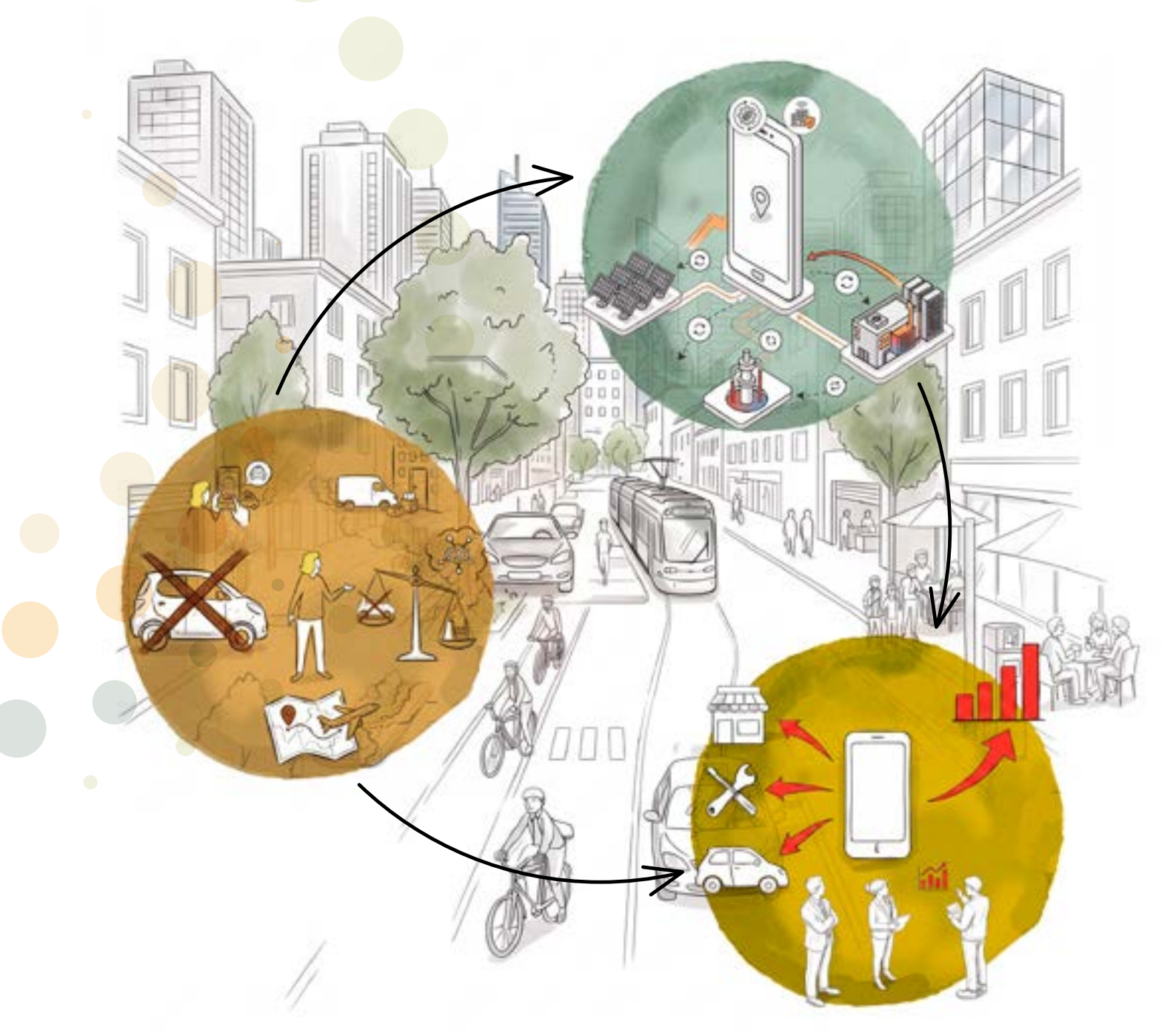
Policy Brief

Circular without rebounds

Mitigating rebound effects in corporate circular practices through EU policy



Key messages

Rebound effects can offset circular economy gains

Circular practices do not automatically reduce resource use or strategic dependencies. Rebound effects - behavioural and market responses that offset environmental benefits - can arise when lower costs, higher profits or consumption shifts erode expected gains.

Awareness of rebound effects is uneven

Nearly half (47%) of surveyed employees report moderate-to-high familiarity, but knowledge is concentrated among sustainability specialists.

Circular services do not guarantee lower consumption

Shared mobility may complement rather than replace car ownership: 66% of surveyed consumers would retain a private car even if car-sharing were available.

