CIRCULAR IMPACTS

Policy Brief

Assessing the impact of the transition to the circular economy in Europe

Funded by the European Union

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Executive Summary

This Policy Brief presents the key results of the EU-funded CIRCULAR IMPACTS project.

The circular economy holds the promise of providing macroeconomic benefits, but we first need to acquire a deeper understanding of its potential economic, environmental and social impacts. This paper presents two main options for measuring these impacts as well as some quantitative and qualitative results of the project. The paper concludes with key messages for policy-makers.

There are eight main processes of the circular economy, all of which have macroeconomic impacts: recycling; using resources efficiently; utilising renewable energy sources; remanufacturing and reusing products and components; extending product life; offering a product as a service; sharing models and shifting patterns of consumption.

In order to assess and quantify the impacts of these processes (separately or in their entirety), the paper presents two methodologies: one that employs models and one that draws on case studies. Assessments that rely on models can either be opportunity-based (i.e. addressing circular business opportunities), target-based (i.e. examining how specific targets can be reached) or policy-based (i.e. analysing policies aimed at overcoming barriers to the circular economy). The latter approach is suitable for policy-makers because circular economy policies are often formulated as targets, e.g. resource efficiency, recycling rates or reduced pollution. The policy-based approach, on the other hand, can indicate how specific circular economy policies might impact economic development. This makes it most useful in the context of the European Semester process.

All three modelling approaches depend heavily on the assumptions and the parameters used to determine how policies and changes work out. They would all benefit from more research into the process of translating circular policies into macroeconomic and environmental outcomes. Scenario research should focus on developing empirical observations about the essential mechanisms that explain the economic, environmental and social results.

In comparison to models, case studies can serve as simpler tools to provide insights into the impact of the transition to the circular economy. Owing to their limited scope, however, case studies represent only a small sample of the changes in processes accompanying the path towards circularity and of the opportunities that may emerge.

The CIRCULAR IMPACTS project conducted case studies on i) electric vehicle batteries in the EU, ii) car sharing in Germany, iii) concrete recycling in France and iv) phosphorus recycling in the Netherlands. The results show that the application of the circular economy in these four sectors can generate, under certain conditions, economic and environmental benefits. However, more intensive research is clearly needed, and also in other sectors.

Despite its potential to support job creation, economic growth and investment, the circular economy is not yet properly reflected in the European Semester. Greater attention to the circular economy in the European Semester could serve to encourage governments to take into account circular economy aspects when drafting their budgets and reform policies. At the same time, such an approach would need to acknowledge the inherent tension between the short-term needs of the political process and the long-term impact of the transition to a circular economy. In a first step, the collection of timely data is required to allow for proper monitoring of policies related to the circular economy and to enable the formulation of practical and effective country-specific recommendations.

