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Circular economy for climate neutrality:
Setting the priorities for the EU

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Summary

The previous Commission policy on resources management was part of the priority for jobs and growth and economic competitiveness. The circular economy will be no less important for the new political priority of climate neutrality; it will become one of the indispensable elements for meeting the EU's ambitions. EU climate policy and the circular economy are by and large complementary and mutually reinforcing. The circular economy is more than just another 'product standards' policy.

In order for this to happen,

- there is a need for a framework that is able to systematically address trade-offs, such as between the circular and the bioeconomy, but also between material efficiency and energy use, as well as
- a mechanism to steer and monitor progress, touching upon the question of whether and if so, how to increase ambition and develop tools to monitor progress, for example via targets, and
- the new Commission will need to develop and then scale up successful products and processes to create opportunities for new value chains while addressing risks, such as dependency on raw materials.

Circular economy products for the foreseeable future will require both technology push and market pull policies. Both the circular economy and low-carbon economy will require new and often yet unknown business models. This will also require new methods of regulation.

The principal challenge will be to create 'lead markets' for the circular economy in combination with low-carbon products. Many ideas for this exist. They include, for example, 'carbon contracts for difference', carbon budgets for projects, consumption charges, taxes and tax exemptions, sustainable finance, product standards and public procurement. Ideas now need to be tested to see whether they could work in practice.

Finally, the EU circular economy will need to be underpinned by a robust and transparent carbon accounting system. If effective, such as system can at the same time act as a catalyst for investment in the circular economy and low-carbon products and processes.

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Introduction

Achieving the net-zero greenhouse gas (GHG) emissions objective by 2050 will lead to a profound transformation of value chains across the economy. New products, processes and business models, often supported by IT and artificial intelligence are an essential element in achieving the emissions reductions needed to reach 'climate neutrality'.

All industries, including notably energy-intensive industries, have to make very significant contributions to the low-carbon transformation. Options for energy-intensive industries include a shift to electrified processes, low-carbon gaseous fuels (e.g. hydrogen) for high-temperature heat and feedstocks currently supplied by natural gas and deploying carbon capture and storage (CCS). Together with energy-efficiency measures, such options can provide significant emissions reductions. At the same time, these routes will lead to a rise in material requirements, which according to OECD (2018) are responsible for about half of current CO_2 emissions. It is already clear from this that the net-zero emission reduction objective is not possible without a transformative change in the way we use and manage our resources. As is increasingly highlighted by recent analysis, for example OECD (2018), Material Economics (2018), Ellen MacArthur Foundation (2019) or the European Commission (2018a) Long-Term Strategy, circularity is a precondition to achieve this.

It bodes well that in recent years, EU policy on sustainable resource use, which had focused traditionally on the end-of-life management of products has gradually been reformed. Promoted as a new model that can unlock growth, competiveness and create new jobs while contributing to environmental sustainability, the circular economy became a flagship policy during the previous Commission cycle. This culminated in the December 2015 Circular Economy Package, establishing a holistic approach towards resource efficiency across value chains. Based on an Action Plan, a series of legislative and non-legislative actions were proposed and implemented, for example in the fields of waste management, plastics, fertilisers, marine litter, critical raw materials and indicators. Consequently, the circular economy has also been identified by the European Commission's (2018a) Long-term Strategy on climate neutrality as one of the 'key enablers'.

It is therefore logical that the circular economy is taken up in the Political Guidelines for the period 2019-2024[1] of Commission President-elect Ursula von der Leyen. The Guidelines integrate the circular economy into climate change – her first priority – and into the 'European Green Deal' to be proposed in her first 100 days in office. The circular economy will be a key cornerstone of future EU industrial policy and for ''developing Europe's future economic model''. 'Circular economy' and 'clean technologies' are mentioned side by side as areas where Europe should become a ''world leader". A "new Circular Economy Action Plan focusing on sustainable resource use, especially in resource-intensive and high impact sectors such as textiles and construction'' has been announced. According to the Mission Letters to the nominated Commissioners, the new Action Plan will feed into the Commission's new long-term industrial strategy for Europe.[2] The circular economy also figures prominently on the agenda of the European Commission's High-level Expert Group on Energy-Intensive Industries Group to develop an Industrial Transformation Master Plan.