Digital applications can both enable and undermine circularity

Circular strategies could reduce projected fivefold growth in data-centre material demand by 20%. Digital applications in buildings can reduce waste and energy use, while mobility applications face greater rebound risks.

Policy recommendations

Embed rebound mitigation in corporate governance

- Strengthen the **Corporate Sustainability Reporting Directive** to integrate rebound risks into corporate governance and decision-making. Complementary support for employee training and recognition schemes can help companies identify and address rebound risks before they erode the expected environmental benefits of circular practices.

Align economic incentives with circular outcomes

- Steer savings and profits generated through circular practices towards low-resource activities. Taxes on non-circular goods, subsidies for circular alternatives and substitution-oriented mechanisms in **Extended Producer Responsibility** schemes can strengthen the competitiveness of circular products and reduce rebound risks.

Enable informed consumer and investor choices

- Improve access to reliable information on the resource intensity of products and services. Product labelling, sustainability-oriented investment criteria, dedicated education programs and standardised methodologies such as **Life Cycle Assessment** can support more informed decision-making. Resource use and rebound-risk reporting under the **Corporate Sustainability Reporting Directive** can further support consumer and investor choices.

Constrain virgin resource use and high-rebound activities

- Complement circular economy measures with policies that limit virgin resource extraction and resource-intensive consumption. Stronger environmental permitting, **Natura 2000** protections, sustainability criteria, extraction and import charges, durability requirements under the **Ecodesign for Sustainable Products Regulation** may reduce extraction of virgin resources. Where rebound risks remain high, quotas for high-impact activities might be needed. Together, these measures can help prevent rebound effects from offsetting environmental gains.

Policy context

The **Circular Economy Act** strengthens raw material security by promoting circular material flows, resource efficiency and reduced material use, supporting the **European Green Deal** and **net-zero targets**. Ensuring that circular practices effectively reduce resource consumption and strategic dependencies remains a key challenge.

The **Corporate Sustainability Reporting Directive** requires large companies to disclose sustainability risks and opportunities related to social and environmental issues. The CSRD could be extended to capture rebound effects by requiring disclosure of related risks, such as whether circular products or investments replace options with lower overall environmental impacts.

Finally, the **Waste Framework Directive** implements the Extended Producer Responsibility scheme, which could further mitigate rebound risks through stricter reduction and substitution targets and differentiated fees favouring circular solutions.

Why this matters

Rebound effects occur when behavioural or market responses reduce - or in some cases reverse ("backfire") - the expected environmental benefits of circular practices. Drawing on evidence from the CircEUlar project, this policy brief examines rebound effects arising from companies' circular practices and their implications for EU resource use and strategic dependencies. It highlights how the EU can ensure that circular practices deliver their intended environmental and resource-saving benefits.

What the evidence shows

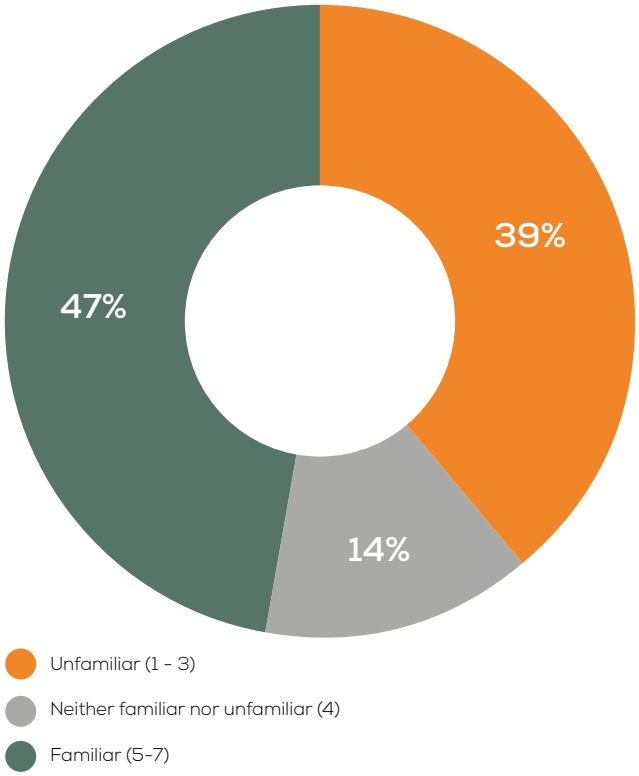
Circular practices do not automatically reduce resource use. Rebound effects can arise through both cost and substitution dynamics. Practices that reduce production costs may increase resource use if lower prices stimulate additional demand or higher profits support resource-intensive activities. Circular products and services can reduce resource use when they replace more intensive forms of consumption, but may generate rebound effects when they complement existing consumption or displace more sustainable alternatives. Rebound risks are lower when demand for additional consumption is limited and consumers continue to favour low-resource alternatives over resource-intensive options [1].

