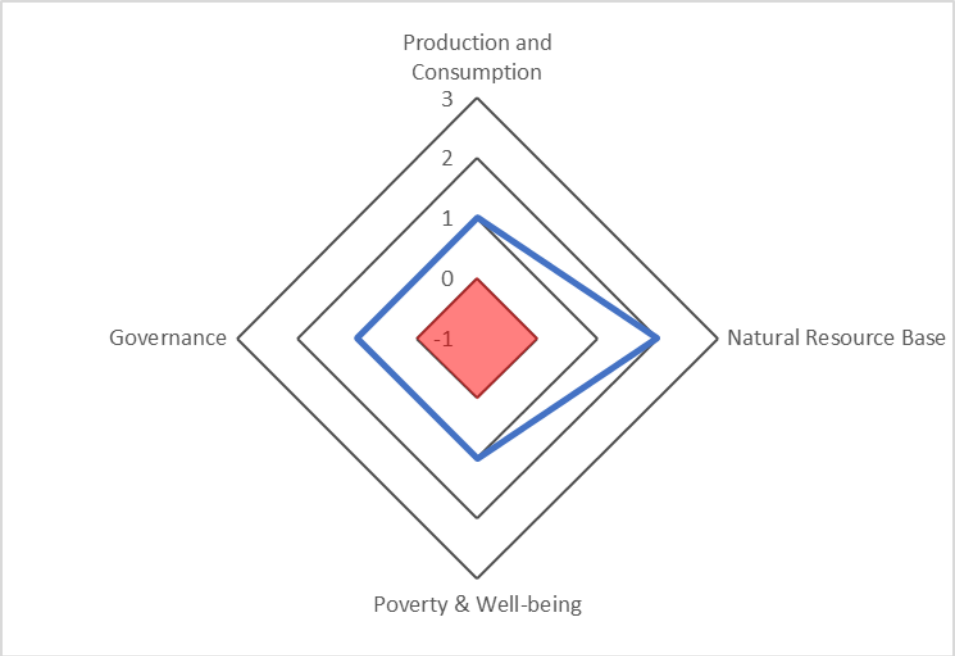
Stressed here was that the greatest contribution to sustainable development could come from the biorefinery model rather than the biorefinery itself – a concept which is evolving around a certain type of raw materials, in this case residues from forest. There is a wide range of applications this could be applied to in dealing with the residues from agriculture, industry, maritime industry, fishing by reusing the raw biological materials that come in the form of a waste from products.

This linked more to sustainable production and consumption through chemicals based on renewable material, replacing petroleum fossil-based chemicals. The only constraining aspect is of course for countries that produce and sell fossil fuel. It directly meets a lot of these goals, especially clean energy, economic growth, everything from Goal 7 onwards. Experts could also see enabling factors for Goal 9 (Industry, Innovation, Infrastructure), particularly in the European refinery industry which has (been going through a rough time / is not going through a great period and has been for a while) – this could be a way to reengineer and revitalise the refinery industry to move forward.

The assumption here was that the biorefineries were based on a sustainable business model, meaning that there was no exploitation of forests, rainforests, and labour. Given this the impact was neutral for to Goal 15 life on land as no greater or lesser quantity of resources is consumed, and enabling for climate targets as more fossil-based materials are replaced with bio-based materials, displacing emissions and transitioning towards circular models of activity. The fossil-based activities are not moving quick enough to a circular model as it is too expensive, but the recycling business model based on biobased is working quite well.

It stood from this discussion that reinforcing effects were seen on all goal categories by this innovation, assuming that it ran on a sustainable business model.

Lime Kilns



This solution looks primarily at ways to reduce process emissions and did not have a significant impact on goals in the *Production & Consumption* cluster, as the emissions that come from the type of production process are unavoidable because of the way it's produced.

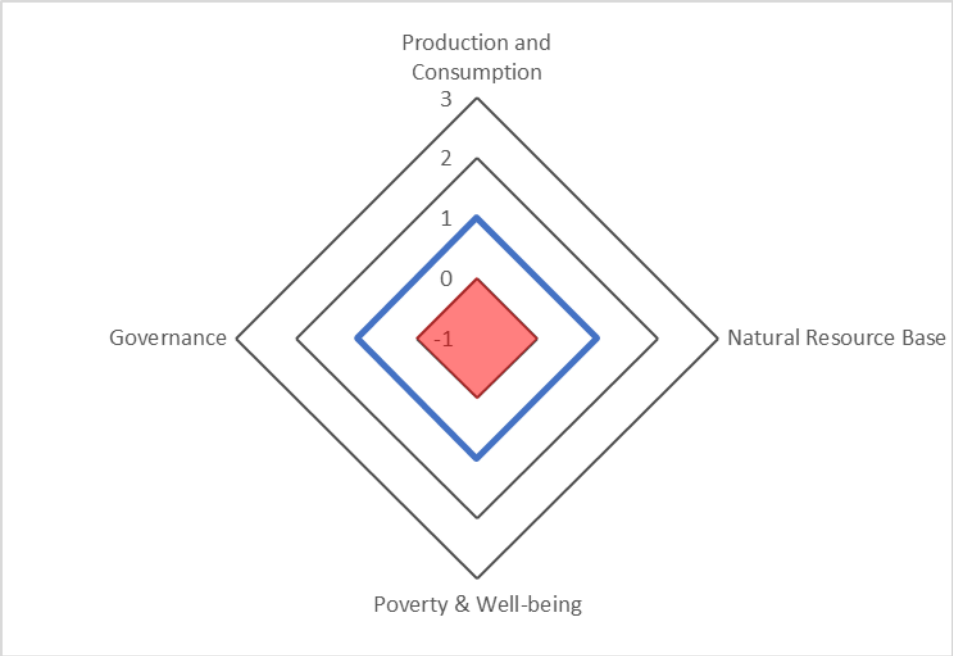
The bulk of the emissions from the pulp and paper industry are from the combustion of fuels, and when you put this into an industry perspective, these sectoral emissions are quite slim. Lime kilns are a technique that will be used for reducing the amounts of residual emissions, which is quite low anyway. This addresses the climate action aspect rather than the *Production & Consumption* aspects of the SDGs. It replaces fossil fuels by going with wood powder but in a wider context there aren't a huge amount of fossil fuels used in this process in Europe. This was seen by experts as a climate measure, but the overall mitigation potential was low.

The renewable energy aspect was for experts in line with Goal 7 (Decent Work & Economic Growth), and Goal 8 (Clean & Affordable Energy). This technology was seen as a way of replacing fuel oil, which represents 1% of consumption in the paper industry and a part of the industry's emissions are 0.9% of EU emissions. Putting all of this into perspective, it addressed climate mitigation but the impact is quite minor.

The impacts on the *Natural Resource Base* depended on the production manner of the biofuels. If this was done in a sustainable way from a sustainably managed forest, then an enabling effect would be seen because it helps having properly managed healthy forests with biofuels coming in a sustainable way from waste and residues connects well with a circular economy so in this way it would have a reinforcing impact. Experts saw this reducing oil consumption but no real connection with Goal 14. In some way it is linked to total bioenergy use and the amount taken out of the forest, which may influence the biodiversity.

With this innovation we see reinforcing conditions for goals in the *Natural Resource Base*, followed by enabling conditions for all other clusters.

Biocomposite



Biocomposites are composite materials usually consisting of a biobased fibre mixed with a plastic. These are used in a range of applications, such as automotive panels and upholstery, noise insulating panels, and indoor furniture. Recent estimates for Europe are that more than 30 compounders are active in the area of biocomposites and together produced more than 100 000 tonnes in 2018.

This innovation connected with many *Production & Consumption* goals as it creates the possibility of having new products with a range of applications for multiple end users. This was an area where there strong capabilities were seen by experts for increasing the source of raw materials for production and moving production to the local area, cutting down on

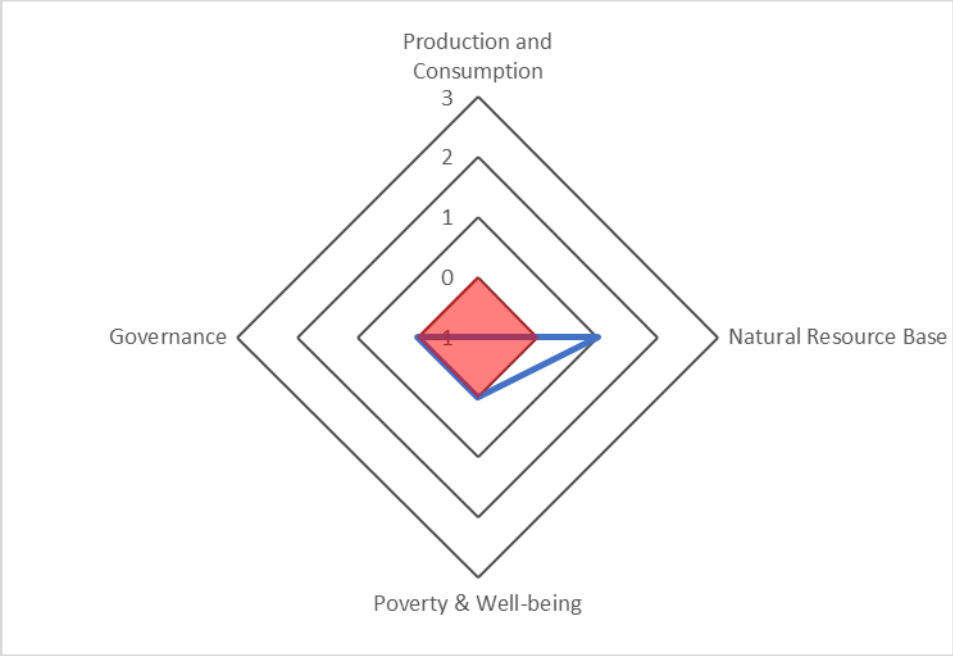
transportation emissions. This then creates the opportunity for industries to reinvent themselves, particularly those that are attached to old models of production

This innovation replaced high value plastic products, but its end-of-life options were uncertain. Recycling biocomposite depended on the application it is used in, and so the circularity of this material will not be as straight forward as other products. The longer the circular loops, the more breathing time the forest has to recover. Experts recognised that if all the biomass used for these bioproducts were sustainably managed, the process then begins with a raw material that is deemed carbon neutral (as emissions are counted from the time the raw materials become available) . Biocomposites had a reinforcing effect on climate impact assuming they replaced more carbon intensive materials, fossil based plastics or less circular materials – however in order to address the bulk of emissions from this industry, transport emissions would need to be addressed.

