Oct, 2026
GRINS DISCUSSION PAPER SERIES DP N° 131/2026 ISSN 3035-5567

GRINS

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DP N° 131/2026

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KEYWORDS

Circular Economy | Italian firms | Circular economy transition | Environmental innovation | Firm-level survey | GRINS survey

ACKNOWLEDGEMENTS

This study was funded by the European Union - NextGenerationEU, in the framework of the GRINS - Growing Resilient, INclusive and Sustainable project (GRINS PE00000018). The views and opinions expressed are solely those of the authors and do not necessarily reflect those of the European Union, nor can the European Union be held responsible for them.

CITE THIS WORK

Title: Mapping the Circular Economy in Italian Firms: Evidence from the GRINS Survey. Publication Date: 2026.

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Mapping the Circular Economy in Italian Firms: Evidence from the GRINS Survey

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Abstract

Firm-level evidence on the circular economy remains fragmented, limiting our understanding of how individual practices relate to innovation and business-model change. This position paper introduces the GRINS survey, a large-scale survey of Italian manufacturing firms with at least ten employees, and presents descriptive evidence for 2022–2024. The survey combines measures of environmental and circular practices, innovation and business models with information on capabilities, knowledge sources, cooperation, territorial conditions and perceived barriers. Around one-third of the sample reports adopting a circular business model, with experimental adoption more frequent than structured implementation. Firms reporting these models also report greater benefits from adopted practices, use a wider range of knowledge sources and place greater value on cooperation. Innovation is especially frequent in energy efficiency, renewable energy and waste management, while product redesign is less common. Perceived barriers differ across activities: weak customer demand is particularly salient for adoption, whereas regulatory complexity and financial constraints lead the rankings for innovation. These findings motivate a research and policy agenda that distinguishes operational adoption from innovation and strategic integration. GRINS provides a basis for investigating their relationships across firms and territories, while the descriptive evidence does not establish causal effects.

JEL codes: Q53, Q55, O33, L25, C83
Key-words: Circular economy; Italian firms; Circular economy transition; Environmental innovation; Firm-level survey; GRINS survey

1. Introduction

The circular economy (CE) has become a central objective of European environmental, industrial and innovation policy. Its implementation ultimately depends on firms changing how they design products, organise production, use resources and manage waste. Circularity is therefore both an environmental goal and a transformation of firms' innovation strategies, value-chain relationships and sources of value creation.

At the firm level, the transition spans technological, organisational and relational change. Firms may reduce virgin inputs, recirculate water, energy and materials, improve product durability and recyclability, or adopt regenerative and product-service business models (Linder and Williander, 2017; Kiefer et al., 2021; Konietzko et al., 2020). Many of these changes are incremental or organisational and are poorly captured by patents and conventional R&D indicators (Ghisetti et al., 2015; Barbieri et al., 2016; Pichlak and Szromek, 2022). Their adoption also depends on managerial capabilities, skills, cooperation and local institutions (de Jesus et al., 2019; Engez et al., 2021). Evidence from listed firms links green executive incentives to the direction of technological search, highlighting the role of internal governance in environmental strategy (Cezanne et al., 2027).

Systematic micro-level evidence nevertheless remains limited. Case studies illuminate adoption mechanisms but rarely support comparisons across sectors, regions and firm types (Guldmann and Huulgaard, 2020). Patents, accounts, sustainability reports and corporate communications capture only selected dimensions of circular activity (Portillo-Tarragona et al., 2022; Fusillo et al., 2021; Scarpellini et al., 2020; Borms et al., 2024). For example, Pernagallo et al. (2026) measure firms' semantic alignment with CE principles through mandatory non-financial disclosures, providing a complementary indicator of strategic communication. Firm surveys can instead observe practices, capabilities and barriers directly, including innovations that are not patented or recorded as R&D.

Existing surveys provide useful but fragmented evidence. The Flash Eurobarometer and Community Innovation Survey cover selected environmental actions, while dedicated national and regional surveys examine circular innovation in greater depth (Cainelli et al., 2020; Bassi and Dias, 2019; Ghisetti and Montresor, 2020; Chioatto and Zecca, 2023; Chioatto et al., 2024; Zecca et al., 2026). Few instruments jointly measure circular business models, practices and innovations together with the internal and external conditions that shape them.

This position paper introduces the GRINS survey, a large-scale survey designed to represent Italian manufacturing firms with at least 10 employees. It records circular business models; current and planned practices; circular innovation; organisational and labour capabilities; cooperation; public support; infrastructure; and perceived barriers. Italy is a useful setting because its large and diverse manufacturing base combines marked sectoral and regional heterogeneity with policy responsibilities distributed across national and regional authorities. We use the survey to establish a descriptive baseline for 2022–2024 and develop an agenda for research and policy on the circular transition.

The results show a transition that is visible but incomplete. About one-third of the sample reports a circular business model, although experimental adoption is more common than structured adoption. Reported innovations concentrate on energy efficiency, renewable energy and waste management; product redesign is less frequent. Firms emphasise machinery and process investment. Weak customer demand is the highest-rated barrier to adopting practices, while regulation, bureaucracy, investment

costs and access to finance are especially prominent for innovation. Cooperation is perceived as most valuable within the region and along proximate sectoral and supply-chain relationships.

The paper contributes in three ways. It first shows how a dedicated survey can complement established innovation and sustainability data. It then distinguishes the adoption of practices, the introduction of innovations and the integration of circularity into business models, allowing their overlap to be examined rather than assuming that they are successive stages of a single transition. Finally, it documents differences in knowledge sources, perceived benefits and external conditions across firms with and without circular business models. These descriptive comparisons connect circular-economy research with work on eco-innovation and regional innovation systems and identify relationships for subsequent explanatory analysis.

Section 2 positions the GRINS survey in the firm-level literature. Section 3 describes the questionnaire and sample; Section 4 examines business models and associated practices, external conditions and circular innovation; and Section 5 discusses policy implications, limitations and directions for research.

2. Firm-level surveys on the circular economy and the GRINS contribution

Firm-level measurement of the circular economy has developed along two routes. General business surveys have added questions on resource efficiency and eco-innovation, whereas dedicated surveys have examined circular strategies in greater detail. The first route offers broad coverage and comparability; the second provides richer measures but usually covers narrower populations or locations.

At European level, the Flash Eurobarometer surveys on SMEs and resource efficiency measure actions such as reducing resource use, recycling and improving energy efficiency. Community Innovation Survey modules likewise support cross-country analysis of environmental innovation (Demirel and Danisman, 2019). The Italian industrial census records selected circular practices. Because circularity is only one part of these instruments, however, they provide limited evidence on the organisational and relational changes associated with circular production.

Dedicated surveys address some of these limitations. The CERCIS programme at the University of Ferrara surveyed a panel of about 4,600 Italian manufacturing firms in 2017–2018 and 2019–2020. Its questionnaire covered firm characteristics, investment and innovation, ten types of circular innovation, and organisation, training and labour relations; the second wave also examined firms' responses to the COVID-19 shock.
Research based on CERCIS has classified innovations by input, use and end-of-life stages and shown that upstream strategies, including resource efficiency and eco-design, are more prevalent than reuse, recycling and industrial symbiosis (Chioatto et al., 2024; Chioatto and Zecca, 2023). Zecca et al. (2026) distinguish the decision to innovate from the number of innovations adopted. Other studies link circular and digital transitions to human-resource practices and assess the economic returns to circular practices (Antonioli et al., 2025; Antonioli et al., 2022).

More targeted studies add sectoral and territorial detail. Chioatto et al. (2026) examine 376 construction firms in Emilia-Romagna, while Ormazabal et al. (2018) study SMEs in Navarra and the

Basque Country. The latter find that firms concentrate on compliance and cost reduction rather than advanced circular strategies, underscoring the importance of regional institutions where waste and circular-economy policies are implemented.

Taken together, these strands reveal a persistent trade-off between breadth of coverage and depth of measurement. Broad surveys permit representative comparisons but measure a restricted set of practices; dedicated surveys capture strategies and capabilities more fully but differ in their coverage of firm sizes, sectors, regions and dimensions of circularity. Survey evidence is especially valuable because circular change frequently consists of incremental technological and organisational practices that administrative data cannot identify directly (Mairesse and Mohnen, 2010).

