JUST2CE

A Just Transition to Circular Economy

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Scenario Analysis

Policy briefs

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3. THE UNIVERSITY OF SHEFFIELD
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A Just Transition to Circular Economy

PROJECT No. 101003491

Just2ce will assess the current state of transition towards the circular economy in relevant economic sectors and analyse possible transition scenarios, as well as their outcomes and impacts. It will identify the key factors that can stimulate or hinder this transition. Natural resources are extracted and transformed into products, which are eventually discarded. As many natural resources are finite, it is important to keep materials in circulation for as long as possible. This makes the transition to circular economy more vital than ever but is a responsible, inclusive, and socially just transition to a circular economy possible or even desirable? What technical, political, and social factors can enable or hamper such transformation? The EU-funded JUST2CE project will answer these questions. It will explore the economic, societal, gender and policy implications of the circular economy paradigm. The project's findings will shed light on how to ensure democratic and participatory mechanisms when designing and managing such technology.

History Chart

Version	Date	Implemented by
V2.0		
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V1.0	23/08/2024	J.B.R.T. Fevereiro, A. Genovese, O. Vallès Codina, M. Veronese Passarella

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A Just Transition to Circular Economy

Version: 1.0

Policy Brief No 1

Extending Product Life of durable consumer goods: Policy Insights

Generalities

Product Lifetime Extension (in the following, PLE) strategies represent a pillar of the transition towards the Circular Economy. Such practices are linked to interventions that slow down resource depletion by lengthening the period in which a product can be used before disposing of it. This can be achieved, for instance, by changing the way products are designed (e.g. design for longevity), improving resistance of materials and components, and facilitating maintenance and repair activities through appropriate after-sale support.

Motivation

While the adoption of PLE practices, within a CE framework, is generally associated with more sustainable futures, less is known about the macroeconomic and social implications of these strategies. This is important because, on the one hand, when goods last longer, demand for them reduces, which leads to a reduction in resource consumption, and employment required in the production of these goods (direct effect). However, on the other hand, for this to be obtained, an increase in investment in new production processes or increased expenditure in repair and maintenance are needed, which would increase demand for resources and employment (indirect effect). Lastly, as income and prices change this might lead to subsequent changes in final demand (induced effect). The overall macroeconomic effect is thus, a priori, undetermined. Hence, it requires macroeconomic assessments, which are able to capture these direct, indirect and induced effects associated with PLE.

Method

To bridge this gap, we employ a data-driven SOCIO-ECO-MRIO to design and evaluate various circular economy policies and practices. The model is:

- *Dynamic*, allowing for the complex reproduction of the emergent behaviour of the system over time.
- *Stock-flow consistent* (SFC), carefully defining the relations between stocks and their related flows, expressed in monetary, real, and physical terms, and thus yielding an accurate description of the institutional structure of the economy, the environment, and society.
- Based on a 54-sector input-output structure, with 8 reprocessing of secondary material and recycling sectors disaggregated, dynamically accounting for cross-industry interdependencies in the production sector within each area and across areas.
- *Open-economy*, dividing the world economy into two regions: the European Union and the rest of the world.

- *Empirically-calibrated*, implying that the model's coefficients are calculated based on available time series data (e.g., technical coefficients) or defined to match current observed values of key variables (e.g., GDP components) for the two areas considered.

In formal terms, the model comprises a system of accounting identities and difference equations that describe the relationships between socio-economic sectors and between industries. Ideally, the model structure is subdivided into three major blocks, concerning the economy, society, and ecosystem, respectively.

Scenario Description

We tested a scenario in which government investment of EU countries increased by 20% (approx. €100B) over 10 years. This investment was aimed at increasing the product lifetime of durable goods (e.g., machinery and equipment, electronics, automobiles, furniture, etc.). As a result, the depreciation rate of capital goods falls (starting 5 periods after the increase in spending), and so does the discarding rate of durable goods. This, in turn, leads to a reduction in the consumption share of durable goods, which is assumed to be equally redistributed to other consumer goods. However, a longer product lifetime comes at a higher cost of production (due to the need for more and better quality components), leading to higher consumer prices.

Findings

Economic Impact. Overall, the impact of the PLE shock is positive for the EU economy but slightly negative for the rest of the world. The EU's GDP increases in the long term, despite a fall in gross output. Similarly, the decline in gross output in the rest of the world is larger than the (small) decrease in GDP. After an initial increase, the EU government deficit (as a ratio to GDP) decreases, while the current account balance (as a ratio to GDP) improves significantly, driven by trade surpluses. Conversely, the government balance of the rest of the world worsens, as does its current account balance (after an initial improvement).