In line with other innovations in this sector, biocomposites have positive impacts on SDG progress albeit to a lesser extent. This innovation present enabling conditions for all SDG clusters,

5.2.4 Meat & Dairy Sector

Meat analogues



Meat analogues, such as cultured meat, are examples of the new field of cellular agriculture produced by in vitro cell culture instead of slaughtered animals. The process begins with the

removal of starter cells from an animal by biopsy. These can be different kind of cells such as embryonic stem cells to fully differentiated muscle cells, which are isolated and placed within a culture media within a bioreactor to enable cell proliferation and provide the required nutrients. Once the desired number of satellite cells have been produced, culture conditions can be altered to induce cellular differentiation and begin protein synthesis – enabling the development of muscle fibres. Due to limited dedicated research activities, cultured meat has not yet been commercialized, although several plants for the production of cultured meat are already being built. Participants here were allowed to speculate on scenarios that could lead to synergies and trade-offs of this innovation with the SDGs. To date, cultured meat has focused on beef production, though scientists have identified possible growth media for turkey, fish, sheep and pig muscle cells.

When looking at some of the SDGs, specifically those linked with the *Natural Resource Base*, the experts mentioned enabling factors resulting from cultured meat due to the implied reduction in activities linked with livestock rearing. This could have positives on Clean Water and Sanitation as well as Life Under Water, in the sense that meat production is a significant user of water and a significant generator of water pollution through fertilizer residue entering the worlds' oceans and water supplies. This now depended on how clean the industrial processes will be and how circular the water will be in said processes. Furthermore, if this technology could be extended to produce fish meat then it had the potential alleviate pressure on fish stocks. The impact on Life on Land, however, depended on where in the world this activity takes place and the type of production talked about. Should meat analogues replace conventional livestock production on grassland, for example, that potentially means there will be a replacement of grassland with cropland along with a reduction of demand for animal feed and its associated land requirements.

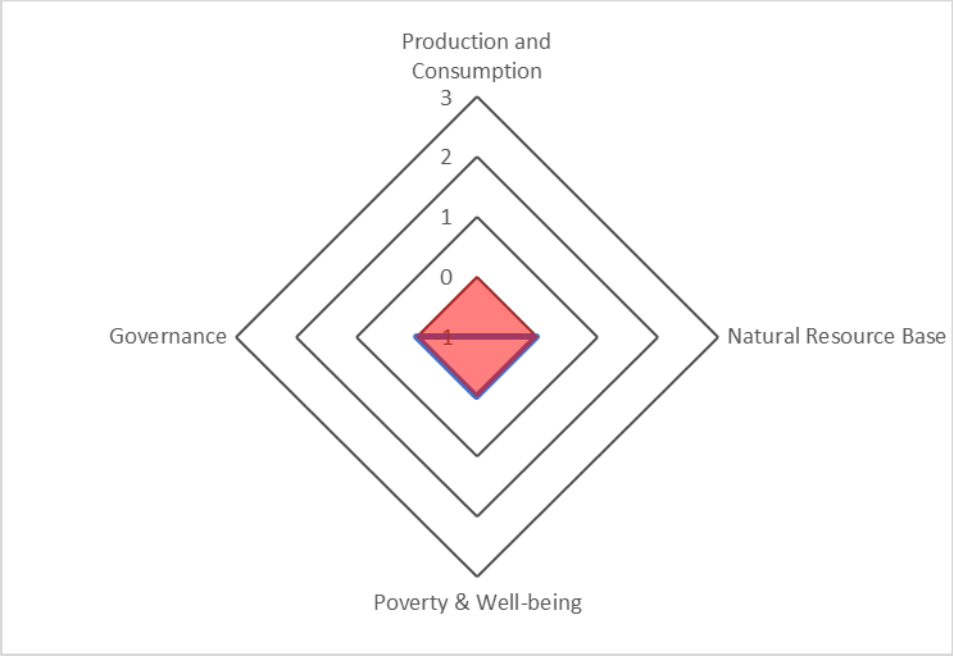
The innovation is more industrial than conventional means of meat production and remains an energy-intensive activity to produce outputs. The potential GHG reductions from this innovation will therefore depend largely on where the inputs come from as these will have the greatest influence on this technology's impact. The emissions reductions would also depend on the extent to which it became a portion of the diet and displaces conventional meat production. This relied heavily on consumer acceptance of the product, an unknown factor in the global market which is being heavily researched. According to experts, an element linked to this acceptance is the nutrition profile of the product. It is not clear yet if the full range of vitamins can be found within cultured meat leading some groups to express concerns over how healthy

cultured meat may be. This tied in with the goal of Zero Hunger – the global context of which addresses malnutrition and calorie deficits, problems that are less relevant in the European context. Zero Hunger is primarily concerned with low income people in developing countries, for whom protein deficiency is a contributor, but not the main cause, to malnutrition. The shift towards this new industrial process may allow for meat to be produced in areas where it was previously unavailable, but this largely depended on the capacities of these regions to invest in the infrastructure to produce cultured meat in the quantities needed to meet the nutrition demands of their populations. Criteria such as this did not serve to accomplish goals linked with Reduced Inequalities in the view of the experts, as some areas will not have the necessary resources for such an operation. Further influencing equality related goals is the impact this technology may have on farming communities. From the perspectives of farmers, cultured meat would be considered counteractive as it ends up supressing demand for conventionally produced meat and moves centres of production away from rural communes. While this enables positive work and economic growth for people in the meat-alternative industry, it presents a constraint for the agriculture sector and could have adverse implications for livelihoods of farmers in both developed and developing countries.

On the other hand, experts recognized that the innovation could have a role in terms of what potential future food production could look like and could be seen to promote the objectives linked with Industry, Innovation, and Infrastructure. This presents a new research area requiring additional structures and innovative technologies to execute on a large scale, as well as new research needs. This applies more to the larger companies that have the capital to invest in new research and development capacities, which could present a blocker to smaller producers who cannot afford to join. Relocating the production to urban areas would shorten supply chains and potentially reduce transport emissions. The overall circularity depended on how the process was run – nutrients would be needed to create the process, which is no different from current agricultural practices. The question for experts then was, if animals are not being cultivated for food, how would this affect the demand for soy produce (used as feedstock) from regions such as South America.

Overall, experts only saw clear enabling factors for economic growth, industry, and innovation while the remaining goal areas remained contentious.

Oat-based dairy analogues



The company this case study was based off of develops oat-based dairy analogues for the international market. Through a patented enzyme process, the company manufactures an oat-base which is then processed into a diverse set of products such as milks, yoghurts, and creams.

Many of the same arguments against cultured meat were seen when discussing this innovation. While oat crops have relatively high water needs compared with other analogues (such as soy), this innovation was still seen as beneficial in terms of clean water and sanitation, in the sense that dairy production is a user of water and a generator of animal waste which can have adverse implications for water quality. However growing oats in regions where it is not endemic and will necessitate high levels of water treatment, making this counterproductive to achieving sustainability targets and making accessibility an issue. There was a perceived positive reduction of carbon footprints as the dairy analogues did not require farm animals and their related resource requirements. Oat milk is, however, notably deficient in terms of nutrition compared with traditional milk sources. This could again counteract goal progress for developing regions where nutrition is a more important topic than in a Global North context.

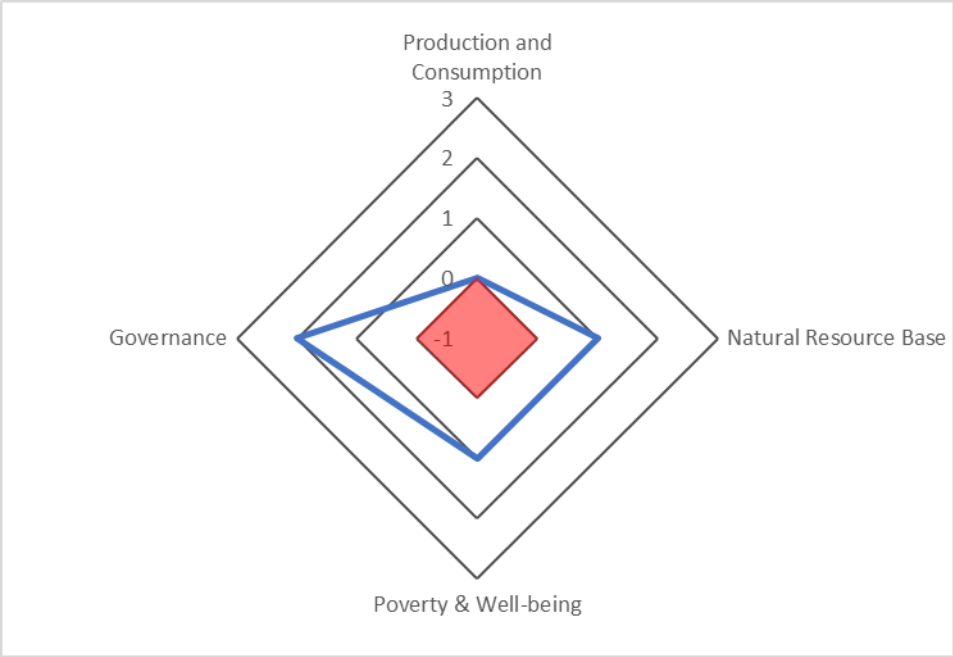
In the Western context enabling factors were seen by experts for *Production & Consumption* goals, as these oat-based products are cultivated from ingredients based in a local climate, making supply chains shorter and lowering transport emissions compared with industrial activities using ingredients sourced from over the world. This then had enabling implications

for creating sustainable communities as ingredients are locally produced and have smaller impacts, as well as for industry and innovation as both large and small companies are able to engage with this production.

The biggest issue faced here was the focus on oat crop and the risks of creating a monoculture of crops to produce the dairy quantities we currently consume. Diversifying the protein resource (soy, rice, oat) will be more beneficial than focusing solely on one analogue. In general, it was agreed that a wider range of dairy analogues were needed to address the sustainability goals linked with dairy production.

This innovation presented constraining factors for goal progress in the *Production & Consumption* cluster, with no interaction on the remaining clusters.

Private governance initiatives to promote dietary change

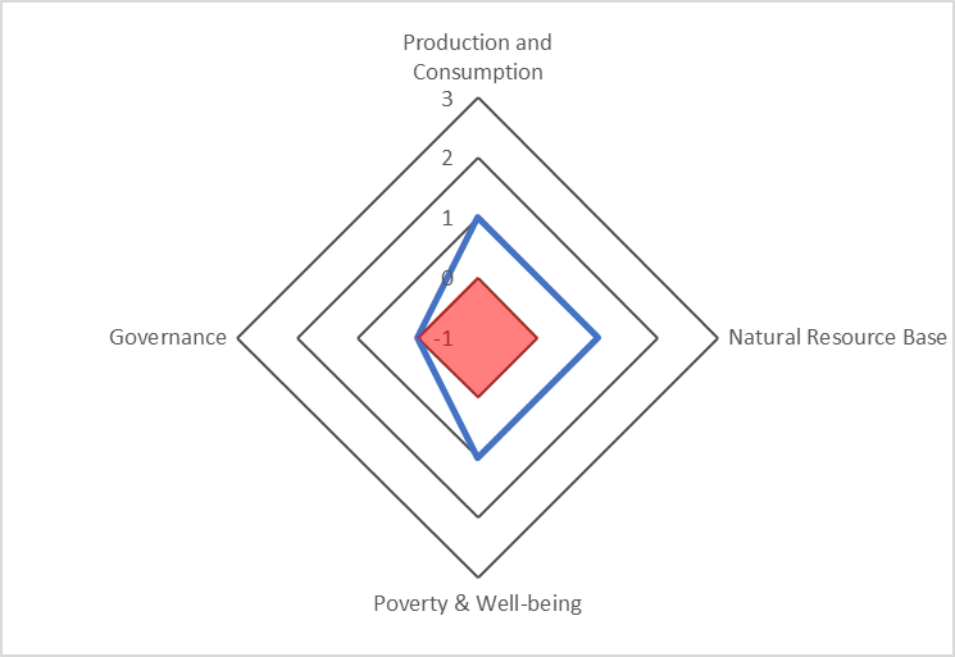


This innovation represents a multi-stakeholder partnership consisting of firms from the complete supply chain of plant-protein products, including the Ministry of Economics, NGOs, and the Dutch Nutrition Centre. It aims to change the protein consumption balance in the Netherlands to 50:50 (plant : animal) by 2025 by providing space for sector organisation activities, including sector-wide product standards, inspiring product development partnerships and new product market introductions and implementing consumer awareness campaigns and education initiatives.