Building on these contributions, the GRINS survey combines a national sampling design with multidimensional measurement. It covers circular business models, individual practices and innovations rather than treating circularity solely as a subset of environmental action. It also measures investment, organisational resources and skills, enabling analysis of the capabilities that support the transition.

The survey further captures relationships with suppliers, customers and other partners, reflecting the coordination required to close material loops. Its regional coverage and questions on infrastructure and institutions allow circular activity to be linked to territorial conditions. Regional differences in the production and citation-based uptake of CE scientific knowledge in Italy further motivate this territorial perspective (Coda Zabetta et al., 2026). Together, these features make GRINS a basis for examining how operational practices, innovation and business-model change are related. The questionnaire translates this distinction into separate measures, alongside information on firm capabilities, value-chain relationships and territorial conditions, as described next.

3. Questionnaire, sample design and data collection

3.1. Questionnaire

The questionnaire operationalises this framework by distinguishing practice adoption, innovation and business-model integration. Its first aim is to measure the adoption of environmental and circular practices in small, medium and large manufacturing firms. Thirteen items cover resource use, reuse and waste management, as well as changes to products that improve their circularity. For these dimensions, the survey records adoption during 2022–2024, intentions to adopt over the following three years, and the perceived economic and environmental impacts of adopted practices. In Figure 1, adoption and perceived impacts are labelled “Outcome 1”.

The second aim is to measure innovation for circularity. Considering the same dimensions used for “Outcome 1”, we collect data on firms’ innovative activities, both in terms of whether innovations were introduced and how many were introduced. This measure is labelled “Outcome 2”.

A separate question identifies firms adopting a circular business model and distinguishes structured implementation from experimental or limited adoption. Cross-classifying this measure with “Outcome 1” and “Outcome 2” allows us to examine whether practices and innovations are embedded in a broader business strategy.

These measures capture related but distinct dimensions: adopting a practice does not necessarily entail innovation, and innovation need not coincide with business-model change. The coverage of environmental practices is deliberately broad. Energy efficiency and renewable energy can complement circular strategies, but do not by themselves demonstrate the closure of material loops or the extension of product life. The distinction is important when interpreting the descriptive results.

The questionnaire also includes several blocks related to potential explanatory factors. In particular, we distinguish between internal and external factors, in addition to standard control variables related to firm characteristics. The questionnaire concludes with a section on barriers to the adoption of and innovation in circularity.

More specifically, the questionnaire is structured into six substantive sections, followed by a questionnaire-evaluation module. The first section includes key firm characteristics, such as geographical location, sector of activity, size, firm age, group affiliation, family business, separation between ownership and management, internationalization and markets, perceived competitive pressure, digital endowment, top management characteristics and management quality.

INSERT FIGURE 1 ABOUT HERE

The second section, representing the "core" of the questionnaire, focuses on practices and innovation related to the circular transition. It records the adoption of specific practices and their perceived impacts, and distinguishes general firm innovativeness from innovation in environmental and circular activities. Complementary questions elsewhere in the questionnaire cover environmental certifications, knowledge channels and awareness of environmental policies and regulations. Together with the business-model measure, these items allow operational activity to be compared with firms' broader engagement in circularity.

The third section is dedicated to the labour market. In particular, it examines firms' employment structures, including contract stability, the share of highly educated human capital, and the proportion of employees involved in R&D and in environmental and circular activities. It also investigates employee training aimed at improving environmental and circular skills, as well as firms' efforts to recruit workers with such skills.

The fourth section examines industrial networks and value-chain relationships, including the location and perceived circular engagement of suppliers and business clients. It also measures the perceived importance of cooperation at different degrees of sectoral and territorial proximity. These responses provide information on the relational context of adoption, rather than direct estimates of knowledge spillovers.

The fifth section collects data on public support and territorial characteristics (e.g., perceived quality of public services in transport, waste management, business support, and universities and research centres), which may influence the adoption of environmental and circular practices.

The final section is devoted to both internal and external barriers to the adoption of and innovation in circularity.

Appendix A reproduces the questionnaire in English.

3.2. Sample design and data collection

The population of firms with at least 10 employees in the Italian manufacturing industry consists of 69,501 units in 2021[1]. This population was used as the reference universe for sample extraction. Although a data update is now available until 2023, growth over time has been limited (1% in 2022 and 0.8% in 2023), and the distribution by region, sector, and size has remained relatively stable.

We extracted a sample of 8,438 firms, corresponding to a coverage rate of approximately 12%, with a target sampling error of 1% at the aggregate level. The probabilistic sample was stratified by region (20 categories), 2-digit ATECO sector (24 categories), and firm size (3 categories). Following a standard classification, firms are grouped into three size classes based on the number of employees: 10–49, 50–249, and 250 or more.

Data were ultimately collected from 7,532 firms, with a non-response rate of approximately 11%. Sampling weights were applied using a constrained statistical calibration procedure to align the sample with the reference population. Table 1 reports the population, expected sample, and collected sample; for brevity, only the regional distribution is shown. The coverage rate in the collected sample ranges from 10% to 13%, with an overall value of 11%. Coverage is slightly lower in southern Italian regions, where data collection proved more challenging; however, deviations from the expected sample are minimal.

INSERT TABLE 1 ABOUT HERE

Interviews were conducted using a combination of CAWI (Computer-Assisted Web Interviewing), CATI (Computer-Assisted Telephone Interviewing), and CAPI (Computer-Assisted Personal Interviewing), adapting the method to the different phases of the survey. This approach maximized sample coverage and improved the response rate. Firms were initially contacted via certified email and invited to complete the online questionnaire independently. A cover letter outlining the purpose of the survey and the importance of participation was attached to the email. At the start of the survey, a toll-free number was activated to help with the online platform[2].

Throughout the data collection process, multiple contact attempts were made (an average of 10 per firm), including reminder emails and telephone follow-ups, to maximize response rates. The collection and processing of sensitive data were carried out in compliance with Italian privacy regulations and quality standards for statistical surveys.

The survey began in March 2025 with a pilot phase. During this stage, data were collected from 170 firms distributed across Italian regions and across different size classes. These firms were also asked to complete an additional module to assess the clarity, complexity, and relevance of the questionnaire. The evaluation covered clarity, interest and response burden using 1–10 scales. The results of the pilot study were presented to ISTAT (Italian National Institute of Statistics) in early April 2025, and the feedback received was used to refine and improve the questionnaire.

[1] Data are obtained from the Italian National Institute of Statistics (ISTAT).

[2] The survey data were collected by three different fieldwork agencies using the same sampling and data collection procedures. The research team provided training to the fieldwork managers of each agency, who in turn trained the interviewers assigned to the study. While efforts were made to ensure consistency through standardized procedures, the possibility cannot be ruled out that differences in the training provided by the individual agencies may have contributed to variation in interviewer practices and, consequently, in the quality and comparability of the data collected.

The analysis below uses the survey to compare dimensions of circular engagement and the conditions firms associate with them. These are descriptive comparisons: reported benefits and barriers are respondents' assessments, and differences across firms should not be interpreted as effects of adopting a circular business model.

4. Descriptive evidence on the circular transition

4.1. The adoption of circular business models

We begin with business models, which indicate how firms report integrating circularity into their strategies. While individual practices may be implemented as isolated technical solutions, circular business models embed circularity in how firms create and capture value. Table 2 shows that 31.2% of the sample reports some form of circular business-model adoption during 2022–2024: 12.1% report structured implementation and 19.1% experimental or limited adoption. A further 18.5% are evaluating adoption, while 35.0% report neither adoption nor plans to adopt. These percentages use the full sample denominator, including 15.4% with missing responses. They therefore need to be distinguished from adoption rates calculated only among firms answering the question.

INSERT TABLE 2 ABOUT HERE

Among firms either implementing circular models systematically or experimenting with them on a limited scale, the geographic distribution shows no clear North–South split but rather marked regional variation (Figure 2). Regions such as Friuli Venezia Giulia, Emilia-Romagna, Campania and Trentino-Alto Adige display relatively high shares of firms adopting circular business models, whereas adoption remains lower in regions such as Marche, Abruzzo and Liguria. This diffusion of strategic circularity may reflect local industrial and institutional conditions worth investigating.