Bringing all these different elements together under a coherent policy framework will require a fresh look at how to truly integrate the circular economy with climate neutrality.

[1] See: https://www.europarl.europa.eu/resources/library/media/20190716RES57231/20190716RES57231.pdf.

[2] See the mission letter to the Commissioner-designate for Internal Market.

Challenges

Circular economy practices in a broad sense have the potential to reduce the scale of, and the demand for primary energy-intensive industrial production. This however does not remove the need to deal with the remaining (potentially significant) product and process-related emissions. With a net-zero greenhouse gas emissions (or climate neutrality) objective, virtually all greenhouse gas emissions need to be eliminated, with residual emissions compensated by negative emissions. This requires a transformation of industrial processes.[3] Two challenges stand out.

Push and pull

To date, a large share of industrial GHG emissions is emitted by installations included in the EU Emissions Trading System (ETS);[4] the carbon price generated by the trading of allowances is considered a central instrument in promoting emissions reductions in energy-intensive industries. Carbon prices at the levels observed throughout 2019 (around €25 per tonne) are insufficient to trigger the uptake of transformational carbon-neutral technology. The carbon price in principle fulfils the 'push' function,[5] to make carbon-intensive production more costly. What is still missing is a set of demand-side 'pull' measures that support innovation beyond the R&D stage to create lead markets for carbon-neutral products.[6] This also touches upon the competitive position of European industry vis-à-vis its trade partners, who may face different carbon costs. The circular economy, very much like the low-carbon transformation, will be affected by linkages between trade and climate policy.[7]

Scale up and implications for resources

Even if many transformational carbon-neutral technologies have been demonstrated at a small scale, they are not yet available at scale, let alone at a competitive cost. The scale up of low-carbon technologies required for the industrial transformation has implications for several resources. Increased electrification in industry implies a vast expansion of renewable electricity generation, in some cases coupled with low-carbon electricity storage solutions. So-called indirect electrification through hydrogen produced by electrolysis[8] – that can be used as a feedstock or contribute to energy storage – is also an option. But likewise, it requires an expansion of renewables capacity to run the electrolysers. The increased demand for renewable energy will impact on the demand of specific raw materials[9] such as for example cobalt, graphite or rare earths, thereby creating new dependencies. For example, the EU depends entirely on imports of rare earth elements neodymium (Nd) and dysprosium (Dy) (European Commission, 2017). The Commission's Joint Research Centre (JRC, 2017, p. 58) concluded in 2017 that ''the reliance of the EU on imports of raw materials is over 50% for around 80% of the materials required in wind turbines, solar PV modules and batteries''. The development of circular economy approaches such as reuse and recycling will become ever increasingly important and ultimately, a precondition for

[3] See also Wyns et al. (2018).

[4] About 750 million tonnes of CO_2e in 2018. Around 10% of EU emissions are emitted by installations not included in the EU ETS.

[5] The exact impact, however, depends on the level of the carbon price coupled with the relative costs of conventional production and abatement technology. See also the discussion in Elkerbout & Egenhofer (2017).

[6] See also Elkerbout & Egenhofer (2018).

[7] Dröge et al. (2019).

[8] Sometimes referred to as 'green' hydrogen.

[9] Examples include critical raw materials (CRMs) and rare earth elements (REEs).

a successful decarbonisation strategy. The circular economy therefore has a double benefit. On the one hand, it reduces emissions from materials, on the other, it can improve the availability of raw materials, ideally supported by an effective policy framework (e.g. Faure-Schuyer et al., 2018).

Circular economy for climate: towards a policy agenda

While the circular economy has enjoyed widespread support by policymakers and businesses in Europe, a concrete and practical vision of what the EU aims to achieve in moving towards a circular economy still remains to be established. In order for the circular economy to fulfil its potential to contribute to the EU's 'climate neutrality' objective, the integration of 'circular economy' and 'climate neutrality' policies is required. A number of elements could become important building blocks.