While this innovation clearly states its intended outcomes on meat consumption, it was not clear to experts if this would have the same effect on meat production within the country of implementation. The impact on sustainability targets was dependant on the geographic level this innovation is implemented on, as well as the development stage of the region. For example, It is entirely plausible that rather than changing the production patterns of major food exporters such as the Netherlands, Germany, France, and Brazil, a social movement such as this would simply change export levels of these products to other countries. Following this narrative, the net impact on sustainability objectives may balance out to zero due to sustained food production levels. Once a movement such as this moves to a Pan-EU and global level, reinforcing effects with sustainability objectives would be seen as the global dietary pattern rebalances in favour of less carbon intensive plant-based protein. However, as stated prior there is a growing demand for meat products in developing countries who can now afford meat and are moving from a plant-based to a meat-based diet. Compounding this issue was the complexity involved in engineering policies over such a broad scope of regions and contexts as well as driving the necessary high levels of participation from national governments.

While this innovation had, in the eyes of experts, reinforcing implications for industry and innovation goals as well as economic growth, it did not address food-based goals linked with zero hunger. Concern was raised in focus groups at the 'private' nature of this movement, which was viewed to be promoting their products from a single viewpoint and aligning themselves with the general trend of promoting green diets (which are only implied to be sustainable or healthy) as well as only promoting products of industrial firms. Additionally, the private sector ultimately gravitates towards profit generation rather than the sustainability objectives linked with the organisation.

Green Bonds



This innovation represents the first 'green' debt instrument issued by a non-German company. The company in question is the largest dairy producer in the Netherlands, controlling approximately 75-80% of the local dairy market. Therefore, reducing emissions within the company's value chain carries the potential to significantly reduce emissions from the Dutch dairy sector as a whole. The funds raised will proceed towards three pillars of green investing; 1) The reduction of environmental footprint in production factories, 2) Sustainable farmer development, 3) The development of healthier products.

It was recognized by experts that the €300m raised by this initiative is not a lot of money in the context of the size of the company and industry. The motivation behind this innovation was praised as the company has shown leadership on driving sustainability, but participants were not as eager to assess the interaction before seeing the outcomes of the fund raising, out of concerns for potential greenwashing. The enabling implications for this impacted all goals as the previous food-related innovations, with the added benefit of reinforcing impacts in rural areas. This innovation departed from all others in the meat/dairy category by including the farmer in its focus and opening up avenues for sustainable community development in rural areas, addressing issues pertaining to poverty and inequality. However, much like the other meat/dairy innovations, this initiative was not viewed as a solution to Zero Hunger.

Financial instruments such as green bonds were viewed positively for countries with a large agricultural base as it is less contentious from the perspective of the farming community. One of the issues at present is that contemporary solutions for the negative impacts of agriculture involve agriculture being constrained or being reduced in size, whereas an initiative like this is probably more welcomed by the agricultural community in the sense that it doesn't alienate farmers. The initiative was perceived by experts to have enabling factors for goals related to Industry, Innovation, and Infrastructure as it provides an appealing route for industries to engage in more socially and environmentally sustainable actions. It is important to note that the company used the money to refinance some ongoing decarbonisation projects rather than putting it forward to new sustainability initiatives.

While this innovation had a neutral impact on goals within the *Governance* cluster, it presents enabling conditions for goal progress in the remaining three clusters.

5.2.5 Summary

Within the steel sector, voluntary low-carbon building standards had the greatest impact on goals progress, reinforcing conditions for goal progress within the *Production & Consumption* and *Natural Resource Base* clusters and crating enabling conditions for goal progress for the *Poverty & Human Well-being* and *Governance* clusters. This was followed closely by the direct reduction of iron ore using hydrogen as a reductant, the most coherent of the technical steel innovations for completing SDG objectives. The least coherent innovation within this category was the improved process technology co-designed with end users as this did not venture far from current production standards and, while it held potential to shorten supply chains through specialisation, this was perceived to make the supply chains less resilient to external shocks. Within the plastics sector, plastic free supermarkets were seen as the most coherent innovation for SDG progression - reinforcing conditions for progress within the *Production & Consumption* and *Natural Resource Base* clusters and crating enabling conditions for goal progress for the *Poverty & Human Well-being* and *Governance* clusters. Academics within the focus groups viewed this innovation as indivisible for goals within the *Natural Resource Base* cluster, as marine-based sustainability cannot be achieved without addressing single use plastics. The technical innovation with the highest synergies with SDG objectives in this sector was 100% bio-based clothing which showed the same degree of impacts as zero-waste supermarkets, save for a neutral impact on *Governance* goals. All innovations within this sector had neutral to positive impacts on SDG progress with the exception of carbon capture and usage (CCU), whose high energy demands constrained the steel industry's ability to meet goals within

the *Production & Consumption* cluster. Innovations within the paper sector had multiple enabling and reinforcing opportunities for SDG progress, the most coherent of which was the biorefinery model. This model was viewed to reinforce goal progress across all SDG clusters, assuming that it operated on a sustainable business model. The lime kilns and biocomposites followed the same logic, indicating that sustainable and inclusive input sourcing was indivisible for SDG progress in the paper industry. The meat/dairy industry had the fewest innovations to reinforce SDG progress. The two most promising innovations here were private governance initiatives to promote dietary change, and green bonds. While the private initiatives had the strongest positive effect on the *Governance* cluster, the green bonds were the only innovation within this sector to include the farmer. Both meat analogues and oat-based analogues constrained goal progress in the *Production & Consumption* cluster due to various factors. These innovations had neutral interactions with all other clusters, save for a slight enabling impact on the *Natural Resource Base* by meat analogues through the reduction in emissions from livestock.

5.3 Coherence between key EU Climate Policy Documents and SDGs

This higher level of integration between the economic, social, biophysical and environmental dimensions within the SDGs targets can allow for a collection of potentially unrelated goals within a system to be grounded into a reality that acknowledges the interdependencies and trade-offs (Le Blanc, 2015). EU policymaking post-2015 has reflected this increased integration. Given the high levels of policy integration which consolidates environmental goals such as decarbonisation with other policy goals, many policy documents pertaining to the REINVENT sectors are cross-cutting policy documents. Alongside the REINVENT sector policy mixes, for this project the cross-cutting policies were thematically organised under three topics which were present as separate but overlapping EU objectives: green employment, circular economy and the energy transition. While this separation allows for a more systematic analysis of the objectives and instruments and their interactions with the SDGs, the reality of the matter is that the policies and goals form a complex and interlinked web of interactions.

5.3.1 Screening Matrices

Tables 6 and 7 shows the results of the screening step. This provides a mapping of the overall interactions between the policy objectives of the 32 policy documents analysed and the SDGs. Presented in Table 6 are the key objectives of each thematic and sector-based policy area, alongside main instruments associated with the areas. Table 7 shows a goal-by-goal breakdown of the positive and negative interactions of each policy area.

Policy Area	Associated Instrument(s)	Objective/strategy	SDG Cluster		
			Poverty & wellbeing	**Production & consumption**	**Natural resource base**
Cross-Cutting Policies: Green Employment	Sustainable Finance Strategy Green Employment Initiative New Skills Agenda for Europe EU Programme for Employment and Social Innovation (EaSI) Internal Market policy	Increasing employment and competitiveness of the EU economy Increasing education, training and research for the green economy Increasing compliance of small and medium enterprises towards environmental goals	+	+++	–
Cross-Cutting Policies: Circular Economy	InnovFin Circular Economy Finance Support Platform Structural and Investment Funds Horizon 2020	Reduce waste in sectors with high potential for resource recovery (such as electronics, plastics, textiles and packaging) Investment into circular economy projects	0	++	+
Cross-Cutting Policies: Energy Transition	Emissions Trading Scheme European Green Deal Investment Plan and the Just Transition Mechanism Regulation on the governance of the energy union and climate action	Providing secure and affordable energy in Europe Transitioning to clean energy sources	0	++	+
Plastic Sector Policies	Waste Framework Directive Directives on specific waste streams Landfill Directive Construction Products Regulation Ecodesign Directive	Reduction of plastic pollution (marine litter and microplastics) Increase market for recycled plastics Investment in supply chain and value chain to promote alternative non-fossil fuel derived plastics	0	++	++

Steel Sector Policies	Trade Defence Instruments Innovation Funds Research Fund for Coal and Steel (RFCS)	Safeguarding European steel industry in the global context Modernisation and decarbonisation of the steel industry via implementation of new technologies	0	++	+
Pulp and Paper Sector Policies	European Agricultural Fund for Rural Development (EAFRD) European Regional Development Fund (ERDF) Forest Management Plans (FMPs) EU Timber Directive EU Habitats Directive	Shifting the pulp and paper sector towards products in the bio-economy and circular economy Increase resource efficiency Increase environmental monitoring of forests	0	+	–
Meat and Dairy Sector Policies	European agricultural fund for rural development (EAFRD) Water Framework Directive Directive on the Sustainable Use of Pesticides Nitrates Directive CAP standards for good agricultural and environmental condition (GAEC) CAP direct payments	Modernising the European meat and dairy sector Reducing the ecological impact of the sector Connecting new technologies and innovations to farmers Ensuring regional and demographic equity amongst European farmers	+	+	–