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1 :: Introduction

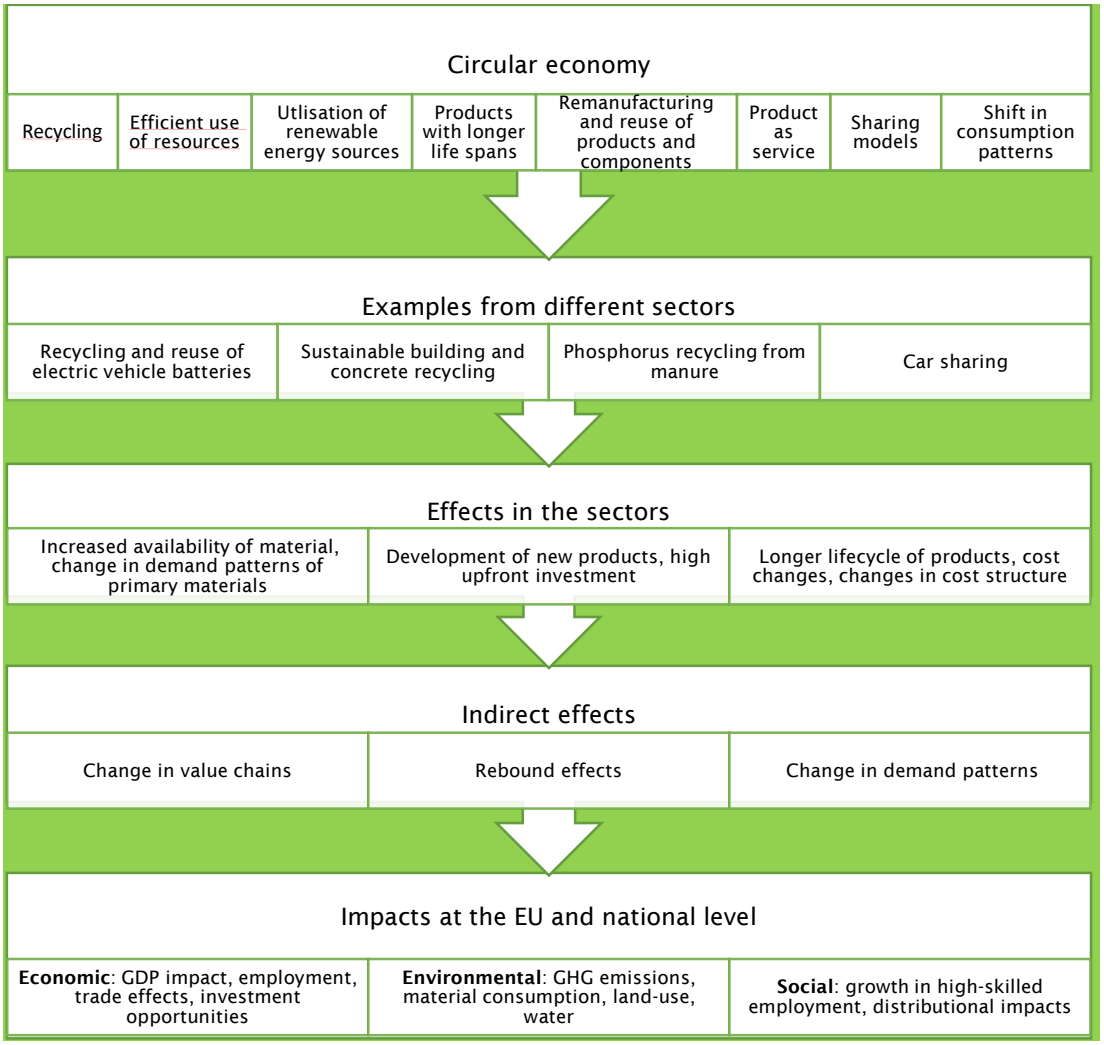
The circular economy has rapidly emerged in the policy debate in recent years as an alternative economic system that aims to preserve the value of materials for as long as possible, to reduce the need for using primary resources, utilise renewable sources of energy and phase out the use of harmful substances (Rizos et al., 2015). The concept is often presented as a solution for reconciling what at first sight seem to be the conflicting objectives of economic growth and environmental sustainability. At the EU level, a number of strategic publications have placed the concept within the jobs and growth policy agenda, including the European Commission's Work Programme 2018 (European Commission, 2017a) and the EU Industrial Policy Strategy (European Commission, 2017b).

The circular economy is often viewed as a promising vehicle for providing significant macroeconomic benefits, but we need a better understanding of its potential economic, environmental and social impacts as well as of the mechanisms that can explain them. This is particularly important for policy-makers who set policy priorities and design instruments to achieve them. Drawing on the results of the EU-funded CIRCULAR IMPACTS project, this Policy Brief discusses the main methodologies one may use in assessing the impact of the transition to the circular economy and presents the principal quantitative and qualitative results developed by the project. The paper concludes with some messages for policy-makers.

2 :: The circular economy: A framework of processes and impacts on the economy

The circular economy is a highly complex concept that is rooted in several schools of thought and theory. Developing a good understanding of the various processes that fit into the scope of the concept and the types of effects that can occur in sectors and value chains is a good starting point for assessing the impact of the transition. Through a review of the literature and interviews with selected stakeholders, Rizos et al. (2017) identified eight main processes associated with the circular economy: recycling; using resources efficiently; utilising renewable energy sources; remanufacturing and reusing products and components; extending product life; offering a product as a service; sharing models and shifting patterns of consumption. As shown in Figure 1, these processes can be adopted by companies operating in different sectors, leading to direct and indirect effects in sectors and value chains. The introduction of circular economy processes will then lead to economic, environmental and social impacts at both the EU and national level.

Figure 1. Circular economy effects on sectors and impacts



Source: Own design based on Rizos et al. (2017).

3 :: Options for measuring the impact of the transition to the circular economy

The previous section illustrated the difficulty of quantifying the future potential impact of the transition due to the complexity of the circular economy concept and the multitude of processes and actors involved. This paper identifies two possible routes available to policy-makers in order to better understand these impacts and be able to take informed decisions. Specifically, two methodologies are available for assessing and comparing possible future outcomes of this transition – one based on models and one on case studies. Both options are presented in more detail in the sections below.