Setting objectives and measuring progress

Some member states have moved in the direction of setting concrete objectives and targets to measure progress. For example, the Netherlands has put forward in its circular economy strategy a target for reducing the use of primary raw materials (minerals, fossil and metals) by 50% by 2030.[10] France includes in its respective strategy a suite of objectives including reducing resource consumption relative to GDP by 30% by 2030 and saving 8 million tonnes of CO_2 emissions each year through plastics recycling[11] therefore establishing the link between the circular economy and climate change. Previously, the European Parliament had called for the introduction of a lead indicator and target on resource efficiency.[12]

Commission President-elect Ursula von der Leyen has committed in her Political Guidelines to integrating the Sustainable Development Goals (SDGs) in the European Semester, the EU's yearly cycle of economic and budgetary coordination. In its current form, the European Semester only reports on and/or provides recommendations on certain aspects of specific SDGs. Readapting the focus of the Semester and further embedding the SDGs into this coordination mechanism provides an opportunity to monitor progress made in individual SDGs and their targets in more detail in all member states. It might also increase the incentive for member states to propose reforms in support of achieving EU SDG targets (Behrens & Rizos, 2017).

The circular economy is relevant to various SDGs including Goal 12, "Ensure sustainable consumption and production patterns'' as well as Goal 13 on "Climate action". In future Commission strategies the concept could be further aligned with the SDGs and framed around a clear set of objectives and SDG indicators monitored through the Semester process. Some of the indicators included in the latest EU SDG indicator set[13] (e.g. circular material use rate)[14] are also featured in the Circular Economy Monitoring Framework introduced by the European Commission in 2018. Given that the SDG indicator set ''is open to annual reviews to incorporate indicators from new data sources and to take into account new EU policy priorities'' (European Commission, 2019, p.2), additional indicators that capture, for

[10] Dutch Ministry of Infrastructure and the Environment and Ministry of Economic Affairs (2016).

[11] See République Française (2018).

[12] See European Parliament resolution of 9 July 2015 on resource efficiency: moving towards a circular economy (http://www.europarl.europa.eu/doceo/document/TA-8-2015-0266_EN.html?redirect).

[13] See European Commission (2019).

[14] The indicator measures the share of material recovered and fed back into the economy, see https://ec.europa.eu/eurostat/web/products-datasets/-/cei_srm030.

example, the CO_2 impacts of circularity approaches could be added to draw a link between circularity and climate change.

Creating 'lead' markets for circular economy products

Circular economy products, such as low-carbon products, face the challenge of being in competition with 'like products' in WTO speak, e.g. those with a higher carbon content or less circularity, which might however be cheaper in the absence of the right policy signals. To date, industry largely faces a missing market for circularity products as it does for zero-carbon products. While in the longer run, products based on the circular economy should be competitive and even superior given lower material use and carbon content – provided that full costs including energy are imposed – the absence of proper pricing of resources and carbon may put EU industry at a competitive disadvantage. This raises the question of how the EU can develop lead markets and what tools can generate market pull. Recently, numerous ideas have been proposed to create lead markets. They include for example carbon contracts for difference (e.g. Sartor & Bataille, 2019), carbon budgets for projects, consumption charges (e.g. Neuhoff et al., 2019), taxes and tax exemptions (e.g. Rizos et al., 2018), sustainable finance, product standards and public procurement,[15] as for example discussed in the climate friendly materials platform.[16] All of these tools have merits, to a different degree for different cases or products. It will be important to test these concepts as to their practical utility to include circularity into investment decisions.

At the same time, circular economy measures may reduce demand for industrial products. The market may face overcapacity, temporarily or structurally. This is what happened in the EU electricity sector. A policy-driven expansion of renewables has led to an increase in generation capacity. The expansion of renewables, however, was not matched by a concomitant closure of carbon-intensive assets. This oversupply pushed down wholesale market prices for electricity and with it remuneration. With net income under pressure, utilities are not well positioned to carry the investment needed for the transition. Similarly, in industry, overcapacity can undercut the need or willingness to invest.

Addressing trade-offs

The circular economy should not be interpreted narrowly as a concept that merely promotes improved recycling. Recycling requires energy and has certain limitations[17] given that quality of material often decreases over consecutive cycles (see, for example, Velenturf et al., 2019). The accumulation of materials in in-use stocks (e.g. buildings, consumer goods)[18] also limits the contribution of recycling to circularity (Haas et al., 2015). To this end, the focus of circular economy policies would need to further shift towards other processes and approaches that hold potential to transform industrial value chains.[19] As the policy develops, it will need to address trade-offs.

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[15] For a more detailed analysis on public procurement see Elkerbout & Egenhofer (2018) and Rizos et al. (2018). Public procurement is not a panacea due to its complexity, but can be effective under certain circumstances.