Table 6 Policy Area Screening Results

SDG Clusters	Sustainable Development Goal	REINVENT Sector Policies				Cross-Cutting Policies		
		Plastic	Steel	Pulp and Paper	Meat and Dairy	Green Employment	Circular Economy	Energy Transition
Poverty and human well-being	1 – No poverty	+	+	+	+	+	+	+
	3 – Good health and wellbeing	0	0	0	+	0	0	0
	4 – Quality education	0	0	0	+	++	0	+
	5 – Gender equality	0	0	0	0	+	0	0
	10 – Reduced inequalities	+	0	+	++	+	+	0
Sustainable production and consumption	2 – Zero hunger	0	0	0	+	+	0	0
	6 – Clean water and sanitation	++	0	0	+	+	+	0
	7 – Affordable and clean energy	0	+	+	0	+	+	+++
	8 – Decent work and economic growth	+	++	+	+	+++	++	++
	9 – Industry, innovation and infrastructure	++	+++	+	0	+++	+++	++
	11 – Sustainable cities and communities	0	+	0	+	+	++	+
	12 – Responsible production and consumption	+++	+	+	0	++	+++	++
Natural resource base	13 – Climate action	0	+	+	– –	–	+	++
	14 – Life below water	+++	0	–	0	–	+	–
	15 – Life on land	++	0	– –	+	–	+	–

Table 7 Goal-by-goal matrix

5.3.2 Qualitative Document Analysis

Cross-Cutting Policies

The cross-cutting policies have been organised into three themes: policies relating to green employment, circular economy and the energy transition. These broad-based policies aim to target environment, societal welfare and economic growth simultaneously. The three themes present a policy system which aims towards coherence, consistency and the generation of synergies, and reflects the EU's commitment towards Policy Coherence for Sustainable Development (PCSD). PCSD, a multi-directional principle defined by the SDG agenda, represents a move towards broader goals-focused policymaking; with synergistic aims rather than a regulatory system that focuses on the elimination of inconsistencies (European Commission, 2019). The EU's policy system represents a shift from previous policy coherence commitments, which between 2009-2016 were found to be heterogenous across policy domains and lacking in a common understanding, despite legal commitments (Núñez-Borja et al., 2018). The increased level of consistency and coherence in policymaking has resulted in the cross-cutting policies which culminate towards the objective of economic modernisation - where decarbonisation and circularity are core aspects. While they are not specifically related to the REINVENT sectors, they do have an impact on the functionality of the sectors through changes in the production and consumption of each sector's products.

These policies are primarily indivisible or reinforcing for the *Sustainable Production and Consumption* cluster, due to their emphasis on transitioning the European economy towards more sustainable and environmentally friendly modes of production. Schroeder et al. (2019) finds that circular economy practices can directly contribute towards the achievement of Clean water and sanitation, Affordable and clean energy, Decent work and economic growth, Responsible production and consumption and Life on land. In the case of the EU's circular economy implementation, there is strong emphasis on the economic and industrial benefits - reflected in the associated policy instrumentation to bolster investment in new technologies and innovations. While the goals of the EU's circular economy presents enabling conditions for the *Natural Resource Base* goals, green employment and the energy transition present constraining interactions for Life below water and Life on land due to increased economic intensification. The quantitative analysis conducted by Pradhan et al. (2017) finds that the goal of Responsible consumption and production is linked with the most problematic trade-offs, particularly for environmental protection goals. Additionally, the goals of Decent work and economic growth; Industry, innovation and infrastructure; and Life on land were also associated with high levels

of trade-offs. As the EU's cross-cutting policies place heavy emphasis on the achievement of the *Sustainable Production and Consumption* cluster while remaining consistent with the *Poverty and human well-being* cluster, it is important to note the trade-offs within the SDGs themselves.

Plastic Sector

Plastic is an ubiquitous material within the functioning of the economy and society itself. A critical material which serves multiple functions, its multifaced forms and functions make it so that policymaking regarding plastics is complex in nature. Addressing the issue of decarbonising the plastics industry is difficult, given its reliance on petrochemical feedstock. According to the EU, to fully decarbonise the industry, it would involve not only the cooperation of stakeholders across the value chain, such as producers, retailers, recyclers and consumers; but the reconfiguration of the value chain itself through the inclusion of bio-based and recycled material feedstocks (European Commission, 2018a)

Much of the EU plastics policy mix builds upon the 2013 Green paper on a European Strategy on Plastic Waste in the Environment (European Commission, 2013). Outlined within the green paper were strategies targeting both the production of plastics and the reduction of plastic waste. Relating to production, the EU strategy involves the promotion of biodegradable plastics and bio-based plastics; product design for increased durability and potential for repair; and plastics design for easy cradle-to-cradle reuse. Regarding the reduction, this involved EU initiatives dealing with plastics that become marine litter; targeting consumer behaviour; and regulations addressing plastic waste management. Following from the 2013 Green Paper is the European Strategy for Plastics in a Circular Economy and the proposal for a single-use plastics directive. The strategy for plastics in a circular economy outlines the initiatives undertaken to increase the use of recycled plastics through the creation of a coherent set of rules. These include the revision of the Packaging Waste Directive, a review of the Construction Products Regulation, and a review of the End-of-life Vehicles Directive. Further efforts include new eco-design measures to increase recyclability of plastics and improved standards and traceability of chemical substances. The single-use plastics directive, driven primarily by the issue of marine litter, provides further regulation on specific single-use items including bans on certain objects and consumption reduction targets.

Within the policy mix for plastics, there is a diverse number of policy instruments providing heterogenous actions with the aim of reduction of plastics in circulation and creating more

environmentally friendly plastics. These include 'hard' regulatory instruments, such as the bans of certain single-use plastic items Single Use Plastics Directive; legal instruments such as the development of eco-design measures and harmonising measures to improve the traceability of chemicals; market-based instruments to bolster the market for recycled plastics and bio-based plastics; economic instruments such as the polluter pays principle and subsidies. There is significant overlap between the policy mix for Circular Economy and plastics.

Relating to the *Poverty and Human Wellbeing* cluster, the policy mix here is primarily consistent with the SDGs, providing no significant positive or negative interactions. In regard to the goals of No Poverty and Reduced Inequalities, there are enabling conditions created by the emphasis on job creation and market creation relating to increased plastics recycling. While these issues are addressed more broadly in the overarching Green Employment policy area, sector-specific questions relating to human health and gender equality are left unaddressed. With regards to the *Sustainable Production and Consumption* cluster, the EU plastics policy creates is indivisible to the goal of Responsible Production and Consumption. Much of this cluster deals specifically with economic activity and industrial modernisation, to which the plastics policy aids in achieving. The plastics policy mix (and the circular economy policy by association) is the only policy area which directly addresses the impact to the *Natural Resource Base* cluster, as evidenced by the efforts to monitor and reduce marine litter. For this reason, reaching the policy goals outlined within the policy mix is indivisible to healthy marine ecosystems. The plastics policy mix presents the most holistic set of policy actions undertaken within the sector-specific policies, and the only sector-based policy to have a direct positive impact on the *Natural Resource Base* goals.

Steel Sector

Steel, a core sector within EU industry, has been subject to decline due to external imports, global overproduction, rising energy prices and subsequent price fluctuations. The 2016 policy document 'Steel: Preserving Sustainable Jobs and Growth in Europe' addresses the industry specifically and discusses the need to safeguard the industry alongside modernising production. Related policies and policy instruments include Trade Defence Instruments to deal with the issue of global production and price fluctuations, the Emissions Trading Scheme to address the industry's climate impact, structural support for carbon-intensive regions, alongside research and development measures such as the industry-specific Research Fund for Coal and Steel and the broader Horizon 2020 scheme.

The objective of the EU's steel policy is aimed at one singular policy objective – the preservation of the European steel industry. In order to do so, the EU cites technological innovation, increased efficiency and reduction in environmental impact as areas which increase European competitiveness on the global scale. This ties the steel industry to the EU's goal of a clean energy transition. Accordingly, instruments utilised are primarily directed towards facilitating research and technological modernisation of the sector, such as the Research Fund for Coal and Steel.

In relation to the SDG clusters, the steel sector is consistent with most goals, neither generating positive or negative effects. Concerning the *Poverty and Human Wellbeing* cluster, policies addressing steel create enabling conditions for No Poverty through the creation and retention of employment within the steel sector. Despite the acknowledgement that the steel sector within Europe is facing challenges and is likely to undergo restructuring, the EU aims to maintain employment and quality of employment. This is outlined primarily to be conducted as re-training and entrepreneurial support for workers who are made redundant. Relating to the *Sustainable Production and Consumption* cluster, it is evident that policy actions towards the steel industry create positive interactions with the goals. It is inextricably tied to the achievement of the Industry, innovation and infrastructure goal, particularly targets 9.4 (upgrading infrastructure and retrofit industries to make them sustainable, with increased resource-use efficiency and greater adoption of clean technologies) and target 9.5 (encouraging innovation and increasing research and development workers). The policies also generate reinforcing conditions for the goal of Decent work and economic growth, and creates enabling conditions for Affordable and clean energy, Sustainable cities and communities and Responsible production and consumption. Efforts to modernise the steel industry do not have strong connections to the *Natural Resource Base* goals. Through the decarbonisation and modernisation of the steel industry (and EU industry in general), conditions are created for the achievement of the climate action goal.

Pulp and Paper Sector

While plastics and steel can be viewed as distinctly industrial sectors, the pulp and paper sector is intrinsically tied to its biological feedstock: wood and timber. The industry, which is inherently dependent on its ecosystem, lends itself towards multiple policy areas – environmental policies, industrial policies and policies addressing rural areas. The key policy areas relating to the sector – the 2015 EU Forest Strategy, a policy framework which

coordinates forest-related policies, and the 2018 revised Bioeconomy Strategy – recognise the inherent interlinkages to the natural environment.

The objectives of the sector-based policies are dual in nature. On one hand, increased monitoring and protection of European forests, while increasing economic activity relating to the same forests on the other. The broad aims of the forestry sector such as ecosystem management, carbon sequestration and biodiversity monitoring are all in conjunction with pulp and paper industry playing an expanded role within the bio-based economy; leading to increased demand and rural development to accommodate demand (European Parliament, 2015). Despite the call for both objectives, it must be examined whether or not the sector can fulfil the seemingly conflicting goals of providing a habitat and whilst increasing demand for wood-based products. Furthermore, the pulp and paper policy mix is interlinked with the EU's circular economy objectives through the production of recyclable material, green employment and the energy transition through the substitution of fossil fuel based materials with wood products (European Commission, 2018b; European Committee of the Regions, 2019). There are further calls for timber to be used as refined biofuel, industrial construction material, and textile and automotive feedstocks. The main economic policy instrument affecting the industry is the European agricultural fund for rural development (EAFRD) which can provide funding for the development of the industry, as well as proposals to create stronger regulatory and monitoring instruments for forests across the EU to meet biodiversity targets.