While the geographical distribution of circular business models appears heterogeneous, their sectoral distribution also shows marked differences (Figure 3). Differences in adoption rates suggest that sector-specific technological and organisational conditions warrant further investigation. The highest adoption rates are observed in sectors such as basic pharmaceutical products, chemicals, rubber and plastics, and basic metals, where between 45 and 52% of firms report adopting a circular business model. In contrast, sectors such as beverages, apparel, and printing show much lower adoption—under 30%—indicating substantial sectoral heterogeneity in circular business model uptake.

INSERT FIGURES 2 & 3 ABOUT HERE

Beyond their distribution, it is important to understand whether circular business models coexist with individual circular practices or instead capture a qualitatively different level of engagement with the circular economy. Although almost all firms adopting a circular business model also implement at least one circular practice (92%), the reverse does not hold. About two-thirds of firms not reporting a circular business model still report using at least one circular practice, indicating that isolated practices do not necessarily reflect a strategic shift to circularity.

This distinction also provides a basis for comparing the perceived benefits of adopted practices. Across all thirteen practices considered, firms reporting circular business models assign higher economic and environmental impact scores than firms without such models (Table 3). The pattern is consistent with complementarities between practices and business strategy, although differences in firm characteristics or reporting behaviour may also contribute to the observed gap.

INSERT TABLE 3 ABOUT HERE

A clear information gap emerges between firms adopting circular business models and those that do not. Table 4 shows that firms with a circular business model rely more heavily on nearly all information channels related to environmental sustainability and the circular economy. The most pronounced differences concern conferences, trade fairs, and exhibitions (54% versus 35%) and scientific or technical publications (43% versus 27%), suggesting a substantially stronger reliance on formal knowledge sources among firms adopting circular business models.

Because the comparison group includes firms adopting individual circular practices, these differences suggest that business-model adoption is associated with broader use of knowledge sources. They do not establish whether access to knowledge precedes business-model change or develops alongside it. The next subsection extends this comparison from information channels to cooperation and the territorial environment.

INSERT TABLE 4 ABOUT HERE

4.2. External conditions and perceived constraints to circularity

The same comparison reveals differences in the value firms attach to cooperation. Table 5 reports assessments of how important cooperation has been, or could be, for the circular transition. Across all dimensions, firms adopting circular business models assign higher scores than firms without such models. These ratings capture perceived relevance, including potential future relevance, rather than the actual intensity of collaboration.

The differences are consistent across different scales of cooperation. Cooperation within the same region receives the highest scores, both among firms operating in the same sector and along the same supply chain. Notably, average ratings above six occur only among firms with circular business models; firms without such models generally rate the importance of all types of cooperation lower.

The perceived importance of cooperation declines as geographical and relational distance increase. This pattern points to the relevance of regional, sectoral and supply-chain relationships in firms' assessments of the transition. It motivates further analysis of whether access to nearby partners facilitates circular activity, without establishing that regional cooperation is its primary cause.

INSERT TABLE 5 ABOUT HERE

Differences between firms become even more apparent when considering the perceived quality and relevance of the external environment. Table 6 shows that firms adopting a circular business model consistently assign higher scores to both the quality and the importance of external infrastructures than the other firms. The gaps in perceived importance are particularly marked for universities and research centres, public services for firms, and waste collection and recycling facilities.

More favourable assessments of infrastructure coexist with substantial perceived obstacles. Table 7 shows that firms with and without circular business models rank barriers to adoption similarly. Weak market demand receives the highest scores in both groups (7.93 and 7.89, respectively), followed by regulation and bureaucracy and high investment costs. Shortages of qualified personnel within firms and insufficient funding are also prominent. Firms adopting circular business models generally assign slightly higher scores to barriers, which may reflect greater exposure to implementation difficulties. As the question concerns barriers facing Italian firms, these responses should be read as perceptions of the wider transition rather than direct measures of each respondent's own constraints.

INSERT TABLES 6 &7 ABOUT HERE

4.3. Circular innovations, drivers and barriers

We now turn from the adoption of practices and business models to the introduction of innovations. Circular innovation and circular business models are closely related but not equivalent: almost half of firms reporting circular innovations do not report a circular business model. This overlap is incomplete, reinforcing the need to measure innovation and strategic integration separately (see Table 2 above).

Among circular innovators, innovation activity is concentrated in a relatively narrow set of domains, primarily related to energy use and production processes. Table 8 provides a breakdown of the main areas of circular innovation among firms identified as innovators. The most frequent areas of innovation concern energy use, with both reducing energy consumption (50.41%) and adopting renewable energy (49.96%) standing out as the most common activities. Waste-related innovations are also relatively common, particularly in waste transfer (37.13%) and waste reduction (36.28%). By contrast, innovations involving product design are less prevalent. Design for recyclability and design for reduced input use are both reported by around 26% of firms, showing that these forms of product redesign are less frequently reported than energy-related innovation. The number of observations varies across items, so the percentages should be read with their respective denominators.

The prominence of energy-related innovation is consistent with an emphasis on production efficiency. However, the survey's broad environmental coverage requires care: these activities need not entail the same changes in material circulation or product lifetimes as reuse and circular design. Their frequency alone does not establish firms' motivations or the environmental gains achieved.

INSERT TABLE 8 ABOUT HERE

To shed light on how firms interpret circular innovation, we focus on their perceptions of the factors that support innovation activities. Figure 4 reports firms' assessment of the importance of different factors in the development of innovations related to environmental and circular practices. As these measures are perception-based, they provide insight into how firms interpret the drivers of the circular transition.

INSERT FIGURE 4 ABOUT HERE

Firms assign the highest scores to investment in machinery and equipment (7.66) and process improvements (7.16). Internet-based technologies and corporate reputation and branding both score 6.09, compared with 5.98 for R&D, 5.64 for product and service design, and 4.98 for artificial intelligence. These assessments are consistent with the prominence of production-related innovation in Table 8. They do not imply that organisational capabilities or skills are unimportant, since Figure 4 does not separately measure all of these dimensions.

The survey also explores firms' perceptions of the main barriers to circular innovation. Table 9 shows that regulatory complexity and bureaucracy represent the most relevant obstacles, followed by high investment costs and limited access to public or private finance. By contrast, factors related to suppliers, collaboration with external organisations and corporate culture receive comparatively lower scores. This ranking differs from that for practice adoption, where weak customer demand

receives the highest score. The contrast suggests that diffusion of existing practices and development of innovations may face different perceived obstacles, a distinction that merits closer investigation.

INSERT TABLE 9 ABOUT HERE

Taken together, the results show why adoption, innovation and business-model integration should be examined jointly while remaining analytically distinct. Business-model adoption is associated with broader knowledge use, higher perceived benefits and greater emphasis on cooperation, while innovation is concentrated in selected environmental and circular domains. These patterns provide the empirical basis for the research and policy agenda developed below.

5. Conclusions

The GRINS survey provides a large-scale empirical basis for studying the circular transition among Italian manufacturing firms with at least 10 employees. Building on existing environmental and innovation surveys, it jointly measures practices, innovation, business models, organisational resources, relationships, territorial conditions and barriers.

The transition is under way but remains uneven. About one-third of the sample reports adopting a circular business model in 2022–2024, yet experimental or partial adoption is more common than structured adoption. Circular activity also varies substantially across sectors and regions.

Reported innovation is especially frequent in energy efficiency, renewable energy and waste management, while product redesign is less common. Together with the diffusion of experimental business models, this suggests that many firms are approaching the transition through changes to existing operations. It also underlines the analytical value of distinguishing environmental improvements from changes that extend product life or close material loops.

The comparisons identify relationships and constraints for further investigation. Firms with circular business models use more knowledge sources and attach greater value to cooperation, especially within their region. Machinery and process improvements dominate perceived innovation drivers. Weak customer demand leads the ranking of adoption barriers, whereas regulatory complexity, investment costs and access to finance are the most prominent perceived barriers to innovation.

These findings suggest a policy agenda that differentiates the diffusion of practices from innovation and business-model development. Alongside financial support and simpler administrative procedures, the prominence of demand-related barriers calls for attention to markets for circular products and services. Support for managerial capabilities, skills and inter-firm coordination may help firms integrate individual activities into broader strategies. Regional institutions offer a relevant setting for such support, given the importance firms attach to nearby partners and infrastructure. The survey identifies priorities for policy design and evaluation; it does not establish the effectiveness of particular instruments.