Social Impact. Focusing on key social indicators, in the absence of any government intervention, total employment is expected to decline in both the EU and the rest of the world. However, there is no significant impact on the employment gender balance in the long term. The wage share of national income decreases in the EU, driven by both domestic profits and net foreign incomes, while no significant change is expected for the rest of the world.

Ecological Impact. Regarding key ecological variables, there is a significant reduction in the extraction of virgin raw materials associated with both areas. While this reduction is more apparent in the EU, the rest of the world also reduces extractions for domestic purposes. Similar considerations apply to the total production of waste, which is expected to fall in both the EU and the rest of the world. By contrast, the effect of the PLE policy on CO2 emissions is less clear-cut. The higher activity level in the EU may increase industrial emissions, although a reduction is expected in the rest of the world.

Implications

Our experiments show that PLE policies are successful in reducing the extraction of raw materials and slowing down the accumulation of waste by decoupling GDP from gross output.

Table 1. Selected findings: change relative to baseline values
(% change; p.p for balances to GDP and labour share of income)

Note: short term = 5 periods after the shock; medium term = 15 periods after the shock; long term = 30 periods after the shock. 1 period corresponds approximately to 1 year. p.p. = percentage point change.

However, these policies may also trigger significant rebound effects, particularly in terms of CO2 emissions, in the long term. This is not surprising, as PLE policies imply the relocalization of some segments of the supply chain (e.g., maintenance, after-sales services, etc.) to the EU. Conversely, PLE policies are expected to have a negative impact on the economy of the rest of the world. This highlights that measuring effects solely at a local level might be misleading.

Two major implications follow. First, coordination among national governments is paramount to ensure that the adoption of PLE policies in one area does not come at the expense of another (e.g., by offsetting the negative impact on the current account balance of the rest of the world through coordinated exchange rate, monetary and fiscal policies). Second, some form of planning (see R. Hahnel, *Democratic Economic Planning*, Routledge, 2021) seems necessary to empower public authorities to pursue PLE targets, support employment, and, at the same time, keep industrial emissions under control.

As mentioned, the implementation of such policies may worsen external imbalances, which can be particularly concerning for the Global South, whose economies - and, most importantly, their

employment - are dependent on the export of raw materials. This situation requires globally coordinated policies aimed at a structural transformation of low-income economies by fostering production diversification and overcoming extractivism.

Recommendations

1) Coordinate International Monetary and Trade Policies. Policymakers in regions adopting PLE strategies, such as the EU, should actively engage in multilateral discussions with trade partners, particularly those from the Global South. This coordination should include establishing mechanisms to mitigate the negative effects of PLE on current account balances. For example, the EU could negotiate trade agreements that provide preferential market access to products from economies transitioning away from raw material exports, as well as coordinating exchange rate adjustments to prevent trade imbalances.

2) Tighten Carbon Pricing Mechanisms to Address Emission Rebounds. To counter the potential increase in CO2 emissions due to supply chain relocalisation, governments should continue to tighten carbon pricing mechanisms, for instance by reducing emission allowances in the EU Emission Trade System (ETS) and promote gradual increase in carbon taxes. This would incentivise industries to adopt low-carbon technologies in maintenance and after-sales services, which, under PLE policies, could be reshored. Such policies could thus prevent a net rise in local emissions.

3) Invest in Green Infrastructure and Green Employment to Offset Industrial Emissions and Loss of Jobs due to the Green Transition. Alongside carbon pricing, governments should invest in green infrastructure projects, such as renewable energy grids and energy-efficient transportation systems, combined to green employment support programs. By supporting industries that need to adapt to PLE policies with green technology grants or subsidies as well as direct public investment, policymakers can prevent increased emissions while still supporting domestic industries and achieving wider environmental objectives.

4) Global Initiative for Diversification of Economies in the Global South. Policymakers, particularly in high-income economies, should initiate or support global funding programs, such as those led by the UN, aimed at fostering economic diversification in low-income countries. This could include direct investment in sectors like sustainable agriculture, manufacturing, and technology, helping countries in the Global South to move away from economic structures solely based on primary resources extraction and become more self-sustaining. Conditional financial assistance could be linked to projects that promote sustainable, non-extractive industries.