The pulp and paper sector is generally consistent with the *Poverty and Human Wellbeing* goal cluster. The goals of No poverty and Reduced inequalities are addressed insofar as the leveraging of the industry towards rural regeneration. Relating to the *Sustainable Production and Consumption* cluster, the industry contributes to creating conditions for the achievement of Affordable and clean energy, Decent work and economic growth and Industry, innovation and infrastructure. This is an effect of the diversification and substitution of products and processes using wood, paper and pulp. However, it is within the *Natural Resource Base* cluster that the effects are most profound. Here, the sector's goals enables the achievement of Climate action through creating increased potential for carbon sequestration, but constrains the options for the achievement of the Life below water goal and counteracts with Life on land if the sector is intensified - particularly the target 15.5 (taking urgent and significant action to reduce the degradation of natural habitats and halt the loss of biodiversity) and 15.1 (ensuring the conservation, restoration and sustainable use of terrestrial and inland freshwater ecosystems and their services). Simultaneously, it has potential positive interactions with target 15.2

(promote the implementation of sustainable management of all types of forest and restore degraded forests). The exact interactions are dependent on the forestry strategies used by the industry, whether or not monoculture or agroforestry practices are adopted.

Meat and Dairy Sector

The meat and dairy sector is encapsulated within the EU's broader agricultural policy domain. The sector faces many challenges: economic challenges, such as changes in product demand and price volatility; environmental challenges, such as soil degradation; social challenges including an aging demographic and rural outward migration. Policymaking within the sector relates primarily to the Common Agricultural Policy (CAP), which has been under discussion for reforms post-2020 (European Comission, 2018c). This is emphasised in the 2017 document 'The Future of Food and Farming', where environmental care and climate resilience becomes a prominent theme within the future development of the industry. Alongside this, there is particular emphasis to the societal impacts of the agricultural industry - particularly the issue of attracting young people to the farming profession. Mentioned within the policies surrounding the industry are efforts to connect technological innovations and agricultural knowledge to farmers and increased educational efforts to assist those entering the profession. In efforts to increase environmental sustainability of the sector, there are proposals to create more conditionality for CAP funding based on environmental standards, and more flexible regimes in order to determine environmental standards based on relative conditions.

Of the four sectors, the meat and dairy sector has the most positive interactions with the *Poverty and human wellbeing* cluster. Bar the lack of explicit mentions to the goal of Gender equality, it creates at least enabling conditions for each of the *Poverty and human wellbeing* goals. There is emphasis on the societal wellbeing of agricultural regions, specifically through the objective of 'generational renewal' (European Commission, 2018c), which emphasises skills development and investment support for young people. It creates reinforcing conditions, or aids in the achievement of Reduced inequalities through the focus towards smaller farmers and the provision of a safety net for food producers and rural communities. It has less emphasis on the *Sustainable Production and Consumption* cluster compared to the other sectors. The environmentally oriented objectives of the policy mix enables the achievement of Zero hunger, Clean water and sanitation; while the emphasis on creating secure rural regional employment enables the achievement of goals Decent work and economic growth and Sustainable cities and communities.

Relating to the *Natural Resource Base* cluster, the meat and dairy sector counteracts with the Climate Action goal, as products of animal agriculture cannot be fully decarbonised. The continued maintenance of the industry through the support of animal agriculture rather than investment into alternative protein sources cannot lead to the achievement of the Climate Action goal, especially if the sector is to be intensified. Nevertheless, EU work towards the increased conditionality of CAP funding, with increased emphasis on environmental protection creates enabling conditions for the achievement of Life on land. The 2016 document 'More sustainable food systems' and the 2019 document 'Promoting short and alternative food supply chains in the EU: the role of agroecology' both emphasise the necessity for alternative forms of agriculture, one which is ecologically sound and focuses on shorter, seasonal supply chains.

6. Discussion

6.1 Coherence of EU climate policy within REINVENT sectors

Based on the policy documents and instruments outlined, there is ample evidence to support the notion that the EU has increased policy coherence in aligning economic policy relating to sector-specific legislation and climate goals. Regarding horizontal coherence, it can be said that the EU's policy agenda for PCSD has led to a wide-reaching set of policy actions – particularly relating to the promotion of the bio-economy and circular economy projects. The emphasis on monitoring materials for reuse, increased funding for research and development, scaling up innovations and promoting SMEs will have strong effects on the pulp and paper industry and the plastics industry, as the policy focus turns towards on encouraging re-use and bio-based materials. The picture for internal coherence within the sectors themselves is more heterogeneous. Within the meat and dairy and pulp and paper sectors, there is incoherence in the policy objectives of scaling up the industries sustainably, while also utilising the industry for environmental objectives such as habitat restoration and carbon sinks.

Through the analysis, many of the instruments cited within EU policy are instruments which focus on resource mobilization and knowledge development. Research and development, investment funds and public-private partnerships in the form of joint undertakings form the bulk of the policy instrumentation in decarbonizing the sectors. There are many instruments in attempting to scale up niches, but little regulatory instruments for existing environmentally suboptimal practices. In the strategy for a Sustainable Inclusive Bio-Economy, it is noted that "an important obstacle relates to product cost-competitiveness, both compared to fossil

alternatives and to equivalent products from elsewhere in the world. This competitiveness issue is compounded by difficulties in accessing finance for innovative projects and production facilities and, often, ongoing low end-user awareness of bio-based products, as well as by a lack of skills and operational relationships to drive the sector forward". While a competitive and difficult environment is recognised, little is done level the playing field by targeting the existing regime.

As policy instruments themselves reveal a specific mode of conceptualizing the practice of governance (Lascoumes and Le Gales, 2007), the lack of regulation of existing practices in favour of attempts at mainstreaming new practices, despite their recognised challenges, highlights the social power imbodied within the policy instrumentation used. Rather than actively disrupt current practices, trade and markets; it must be hoped that the policy instrumentation used will achieve a better practice through market forces. This is acknowledged in the EUs industrial policy, wherein the 'first mover advantage' and strong scientific knowledge base is automatically assumed to bolster the transition to a decarbonised economy.

This mode of coherence reflects what Schmitz and Eimer (2019) refer to as 'cohereitization' in their study of PCD policymaking. There, critiques of the impact of liberal trade policy were subsumed under the overarching goal of increased market liberalization and defending free trade. Rather than placing development goals in the forefront, they are incorporated into existing trade policies, and instead of having policy instruments which generate direct effects to environmental or developmental goals, these goals are generated indirectly through market processes, or, what can be termed as synergistic win-win solutions. The incorporation and integration of goals, which has nonetheless generated tangible goalposts for policymakers, has also created a system in which the power relations between incumbent regimes and niche actors is erased – evident in the EU's incoherent plastics policy, where a market for recycled plastics is required but not generated through the reduction of virgin plastic production.

Funding towards sustainable technology is still necessary to create niche innovations for decarbonisation, alongside the reduction of risks and promotion of research and development. However, the predominance on creating synergy and ignoring necessary trade-offs will hinder progress. This is coupled with the tendency for all sectors to embrace ecological modernisation, that is, the belief that policies for economic development and environmental protection can be combined to create a positive-sum game between the two domains (Berget et al., 2001). Bar the discursive outlier of agroecology within this analysis, the sectors all subscribe to this belief.

Herein lies a fundamental incoherence: the subscription to the belief that the green economy can create a positive-sum game, but essentially gambling the successes of new green technologies against pre-existing regimes bolstered by lack of consumer awareness and infrastructural lock-ins. Without the necessary trade-offs enacted through regulation, the policy mix for decarbonisation will remain incoherent towards the overall objective.

6.2 Coherence between sector-based innovations and the SDGs

This study has observed that implementation practices in the form of decarbonisation innovations are largely coherent with carbon reduction, energy saving, and climate objectives. Broadly speaking, the innovations are most coherent with the SDG clusters of Production & Consumption and Natural Resource Base. The majority of innovations create enabling conditions for goal achievement within these clusters, while nearly half display a stronger, reinforcing impact on SDG goal progress. According to the rationale by which the SDGs were clustered in this research, production and consumption activities rely on conditions in the biophysical systems, including climate, oceans, land and biodiversity. This is the 'ceiling' which sectoral activities cannot exceed without risking environmental – and as a consequence, social – collapse (Raworth, 2017; Rockström et al., 2009). The majority of innovations show positive vertical interplay favouring goals in the Production & Consumption cluster creating secondary enabling conditions for the Natural Resource Base cluster. This shift towards social and environmental objectives represents a reframing of perspectives within sectors and strategies towards sustainable development (Nilsson & Eckerberg, 2007). Enabling and reinforcing effects can also be seen on the remaining clusters of Poverty & Human Well-being and Governance, though to lesser extents and often due to secondary impacts from goal progress within the first two clusters, with the Governance cluster showing the highest number of neutral interactions between innovations and SDGs. Technical innovations generally have fewer impacts on the last two clusters given their industrial orientation, while social initiatives impacts spread across the four clusters. This is true for every sector apart from pulp and paper – whose technical innovations linked to biofuel and biocomposites stand to enable progress for all clusters given that the inputs are sourced from sustainable, community involved sources.

Steel, plastic, and paper innovations are largely coherent with the EU climate policy objectives of their sectors, in that the innovations presented a means to achieve the intended policy outcomes (Nilsson et al., 2012). While steel innovations are coherent with sector-based climate policy objectives, the cross-cutting policy areas of Green Employment, Circular Economy, and

Energy Transition provided a different perspective. Here, process-based innovations of strip casting and improved process technology with co-design with end users do not interact with the cross-cutting policy objectives. The findings also indicate that Carbon Capture and Usage technology has short term and niche potential for enabling climate policy objectives, but due to its reliance on large volumes of carbon inputs this innovation conflicts with the policy objective of promoting non-fossil fuel derived plastics and can be viewed as incoherent with the long-term decarbonisation of the plastics sector. However, the European Commission (2018) has created instruments to invest in energy technologies such as this, which in this research presents an inconsistency that stands to weaken policy coherence in EU climate policy through uncoordinated action and mis-aligned efforts (Bouckaert et al., 2010). The meat/dairy innovations are largely incoherent with their sector policy objectives. As mentioned prior, green bonds are the only innovation to include farmers, whose equity and development are high on the EU agenda and essential to agricultural reform policy. While it can be argued that meat analogues are coherent with the objective of reducing the ecological impact of the meat/dairy sector through reduced emissions from livestock, the technology is still in the early development stage and can thus only be speculated on.

Innovations alone are insufficient to meet global sustainable development objectives and must be supported by co-ordinated action in the form of policy instruments (Stafford-Smith et al., 2016). Uncoordinated action may create internal conflicts, for example, where decarbonisation innovations such as Wire Arc Added Manufacturing are used to build fossil-fuel infrastructure. This lack of coordination may also result in missed synergies, for example, inclusive, responsibly sourced biofuel inputs reduce carbon emissions, but could also increase equality and education in rural areas and improve these communities. The technology narrative in the SDGs is mainly framed around transferring technologies from the 'Global North' to the 'Global South', gambling on lower income countries to leapfrog western development paths (Berkhout et al., 2010). Many of the technologies here were found appropriate only in the Global North setting, save for a few that could bring development to remote regions or involve lower-income populations in some way. Innovations that were of a social nature were shown here to be the most accessible and inclusive, having the widest range of enabling effects on SDG progress due to their cross-sectoral and cross-societal linkages. Stafford-Smith et al (2016) highlight in their research that these links across sectors and societal actors are vital for achieving global sustainability goals, owing to the capacity building that results and provides a long-term foundation for growth.