These implications must be read in light of the survey's scope. The cross-sectional, retrospective evidence cannot establish causal effects or the sequence linking practice adoption, innovation and business-model change. Self-reported impacts and perceptions do not substitute for measured environmental or economic outcomes. Item non-response and differences in sector, size and location

may affect comparisons, and the coverage excludes micro-firms with fewer than 10 employees and non-manufacturing activities. Future research should account for these sources of heterogeneity and distinguish broad environmental innovation from more specific forms of circular change.

Subject to access and linkage feasibility, future research can combine GRINS responses with balance sheets, patents, employment records and territorial indicators to study productivity, competitiveness, employment, wages, exports and environmental outcomes. A central question is whether practices, innovation and business-model integration complement one another, and under which organisational and territorial conditions. Follow-up waves could clarify the timing of these relationships and assess how firms respond to changing policy requirements, with appropriate research designs needed to identify causal effects.

The central contribution of this position paper is therefore a measurement framework and an empirical agenda for studying the circular transition. GRINS makes it possible to examine how operational practices, innovation and business strategies intersect across firms and territories, providing a foundation for explaining their development and assessing their outcomes.

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Tables and Figures

Tables

Table 1. Sample design and completed interviews by region

Region	Population	Expected sample	Coverage rate	Collected sample	Coverage rate
Abruzzo	1240	151	12%	162	13%
Basilicata	287	35	12%	31	11%
Calabria	465	56	12%	49	11%
Campania	3677	446	12%	386	10%
Emilia-Romagna	7929	963	12%	859	11%
Friuli-Venezia Giulia	1793	218	12%	172	10%
Lazio	2271	276	12%	234	10%
Liguria	936	114	12%	111	12%
Lombardia	17689	2148	12%	1924	11%
Marche	3192	388	12%	409	13%
Molise	170	21	12%	18	11%
Piemonte	5596	679	12%	673	12%
Puglia	2685	326	12%	261	10%
Sardegna	564	68	12%	64	11%
Sicilia	1601	194	12%	163	10%
Toscana	6566	797	12%	709	11%
Trentino Alto Adige	1203	146	12%	148	12%
Umbria	1135	138	12%	109	10%
Valle d'Aosta	57	7	12%	7	12%
Veneto	10445	1268	12%	1043	10%
ITALY	**69501**	**8438**	**12%**	**7532**	**11%**

Table 2. Circular Business Models Adoption

In the three years 2022–2023–2024, has your firm adopted circular business models?	*Freq.*	*Percent*	*Cum.*
Yes, in a structured manner	912	12.11	12.11
Yes, on an experimental or limited basis	1439	19.11	31.21
No, but under evaluation	1391	18.47	49.68
No, and not planned	2633	34.96	84.64
Missing values	1157	15.36	100.00
Total	7532	100.00	

Table 3. Perceived impacts of circular practices, by circular business model adoption

	Economic Impact		**Environ. Impact**	
	Circular Model		*Circular Model*	
Practice	*No*	*Yes*	*No*	*Yes*
Reuse of water already used in other production	5.545	5.732	6.174	6.599
Reduction of water use to improve production process	5.443	5.575	6.001	6.362
Use of energy generated from renewable sources *(v53)*	**6.775**	**7.111**	**6.801**	**7.427**
Reduction of electricity use (from any source) to tion process efficiency *(v54)*	**6.313**	**6.688**	**6.34**	**6.942**
Reuse of waste within the firm's own production cycle	5.803	6.541	6.166	7.011
Reduction of waste generated to improve production cy *(v56)*	**5.691**	**6.368**	**6.06**	**6.883**
Transfer of the firm's waste to other firms that reuse it on processes *(v57)*	**5.892**	**6.437**	**6.341**	**6.976**
Reuse of raw materials (other than water and energy) other production processes *(v58)*	4.631	5.519	4.662	5.778
Reduction in the use of raw materials (other than water mprove production process efficiency *(v59)*	5.707	6.219	5.885	6.455
Changes in product design to maximise recyclability	5.79	6.225	5.969	6.676
Changes in product design to minimise the use of raw ding water and energy) *(v61)*	5.756	6.349	5.888	6.581
Increase in product durability *(v62)*	**6.237**	**6.63**	**6.294**	**6.846**
Increase in product repairability *(v63)*	6.347	6.782	6.316	6.995

Note: average values

Table 4. Knowledge sources used by firms, by circular business model adoption

In the three-year period 2022–2023–2024, which channels were used by the firm to acquire information and knowledge on environmental sustainability and the circular economy?	**Circular Model**	
	No	*Yes*
Conferences, trade fairs, and exhibitions *(v37)*	35.14	53.80
Scientific journals and technical/trade publications *(v38)*	27.15	43.02
Professional and industry associations *(v39)*	60.70	66.39
Social networks *(v40)*	40.23	50.21
Software open source, open B2B platforms *(v41)*	10.77	21.16
Private consultants for accessing public incentives *(v42)*	55.72	60.44
Government ministries and local public authorities *(v43)*	16.42	30.43
Feedback received from customers and the marketing	34.03	44.72
Feedback received from client companies *(v45)*	39.12	47.16

Note: % frequencies

Table 5. Perceived importance of cooperation, by layers of proximity (region, sector, supply chain)

How important has cooperation between your company and other firms been, or how important could it be, for the transition towards a circular economy?	**Circular Model**	
	No	*Yes*
Same sector:		
Same region	5.394	**6.127**
Outside the region	4.855	5.865
Outside the country	4.136	5.274
Same supply chain:		
Same region	5.125	**6.056**
Outside the region	4.691	5.765
Outside the country	4.052	5.207
Outside supply chain:		
Same region	4.399	5.390
Outside the region	4.101	5.153
Outside the country	3.671	4.767

Note: average values from Likert scales 1-10

Table 6. Perceived quality and importance of external infrastructures for circular economy activities

No circular model	Infrastructure Quality		Importance of Infrastructure	
Infrastructure	Local/Regional	National	Local/Regional	National
Public transport	5.068	5.365	5.271	5.119
Collection/recycling/disposal centres	6.105	5.555	6.338	5.952
Public services for companies (e.g. SUAP)	5.391	5.238	5.919	5.677
Universities and research centres	6.259	6.156	5.999	5.849

Circular model	Infrastructure Quality		Importance of Infrastructure	
Infrastructure	Local/Regional	National	Local/Regional	National
Public transport	5.555	5.749	5.670	5.540
Collection/recycling/disposal centres	6.474	5.942	**6.824**	**6.546**
Public services for companies (e.g. SUAP)	5.909	5.733	6.460	6.279
Universities and research centres	6.718	6.576	**6.609**	**6.473**

Table 7. Perceived relevance of barriers to the adoption of circular economy practices

How relevant do you consider the following barriers to the adoption of circular economy practices in Italian firms?	**Circular Model**	
	No	*Yes*
Regulation and bureaucracy	**7.411**	**7.521**
Economic and financial factors (high costs)	**7.129**	**7.237**
Insufficient public/private funding	**6.714**	**6.879**
Public infrastructure	6.445	6.537
Difficulty in finding qualified personnel in the labour market	6.374	6.440
Market demand (lack of interest from final customers)	**7.889**	**7.928**
Lack of qualified personnel within the firm	**6.943**	**7.042**
Corporate culture (e.g. perception of lack of usefulness)	5.965	6.219
Suppliers (e.g. sourcing difficulties)	6.466	6.569
Collaboration with external actors (universities, research institutions, etc.)	6.165	6.391

Note: average values from Likert scales 1-10

Table 8. Type of Circular Innovation

Innovation	Obs.	% innovators
Water reuse	3334	19.23%
Reduction of water use	3394	24.57%
Renewable energy	3635	49.96%
Reduction of energy use	3622	50.41%
Waste reuse	3625	29.77%
Waste reduction	3545	36.28%
Waste transfer	3560	37.13%
Reuse of raw material use	3430	26.24%
Reduction of raw material use	3379	26.12%
Design for recyclability	3335	26.12%
Design for reduced input use	3326	24.89%
Increase in durability	3504	38.61%
Increase in repairability	3461	32.42%

Table 9. Perceived barriers to circular innovation

Barrier to circular innovation	Average value
Regulation and bureaucracy	7.55
Economic and financial factors (high costs)	7.44
Insufficient public/private funding	7.22
Public infrastructure	6.86
Difficulty in finding qualified personnel in the labour market	6.77
Market demand (lack of interest from final customers)	6.56
Lack of qualified personnel within the firm	6.58
Corporate culture (e.g. perception of lack of usefulness)	6.58
Suppliers (e.g. sourcing difficulties)	6.41
Collaboration with external actors (universities, research institutions, etc.)	6.27