5) Establish a Long-term Democratic Economic Planning Framework. National governments should adopt planning frameworks that allow public authorities to set and enforce targets for PLE adoption. This can be done through the creation of national PLE councils or similar bodies that bring together policymakers, industry leaders, and labour representatives. These bodies would oversee the integration of PLE policies with employment and industrial strategies, ensuring that economic, social and environmental goals are met, also overseeing the effect of PLE policies on non-renewable material stocks. For instance, subsidies could be directed towards industries with high PLE compliance and low emissions, which also commit to an absolute decrease in the usage of virgin raw materials, in such a way to avoid rebound effects.

6) **Design Fair Trade and Labour Transition Policies.** PLE policies will affect global supply chains and industries reliant on exports. Policymakers should design fair trade agreements that include labour transition clauses to assist workers displaced by reduced demand for raw materials. These clauses could provide funds for retraining programs, ensuring that affected workers in both exporting and importing regions can transition into jobs originating from the promotion of more sustainable industries. In this context, the government should act as a green employer of last resort.

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Policy Brief No 2

Closing the Supply Chain: Policy Insights

Generalities

CSC-based strategies involve replacing materials from virgin sources with secondary ones. This includes reintegrating materials at different stages of the supply chain after they have been used (e.g., through product reuse, component reuse, refurbishing, and material recycling), which can reduce the consumption of virgin raw materials.

Motivation

While the adoption of CSC practices, within a CE framework, is generally associated with more sustainable futures, less is known about the macroeconomic implications of these strategies. It must be highlighted that recycled materials and remanufactured products are not always perfect substitutes of primary ones; thus, prices of secondary goods may be a fraction of those of original goods. In addition, despite the general acceptance of the fact that CSC practices might be associated with higher labour intensity, a general quantification of these effects can really be hard, along with the impact on final demand. The overall macroeconomic effect is thus, a priori, undetermined. Hence, it requires macroeconomic assessments, which are able to capture these direct, indirect and induced effects associated with CSC.

Method

To bridge this gap, we employ a data-driven SOCIO-ECO-MRIO to design and evaluate various circular economy policies and practices. The model is:

- *Dynamic*, allowing for the complex reproduction of the emergent behaviour of the system over time.
- *Stock-flow consistent* (SFC), carefully defining the relations between stocks and their related flows, expressed in monetary, real, and physical terms, and thus yielding an accurate description of the institutional structure of the economy, the environment, and society.
- Based on a 54-sector input-output structure, with 8 reprocessing of secondary material and recycling sectors disaggregated, dynamically accounting for cross-industry interdependencies in the production sector within each area and across areas.
- *Open-economy*, dividing the world economy into two regions: the European Union and the rest of the world.
- *Empirically-calibrated*, implying that the model's coefficients are calculated based on available time series data (e.g., technical coefficients) or defined to match current observed values of key variables (e.g., GDP components) for the two areas considered.

In formal terms, the model comprises a system of accounting identities and difference equations that describe the relationships between socio-economic sectors and between industries. Ideally, the model structure is subdivided into three major blocks, concerning the economy, society, and ecosystem, respectively.