6.3 Coherence between EU policy documents and SDGs

The concept of 'coherence' in policy studies is broad and ambiguous. Focusing on the framework outlined by Nilsson et al., (2012), coherence is measured through policy outputs - that is, objectives and instruments within a policy. These were listed in Table 2, gathered through the qualitative document analysis. As the aim of this report was to access the degree of coherence between the EU's policies with the SDGs, the objectives and instruments - which formed the policy mix for each sector - are evaluated for external coherence with the SDGs. This section will discuss the coherence of the policy objectives and instruments with the SDGs, and the implications of the results of the screening matrices.

Broadly speaking, the four sectors (and the associated cross-cutting policies) show similar trends in terms of coherence with the SDG clusters. Of the three clusters, the most positive interactions are exhibited within the Sustainable production and consumption cluster - with many synergistic relationships generated through the joint efforts to decarbonise and technologically modernise the industries. The four sectors are generally consistent with the Poverty and human wellbeing cluster, with most benefits primarily based around the increased economic gains to a region. Overall, there are most negative interactions with the EU policies and the Natural Resource Base cluster. However, interactions are still relatively heterogenous when viewed in terms of climate goals (Climate action) and ecological goals (Life on land and Life below water).

From the analysis, it is clear that each policy mix exhibits a multitude of interactions with the SDGs. To assess the implications for these enforcing or constraining interactions on the overall aim of policy coherence, attention must be returned to the clustered model of the SDGs devised by Lucas et al. (2016) (presented in the Methodology section, Figure 3.). This clustering works within a hierarchical 'doughnut model' where the Natural resource base goals presuppose the industrial and societal goals, as the welfare of the planet is necessary to ensure the functioning of human society. The policies analysed in this report were shown to have high coherence with the Sustainable production and consumption cluster. Given that the sectors are primarily industrial, and the primary goal of each of the REINVENT sectoral policies were to secure employment, maintain competitiveness and apply technological innovations to modernise the industries. Despite increased integration and internal coherence within EU policy, it cannot be said that the policies are coherent with the SDGs, especially when taken under the working

model of sustainable development which must function within planetary boundaries (Rockström, 2015).

This leads to broader issues with the implementation of policy coherence itself: whether or not it is a sufficient mechanism in reaching the SDGs. Critics of the policy coherence approach, such as Schmitz and Eimer (2019), term the coherence of objectives as 'coheritization', a discursive act which integrates limited critique of certain practices (in their case, free trade policies in the relation to discourse on international development) in order to legitimate said practices. Alternatively, Aykut et al. (2020) term this mode of governance as 'incantatory governance': a distinct feature in soft, goals-based governance where communicative and symbolic devices are recognised as core instruments in the implementation of the policy goals. This can be seen in the EU's 'Opinion instruments', a non-binding act which conveys an evaluation without imposing a mandatory legal framework, such as the policy documents analysed in this report. Coherence, when it comes to objectives, exists as a discursive act which may or may not generate coherence with the SDGs in practice.

Whether or not there is coherence of instruments with the SDGs is also tentative. Instruments create governing strategies, but also shape the practices, allocate roles and create social positions (Lascoumes and Le Gales, 2007). While direct financial instruments and regulatory instruments are used within the policy mix to foster research and create markets, instruments directly addressing welfare or environmental goals are less common. Reflected within the instruments used to create coherence with the SDGs, it is evident that the roles in which the industrial base occupies takes the forefront - even within the meat and dairy sector, which exhibited the most positive connections with the human wellbeing goals, calls for rural wellbeing is reflected in the population's skillset which represents a source of human capital. The instruments addressing one stakeholder group, or the lack thereof for addressing another, constrains the ability to address the SDGs across economic, social and environmental domains.

Nilsson and Weitz (2019) state that the progress in the practice of implementing coherence has been limited. This is due to the technocratic approach assuming that once information is available for cross-sectorial interactions (such as indicators and monitoring instruments) is available, policy can be adjusted to resolve them. Instead, the authors note the lack of discussion around trade-offs. This is further backed by Wong and Heijden's (2019) analysis of national strategies for SDG integration, which highlights the prevalence of avoiding trade-offs. In their findings, the discussion around trade-offs is off limits due to 'boundary rules' such as neoliberal

ideology, leading to abstract deliberation or certain issues being out of bounds of the institution. Trade-offs are inherent in the SDG agenda itself, particularly between economic goals, welfare goals and environmental goals. Within the Reduced inequalities goal, inequality is addressed through economic growth - rather than a commitment to redistribution (Weber, 2017); whilst tensions exist between the Decent work and economic growth goal, which assumes that efficiency improvements will reconcile the tension between growth and ecological sustainability (Hickel, 2019). While this is not to say that the measures undertaken to create SDG-coherent industrial policies are totally inconsistent with the SDGs or actively hindering the achievement of the SDGs; it must be acknowledged that policies can go further to assist in the realisation of the SDG agenda.

7. Conclusion

The concept of 'coherence' in policy studies is broad and ambiguous. In the case of sustainability it can be seen as a function of how rules, policies, and arrangements across dimensions of global governance are coordinated. Implicit in this are arrangements of institutional coherence, which we classify as an element of policy coherence. Policy coherence is typically analysed top-down, searching for mismatches and synergies in policy goals and instruments within and between sectors. Huttunen (2014) outlines two complications with this method: first, in the identification of relevant policies and, second, the measuring of policy coherence from often vaguely stated policy goals or preambles to statutes (May et al 2006). This report addresses these issues by focusing on climate policy within four key sectors to aid with the document scoping search, and by adopting a 7-point grading scale designed by Nilsson et al (2016), measuring coherence through the identification of synergies and trade-offs.

Focusing on the framework outlined by Nilsson et al., (2012), coherence is measured through policy outputs - that is, objectives and instruments within a policy. These were listed in Table 2, gathered through the qualitative document analysis, and shown in diagrams within each innovation. As the main aim of this report was to access the degree of coherence between the EU's policies with the SDGs, the objectives and instruments - which formed the policy mix for each sector - are evaluated for external coherence with the SDGs. While it is possible to conclude that EU policymaking is increasingly coherent across sectors, with converging overarching goals driven by the SDGs and increasing the instrumentation needed to support decarbonisation, the analysis must turn to what *form* of coherence is being achieved.

The distinction between coherence in process, and the coherence in outcome – that is, coherence in how it is being done and coherence in what is being done – must be considered. From the policy analysis, it appears that policy mixes are coherent in both what is being done, as presented in the roadmaps, action plans and strategies for decarbonisation and bio-based economy; and mostly coherent in how it is being done, through a mix of instrumentation which facilitates technological innovation systems. This same trend follows in the decarbonisation innovations where most technologies align with the objectives of both EU sectoral policies and the SDGs. These innovations largely favoured goals linked to production and consumption with minor indirect enabling factors linked the natural resource base upon which this production relies. It must be acknowledged that the intensification of specific sectors will have a negative effect on the natural resource base. Rather than aiming for only synergistic solutions, there must be an expansion of 'hard' regulatory instruments (such as the single-use plastics ban); less reliance on industry-suggested voluntary guidelines and moving towards directives instead; increased conditionality to EU funding; and strengthening environmental protection targets through the establishment of set goals. These measures may represent trade-offs, but managed correctly and through exploring alternative practices, may generate benefits beyond economic gain.

When assessing coherence between EU policy documents and the SDGs, the results showed coherence with the SDGs was mainly exhibited with the industrial and economic goals and relative consistency or having no impact with societal goals beyond welfare through economic gain. With the exception of the plastics/circular economy policies, the policies formed trade-offs with ecological goals. The general trend when implementing policy coherence shows that trade-offs are often ignored (Nilsson and Weitz, 2019; Wong and van der Heijden, 2019). However, previous research on SDG implementation indicates that trade-offs must be negotiated, and structural change is required (Pradhan et al., 2017).

Based on the findings of this report, the following course of action to increase coherence with the SDGs is recommended. Nilsson and Weitz (2019) state that the progress in the practice of implementing coherence has been limited. This is due to the technocratic approach assuming that once information is available for cross-sectorial interactions (such as indicators and monitoring) is available, policy can be adjusted to resolve them. This however, is not what is required according to the academic literature, which emphasises the need for political and cognitive factors such as leadership, drive and ownership.

The EU's inclusion of stakeholder engagements and platforms for knowledge sharing show signs that these issues are being taken on board to optimise policy coherence. Nevertheless, the EU's understandings of coherence – as a process of promoting synergy – may have dominated the other side of the definition: removing policy inconsistencies. Despite coherence in action and goals, it may still be the case that it is still not reaching the full definition of a coherent policy mix through the subordination of the 'trade-off' section of coherence within a system. While many of the innovations identified have the potential for decarbonisation within their industries, these should not be presented as industry-wide solutions for meeting global sustainability objectives. Innovations such as carbon capture and use, meat analogues, and oat-based analogues carry the potential to reduce emissions and environmental impacts, but only within niche settings as part of a mix of solutions.

The results have shown that for the greatest change to occur, existing policy instruments used by the EU can be geared towards fostering specific niche innovations that go beyond technological changes. While funding for innovation in the hopes of achieving the SDG targets is present within the policies, innovation funding should not just be directed towards technological change. Instead, fostering social innovations and niche practices may allow for the achievement of multiple SDG targets, particularly ones which have been neglected in the human wellbeing dimension.