3.1 Ex-ante assessments based on models

Macro-economic models can be used as a basis for conducting a scenario analysis of the consequences of circular economy policies or opportunities that go beyond baseline developments. There is an emerging body of ex-ante studies that employ such quantitative models; these studies can be categorised according to the approach that they use for the scenario analysis (Woltjer, 2018a).

The first group of studies uses an opportunity-based approach (see, for example, Ellen MacArthur Foundation et al., 2015; European Commission, 2014; Bastein et al., 2013). The opportunity-based scenario approach starts with a list of concrete circular business opportunities ranked according to their economic potential. Barriers are identified that prevent these opportunities from materialising in the baseline scenario. These barriers are addressed by policies aimed at unlocking the best opportunities to promote the circular economy. The resulting impact on input-output coefficients, i.e. the coefficients that represent the amount of input needed per unit of output, allows for a calculation of the economic, employment and environmental benefits of such a scenario by implementing the change in input-output coefficients in economic models (Woltjer, 2018a).

The second group (see Wijkman & Skånberg, 2015; Hartley et al., 2016) uses a target-based scenario approach which focuses on how to achieve specific targets. In this approach, input-output coefficients are changed according to available opportunities and the policies implemented to reach the targets. The macroeconomic consequences of these changes are then calculated using models.[1] By listing available opportunities and calibrating policies to reach the targets, most target-based scenarios are closely related to the other two scenario approaches (Woltjer, 2018a).

The third, policy-based scenario approach (see Meyer, 2012; Schandl et al., 2016) starts with an analysis of the reasons why circular opportunities are not realised and derives concrete policies for overcoming these barriers (e.g. taxation, standardisation, green public procurement, etc.). The policies may, for example, induce technological change and therefore implicitly or explicitly change input-output coefficients, change consumption patterns or change international trade patterns. The model calculates the macroeconomic effects by explicitly relating the policies to the adjustment mechanisms implemented in the model (Woltjer, 2018a).

While the opportunity-based scenario approach focuses on the economic efficiency of concrete circular business opportunities, the target-based approach is more outcome oriented in the sense that it looks at how economy-wide resource efficiency targets can be achieved. This makes it suitable for policy-makers because circular economy policies are often formulated as targets, for example for resource efficiency, recycling rates or the reduction of pollution. The policy-based approach, on the other hand, focuses explicitly on circular economy policies and can provide indications as to how they might impact economic development. As argued in Woltjer (2018a), this makes it the most relevant scenario approach in the context of the European Semester process (see further details below in section 5).

[1] These models implicitly or explicitly have abatement cost curves included in order to calculate how these targets may be reached and may also implement explicit policies about how the targets can be reached. Implicitly or explicitly, input-output coefficients or other parameters are changed to realise the targets.

Notably, while the path dependency of technological change and future costs of scarcity may be important mechanisms behind why the transition towards a circular economy may generate extra growth in the long term, these mechanisms do not feature in most studies that evaluate the circular economy. Most studies on the economic effects of the circular economy focus on GDP and employment, while environmental concerns (e.g. reducing resource use, energy consumption and GHG emissions) also reside at the core of the circular economy concept. To include these environmental issues in the economic evaluation, a welfare concept that is broader than GDP is required (Woltjer, 2018b).

Although ex-ante studies adopting these approaches can provide useful messages to policy-makers, one should keep in mind that their results depend heavily on the assumptions and the parameters used to determine how policies and changes work out. (OECD, 2017; Woltjer, 2018a). Moreover, the assumptions generating the outcomes are often not clear for the normal reader and even for specialists, and it is difficult to trace the exact causal relationships that explain the model results and the empirical foundation of these relationships. To this end, it may be useful to focus scenario research on empirical information about the essential mechanisms that explain the economic, environmental and social results. Targeted case studies, econometric studies and other studies that reveal plausible mechanisms and estimates of input-output coefficients are necessary to fill this gap in the research (Woltjer, 2018a).

3.2 Case studies

As explained in the previous section, while ex-ante, economy-wide quantitative models can be useful for policy-makers, studies based on fully transparent and simpler calculation tools may provide important insights into the mechanisms that explain the economic, environmental and social impacts. In this context, targeted case studies can provide an idea of the costs and revenues involved in the circular economy and how policies may influence and encourage a shift towards circularity. More specifically, they can be used to provide important insights into the mechanisms and parameters that are relevant for the evaluation of the transition towards a circular economy and provide a source of inspiration for the formulation of policies (Woltjer, 2018a). Owing to their limited scope, however, case studies represent only a small sample of the process changes towards a circular economy and of the opportunities that may emerge (Woltjer, 2018b).