Figures

Figure 1. Survey structure

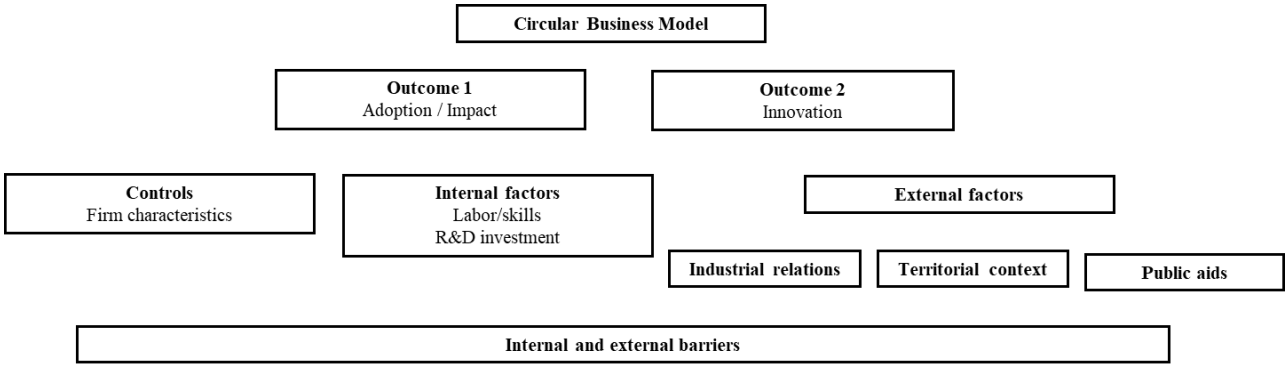


Figure 2. Regional distribution of firms adopting circular models (% values)

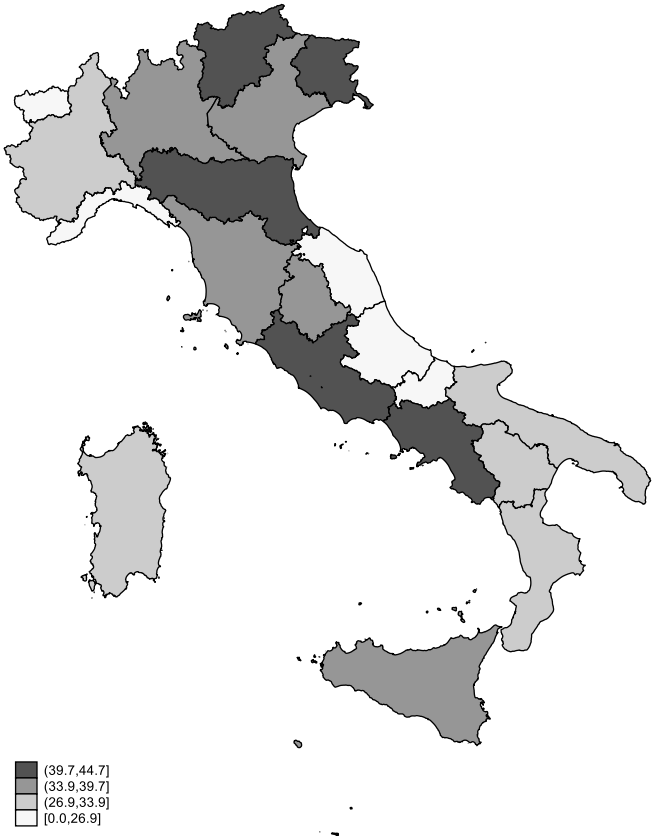
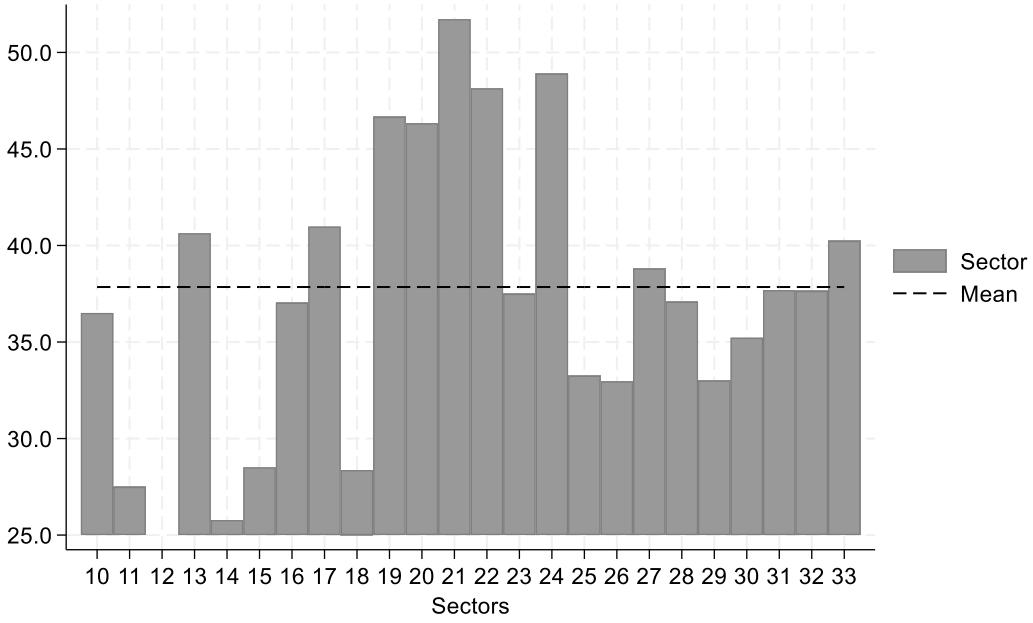
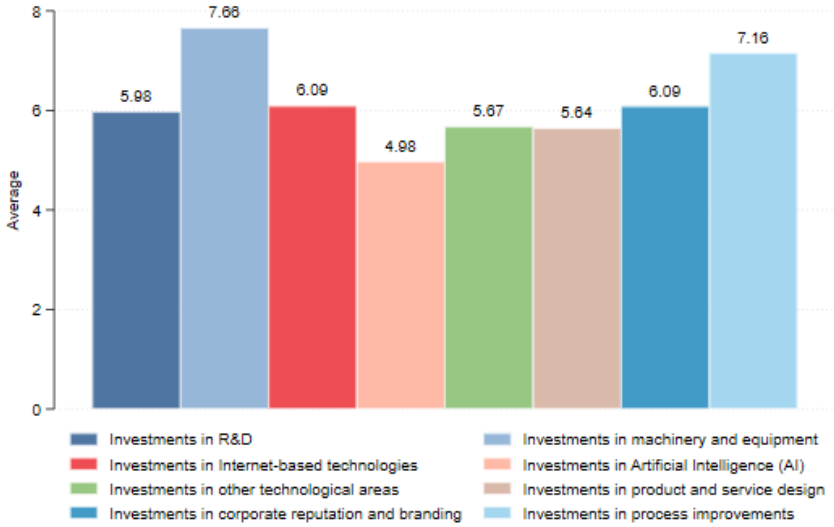


Figure 3. Share of firms adopting circular business models by manufacturing sector



Note: The horizontal axis provides the sector codes (ATECO 2-digit). 10 Food; 11 Beverages; 13 Textiles; 14 Wearing apparel; 15 Leather; 16 Wood; 17 Paper; 18 Printing; 19 Coke & petroleum; 20 Chemicals; 21 Pharmaceuticals; 22 Rubber & plastics; 23 Non-metallic minerals; 24 Basic metals; 25 Fabricated metals; 26 Computer & electronics; 27 Electrical equipment; 28 Machinery; 29 Motor vehicles; 30 Other transport; 31 Furniture; 32 Other manufacturing; 33 Repair & installation.

Figure 4. Perceived importance of drivers of circular innovations



Appendix

Appendix A: Questionnaire of the survey

English translation of the questionnaire used in the GRINS survey. Response boxes and tables are reproduced in a simplified format for publication as an appendix.