[16] See: https://climatestrategies.org/projects/european-climate-friendly-materials-platform/.

[17] According to the second law of thermodynamics, it is not possible, due to physical constraints, to set up a system where all waste is recycled and transformed back into natural resources with 100% efficiency (Korhonen et al., 2018).

[18] As an example, Rizos et al. (2019) estimate that currently in Europe there is a stock of around 700 million mobile phones that remain unused in EU households. Collecting these devices for recycling would offer opportunities for making significant amounts of secondary material available in the EU.

[19] Examples of such processes featured in the European Commission's (2018b) long-term climate strategy for achieving net-zero emissions by 2050 include material substitution, higher utilisation of products through sharing

Bioeconomy

An example is the trade-offs existing in the bioeconomy. A challenge of both climate and circular economy policy is a desire to ensure optimal use of bio-based resources; e.g. to use biomass as a feedstock in industry or as a substitute for energy-intensive products. This is ostensibly no different for other types of resources, but biomass use can result in particular opportunity costs due to its impact on land use. As the IPCC's (2019) report on Climate Change and Land makes clear, land is a critical resource due to its role as a carbon sink, in food production, bioenergy and biodiversity.

From a climate policy perspective, bioenergy can be attractive because it can replace existing fossil fuels, thereby reducing emissions without wholly transforming processes. In addition, in combination with carbon capture and storage, bioenergy[20] can also deliver net-negative emissions by permanently removing CO_2 from the atmosphere and storing it in geological formations. However, this requires CO_2 transport and storage infrastructure. Moreover, transforming energy use and production processes can be desirable precisely because of the (undesirable) impact on carbon sinks and food production that bioenergy use on a large scale could bring.

From a circular economy perspective on the other hand, biomass can be used to produce bio-based materials that substitute for carbon-intensive basic materials, thereby reducing demand for the latter, as well as reducing demand for the (low-carbon) energy and other resources[21] needed to produce the materials. Moreover, some bio-based materials ranging from wood to plastics, can also store CO_2 inside them, acting as a sink. The trade-off then is not only between the immediate substitution effects but also on the dynamic impacts on forest and land use, i.e. how the demand for land will change over time and what this means for the accounting of carbon sinks and negative emissions. Climate and circular economy policies that potentially promote – even if indirectly – one specific use of bio-based resources should be mindful of these opportunity costs. This requires accounting approaches that are also capable of recognising the long time-scales (exceeding a century)[22] over which biomass, bioenergy, and biomaterials can affect the stock of greenhouse gases in the atmosphere.

Resource competition

Another prospective challenge can relate to the setting of climate and circular economy/resource efficiency objectives. Less resource use will normally reduce emissions. In the case of some specific (sub)-sectors, however, moving towards climate-neutral production might require at least some increased resource use. Specifically, large-scale deployment of renewable electricity (with storage systems), or 'green' and 'blue hydrogen' production, including carbon capture and storage can drive up demand for specific resources, thereby creating a trade-off between climate and resource efficiency objectives.

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models, reduced raw material needs in the production processes, product design aimed at achieving higher resource efficiency, waste heat recovery and biomass cascading.

[20] This is also known as bioenergy with carbon capture and storage (BECCS).

[21] This refers to the entire production process that eventually has to be climate-neutral to address greenhouse gas emissions in industrial sectors.

[22] See, for instance, the discussion in Peñaloza (2017).

Standards

Carbon intensity standards could play a role in later stages of climate-neutral product diffusion by pushing out of the market equivalent products that are more carbon-intensive to produce. This can only be done once climate-neutral products are available on the market. Getting to this point requires scaling up climate-friendly production for which other policies are needed.[23] One downside to using standards is that they can be static. A standard once achieved can reduce the incentives for further innovation and improvement, if the standard is broken down into a broader set of requirements that 'freeze' contemporary production methods. Emissions and carbon intensity standards can be more dynamic, however, and allow for progressive strengthening, such as with vehicle emissions standards.