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Appendix A – EU Policy Documents

Policies Cross Cutting Policy	Document Number	Date	Authors
European Parliament resolution on green growth opportunities for SMEs	52015IP0198	2015-05-19	Committee on Regional Development, Committee on Industry, Research and Energy, Committee on the Environment, Public Health and Food Safety, Committee on Employment and Social Affairs, Committee on

			Budgets, European Parliament
European Parliament resolution on the Green Employment Initiative: Tapping into the job creation potential of the green economy	52015IP0264	2015-07-08	Committee on Development, Committee on Women's Rights and Gender Equality, Committee on Industry, Research and Energy, Committee on the Environment, Public Health and Food Safety, Committee on Employment and Social Affairs, European Parliament, Committee on International Trade, Committee on Economic and Monetary Affairs
The implementation of the circular economy package: options to address the interface between chemical, product and waste legislation	52018SC0020	2018-01-16	Directorate-General for Environment, European Commission
Communication on a monitoring framework for the circular economy	52018DC0029	2018-01-16	Directorate-General for Environment, European Commission
European Parliament resolution on accelerating clean energy innovation	52018IP0026	2018-02-06	Committee on Transport and Tourism, European Parliament, Committee on Regional Development, Committee on Industry, Research and Energy, Committee on the Environment, Public Health and Food Safety
'European Finance-Climate Pact' (own-initiative opinion)	52018IE1241	2018-10-17	European Economic and Social Committee
'Consumers in the circular economy'(own-initiative opinion) Plastics	52019IE1026	2019-07-17	European Economic and Social Committee
A European Strategy for Plastics in a Circular Economy	52018DC0028	2018-01-16	European Commission, Secretariat-General

Communication on a European Strategy for Plastics in a circular economy	52018AR0925	2018-10-10	European Committee of the Regions, Commission for the Environment, Climate Change and Energy
Opinion of the European Committee of the Regions — Proposal for a single-use plastics directive Steel	52018AR3652	2018-10-10	European Committee of the Regions, Commission for the Environment, Climate Change and Energy
European Parliament resolution on developing a sustainable European industry of base metals	52015IP0460	2015-12-16	Committee on Industry, Research and Energy, European Parliament
Steel: Preserving sustainable jobs and growth in Europe	52016DC0155	2016-03-16	Committee on Economic and Monetary Affairs, European Committee of the Regions
Opinion of the European Committee of the Regions — 'Steel: Preserving sustainable jobs and growth in Europe'	52016IR1726	2016-06-15	European Commission, Directorate-General for Trade
Towards a robust trade policy for the EU in the interest of jobs and growth	52016DC0690	2016-10-18	European Economic and Social Committee
Adopting a comprehensive approach to industrial policy in the EU — improving business environment and support for the competitiveness of the European industry (exploratory opinion)	52017AE4732	2018-01-17	European Committee of the Regions, Commission for Economic Policy
A European strategy for industry: the role and perspective of regional and local authorities	52017IR3214	2018-03-23	European Economic and Social Committee
'The sectoral industrial perspective on reconciling climate and energy policies' (own-initiative opinion) Meat and Dairy	52019IE0927	2019-07-17	European Economic and Social Committee
Opinion of the European Committee of the Regions	52015IR0642	2015-04-16	Commission for Natural Resources, European

— The future of the dairy industry			Committee of the Regions
The implications of climate and energy policy on agricultural and forestry sectors (exploratory opinion)	52014AE6932	2015-04-22	European Economic and Social Committee
Resolution on sustainable food	52015XR3306	2015-07-08	Committee of the Regions, Commission for Natural Resources
Opinion of the European Committee of the Regions — Innovation and modernisation of the rural economy	52015IR2799	2016-02-10	Commission for Natural Resources, European Committee of the Regions
'More sustainable food systems' (exploratory opinion)	52016AE0232	2016-05-26	European Economic and Social Committee
Opinion of the European Committee of the Regions — Towards a sustainable EU food policy that creates jobs and growth in Europe's Regions and Cities	52016IR3170	2017-03-22	Commission for Natural Resources, European Committee of the Regions
The Future of Food and Farming	52017DC0713	2017-11-29	European Commission, Directorate-General for Agriculture and Rural Development
On the implementation of the EU Strategy on adaptation to climate change	52018DC0738	2018-11-12	Directorate-General for Climate Action, European Commission
Opinion of the European Committee of the Regions on 'CAP reform'	52018AR3637	2018-12-05	European Committee of the Regions, Commission for Natural Resources
'Promoting short and alternative food supply chains in the EU: the role of agroecology'(own-initiative opinion) Pulp and Paper	52019IE1463	2019-07-17	European Economic and Social Committee
European Parliament resolution on 'A new EU Forest Strategy: for forests and the forest-based sector'	52015IP0109	2015-04-28	European Parliament, Committee on Industry, Research and Energy, Committee on the Environment, Public Health and Food Safety, Committee on

			Agriculture and Rural Development
A sustainable Bioeconomy for Europe: Strengthening the connection between economy, society and the environment	52018SC0431	2018-10-11	Directorate-General for Research and Innovation, European Commission
'Sustainable inclusive bio-economy — new opportunities for European economy' (own-initiative opinion)	52018IE1021	2019-03-22	European Economic and Social Committee
Opinion of the European Committee of the Regions — Implementation of the EU Forest Strategy	52019IR0973	2019-04-11	Commission for Natural Resources, European Committee of the Regions
Proposal for a COUNCIL REGULATION for a European Partnership for a Circular bio-based Europe: sustainable innovation for new local value from waste and biomass	Ares(2019)4972449	2019-07-30	Directorate-General for Research and Innovation, European Commission

Appendix B – Documents identified for scoping search

Steel Policy Documents
Opinion of the European Economic and Social Committee on 'Industrial change to build sustainable Energy Intensive Industries (EIIs) facing the resource efficiency objective of the Europe 2020 strategy' (own-initiative opinion)
Opinion of the European Economic and Social Committee on the Action Plan for the European Steel Industry COM(2013) 407 final
Opinion of the European Economic and Social Committee on The challenges of the European engineering industry (mechanical, electrical, electronic and 'metalworking') in a changing global economy (own initiative opinion)
COMMISSION STAFF WORKING DOCUMENT Industrial Performance Scoreboard and Report on Member States' Competitiveness Performance and Policies - Accompanying the document Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions A Stronger European Industry for Growth and Economic Recovery Industrial Policy Communication Update
COMMISSION STAFF WORKING DOCUMENT Accompanying the document COMMUNICATION FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT, THE COUNCIL, THE ECONOMIC AND SOCIAL COMMITTEE AND THE COMMITTEE OF THE REGIONS INDUSTRIAL POLICY COMMUNICATION

UPDATE A STRONGER EUROPEAN INDUSTRY FOR GROWTH AND ECONOMIC RECOVERY
COMMUNICATION FROM THE COMMISSION TO THE PARLIAMENT, THE COUNCIL, THE EUROPEAN ECONOMIC AND SOCIAL COMMITTEE AND THE COMMITTEE OF REGIONS Action Plan for a competitive and sustainable steel industry in Europe
European Parliament resolution of 16 December 2015 on developing a sustainable European industry of base metals (2014/2211(INI))
JOINT COMMUNICATION TO THE EUROPEAN PARLIAMENT AND THE COUNCIL Elements for a new EU strategy on China
Opinion of the European Committee of the Regions — 'Steel: Preserving sustainable jobs and growth in Europe'
COMMISSION STAFF WORKING DOCUMENT Review of available information Accompanying the document Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions on an EU Strategy for Heating and Cooling
Commission Implementing Regulation (EU) 2019/159 of 31 January 2019 imposing definitive safeguard measures against imports of certain steel products
Opinion of the European Committee of the Regions — A European strategy for industry: the role and perspective of regional and local authorities
COMMUNICATION FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT, THE EUROPEAN COUNCIL, THE COUNCIL, THE EUROPEAN ECONOMIC AND SOCIAL COMMITTEE, THE COMMITTEE OF THE REGIONS AND THE EUROPEAN INVESTMENT BANK Investing in a smart, innovative and sustainable Industry A renewed EU Industrial Policy Strategy
A comprehensive approach to industrial policy
Opinion of the European Economic and Social Committee on 'Adopting a comprehensive approach to industrial policy in the EU — improving business environment and support for the competitiveness of the European industry' (exploratory opinion)
COMMUNICATION FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT, THE EUROPEAN COUNCIL, THE COUNCIL, THE EUROPEAN ECONOMIC AND SOCIAL COMMITTEE, THE COMMITTEE OF THE REGIONS AND THE EUROPEAN INVESTMENT BANK Steel: Preserving sustainable jobs and growth in Europe
Opinion of the European Economic and Social Committee on 'Strategic developments in industrial policy by 2030, with a view to strengthening the competitiveness and diversity of the industrial base in Europe and focusing on long-term performance within global value chains' (exploratory opinion requested by the Austrian Presidency)
COMMUNICATION FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT, THE EUROPEAN COUNCIL AND THE COUNCIL Towards a robust trade policy for the EU in the interest of jobs and growth
Opinion of the European Economic and Social Committee on the Communication from the Commission to the European Parliament, the European Council, the Council, the European Economic and Social Committee, the Committee of the Regions and the European Investment Bank — Steel: Preserving sustainable jobs and growth in Europe [COM(2016) 155 final]
REPORT FROM THE COMMISSION TO THE COUNCIL on the five yearly review of the multiannual financial guidelines for managing the assets of the ECSC in liquidation and, on completion of the liquidation, the Assets of the Research Fund for Coal and Steel Review of the Financial Guidelines for the five-year period 2012 – 2017

Opinion of the European Economic and Social Committee on ‘The sectoral industrial perspective on reconciling climate and energy policies’(own-initiative opinion)
Commission Implementing Regulation (EU) 2019/1590 of 26 September 2019 amending Implementing Regulation (EU) 2019/159 imposing definitive safeguard measures against imports of certain steel products
European Parliament resolution of 4 February 2014 on the Action Plan for a competitive and sustainable steel industry in Europe (2013/2177(INI))
European Parliament resolution of 15 January 2014 on reindustrialising Europe to promote competitiveness and sustainability (2013/2006(INI))
European Parliament resolution of 17 December 2014 on the steel sector in the EU: protecting workers and industries (2014/2976(RSP))
Plastic Policy Documents
Commission Decision (EU) 2019/1268 of 3 July 2019 on the proposed citizens' initiative entitled ‘Let's put an end to the era of plastic in Europe’ (notified under document C(2019) 4974)
Commission Implementing Decision (EU) 2019/665 of 17 April 2019 amending Decision 2005/270/EC establishing the formats relating to the database system pursuant to European Parliament and Council Directive 94/62/EC on packaging and packaging waste (notified under document C(2019) 2805) (Text with EEA relevance.)
Proposal for a COUNCIL REGULATION laying down implementing measures for the system of Own Resources of the European Union
Opinion of the European Committee of the Regions — Communication on a European Strategy for Plastics in a circular economy
COMMISSION STAFF WORKING DOCUMENT Synopsis Report Stakeholder Consultation Accompanying the document Proposal for Directive of the European Parliament and of the Council on the reduction of the impact of certain plastic products on the environment
COMMISSION STAFF WORKING DOCUMENT EXECUTIVE SUMMARY OF THE IMPACT ASSESSMENT Single Use Plastics & Fishing Gear Accompanying the document Proposal for a Directive of the European Parliament and of the Council on the reduction of the impact of certain plastic products on the environment
Proposal for a COUNCIL DECISION on the position to be taken on behalf of the European Union at the 14th Conference of the Parties to the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal with regard to certain amendments of Annexes II, VIII and IX thereto
Commission Implementing Decision (EU) 2018/896 of 19 June 2018 laying down the methodology for the calculation of the annual consumption of lightweight plastic carrier bags and amending Decision 2005/270/EC (notified under document C(2018) 3736) (Text with EEA relevance.)
Opinion of the European Committee of the Regions — Proposal for a single-use plastics directive
Opinion No 5/2018 (pursuant to Articles 287(4) and 322(2) TFEU) concerning: (a) the proposal for a Council Decision on the system of own resources of the European Union (COM(2018) 325 final); (b) the proposal for a Council Regulation on the methods and procedure for making available the Own Resources based on the Common Consolidated Corporate Tax Base, on the European Union Emissions Trading System and on Plastic packaging waste that is not recycled, and on the measures to meet cash requirements (COM(2018) 326 final); and (c) the proposal for a Council Regulation amending Regulation (EEC, Euratom) No 1553/89 on the definitive uniform arrangements for the collection of own resources accruing from value added tax (COM(2018) 328 final)