A number of different indicators can be used in targeted case studies. Indicators can be relevant at both the micro and macro levels (Woltjer, 2018b). With regard to the former, they can provide information on the opportunities that may be relevant for a macroeconomic evaluation. Examples of such indicators include changes to the following: factor productivity (i.e. input requirements per unit of output, where one has to be aware that also the quality of the output may change); trade flows; amount of investment needed; number of jobs created; composition of labour demand compared with scarcities on the labour market; and externalities in production that may be reduced by the circular opportunity (for instance, improved waste management practices may lead to lower external costs).

At the macro level, indicators can be used to evaluate the macroeconomic and societal consequences at a national or EU level. Some key macro-level indicators and indicator groups are GDP, employment and environmental effects. The GDP indicator is relevant in political practice since it can provide some information on economic impacts, for example

if resource scarcity rises in the future or if in the short-term externalities are reduced that generate increases in productivity. The main benefits to be derived from the circular economy, however, are not captured by GDP, and their assessment requires a broad welfare concept that at a minimum includes changes in natural capital and in other environmental externalities. With regard to employment effects, circular processes may generate new employment at the cost of employment in traditional sectors. By comparing these transitions with labour supply, one may get information on the extent to which employment is created in regions or for skills with excess supply of labour and therefore where employment may increase. Finally, environmental effects are not only restricted to the reduced dependence on resources, often imported, but also indirect effects associated with the reduction of environmental pollution are important. The calculation of such effects at the macro level should also take into account potential rebound effects (Woltjer, 2018b).

4 :: Results of targeted case studies

As part of the CIRCULAR IMPACTS project, case studies were conducted in order to assess the impact of the transition to the circular economy on i) electric vehicle batteries in the EU, ii) car sharing in Germany, iii) concrete recycling in France and iv) phosphorus recycling in the Netherlands. In selecting these case studies, the research team took into account the priority sectors defined in the EU Action Plan for the Circular Economy (European Commission, 2015) and also tried to cover a range of the various circular processes presented in Figure 1 of this paper.

To assess the economic, societal and environmental impacts of the transition to the circular economy through these case studies, the research team used a stepwise methodology developed by Smits & Woltjer (2018). The steps followed in this methodology2 were adapted to the specificities of each case study. The following boxes include a short summary of the results of the case studies.

Box 1. Prospects for electric vehicle batteries in a circular economy

Recycling lithium-ion batteries for electric vehicles (EVs) within the EU through investment and policy support could mitigate dependence on imported materials and help retain the value of recovered materials in the EU economy, especially if achieved at high rates. It is estimated that in 2030 €408 million in current prices could be recovered from the four key materials included in the study, i.e. cobalt, nickel, aluminium and lithium from EV batteries under scenario 1, and €555 million under a more ambitious scenario 2. In 2035, as many more batteries reach their end-of-life stage, materials worth €909 million could be recovered under scenario 1, and around €1.2 billion under the more ambitious scenario 2. In 2040, materials with a value of about €1.9 billion could be recovered under scenario 1 and €2.6 billion under scenario 2. Regarding cobalt, a critical raw material, 2,922 tonnes of material worth of €213 million could be recovered by 2030 under scenario 1. Under scenario 2, 4,058 tonnes with a value of €295 million could be recovered during the same year; this amount is 41% of all cobalt imports into the EU in 2012. In 2040, 18,763 tonnes of material worth €1.37 billion could be recovered under scenario 2.

[2] The methodology envisages the following eight steps: 1: Defining the baseline; 2: Defining the new business case; 3: Tracing changes in the key sector; 4: Mapping expected effects on other parts of the economy; 5: Mapping the impact on society; 6: Investigating available alternatives; 7: Devising policy options; and 8: Reaching overall conclusions (Smits & Woltjer, 2018).

In addition, there is potential to create employment in the lithium-ion battery recycling industry. Specifically, it is estimated that in 2040, around 12,100 jobs could be created for the collection, dismantling and recycling of EV batteries in the EU under scenario 1 and 15,130 under the more ambitious scenario 2. The study furthermore concludes that recycling certain materials in lithium-ion batteries, as opposed to extracting the raw material, may mitigate CO_2 emissions. The net savings of over 1 million tonnes of CO_2-eq in 2040 (Scenario 2) are equivalent to the CO_2 emissions entailed in producing 261,000 tonnes of aluminium, which is comparable to the annual production of two primary aluminium smelters.