Survey: Environmental sustainability and circularity in Italian manufacturing firms

Contact information and key economic data of the firm

Information on the firm

A. Name of the firm: _____

B. Registered business name of the firm: _____

C. Registered office address:

Street: _____

Municipality: _____

Province: |__|__|

D. Telephone:

Area code |__|__|__|__| Number |__|__|__|__|__|__|__|__|__|__|

E. Company email or certified email (PEC): _____

F. Istat code (ATECO) – enter only the first four digits of the ATECO code (a link to the ISTAT classification was provided): |__|__|__|__|

G. Number of employees (consider the end of the indicated year; a link to the definition of employees was provided)

Year 2022: no. _____

Year 2024: no. _____

H. What was the firm's turnover?

Year 2022: _____ euro

Year 2024*: _____ euro

*If the exact figure is not available, please provide an estimate.

Information on the respondent

I. Surname and name (optional): _____

L. Role held in the firm:

[ ] Chief executive officer [ ] Manager responsible for environmental matters [ ] Other executive or middle manager
[ ] Employee [ ] Person external to the firm

1. Firm characteristics and management

1.1. Please indicate the year in which the firm was founded: |__|__|__|__|

1.2. Is the firm part of a group of firms?

[ ] Yes [ ] No

If the answer to 1.2 is Yes, please also answer 1.2bis:

1.2bis. In which country is the group's parent company headquartered?

[ ] Italy [ ] Europe (excluding Italy) [ ] Asia [ ] United States [ ] Rest of the world

1.3. Is the firm a family business? (Relatives by marriage up to the second degree or blood relatives up to the third degree are involved in managing the firm.)

[ ] Yes [ ] No

If the answer to 1.3 is Yes, please also answer 1.3bis:

1.3bis. Which family generation currently manages the firm? If more than one generation is involved, indicate the oldest.

[ ] First generation (founders of the firm) [ ] Second generation [ ] Third generation [ ] Fourth generation or later

1.4. Is the firm managed by its owners?

[ ] Yes [ ] No

1.8. Does the firm export goods or services abroad directly, including through other firms belonging to the group?

[ ] Yes [ ] No

If the answer to 1.8 is Yes, please also answer 1.8bis:

1.8bis. To which country does the firm mainly export? _____

1.9. How was the firm's turnover in 2022 distributed, on average, by destination market of its products? Provide a percentage breakdown that sums to 100%. If exact data are not available, please provide an estimate.

Market	**%**
In the province where the firm is located	____%
Other provinces in the same region	____%
Other Italian regions	____%
Abroad	____%
TOTAL	100%

1.10. In your main market, what level of competitive pressure do you perceive from Italian or foreign firms offering similar products or services that compete directly with you? (scale 1 = minimum pressure, 10 = maximum pressure)

Perceived competitive pressure on…	**1 = minimum pressure, 10 = maximum pressure**
Costs	1 2 3 4 5 6 7 8 9 10
Product quality	1 2 3 4 5 6 7 8 9 10
Supply channels	1 2 3 4 5 6 7 8 9 10
Distribution channels	1 2 3 4 5 6 7 8 9 10
Technology	1 2 3 4 5 6 7 8 9 10
Other (please specify) _____	1 2 3 4 5 6 7 8 9 10

1.11. Does the firm have an Internet connection via fibre optic or ultra-broadband?

[ ] Yes [ ] No

1.12. Characteristics of the top manager (chief executive officer or sole director):

Age: year of birth |__|__|__|__| Gender: [ ] Male [ ] Female

1.13. Please assess the importance of the following elements in your organisation (scale 1 = not important at all, 10 = very important).

Elements	1 = not important at all, 10 = very important
In this firm, people are willing to take risks in order to be innovative	1 2 3 4 5 6 7 8 9 10
This firm values interaction with customers, suppliers, universities and other organisations to collect and share information	1 2 3 4 5 6 7 8 9 10
Employees are encouraged to communicate openly and freely and to work as a team	1 2 3 4 5 6 7 8 9 10
Managers frequently involve employees in important decisions	1 2 3 4 5 6 7 8 9 10
The firm recognises and rewards employees for generating new ideas	1 2 3 4 5 6 7 8 9 10

2. Practices and innovation for the circular transition

2.A. Does the firm hold environmental certifications beyond those required by law?

[ ] Yes [ ] No

2.B. In the three-year period 2022–2023–2024, which channels did the firm use to acquire information and knowledge on environmental and circular economy matters?

Channels	Yes	No
Conferences, trade fairs and exhibitions		
Scientific journals and technical or trade publications		
Information provided by trade associations		
Social networks		
Open-source software and/or open business-to-business (B2B) platforms		
Private consultants for accessing public incentives		
Ministries and local public offices		
Feedback received from customers and the marketing department		
Feedback received from client firms		

2.C. On a scale from 1 (not known at all) to 10 (in-depth knowledge), indicate your level of knowledge of the following environmental and circular policies and regulations:

Policies and regulations	1 = not known at all, 10 = in-depth knowledge
National and EU strategies on the circular economy (e.g., National Strategy for the Circular Economy, EU Action Plan)	1 2 3 4 5 6 7 8 9 10
Environmental and social regulations and directives (e.g., Pollutants Regulation, Greenwashing Directive)	1 2 3 4 5 6 7 8 9 10
Sectoral directives (e.g., Packaging Directive, Single-Use Plastics Directive)	1 2 3 4 5 6 7 8 9 10
Technical standards (e.g., UNI/TS 11820, ISO 59000)	1 2 3 4 5 6 7 8 9 10

2.D. In the three-year period 2022–2023–2024, did your firm adopt circular business models?

“Circular business models” are organisational and/or commercial approaches to value creation based on circularity, such as renting or leasing instead of selling, pay-per-use for the actual use of the product or service, and innovative reuse or remanufacturing of used goods.

[ ] Yes, in a structured manner [ ] Yes, on an experimental or limited basis [ ] No, but under evaluation [ ] No, and not planned [ ] Don’t know / No answer

2.1. Indicate whether, in the three-year period 2022–2023–2024, your firm adopted the following practices, which are relevant to both environmental sustainability and the circular economy. If a practice was not adopted, indicate whether the firm intends to adopt it in the next three years.

Practice	**The firm adopted the practice**	**The firm has not adopted the practice but intends to adopt it in the next three years**	**The firm has not adopted the practice and does not intend to adopt it in the next three years**
Reuse of water already used in other production processes			
Reduction of water use to improve production process efficiency			
Use of energy generated from renewable sources			
Reduction of electricity use (from any source) to improve production process efficiency			
Reuse of waste within the firm's own production cycle			
Reduction of waste generated to improve production process efficiency			
Transfer of the firm's waste to other firms that reuse it in their production processes			
Reuse of raw materials (other than water and energy) already used in other production processes			
Reduction in the use of raw materials (other than water and energy) to improve production process efficiency			
Changes in product design to maximise recyclability			
Changes in product design to minimise the use of raw materials (including water and energy)			
Increase in product durability			
Increase in product repairability			

If the firm answered "The firm adopted the practice" for at least one of the items in 2.1, please also answer 2.1bis and 2.1ter.

2.1bis. Provide a qualitative assessment of the economic and environmental impact of the practices adopted in 2022–2023–2024 on a scale from 1 to 10 (where 1 = negative or no impact, 2 = minimal positive impact, up to 10 = maximum positive impact).

Practice	**Economic impact for the firm (e.g., cost reduction, access to new markets)**	**Environmental impact for the firm (e.g., emission reduction, waste reduction)**
Reuse of water already used in other production processes	Scale 1–10	Scale 1–10
Reduction of water use to improve production process efficiency	Scale 1–10	Scale 1–10
Use of energy generated from renewable sources	Scale 1–10	Scale 1–10
Reduction of electricity use (from any source) to improve production process efficiency	Scale 1–10	Scale 1–10
Reuse of waste within the firm's own production cycle	Scale 1–10	Scale 1–10
Reduction of waste generated to improve production process efficiency	Scale 1–10	Scale 1–10
Transfer of the firm's waste to other firms that reuse it in their production processes	Scale 1–10	Scale 1–10
Reuse of raw materials (other than water and energy) already used in other production processes	Scale 1–10	Scale 1–10
Reduction in the use of raw materials (other than water and energy) to improve production process efficiency	Scale 1–10	Scale 1–10
Changes in product design to maximise recyclability	Scale 1–10	Scale 1–10
Changes in product design to minimise the use of raw materials (including water and energy)	Scale 1–10	Scale 1–10
Increase in product durability	Scale 1–10	Scale 1–10
Increase in product repairability	Scale 1–10	Scale 1–10

2.1ter. Did the adoption of environmental and circular practices lead to a change in the supply network because previous suppliers were unable to support the firm in the circular transition?