COMMUNICATION FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT, THE COUNCIL, THE EUROPEAN ECONOMIC AND SOCIAL COMMITTEE AND THE COMMITTEE OF THE REGIONS A European Strategy for Plastics in a Circular Economy
Opinion of the European Economic and Social Committee on the 'Proposal for a Directive of the European Parliament and of the Council amending Directive 94/62/EC on packaging and packaging waste to reduce the consumption of lightweight plastic carrier bags' COM(2013) 761 final — 2013/0371 (COD)
Opinion of the European Economic and Social Committee on the 'Green Paper on a European Plastic Waste Strategy' COM(2013) 123 final
Proposal for a COUNCIL REGULATION on the methods and procedure for making available the Own Resources based on the Common Consolidated Corporate Tax Base, on the European Union Emissions Trading System and on Plastic packaging waste that is not recycled, and on the measures to meet cash requirements
COMMISSION STAFF WORKING DOCUMENT Financing the EU budget: report on the operation of the own resources system Accompanying the document Proposal of a Council Decision on the system of Own Resources of the European Union
Opinion of the Committee of the Regions — 'Green Paper on a European strategy on plastic waste in the environment'
COMMISSION STAFF WORKING DOCUMENT EXECUTIVE SUMMARY OF THE IMPACT ASSESSMENT Accompanying the document Proposal for a DIRECTIVE OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL amending Directive 94/62/EC on packaging and packaging waste to reduce the consumption of lightweight plastic carrier bags
Opinion of the Committee of the Regions — Proposal for a Directive on Lightweight Plastic Carrier Bags
P7_TA(2014)0417 Reducing the consumption of lightweight plastic carrier bags ***I European Parliament legislative resolution of 16 April 2014 on the proposal for a directive of the European Parliament and of the Council amending Directive 94/62/EC on packaging and packaging waste to reduce the consumption of lightweight plastic carrier bags (COM(2013)0761 — C7-0392/2013 — 2013/0371(COD)) P7_TC1-COD(2013)0371 Position of the European Parliament adopted at first reading on 16 April 2014 with a view to the adoption of Directive 2014/…/EU of the European Parliament and of the Council amending Directive 94/62/EC on packaging and packaging waste to reduce the consumption of lightweight plastic carrier bagsText with EEA relevance.
REPORT FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT AND THE COUNCIL on the impact of the use of oxo-degradable plastic, including oxo-degradable plastic carrier bags, on the environment
Directive (EU) 2019/904 of the European Parliament and of the Council of 5 June 2019 on the reduction of the impact of certain plastic products on the environment (Text with EEA relevance)
European Parliament resolution of 14 January 2014 on a European strategy on plastic waste in the environment (2013/2113(INI))
COMMISSION STAFF WORKING DOCUMENT Accompanying the document Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions A European Strategy for Plastics in a Circular Economy
Proposal for a DIRECTIVE OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL on the reduction of the impact of certain plastic products on the environment
COMMISSION STAFF WORKING DOCUMENT IMPACT ASSESSMENT Reducing Marine Litter: action on single use plastics and fishing gear Accompanying the document

Proposal for a Directive of the European Parliament and of the Council on the reduction of the impact of certain plastic products on the environment
COMMISSION STAFF WORKING DOCUMENT Implementation Plan Accompanying the document Proposal for a Directive of the European Parliament and of the Council on the reduction of the impact of certain plastic products on the environment
Opinion of the European Economic and Social Committee on 'Proposal for a Directive of the European Parliament and of the Council on the reduction of the impact of certain plastic products on the environment' (COM(2018) 340 final — 2018/0172 (COD))
Opinion of the European Economic and Social Committee on — Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions — A European Strategy for Plastics in a Circular Economy (COM(2018) 28 final) — Proposal for a Directive of the European Parliament and of the Council on port reception facilities for the delivery of waste from ships, repealing Directive 2000/59/EC and amending Directive 2009/16/EC and Directive 2010/65/EU (COM(2018) 33 final — 2018/0012 (COD))
Paper Policy Documents
Regulation (EU) No 995/2010 of the European Parliament and of the Council of 20 October 2010 laying down the obligations of operators who place timber and timber products on the market Text with EEA relevance
COMMISSION STAFF WORKING DOCUMENT A BLUEPRINT FOR THE EU FOREST-BASED INDUSTRIES (woodworking, furniture, pulp & paper manufacturing and converting, printing) Accompanying the document COMMUNICATION FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT, THE COUNCIL, THE EUROPEAN ECONOMIC AND SOCIAL COMMITTEE AND THE COMMITTEE OF THE REGIONS A new EU Forest Strategy: for forests and the forest-based sector
2014/256/EU: Commission Decision of 2 May 2014 establishing the ecological criteria for the award of the EU Ecolabel for converted paper products (notified under document C(2014) 2774) Text with EEA relevance
2014/687/EU: Commission Implementing Decision of 26 September 2014 establishing the best available techniques (BAT) conclusions, under Directive 2010/75/EU of the European Parliament and of the Council, for the production of pulp, paper and board (notified under document C(2014) 6750) Text with EEA relevance
Corrigendum to Commission Decision 2014/256/EU of 2 May 2014 establishing the ecological criteria for the award of the EU Ecolabel for converted paper products (OJ L 135, 8.5.2014)
Opinion of the European Economic and Social Committee on the implications of climate and energy policy on agricultural and forestry sectors (exploratory opinion)
European Parliament resolution of 28 April 2015 on 'A new EU Forest Strategy: for forests and the forest-based sector' (2014/2223(INI))
Commission Decision (EU) 2017/1525 of 4 September 2017 amending Decision 2014/256/EU in order to prolong the validity of the ecological criteria for the award of the EU Ecolabel to converted paper products (notified under document C(2017) 5948) (Text with EEA relevance.)
Sustainable inclusive bio-economy - new opportunities for European economy
COMMISSION STAFF WORKING DOCUMENT Accompanying the document COMMUNICATION FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT, THE COUNCIL, THE EUROPEAN ECONOMIC AND SOCIAL COMMITTEE AND THE COMMITTEE OF THE REGIONS A sustainable Bioeconomy for Europe: Strengthening the connection between economy, society and the environment

Commission Decision (EU) 2019/70 of 11 January 2019 establishing the EU Ecolabel criteria for graphic paper and the EU Ecolabel criteria for tissue paper and tissue products (notified under document C(2019) 3) (Text with EEA relevance.)
Commission Delegated Decision (EU) 2019/708 of 15 February 2019 supplementing Directive 2003/87/EC of the European Parliament and of the Council concerning the determination of sectors and subsectors deemed at risk of carbon leakage for the period 2021 to 2030 (Text with EEA relevance.)
Opinion of the European Economic and Social Committee on 'Sustainable inclusive bio-economy — new opportunities for European economy' (own-initiative opinion)
Opinion of the European Committee of the Regions — Implementation of the EU Forest Strategy
Opinion of the European Economic and Social Committee on 'Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions — A sustainable bioeconomy for Europe: Strengthening the connection between economy, society and the environment'(COM(2018) 673 final)
Proposal for a COUNCIL REGULATION for a European Partnership (Joint Undertaking) for a Circular bio-based Europe: sustainable innovation for new local value from waste and biomass
Meat & Dairy Sector
Opinion of the European Economic and Social Committee on the implications of climate and energy policy on agricultural and forestry sectors (exploratory opinion)
Resolution on sustainable food
Opinion of the European Economic and Social Committee on 'The importance of agricultural trade for the future development of farming and the agricultural economy in the EU in the context of global food security' (own-initiative opinion)
Opinion of the European Committee of the Regions — The simplification of the common agricultural policy (CAP)
Opinion of the European Economic and Social Committee on 'CAP simplification' (exploratory opinion)
Opinion of the European Committee of the Regions — Innovation and modernisation of the rural economy
Opinion of the European Economic and Social Committee on 'More sustainable food systems' (exploratory opinion)
European Parliament resolution of 7 June 2016 on enhancing innovation and economic development in future European farm management (2015/2227(INI))
Special Report No 31/2016 — 'Spending at least one euro in every five from the EU budget on climate action: ambitious work underway, but at serious risk of falling short'
COMMISSION STAFF WORKING DOCUMENT Evolution of compulsory contracts, Producer Organisations and the market situation for milk and milk products. Accompanying the document REPORT FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT AND THE COUNCIL Development of the dairy market situation and the operation of the "Milk Package" provisions
Opinion of the European Economic and Social Committee on 'The main underlying factors that influence the Common Agricultural Policy post-2020' (own-initiative opinion)
Opinion of the European Economic and Social Committee on the role of agriculture in multilateral, bilateral and regional trade negotiations in the light of the Nairobi WTO Ministerial meeting (Own-initiative opinion)

Opinion of the European Committee of the Regions — Towards a sustainable EU food policy that creates jobs and growth in Europe's Regions and Cities
Opinion of the European Economic and Social Committee on 'A possible reshaping of the Common Agricultural Policy' (Exploratory opinion)
Opinion of the European Committee of the Regions — The CAP after 2020
Opinion of the European Economic and Social Committee on the 'Land use for sustainable food production and ecosystem services' (exploratory opinion at the request of the Estonian Presidency)
COMMUNICATION FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT, THE COUNCIL, THE EUROPEAN ECONOMIC AND SOCIAL COMMITTEE AND THE COMMITTEE OF THE REGIONS The Future of Food and Farming
Opinion of the European Economic and Social Committee on 'Civil society's contribution to the development of a comprehensive food policy in the EU' (own-initiative opinion)
Special Report No 21/2017 — 'Greening: a more complex income support scheme, not yet environmentally effective'
Opinion of the European Economic and Social Committee on — Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions — The Future of Food and Farming (COM(2017) 713 final)
COMMISSION STAFF WORKING DOCUMENT Accompanying the document COMMUNICATION FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT, THE COUNCIL, THE EUROPEAN ECONOMIC AND SOCIAL COMMITTEE AND THE COMMITTEE OF THE REGIONS A sustainable Bioeconomy for Europe: Strengthening the connection between economy, society and the environment
Opinion No 7/2018 (pursuant to Article 322(1)(a) TFEU) concerning Commission proposals for regulations relating to the common agricultural policy for the post-2020 period (COM(2018) 392, 393 and 394 final)
REPORT FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT AND THE COUNCIL on the implementation of the EU Strategy on adaptation to climate change
COMMISSION STAFF WORKING DOCUMENT Evaluation of the EU Strategy on adaptation to climate change Accompanying the document REPORT FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT AND THE COUNCIL on the implementation of the EU Strategy on adaptation to climate change
Opinion of the European Committee of the Regions on 'CAP reform'
Opinion of the European Economic and Social Committee on 'Promoting short and alternative food supply chains in the EU: the role of agroecology'(own-initiative opinion)
Regulation (EU) 2018/848 of the European Parliament and of the Council of 30 May 2018 on organic production and labelling of organic products and repealing Council Regulation (EC) No 834/2007