Source: Drabik & Rizos (2018).

Box 2. Sustainable building – A case study on concrete recycling in France

Waste concrete can find new life as an ingredient in new structural concrete applications. Up to 15% of quarried aggregates can be replaced by recycled concrete aggregates (RCA) in structural concrete, according to the French standard NF EN 206/CN, which is in line with European legislation. As a result, the management of one of the heaviest and most voluminous waste streams in the EU—construction and demolition waste—could potentially be improved.

Recent research based on a life-cycle assessment (LCA) for concrete made of RCA has shown that partially replacing quarried aggregate by RCA in France can provide environmental benefits.[i] Several key environmental impact indicators, such as the consumption of energetic resources, global warming and air pollution were 1-2% lower in the circular-economy scenario compared to the business-as-usual scenario. The extent of the environmental benefits is closely linked to the transport distances of the aggregates, which are extremely heavy and relatively inexpensive by weight, making long-distance transport uneconomical. In the aforementioned LCA, the transport distances of the recycled aggregates were around one-third those of the quarried aggregates. A shift from quarrying to recycled concrete would retain local jobs and the required skillset is similar in both supply chains.

Source: Duin & Best (2018).

Box 3. Phosphorus recycling from manure in the Netherlands

Current manure policy in the Netherlands reduces GDP by about €350 million, but increases welfare by around €2 billion when the benefits for nature and health are included in the calculations (Van Grinsven et al., 2016; PBL, 2017). The policy limits the amount of manure that can be directly applied on land in the Netherlands while it requires that all manure be used, and therefore forces either direct exports of manure or manure processing. Both are costly, implying that intensive livestock farmers have to pay to get rid of their manure: a negative manure price emerges, implying that the marginal value of manure as a fertilizer in the Netherlands is negative (Woltjer & Smits 2018).

Newly developed manure processing technologies such as one developed by the EU-funded project BioEcoSIM, may reduce the cost of the manure policy with benefits for the circular economy. In the current policy and economic circumstances, if all Dutch pig manure would be processed by a process like BioEcoSIM and the cost estimates are correct, this would generate a GDP increase of €15 million and would reduce environmental costs of greenhouse gas emissions and particulate matter formation by about €75 million (Woltjer & Smits 2018).

Box 4. Car sharing in Germany

Despite its present-day prominence in news headlines and visibility on some city streets, car sharing presently makes up only about one-tenth of 1% of passenger-km by motor vehicle in Germany. This could change dramatically in the near future, however, and not just in Germany. Globally, the transportation sector is set for several disruptive changes such as car sharing, ridesharing, autonomous vehicles, robotaxis, electric vehicles and more.

A recent case study examined the future of car sharing in Germany, comparing three future scenarios for the year 2030, each with different levels of car sharing. By 2030, a circular "green" scenario with higher car sharing saw reductions of 10% in greenhouse-gas emissions beyond those achieved in the baseline scenario. In addition, due to the increased use intensity of car-sharing vehicles, the total number of new cars was 16% lower, the number of fossil-fuel vehicles travelling German roads was 9% lower and overall, 7% fewer passenger-km were travelled by car. The circular "green" results assumed that policies will be put in place that effectively counteract modal shifts away from public transport (itself a long-established form of shared mobility), as well as prevent net increases in motor-vehicle travel stemming from the cost-savings of shared mobility models. If such policy measures prove necessary but are not implemented, the coming transport revolutions (sharing models, electro-mobility and autonomous vehicles) could actually have the opposite effect from that outlined in the circular "green" scenario. Such a circular "gray" scenario was also analysed for 2030, in which car-sharing reaches equivalent levels to the circular "green" scenario, but fails to cause a net reduction in motor-vehicle ownership and use, resulting in motor vehicles generating passenger-kilometers 11% higher and greenhouse-gas emissions 12% higher than in the circular "green" scenario. Significant questions remain regarding the nature and impact of the coming transport revolution.

Source: Best & Hasenheit (2018).

5 :: Implications for the European Semester and other major initiatives

The European Semester is the EU's annual cycle of economic policy guidance and oversight. It is essentially a mechanism to coordinate the economic policies of all EU member states and to address economic challenges. Although the mandate of the Semester is to monitor all five targets set out in the 'Europe 2020 Strategy', the focus since its introduction in 2010 has been on economic policies for jobs, growth and investment. In line with the current political priorities of the European Commission, however, the circular economy is part of the agenda for jobs, growth and investment. Thus, the circular economy is closely linked to the goals of the European Semester (Behrens & Rizos, 2017).