[ ] Yes [ ] No

2.2. In the three-year period 2022–2023–2024, did the firm introduce the following types of innovation?

Innovation	Yes	No
Product innovation (the introduction to the market of a product or service that is technologically new, or significantly improved, compared with those previously available in terms of technical and functional characteristics, performance, ease of use, etc.)		
Process innovation (the introduction of processes that are new, or significantly improved, compared with those previously adopted by the firm in terms of technical and functional characteristics, performance, ease of use, etc.)		
Organisational innovation (the redesign of the firm's internal structure, processes or management practices; it may include the adoption of new decision-making models, the promotion of a culture of innovation, or the promotion of collaboration and knowledge sharing among teams)		

If the answer to 2.2 is Yes, please also answer 2.2bis and 2.6:

2.2bis. Were the innovations introduced in 2022–2023–2024 aimed at creating new products, processes or organisational models within the following environmental and circular practices? (Mark Yes if at least one product, process or organisational innovation was introduced and indicate the number of innovations introduced.)

Practice	Innovation introduced	How many innovations?
Reuse of water already used in other production processes	[ ] Yes [ ] No	If yes, how many: _____
Reduction of water use to improve production process efficiency	[ ] Yes [ ] No	If yes, how many: _____
Use of energy generated from renewable sources	[ ] Yes [ ] No	If yes, how many: _____
Reduction of electricity use (from any source) to improve production process efficiency	[ ] Yes [ ] No	If yes, how many: _____
Reuse of waste within the firm's own production cycle	[ ] Yes [ ] No	If yes, how many: _____
Reduction of waste generated to improve production process efficiency	[ ] Yes [ ] No	If yes, how many:
Transfer of the firm's waste to other firms that reuse it in their production processes	[ ] Yes [ ] No	If yes, how many: _____
Reuse of raw materials (other than water and energy) already used in other production processes	[ ] Yes [ ] No	If yes, how many: _____
Reduction in the use of raw materials (other than water and energy) to improve production process efficiency	[ ] Yes [ ] No	If yes, how many: _____
Changes in product design to maximise recyclability	[ ] Yes [ ] No	If yes, how many: _____
Changes in product design to minimise the use of raw materials (including water and energy)	[ ] Yes [ ] No	If yes, how many: _____
Increase in product durability	[ ] Yes [ ] No	If yes, how many:
Increase in product repairability	[ ] Yes [ ] No	If yes, how many: _____

2.3. In the period 2022–2023–2024, did the firm apply for or file patents?

[ ] Yes [ ] No

If the answer to 2.3 is Yes, please also answer 2.3bis and 2.3ter:

2.3bis. Indicate the number of patents filed: no. _____

2.3ter. How many of these patented technologies contribute to reducing the firm's environmental impact? no. _____

2.4. Did the firm invest in Research and Development (R&D) in the period 2022–2023–2024?

[ ] Yes [ ] No

If the answer to 2.4 is Yes, please also answer 2.4bis and 2.4ter:

2.4bis. Indicate the average percentage of R&D investment carried out internally by the firm and the percentage commissioned externally (outsourcing) in 2022–2023–2024.

Internal R&D: _____% External R&D: _____%

2.4ter. Indicate the percentage of total R&D expenditure in 2022–2023–2024 aimed at reducing the firm's environmental impact. If exact data are not available, please provide an estimate: _____%

2.5. Did the firm collaborate with the following partners for the innovations introduced in 2022–2023–2024?

[ ] Firms belonging to the same group [ ] Firms not belonging to the group [ ] Universities and/or public research institutes [ ] Public clients [ ] Non-profit institutions

Answer question 2.6 only if the answer to question 2.2bis was Yes at least once.

2.6. In the three-year period 2022–2023–2024, how important were the following factors, or how important do you think they could be, for creating new products, processes or organisational models within environmental and circular practices?

Factors	**1 = not important at all, 10 = very important**
Investment in R&D	1 2 3 4 5 6 7 8 9 10
Investment in machinery and equipment	1 2 3 4 5 6 7 8 9 10
Investment in Internet-based technologies	1 2 3 4 5 6 7 8 9 10
Investment in Artificial Intelligence (AI)	1 2 3 4 5 6 7 8 9 10
Investment in other technological areas	1 2 3 4 5 6 7 8 9 10
Investment in product and service design	1 2 3 4 5 6 7 8 9 10
Investment in corporate reputation and branding	1 2 3 4 5 6 7 8 9 10
Investment in improvements to organisational or business processes	1 2 3 4 5 6 7 8 9 10

3. Labour market

3.1. In the three-year period 2022–2023–2024, what percentage of personnel was employed on para-subordinate and/or non-standard contracts (e.g., coordinated and continuous collaboration contracts (co.co.co.), fixed-term, staff-leasing, temporary agency and apprenticeship contracts, etc.)? _____%

3.2. Indicate the average percentage of employees who held a university diploma or degree in 2022–2023–2024: _____%

3.3. Indicate the average percentage of employees engaged in Research and Development activities in 2022–2023–2024: _____%

3.4. Indicate the average percentage of employees engaged in environmental and circular activities in 2022–2023–2024: _____%

3.5. Indicate whether, in the three-year period 2022–2023–2024, the firm organised training courses to develop or update its employees' environmental and circular skills:

Courses	**Yes**	**No**
a. Training courses for employees with specialist environmental and circular skills		
b. Training courses for employees without specialist environmental and circular skills		

3.6. During the three-year period 2022–2023–2024, did the firm hire, or try to hire, professional profiles with specialist skills in environmental and circular matters?

(Note: employees do not include temporary agency workers, project-based collaborators, consultants, or employees of other firms in the group to which the responding firm may belong.)

[ ] Yes [ ] No

If the answer to 3.6 is Yes, please also answer 3.6bis:

3.6bis. During the three-year period 2022–2023–2024, for which tasks did the firm hire, or try to hire, professional profiles requiring specialist skills in environmental and circular matters? Assign a percentage to each category so that the total equals 100%.

Skills (type of task)	**%**
Routine manual tasks (e.g., production worker)	____%
Non-routine manual tasks (e.g., production worker with organisational functions)	____%
Routine cognitive tasks (e.g., office worker)	____%
Non-routine cognitive tasks (e.g., middle manager/manager)	____%

4. Global dynamics and industrial networks

4.1. The firm's suppliers are mainly located in:

[ ] Italy [ ] European Union [ ] Non-EU Europe [ ] United States [ ] Asia [ ] Other

4.2. Do the firm's suppliers adopt environmental and circular practices? Scale from 1 to 10, where 1 means NONE and 10 means ALL suppliers.

Suppliers adopting environmental and circular practices: 1 = None 2 3 4 5 6 7 8 9 10 = All [ ] Don't know

4.3. The firms that are your clients are mainly located in:

[ ] Italy [ ] European Union [ ] Non-EU Europe [ ] United States [ ] Asia [ ] Other

4.4. Do the firms that are your clients adopt environmental and circular practices? Scale from 1 to 10, where 1 means NONE and 10 means ALL clients.

Business clients adopting environmental and circular practices: 1 = None 2 3 4 5 6 7 8 9 10 = All [ ] Don't know

4.5. How important has cooperation between your firm and other firms been, or how important could it be, for the transition towards the circular economy? Scale 1–10.

Cooperation partners	**1 = not important at all, 10 = very important**
Firms in the same sector:	
– in the same region	1 2 3 4 5 6 7 8 9 10
– outside the firm's region	1 2 3 4 5 6 7 8 9 10
– outside the firm's country	1 2 3 4 5 6 7 8 9 10
Firms in different sectors but in the same supply chain:	
– in the same region	1 2 3 4 5 6 7 8 9 10
– outside the firm's region	1 2 3 4 5 6 7 8 9 10
– outside the firm's country	1 2 3 4 5 6 7 8 9 10
Firms in different sectors outside the firm's own supply chain:	
– in the same region	1 2 3 4 5 6 7 8 9 10
– outside the firm's region	1 2 3 4 5 6 7 8 9 10
– outside the firm's country	1 2 3 4 5 6 7 8 9 10

5. Policies and external factors

Answer question 5.1 only if the answer to question 2.1 was Yes at least once.