However, awareness of rebound effects remains concentrated among sustainability-oriented employees rather than embedded across organisations, potentially limiting companies' ability to identify and mitigate rebound effects.

Almost half (47%) of surveyed employees report moderate-to-high familiarity with rebound effects. Two-fifths (39%), however, indicate low or no familiarity, including 23% with no familiarity at all.

Awareness is highest among employees in sustainability-related roles, younger employees, and those with a strong sense of personal responsibility and environmental awareness. These findings are based on a non-statistically representative survey [2,3] of 3,391 employees across the mobility, building and manufacturing sectors.

To what extent are you familiar with the concept of rebound effect?



Beyond individual companies, circular practices can reshape material flows, prices and consumption patterns. By reducing material demand or increasing the supply of secondary materials, they can lower prices and influence resource use across the wider economy. Environmental gains therefore depend on high substitution rates, where circular goods and services replace rather than complement resource-intensive alternatives.

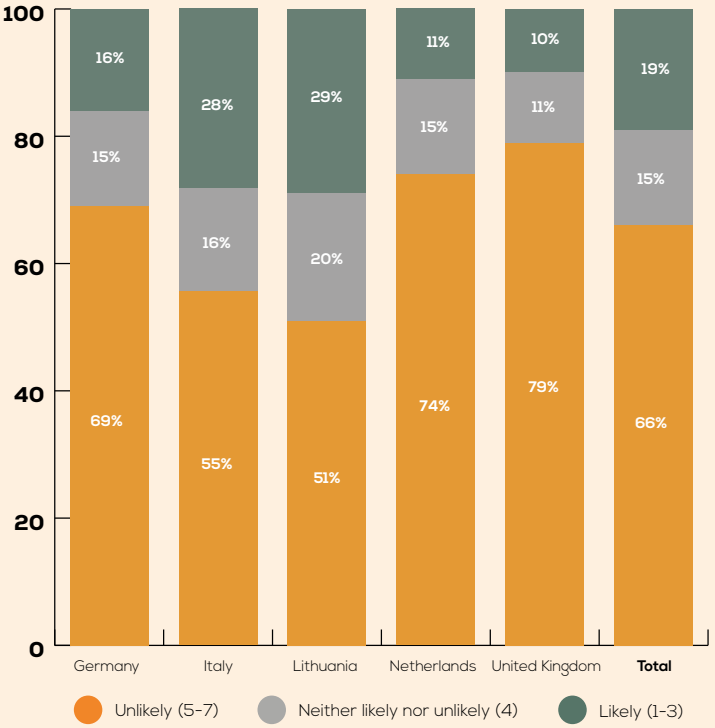
Shared mobility may complement rather than replace private cars

Based on the consumer survey (n = 2,636), around two-thirds (66%) of respondents would be unlikely to give up their car if car-sharing services were available, while only 19% would be likely to do so [4].

Respondents in Italy and Lithuania appear slightly more willing to transition away from private car ownership than those in other surveyed countries, although reluctance remains high overall.

Without substantial substitution away from private vehicles, shared mobility may complement rather than replace existing travel, increasing overall mobility demand or displacing more sustainable modes such as walking and cycling.

Would you get rid of your car if adequate car sharing was available?



Achieving circularity also requires resources. Recycling, transport, machinery and digital infrastructure can all increase demand for materials. Data-centre material demand is projected to increase fivefold by 2030, although circular strategies could reduce this growth by around 20% [5]. Expanding digital infrastructure may therefore increase demand for critical raw materials, particularly platinum group metals, where supply constraints are already acute.

Digital applications can enable - and undermine - circularity

Circular practices enabled by digital applications can both reduce and increase resource use, depending on how they affect consumption patterns, substitution dynamics, and infrastructure demand. Resource savings can arise through substitution, higher utilisation of physical goods, and waste avoidance, for example through Building Information Modelling (BIM) and smart heating or cooling systems. In buildings, **digital applications have been associated with reductions in construction waste of up to 57%** (from BIM) and **reductions in energy use of up to 36%** (for smart building control technologies) [6]. ››

Digital applications can also generate significant rebound effects through additional demand and substitution effects. Shared mobility, for example, may substitute for cycling or public transport rather than private car ownership, while autonomous vehicles may create additional travel demand. Ride-hailing and autonomous vehicles have been associated with increases in energy use of up to 90% and 60%, respectively [6]. By contrast, rebound risks appear more limited in buildings, where there is less scope to increase additional heating or cooling in response to efficiency gains.