Yet, the European Semester takes the circular economy into account only to a limited extent. This is due to the current structure and emphasis of the Semester, the lack of information of macroeconomic relevance, the availability and timeliness of relevant indicators and the political priorities that originally guided the introduction of the Semester. The Commission should thus consider dedicating more coverage to the circular economy in the Annual Growth Survey and going beyond the current spotlight on sustainable investment. There is also a need to take a more harmonised approach to include circular economy-related issues than is currently the case in the country reports and the country-specific recommendations (Behrens & Rizos, 2017).

With the introduction of the circular economy monitoring framework in January 2018, the European Commission has created the basis for a standardised evaluation of member states' progress towards the circular economy. The monitoring framework has a set of 10 indicators grouped into four aspects of the circular economy: 1) production and consumption, 2) waste management, 3) secondary raw materials and 4) competitiveness and innovation (European Commission, 2018). Statistical offices now need to provide timely data to allow for proper monitoring of circular economy-related policies and to enable the formulation of practical and effective country-specific recommendations. In addition, reliable information and data on the macroeconomic impacts of the circular economy are required in order to better reflect the circular economy in the Semester. At the present time, there are limited sources that provide such information (Behrens & Rizos, 2017).

Beyond 2020, there may be the need to expand the coverage of the European Semester. Given the Commission's intention to fully integrate the Sustainable Development Goals (SDGs) into the European policy framework and Commission priorities, this will require a proper monitoring framework covering progress towards all 17 SDGs, including SDG 12 on responsible consumption and production. Embedding the SDGs into the European Semester would also increase the incentive for member states to propose reforms that converge towards EU SDG targets. Alternatively, the monitoring of SDGs could be divided over various existing (and/or new) policy coordination mechanisms (European Semester, Environmental Implementation Review, Energy Union, monitoring framework for the circular economy, etc.). Still, such an approach would need to ensure that similar political weight and visibility would be assigned to the different monitoring mechanisms (Behrens & Rizos, 2017).

6 :: Conclusions and key policy messages

- Scenario analysis can provide crucial information on the potential future economic and environmental effects of today's policy choices. Three approaches to scenario analysis have been analysed in the context of this project: opportunity-based, target-based and policy-based scenario approaches. While the policy-based approach may be the most relevant approach in the context of the European Semester, all three approaches would benefit from more research into the process of translating circular policies into macroeconomic and environmental outcomes.
- Scenario research should focus on empirical information about the essential mechanisms that explain the economic, environmental and social results. Targeted case studies, econometric studies and other studies that reveal plausible mechanisms and estimates of input-output coefficients are necessary to fill this gap in the research.
- The four case studies conducted by the CIRCULAR IMPACTS project illustrate that the application of the concept in different sectors can generate, under certain conditions, economic and environmental benefits. However, more intensive research is clearly needed, and also in other sectors.
- In the economic evaluation of the circular economy, a broader welfare concept than GDP and employment is needed to more directly take into account environmental concerns (e.g. reducing resource use, energy consumption and GHG emissions), which also reside at the core of the circular economy concept.

- While path dependency of technological change and the consequences of future scarcity of resources may be important arguments for a transition towards a circular economy, these mechanisms do not feature in most studies that evaluate the circular economy.
- The current political priorities of the European Commission, where the circular economy is part of the agenda for jobs, growth and investment, warrant a closer reflection of the circular economy in the European Semester. In a first step, this move would require timely data to allow for proper monitoring of circular economy-related policies and to enable the formulation of practical and effective country-specific recommendations.
- Given the Commission's intention to fully integrate the Sustainable Development Goals (SDGs) into the European policy framework, the next step – beyond 2020 – may be to expand the European Semester to allow for proper monitoring towards the 17 Sustainable Development Goals (SDGs), including SDG 12 on responsible consumption and production.

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About the Circular Impacts project

The project is developing an assessment based on concrete data and indicators of the macro-economic, societal, environmental and labour market impacts of a transition to a circular economy. The assessment will support the European Commission in its discussions with the Member States on progress in the circular economy transition and the implications for the EU economy especially in the context of the European Semester. This paper focuses on the theoretical dimensions of the concept and aims to improve understanding of the impacts of the circular economy transition. For information on the project, see http://circular-impacts.eu/.

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