5.1. Indicate the relative weight that the following sources of finance had for the adoption of circular practices. Rank the relevance of the sources by assigning a progressive value from 1 (most relevant source) to 3 (least relevant source).

Sources	**Rank (1–3)**
Internal financial sources (e.g., profits reinvested in the firm, own capital of partners or shareholders, funds dedicated to internal innovation projects)	
External private financial sources (e.g., bank loans or financing from credit institutions, venture capital or private investors, leasing, factoring or other forms of non-bank financing)	

Sources	Rank (1–3)
External public financial sources (e.g., national or regional grants for the circular economy, European structural and investment funds and programmes such as Horizon Europe or the LIFE Programme, tax incentives linked to the adoption of sustainable technologies or practices, specific support programmes offered by local or national governments)	

5.2. Which financial incentives related to the circular economy do you know, and which have you applied for and obtained?

Type of incentive	Specific incentive	Do you know it?	If known, did you apply?	If you applied, what was the outcome?
Incentives for industrial reconversion	Reconversion of single-use plastic production cycles. Year: 2022. Legal reference: National Ecological Transition Plan; National Strategy for the Circular Economy	[ ] Yes [ ] No	[ ] Yes [ ] No	[ ] Accepted [ ] Rejected [ ] Pending
	Nuova Sabatini Green/Sud. Year: 2024 (refinanced until 2025). Legal reference: 2023 Budget Law (Art. 1, para. 226, Law no. 160/2019); MIMIT Circular 2023	[ ] Yes [ ] No	[ ] Yes [ ] No	[ ] Accepted [ ] Rejected [ ] Pending
	PNRR funds for the circular economy. Years: 2021–2026. Legal reference: National Recovery and Resilience Plan, Mission 2 – Green Revolution and Ecological Transition	[ ] Yes [ ] No	[ ] Yes [ ] No	[ ] Accepted [ ] Rejected [ ] Pending
Tax credit	Tax credit for recovered materials. Year: 2022. Legal reference: "Simplifications" Decree-Law (DL 77/2021); updates to the Italian Green New Deal	[ ] Yes [ ] No	[ ] Yes [ ] No	[ ] Accepted [ ] Rejected [ ] Pending
	R&D tax credit for sustainable innovation. Years: 2023–2025. Legal reference: Transition 4.0 Plan; 2023 Budget Law (Law 197/2022, Art. 1, paras. 44–46)	[ ] Yes [ ] No	[ ] Yes [ ] No	[ ] Accepted [ ] Rejected [ ] Pending
Specific public funds	MISE "Circular Economy" call. Year: 2022. Legal reference: MISE Decree of 11 June 2020, refinanced for 2022–2024	[ ] Yes [ ] No	[ ] Yes [ ] No	[ ] Accepted [ ] Rejected [ ] Pending
	Italian Green New Deal. Years: 2021–2026. Legal reference: Decree-Law of 14 August 2020, no. 104, Art. 38-ter (PNRR and complementary funds)	[ ] Yes [ ] No	[ ] Yes [ ] No	[ ] Accepted [ ] Rejected [ ] Pending
	Women's Enterprise Fund (Fondo impresa femminile). Years: 2022–2024. Legal reference: MISE Decree of 30 September 2021; Law of 30 December 2020, no. 178 (Art. 1, para. 97)	[ ] Yes [ ] No	[ ] Yes [ ] No	[ ] Accepted [ ] Rejected [ ] Pending
Other (please specify)		[ ] Yes [ ] No	[ ] Yes [ ] No	[ ] Accepted [ ] Rejected [ ] Pending

5.3. How would you assess the quality of the following public infrastructures on a scale from 1 to 10?

Infrastructure	1 = minimum quality, 10 = maximum quality
Public transport:	
– local and regional level	1 2 3 4 5 6 7 8 9 10
– national level	1 2 3 4 5 6 7 8 9 10
Collection/recycling/disposal centres:	
– local and regional level	1 2 3 4 5 6 7 8 9 10
– national level	1 2 3 4 5 6 7 8 9 10
Public services for firms (e.g., SUAP – one-stop shop for productive activities):	
– local and regional level	1 2 3 4 5 6 7 8 9 10
– national level	1 2 3 4 5 6 7 8 9 10
Universities and research centres:	
– local and regional level	1 2 3 4 5 6 7 8 9 10
– national level	1 2 3 4 5 6 7 8 9 10

5.4. On a scale from 1 to 10, how important have current public infrastructures been, or how important could they be, for the adoption of environmental and circular practices by your firm?

Infrastructure	**1 = not important at all, 10 = very important**
Public transport:	
– local and regional level	1 2 3 4 5 6 7 8 9 10
– national level	1 2 3 4 5 6 7 8 9 10
Collection/recycling/disposal centres:	
– local and regional level	1 2 3 4 5 6 7 8 9 10
– national level	1 2 3 4 5 6 7 8 9 10
Public services for firms (e.g., SUAP – one-stop shop for productive activities):	
– local and regional level	1 2 3 4 5 6 7 8 9 10
– national level	1 2 3 4 5 6 7 8 9 10
Universities and research centres:	
– local and regional level	1 2 3 4 5 6 7 8 9 10
– national level	1 2 3 4 5 6 7 8 9 10

6. Barriers to adoption and innovation

6.1. How relevant do you consider the following obstacles to be for the ADOPTION of circular economy practices in Italian firms? Scale 1 (not relevant at all) – 10 (very relevant).

Obstacles	**Relevance for ADOPTION (1–10)**
Economic and financial factors (e.g., high investment costs and risks)	1 2 3 4 5 6 7 8 9 10
Insufficient public funding and/or access to credit	1 2 3 4 5 6 7 8 9 10
Lack of and/or difficulty in finding qualified personnel in the labour market (e.g., shortage of qualified personnel, mismatch between labour demand and supply)	1 2 3 4 5 6 7 8 9 10
Lack of qualified personnel within the firm	1 2 3 4 5 6 7 8 9 10
Corporate culture (e.g., perceived lack of usefulness with respect to the firm's mission)	1 2 3 4 5 6 7 8 9 10
Regulation and bureaucracy (e.g., complex regulations, lengthy and complex administrative procedures to access public funds)	1 2 3 4 5 6 7 8 9 10
Public infrastructure (e.g., inefficient public services, inadequate transport infrastructure, waste management)	1 2 3 4 5 6 7 8 9 10
Collaboration with external organisations (e.g., other firms, trade associations, universities)	1 2 3 4 5 6 7 8 9 10
Market demand (e.g., lack of interest from final customers)	1 2 3 4 5 6 7 8 9 10
Suppliers (e.g., difficulties in sourcing raw materials or specialised services)	1 2 3 4 5 6 7 8 9 10

6.2. How relevant do you consider the following obstacles to be for INNOVATION in the circular economy in Italian firms? Scale 1 (not relevant at all) – 10 (very relevant).

Obstacles	**Relevance for INNOVATION (1–10)**
Economic and financial factors (e.g., high investment costs and risks)	1 2 3 4 5 6 7 8 9 10
Insufficient public funding and/or access to credit	1 2 3 4 5 6 7 8 9 10
Lack of and/or difficulty in finding qualified personnel in the labour market (e.g., shortage of qualified personnel, mismatch between labour demand and supply)	1 2 3 4 5 6 7 8 9 10
Lack of qualified personnel within the firm	1 2 3 4 5 6 7 8 9 10
Corporate culture (e.g., perceived lack of usefulness with respect to the firm's mission)	1 2 3 4 5 6 7 8 9 10
Regulation and bureaucracy (e.g., complex regulations, lengthy and complex administrative procedures to access public funds)	1 2 3 4 5 6 7 8 9 10
Public infrastructure (e.g., inefficient public services, inadequate transport infrastructure, waste management)	1 2 3 4 5 6 7 8 9 10
Collaboration with external organisations (e.g., other firms, trade associations, universities)	1 2 3 4 5 6 7 8 9 10
Market demand (e.g., lack of interest from final customers)	1 2 3 4 5 6 7 8 9 10
Suppliers (e.g., difficulties in sourcing raw materials or specialised services)	1 2 3 4 5 6 7 8 9 10