Rebound risks differ across digital applications and sectors. In mobility, digitalisation can stimulate additional activity and weaken substitution away from resource-intensive travel, while digitally enabled practices in buildings appear to deliver more stable efficiency gains and lower rebound risks.

Circular practices are more likely to deliver lasting resource savings when wider market conditions reinforce them. Redirecting cost savings towards low-resource activities, strengthening consumer and investor demand for circular alternatives, and constraining virgin resource extraction can all help reduce rebound effects [1].

Efficiency improvements alone are insufficient indicators of environmental benefits, which depend on changes in consumption, infrastructure demand, and system-wide resource use.

Research Methodology

Rebound framework: The framework was developed through sequential economic reasoning and synthesises evidence from the rebound, circular economy and industrial ecology literatures to identify the conditions under which firm-level circular practices translate into economy-wide resource savings. It assumes that a significant share of profit-maximising firms adopts circular strategies, while some consumers are willing to pay more for circular goods. The analysis examines the short- to medium-term effects of a shift toward firm circular practices (excluding energy recovery) on macro-level resource use. Alternative scenarios are analysed based on how circular practices affect costs and resources, and whether market power is present in business-to-consumer sales. For each scenario, rebound mechanisms and the conditions under which rebound may be prevented or mitigated are identified based on economic reasoning and relevant literature. The analysis yields six conditions: (i) constrained virgin resource extraction; (ii) saturated consumer demand; (iii) redirection of cost savings and profits towards low-resource activities; (iv) high substitution rates of non-circular goods and services by circular alternatives; (v) consumer and investor preferences for low-resource activities; and (vi) access to reliable information and technologies supporting low-resource choices. The associated policy levers are derived from a literature review and should be understood as informed suggestions for materializing these theoretical conditions.

Employee survey: 3,391 surveyed employees through an online questionnaire across sectors: 19% of surveyed employees in mobility, 37% in buildings and 44% in manufacturing, and countries: 23% in the Netherlands, 23% in Germany, 26% in Italy, 8% in Lithuania, and 20% in the United Kingdom. This is not a statistically representative sample of the EU employee population (no representative quotas were used). Variables were identified as drivers only if they remained statistically significant after accounting for multiple other factors in a multivariable statistical analysis (pooled Ordinary Least Squares (OLS) estimation).

Consumer survey: A total of 5,651 observations were collected online using nationally representative quotas and weights assigned based on age, gender, education, and region. The countries covered were 19% of respondents in the Netherlands, 19% in Germany, 25% in Italy, 18% in Lithuania and 19% in the United Kingdom. Results are based on descriptive and segmentation analyses of survey responses. Results used here are based on a subsample of 2,636 consumers without access to car sharing.

Digitalisation: The digital applications with highest magnitude impact in each resource-using sector (mobility, buildings, industry) were identified. For each application, the recent literature was reviewed to provide quantitative estimates of indirect impacts on resource use (energy and materials), drawing on systematic reviews if available, and focusing where possible on empirical rather than prospective modelling studies.

References

Numbers in brackets correspond to this reference list.

[1] **Joltreau et al. (2025).** From (micro-) circularity to (macro-) mitigation: A framework bridging firm-level circularity, rebound effects and policies. Working paper. Zenodo. https://doi.org/10.5281/zenodo.16982589

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[6] **Wilson et al. (2024).** Evidence synthesis of indirect impacts of digitalisation on energy and emissions. In Proceedings of ICT4S 2024, 116–127. https://doi.org/10.1109/ICT4S64576.2024.00021

Further information and authors

Joltreau et al. (2025). Online tool containing information on available circular approaches in the provision of goods and services (CircEUlar Project Deliverable 3.2).

CircEUlar. Circular ReBoundary website. www.circular-reboundary.com

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CircEUlar project

CircEUlar is a Horizon Europe project (2022–2026) led by the International Institute for Applied Systems Analysis (IIASA) and involving 11 European partners. It develops integrated modelling frameworks and circular pathways for a net-zero economy, with detailed analysis of mobility and buildings as material-intensive demand sectors, and digitalisation as a potential enabler of circularity. Combining quantitative modelling, qualitative research, and stakeholder engagement, the project generates evidence to support Europe's climate and circular economy objectives.**Visit our website: https://circeular.org/**

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