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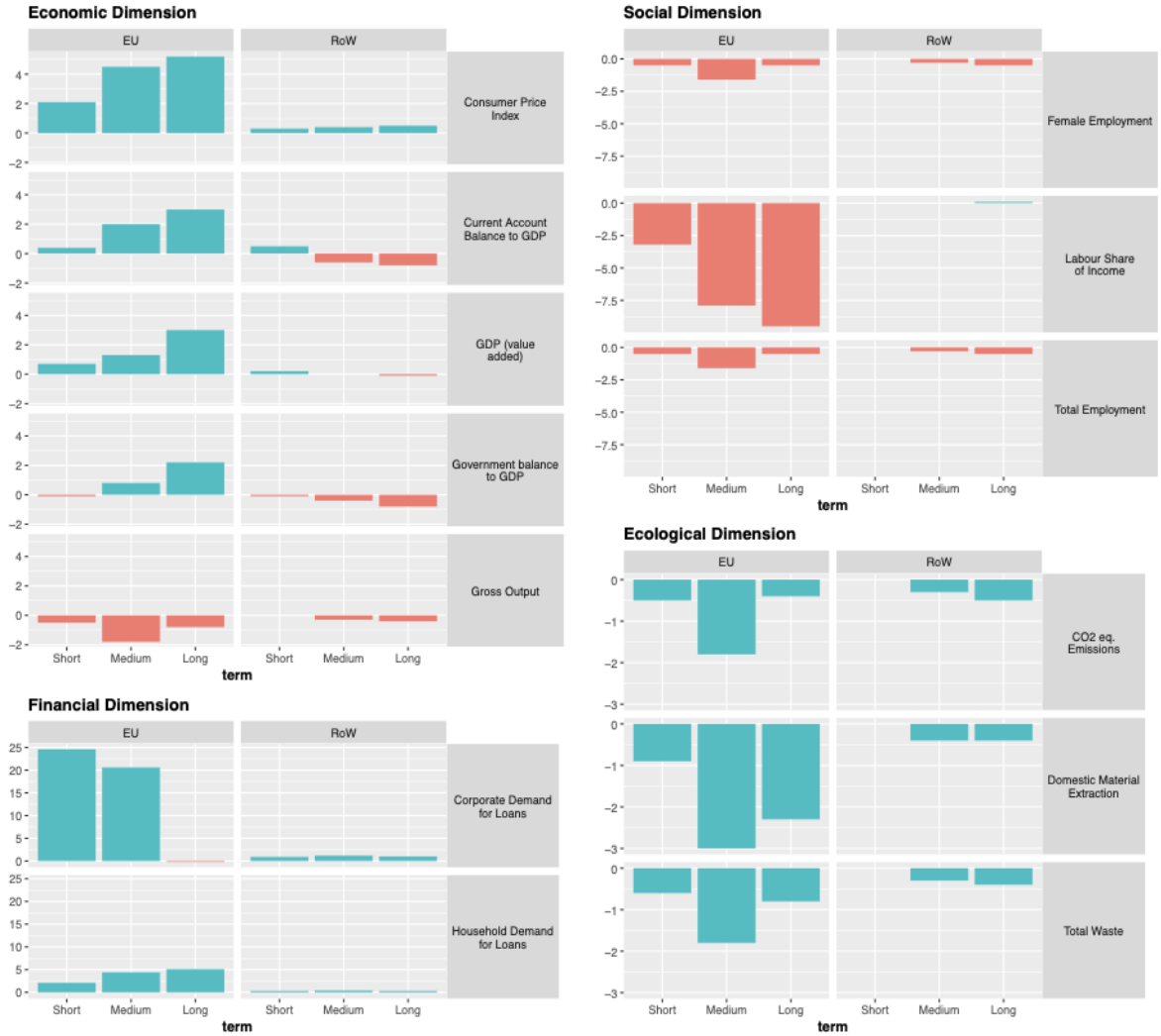
Scenario description

We tested a scenario where 30% of inputs (such as wood, pulp, manufactured wood products, plastics, glass, cement, metals, and construction materials) produced from virgin raw materials are progressively substituted by inputs produced from reprocessed secondary materials, with the 30% target being reached after 10 periods. To support the transition towards a more circular supply chain, we assume that the government provides a tax exemption on the purchase of inputs from reprocessing industries during the transition period.

Findings

Table 1. Selected findings: change relative to baseline values
(% change; p.p for balances to GDP and labour share of income)



Note: short term = 5 periods after the shock; medium term = 15 periods after the shock; long term = 30 periods after the shock. 1 period corresponds approximately to 1 year.

Economic impact. Overall, the impact of the CSC shock is positive for the EU economy. The EU's GDP increases in the short to medium term and even more so in the long term, despite a small reduction in gross output. The rest of the world is expected to experience a slight reduction in GDP and a somewhat more significant reduction in gross output. However, this negative

effect is likely negligible. After an initial (small) deficit, the EU's current account balance (as a ratio to GDP) consistently improves over time, stabilizing somewhat in the long term. Conversely, the current account balance of the rest of the world improves in the very short term but deteriorates progressively in the medium to long term. These changes are initially driven by shifts in the trade balance, although net foreign incomes play a significant role in the long term. The impact on government balance is less clear-cut, depending on the timing of government investment. However, overall, the EU records tendential deficits in the short to medium term, followed by a sharp improvement in the long term. Similarly, the rest of the world records a surplus in the short term, followed by increasing deficits in the long term. This suggests that the EU's private sector is accumulating net financial assets, both domestically (in the short to medium term) and internationally (in the long term).

Social impact. Focusing on key social indicators, the changes in sectoral balances described above are likely to worsen both wealth and income inequality in the EU. The wage share of national income decreases, while the non-labour income share increases, supported by growing financial incomes. In the absence of government-led employment policies, total employment is expected to decline in both the EU and the rest of the world in the long term, although a positive effect is anticipated in the short term due to the higher labour intensity of remanufacturing, recycling, and reuse industries compared to traditional industries. Additionally, the share of female employees (relative to total employees) is expected to decrease due to changes in the structure of production. This trend occurs in both the EU and, to a lesser extent, the rest of the world.