Product design

Setting ecodesign requirements (e.g. on reparability, durability, upgradability and recyclability) for different product groups is generally considered to be an essential policy tool for developing a circular economy. The Ecodesign Directive has established a framework for setting mandatory design requirements for energy-related products sold on the EU market and has been successful in improving the energy efficiency of a variety of energy-related products and lowering greenhouse gas emissions in the EU. Nevertheless, introducing circular economy requirements into the regulations under the framework Ecodesign Directive has proved to be more complex, although recently there has been progress in this direction with the adoption of 10 ecodesign implementing regulations for different product groups.[24] Introducing such requirements that need different standards and testing methods has proved to be more complex than energy-efficiency requirements. Concerns about compliance and enforcement action have also been raised by different stakeholders (Egenhofer et al., 2018). An important area will be to develop circular economy design requirements that are verifiable, flexible and linked with some element of the life-cycle impacts of products. In addition, non-energy related product groups have not been included in the scope of the Ecodesign Directive to date. The extent to which a more ambitious framework for ecodesign, supporting both climate and circular economy goals, can be developed should be tested.

Carbon accounting

A transparent and reliable system of carbon accounting with monitoring, reporting, and verification of emissions (MRV) is important for the effectiveness and credibility of both the climate and circular economy framework. At the same time, carbon accounting can support demand for climate-neutral or circular economy compatible products, provided there is an element of additionality. The proposed Green Label by the European Commission is an example of a tool that has the potential to support demand for low-carbon products.

In principle, the Label could be extended to guarantees of origins. They would need to be strictly linked to the creation of climate-neutral product supply that would not exist otherwise: i.e. the demand for certificates proving that a product is climate-neutral can under certain circumstances increase the demand for climate-neutral production. While guarantees of origin currently exist primarily as evidence of renewable electricity generation and therefore have a different purpose,[25] such an accounting

[23] See also the section on demand measures on page 5.

[24] See https://ec.europa.eu/commission/presscorner/detail/en/ip_19_5895.

[25] See also Jansen (2018).

system could also be applied to low-carbon gaseous fuels, e.g. hydrogen or carbon-neutral versions of basic materials such as steel and cement.

Another area where carbon accounting can play an important role is with some forms of sector integration that could materialise as part of a (circular) industrial transformation. One such example is the increased use of carbon dioxide as an input, as part of carbon capture and use strategies. From the perspective of the company that captures CO_2, carbon capture leads to lower emissions as the CO_2 is not released into the atmosphere. However, depending on where it is used, the CO_2 might still be released later, such as when it used to create fuels. Ideally, a carbon accounting system reflects both the potential for emissions reductions in the capturing sector, but also its end-use which may lead to further emissions. Similar accounting issues may arise with (waste) heat exchanges between industries. It may be efficient to reuse waste heat – and policy incentives should recognise this – but at the same time the industrial process leading to the generation of waste heat can still be emission-intensive and, therefore, needs to be accounted for.

Carbon accounting tools, for example across a specific value chain, would give an indication for carbon intensity and potentially become an instrument to assign some type of carbon budgets for final, larger products and services, e.g. for a house. Taking the example of a house over a given period of time, from construction (including the embedded emissions in the materials used to build the house) to energy use (e.g. heating, cooling, cooking – in other words the operational costs), there could be competition between the many different ways of staying within the limits of this carbon budget. Such a budget could also be tightened over time to boost further innovation and reduction of greenhouse gas emissions across the value chain.

Priorities

As has been pointed out in many recent publications, notably the European Commission's long-term strategy, the circular economy is one of the indispensable elements for meeting EU's climate and economic ambitions. In order for this to happen, we have identified the following priorities for the new European Commission:

1. A more explicit acknowledgement of the existing trade-offs, such as between the circular and the bioeconomy but also between material efficiency and energy use, and policies and measures to systematically identify and then to address them.
2. A political discussion on how steer and monitor progress. This will require an answer to the question of how to increase ambition and create tools to monitor progress, for example via targets and other means.
3. Attention to how to develop and then scale up successful products and processes with a view to creating new value chains. This will also require the need to address risks, such as dependency on raw materials.
4. The principal challenge will be to create 'lead markets'. A lot of work in this area is ongoing, including for example ideas such as carbon contracts for difference, carbon budgets for projects, consumption charges, taxes and tax exemptions, sustainable finance, product standards and public procurement. Many of these ideas relate to low-carbon products; however, they also hold lessons for circular economy.
5. The EU strategy on the circular economy will need to be underpinned by a robust and transparent carbon accounting system. If effective, it can at the same time act as a catalyst for investment in circular economy products and processes.

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