Ecological impact. Regarding key ecological variables, there is a significant reduction in the extraction of virgin raw materials associated with the EU economy. A slight reduction is also expected for economic activities in the rest of the world. The same applies to the total production of waste. However, both the extraction of resources and the production of waste show a tendency to recover in the long term, indicating a partial rebound effect. The impact of the PLE policy on CO2 emissions follows a similar pattern. After an initial spike, emissions decrease in the short to medium term, followed by a partial recovery in the long term. This trend is particularly noticeable in the EU, while changes in the rest of the world are negligible.

Implications

Overall, the results show that CSC policies tend to have a positive impact on the EU's GDP, although this may come at the expense of employment levels (especially in the medium to long term) and the gender composition of employment (reducing the share of female employment). The environmental effects at a global level are also positive, despite a tendency for a rebound effect in the long run, which could undermine medium-term reductions in the extraction of virgin raw materials, industrial CO2 emissions, and waste accumulation. The main issue is the imperfect substitution of primary materials with those provided by CSC-related industries, which leads to an increase in final demand and production. Additionally, the benefits of CSC policies for the EU economy are unevenly distributed, with positive effects for rentiers and domestic producers but negative effects for wage earners and exporters.

It follows that CSC policies and practices cannot be implemented without additional interventions aimed at supporting employment levels in the EU in the medium term, particularly female employment. Income redistribution policies are also necessary to prevent the burden of the transition from falling on low- and middle-income households. Public resources should be allocated to industries with low material and energy consumption rates to prevent the emergence of long-term rebound effects. Furthermore, coordination among regions and

governments is crucial to maximize the transfer of CSC-related technologies and know-how, thereby creating global synergies. Fiscal, monetary, and exchange rate policy coordination is essential to minimize the negative effects of CSC policies in the EU on the external balances of other regions, particularly low-income countries whose economies depend on raw material exports.

Recommendations

1) Introduce Employment Support Programs Focused on Female Employment. To address the negative impact of CSC policies on employment, particularly on female workers, the EU should implement targeted employment programs. These could include incentives for companies to hire or retain workers, particularly women and in industries affected by CSC transitions, and to provide training for women in emerging sectors like recycling, refurbishment, and sustainable production. Policymakers could also offer subsidies or tax breaks to companies that maintain or increase female workforce participation in CSC-related sectors.

2) Implement Wage Protection and Income Redistribution Policies. To counterbalance the uneven distribution of benefits from CSC policies, which favour rentiers and domestic producers over wage earners and exporters, the EU should introduce progressive tax reforms or income support mechanisms. These could include higher taxes on capital gains and dividends, paired with enhanced social safety nets like unemployment benefits or wage subsidies for workers affected by the transition. Such measures will ensure that the costs of CSC policies do not disproportionately burden low- and middle-income households.

3) Support for Low-Material and Low-Energy Industries. Governments should prioritise public funding and investment in industries with lower material and energy consumption rates to minimise the long-term rebound effects of CSC policies. Specific initiatives could include grants for R&D in green technologies, subsidies for industries adopting sustainable practices, and the promotion of circular business models such as leasing, repairing, and sharing services; such grants should be linked to target aimed at reducing overall material and energy consumption, rather than intensity measures. This would reduce the final demand for primary materials and help keep industrial emissions and waste accumulation in check.

4) Coordinate Technology Transfer and Knowledge Sharing at Global Levels. Policymakers should establish frameworks for international collaboration on CSC-related technologies. This could involve creating global CSC partnerships or consortia that facilitate the exchange of innovations, know-how, and best practices between regions. These collaborations would help low-income countries adopt CSC practices more efficiently, benefiting their economies while reducing dependence on raw material exports. The EU should also provide technical assistance and financial aid to help low-income countries implement CSC technologies.

5) Harmonise Fiscal, Monetary, and Exchange Rate Policies to Address Global Imbalances. To mitigate the negative effects of CSC policies on the external balances of other regions, particularly those dependent on raw material exports, the EU should coordinate fiscal and monetary policies with its trade partners. For example, the EU could offer targeted financial support to countries affected by reduced demand for raw materials. Coordinating exchange rate policies would help manage trade imbalances and support stable growth in both the EU and its trade partners.

6) Strengthen Rebound Effect Monitoring and Regulation. The EU should establish monitoring frameworks to track rebound effects from CSC policies, such as the one linked to increased material demand and emissions, over time. By regularly assessing these impacts, governments can adjust policies, tightening regulations where necessary. For example, introducing stricter environmental standards, taxation on primary resource extraction, or extending carbon pricing mechanisms could prevent long-term increases in production and material demand, ensuring that CSC policies achieve their intended environmental benefits.

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